

PART 1 GENERAL

1.1 SECTION INCLUDES

- A. Radiant floor heating systems for various floor constructions and control strategies, using electric heating mats and cable assemblies.

1.2 RELATED SECTIONS

- A. Section 03300 – Concrete
- B. Section 06100 – Rough Carpentry
- C. Section 07210 – Insulation
- D. Section 15774 – Radiant-Heating Electric Cables

1.3 REFERENCES

- A. General: Standards listed by reference, including revisions by issuing authority, form a part of this specification section to the extent indicated. Standards listed are identified by issuing authority, authority abbreviation, designation number, title or other designation established by issuing authority. Standards subsequently referenced herein are referred to by issuing authority abbreviation and standard designation.
- B. Canadian Standards Association (CSA):
 - 1. CAN/CSA C22.2 No. 130 – Requirements for Electrical Resistance Heating Cables and Heating Device Sets
 - 2. CSA C02.2 No. 24 – Temperature-Indicating and –Regulating Equipment
 - 3. CAN/CSA C22.2 No. 14 – Industrial Control Equipment
- C. National Fire Protection Association (NFPA):
 - 1. NFPA 70, National Electrical Code (NEC), especially Sec. 424 and 426
- D. Tile Council of North America (TCNA):
 - 1. Any applicable standards relating to the installation of tile or stone.
 - 2. TCNA #RH115-0 – Latex – Portland Cement Mortar, Electric System
 - 3. TCNA #RH116-07 – Cementitious Self-leveling Underlayment, Bonded Electric System Thin-set
 - 4. TCNA #RH130-07 – EGP (Exterior Glue Plywood) Latex – Portland Cement Mortar Electric System
 - 5. TCNA #RH135-07 – Backer Board Electric System Thin-set
- E. Underwriters Laboratory (UL):
 - 1. UL Standard 508A – Industrial Control Panels
 - 2. UL Standard 515 – Electric Resistance Heat Tracing for Commercial and Industrial Applications
 - 3. UL Standard 758 – Appliance Wiring Materials
 - 4. UL Standard 873 – Temperature-Indicating and Regulating Equipment

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5. UL Standard 1673 – Electric Radiant Heating Cables
 6. UL Standard 1693 – Electric Radiant Heating Panels and Heating Panel Sets
- F. American National Standards Institute (ANSI)/Underwriters Laboratories, Inc. (UL):
1. Any applicable standards relating to the installation of tile or stone.
- G. Watts Radiant
1. Watts Radiant HeatWeave Installation Manual
 2. Watts Radiant HeatWeave WarmWire Installation Manual
 3. Watts Radiant HeatWeave UnderFloor Installation Manual
 4. Watts Radiant HeatWeave Installation Video
 5. Watts Radiant Electric Floor Warming Design Software (WireWorks)
 6. Radiant Electric Emissions Test (REET)

1.4 SYSTEM DESCRIPTION

- A. Design Requirements:
1. Show compliance with UL, CSA Standards.
 2. Show testing to REET procedure
 3. Show compliance with any applicable ANSI or NTCA Standards as they relate to the installation of tile or stone.
- B. Performance Requirements: Provide electric radiant floor heating system manufactured, fabricated, and installed to comply with regulatory agencies and authorities with jurisdiction, and maintain performance criteria stated by the manufacturer without defects, damage, or failure.

1.5 SUBMITTALS

- A. General: Submit listed submittals in accordance with Conditions of the Contract and Division 1 Submittal Procedures Section.
- B. Product Data: Submit manufacturer's product submittal data and installation instructions for each product.
- C. Shop Drawings – Electric Floor Warming System:
1. Provide installation drawings indicating detailed mat/cable layout for each room, mat/cable dimensions, thermostat locations, zoning requirements, and/or other details required for installation of the system.
 2. Provide electrical schematics, as needed.
- D. Samples: Submit selection and verification samples of primary materials.
- E. Documentation:
1. Provide manufacturer's detailed instructions for site preparation and product installation.
 2. Provide manufacturer's electrical power requirements and heat output in watts delivered to the structure.
 3. Provide documentation indicating the installer is trained to install the manufacturer's products, as needed.

- F. Quality Assurance and Control Submittals:
 - 1. Upon request, submit test reports from recognized testing laboratories.
- G. Closeout Submittals – Submit the following:
 - 1. Warranty documents specified
 - 2. Operation and maintenance data
 - 3. Manufacturer's field reports as specified in this document
 - 4. Final as-built mat/cable layout drawing

1.6 QUALITY ASSURANCE

- A. Manufacturer Qualifications:
 - 1. Manufacturer shall have a minimum of ten years experience in similar systems.
 - 2. Manufacturer shall provide products of consistent quality in appearance and physical properties.
 - 3. Manufacturer shall use the highest quality products in the production of systems and components referenced in this document.
 - 4. Materials shall be from a single manufacturer to ensure consistent quality and compatibility.
- B. Installer Qualifications:
 - 1. Use and installer with demonstrated experience on projects of similar size and complexity and/or documentation proving successful completion of familiarization training hosted/approved in writing by the system manufacturer.
 - 2. Electrical rough-in and connections shall be done by a licensed electrician.
- C. Certifications: Provide letters of certification as follows:
 - 1. Installer employs skilled workers holding a trade qualification license or equivalent, or apprentices under the supervision of a licensed trades person.
- D. Regulatory Requirements and Approvals: Provide a radiant floor heating system that complies with the following requirements:
 - 1. Heating cables for manufacture in mat form or loose cable form shall be recognized to UL 758.
 - 2. Heating mats for installation in cement-based mortar or under wood subfloors shall be listed to UL01693 and CSA C22.2 No. 130.
 - 3. Heating cables for installation in cement-based mortar shall be listed to UL 1673 and CSA C22.2 No. 130.
 - 4. Floor-sensing thermostats (controls) shall be GFCI Class A (5 mA) protected and listed to UL873 and CSA C22.2 No. 24.
 - 5. REET Test Results: Less than 0.25 mG.
 - 6. Robinson Floor Test (ASTM C627): to meet Moderate Commercial standards.
- E. Pre-installation meetings
 - 1. Verify project requirements, substrate conditions, excavation conditions, system performance requirements, coverings, manufacturer's installation instructions, and warranty requirements.
 - 2. Review project construction timeline to ensure compliance or discuss modifications as required.

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3. Coordinate with other trade representatives to verify areas of responsibility.
 4. Establish the frequency (during construction phase of the project) the engineer intends for site visits and inspections by the manufacturer's representative.
- F. Mock-up: Provide a mock-up for evaluation of surface preparation techniques and application workmanship.
1. Finish areas designated by Architect
 2. Do not proceed with remaining work until workmanship, color, and sheen are approved by Architect.
 3. Refinish mock-up area as required to produce acceptable work

1.7 DELIVERY, STORAGE, AND HANDLING

- A. General: Comply with Division 1 Product Requirements Section.
- B. Comply with manufacturer's ordering instructions and lead-time requirements to avoid construction delays.
- C. Deliver materials in manufacturer's original, unopened, undamaged containers with identification labels intact.
- D. Store materials protected from exposure to harmful environmental conditions and at temperature and humidity conditions recommended by the manufacturer.

1.8 PROJECT CONDITIONS

- A. Maintain environmental conditions (temperature, humidity, and ventilation) within limits recommended by manufacturer for optimum results. Do not install products under environmental conditions outside manufacturer's absolute limits.
- B. Mortar-set Systems: Mortar shall cure for 25 days (or time specified by mortar manufacturer) prior to starting heating systems.

1.9 WARRANTY

- A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.
- B. Manufacturer's Warranty:
 1. Submit manufacturer's standard warranty document executed by authorized company official.
 2. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
 - a. Warranty covers the repair or replacement of any materials proven defective.
 - b. Warranty may transfer to subsequent owners.
 - c. Warranty Period for Electric Floor Heating Mats/Cables: Refer to manufacturer's 25-year, prorated warranty against failure due to defect in material or workmanship, beginning with date of manufacture.
 - d. Warranty Period for Thermostats, Controls, and Accessories: Refer to manufacturer's 1-year (2-year for SunStat), non-prorated warranty against

failure due to defect in material or workmanship, beginning with date of purchase.

1.10 SYSTEM START-UP

- A. Do not start the system for a minimum of 25 days or as specified by mortar, concrete and/or covering manufacturer as applicable.
- B. Verify all electrical components are installed per local and National Electrical Code (NEC) prior to start-up.

1.11 OWNER'S INSTRUCTIONS

- A. Instruct Owner about operation and maintenance of installed system.
- B. Provide Owner with manufacturer's installation instructions for installed components within the system, including ohm reading information for the mats/cables as recorded in installation manual.
- C. Provide Owner with all operating instructions/documents for sensors and controls.
- D. Provide Owner with copies of any detailed layout drawings and photos of installed product before coverings are installed.

PART 2 PRODUCTS

2.1 MANUFACTURERS

- A. Acceptable Manufacturer:
 - Watts Radiant, Inc.
 - (Subsidiary of Watts Water Technologies, Inc.)
 - 4500 E. Progress Place
 - Springfield, MO 65803
 - (800) 276-2419; (417) 864-6108; Fax: (417) 864-8161
 - Web: <http://www.wattsradiant.com>
- B. Substitutions: not permitted

2.2 PRODUCT CHARACTERISTICS

- A. Electric Radiant Floor Systems: HeatWeave electric radiant heating, including:
 - 1. HeatWeave mats
 - 2. HeatWeave UnderFloor mats
 - 3. HeatWeave WarmWire cables
 - 4. CableStrap as applicable.

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2.3 ELECTRIC RADIANT FLOOR HEATING MAT, FOR PLACEMENT IN MORTAR

- A. Floor heating mat to have the following construction:
 - 1. Heating Cable Construction: Dual heating elements that are insulated, ground system, outer jacket.
 - 2. Power Lead Construction: Insulated current-carrying color-coded conductors, metal-braided outer jacket/ground, minimum 10 feet (3.05 m) long.
 - 3. Mat Construction: Heating cable woven into plastic open-weave mesh in pre-set spacing.
- B. Size:
 - 1. Floor heating mat size in widths of 1 foot (305 mm), 2 feet (610 mm), 3 feet (914 mm) and lengths 5 feet (1.5 m) through 80 feet (24.4 m)– Refer to Drawings.
- C. Ratings:
 - 1. Floor heating mat shall be provided in 120 VAC or 240 VAC per drawings and submittals.
 - 2. 12 watts per square foot (41 Btu/h/sqft).

2.4 ELECTRIC RADIANT FLOOR HEATING MAT, FOR SUSPENSION BELOW WOOD SUBFLOOR

- A. Floor heating mat to have the following construction:
 - 1. Heating Cable Construction: Dual heating elements that are insulated, ground system, optional outer jacket.
 - 2. Power Lead Construction: Insulated current-carrying color-coded conductors, metal-braided outer jacket/ground, minimum 10 feet (3.05 m) long.
 - 3. Mat Construction: Heating cable secured into conductive sheet material with “ears” to allow mounting against sides of wooden joists.
- B. Size:
 - 1. Floor heating mat size in widths of 12 inches (305 mm) and 16 inches (406 mm), and lengths 4 feet (1.2 m) through 26 feet (7.9 m). Refer to Drawings.
- C. Ratings:
 - 1. Floor heating mat shall be provided in 120VAC or 240VAC per drawings and submittals.
 - 2. 10 watts per square foot (34 Btu/h/sqft).

2.5 ELECTRIC RADIANT FLOOR HEATING CABLE, FOR PLACEMENT IN MORTAR

- A. Floor heating mat to have the following construction:
 - 1. Heating Cable Construction: Dual heating elements that are insulated, ground system, optional outer jacket.
 - 2. Power Lead Construction: Insulated current-carrying color-coded conductors, metal-braided outer jacket/ground, minimum 10 feet (3.05 m) long.
 - 3. Packaging: Cable wound onto spool or proprietary package system.

B. Size:

1. Floor heating cable size in factory set lengths of 47 feet (14.3 m) up to 940 feet (286.5 m). Cannot be cut to length on site.

C. Ratings:

1. Floor heating mat shall be provided in 120VAC or 240VAC per drawings and submittals.
2. Secured to floor using proprietary CableStrap allows on-site spacing at 3 inch (76 mm) o.c. (10 watts/sq.ft. (34 Btu/h/sqft)), 2.5 (64 mm) o.c. (12 watts/sq.ft. (41 Btu/h/sqft)), and 2 inch (51 mm) o.c. (15 watts/sq.ft. (51 Btu/h/sqft)). Refer to Drawings.

2.6 THERMOSTATS FOR ELECTRIC RADIANT FLOOR HEATING MATS/CABLES

A. Thermostats: Use thermostats provided by manufacturer.

1. SunStat Pro digital programmable thermostat to have the following capabilities:
 - a. 5/1/1 day programming.
 - b. Factory set programming with user changeability and manual override.
 - c. 4 cycle times and temperatures per day.
 - d. Setback temperatures and Hold feature for energy savings.
 - e. Smart Start features.
 - f. Usage monitoring capabilities.
 - g. 120V/240V dual voltage in one thermostat, 15A maximum.
 - h. Floor temperature sensing and air sensing w/floor limit control.
 - i. 10K ohm, double-insulated floor thermistor sensor.
 - j. On/off switch.
 - k. GFCI Class A (5mA) integral.
 - l. Master capability to drive a SunStat Relay.
 - m. Remote capability for automated home system control.
 - n. Amber back-light.
2. SunStat digital non-programmable thermostat to have the following capabilities:
 - a. User settable temperature.
 - b. Setback temperature for energy savings.
 - c. 120V/240V dual voltage in one thermostat, 15A maximum.
 - d. Floor temperature sensing and air sensing w/floor limit control.
 - e. 10K ohm, double-insulated floor thermistor sensor.
 - f. On/off switch.
 - g. GFCI Class A (5mA) integral.
 - h. Master capability to drive a SunStat Relay.
 - i. Remote capability for automated home system control.
 - j. Amber back-light.
3. SunStat Dial thermostat to have the following capabilities:
 - a. User settable temperature.
 - b. 120V/240V dual voltage in one thermostat, 15A maximum.
 - c. Floor temperature sensing and air sensing.
 - d. 10K ohm, double-insulated floor thermistor sensor.
 - e. On/off switch.
 - f. GFCI Class A (5mA) integral.
 - g. Master capability to drive a SunStat Relay.

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4. SunStat Relay – For systems that require more than 15-amp capability, install one or more SunStat Relays to control additional loads. Relays to have the following capabilities:
 - a. 120V/240V dual voltage in one control, 15A maximum.
 - b. On/off switch.
 - c. GFCI Class A (5mA) integral.
 - d. Connection to Master SunStat and other SunStat Relay(s) by low-voltage 2-conductor wire.
 - e. Up to 10 SunStat Relays controlled by single Master SunStat

2.7 ELECTRIC FLOOR HEATING ACCESSORY COMPONENTS

- A. Monitoring Device: Use device called LoudMouth provided by manufacturer. It is battery powered and connects to all three power lead wires of mats/cable to monitor installation. Provides both visual (red LED) and audio (loud beep) alarms if heating mats/cables are damaged.
- B. CableTrowel: For system compatibility, use manufacturer's plastic CableTrowel to help prevent cutting of the heating mat/cable during thin-set mortar installation.
- C. CableStrap: For system compatibility in floor heating cable installations, use manufacturer's CableStrap. CableStrap to allow different cable spacings:
 1. 3 inch (76 mm) o.c. (10 watts/sqft)
 2. 2.5 (64 mm) o.c. (12 watts/sqft)
 3. 2 inch (51 mm) o.c. (15 watts/sqft).

PART 3 EXECUTION

3.1 EXAMINATION

- A. Site Verification of Conditions:
 1. Verify that site conditions are acceptable for installation of the system. Refer to manufacturer's installation manual for information.
 2. Do not proceed with installation of the system until unacceptable conditions are corrected.

3.2 INSTALLATION OF ELECTRIC FLOOR HEATING SYSTEMS

- A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings.
- B. Electric radiant floor heating mat, for placement in mortar
 1. Perform electrical resistance test to verify product integrity before beginning work.
 2. Secure LoudMouth monitor device to mat power leads as specified by LoudMouth instructions.
 3. Test-fit the mat in the area specified. Mat heating cable cannot be cut to fit.
 4. Secure the mat mesh to the surface of the floor.
 5. Perform electrical resistance test to verify product integrity again.
 6. Secure thermostat floor sensor into mat area.

7. Bring electrical power source to thermostat location.
 8. Pull mat power leads into thermostat electrical box.
 9. Photograph installation for records.
 10. Apply cement-based, polymer-modified mortar over floor heating mat and finish floor surfaces as specified.
 11. Perform electrical resistance test to verify product integrity again.
 12. Connect thermostat to mat power leads, floor sensor, and power source. Test system briefly and shut down.
 13. Do not place system into full operation until floor mortars are fully cured per mortar manufacturer specifications.
- C. Electric radiant floor heating mat, for suspension below wood subfloor.
1. Perform electrical resistance test to verify product integrity before beginning work.
 2. Secure LoudMouth monitor device to mat power leads as specified by LoudMouth instructions.
 3. Test-fit the mat in the area specified. Mat cannot be cut to fit and must be laid flat.
 4. Secure thermostat floor sensor into mat area, either in floor surface or on bottom side of subfloor.
 5. Secure the mat mesh to the sides of the floor joists at 2 inches (51 mm) below the subfloor.
 6. Insulate under mat per manufacturer's recommendations.
 7. Bring mat power leads to an accessible junction box below the subfloor.
 8. Perform electrical resistance test to verify product integrity again.
 9. Bring electrical power source to thermostat location and pull wire from thermostat location to junction box and make connection to mat power leads.
 10. Photograph installation for records.
 11. Secure minimum R-13 to R-19 insulation below the mats and in surrounding joist areas as specified to force heat upward into floor surface.
 12. Perform electrical resistance test to verify product integrity again.
 13. Connect thermostat to wiring, floor sensor, and power source. Test system briefly and shut down.
 14. If floor coverings are fresh, do not place system into full operation until floor mortars are fully cured per mortar manufacturer specifications.
- D. Electric radiant floor heating cable, for placement in mortar.
1. Perform electrical resistance test to verify product integrity before beginning work.
 2. Secure LoudMouth monitor device to heating cable power leads as specified by LoudMouth instructions.
 3. Verify measurements of area specified are correct per cable size. Cable cannot be cut to length to fit.
 4. Secure the cable to the surface of the floor using Cable Strap product, using spacing per specifications.
 5. Perform electrical resistance test to verify product integrity again.
 6. Secure thermostat floor sensor into heating cable area.
 7. Bring electrical power source to thermostat electrical box.
 8. Pull heating cable power leads into thermostat electrical box.
 9. Photograph installation for records.

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10. Apply cement-based, polymer-modified mortar over floor heating cable and finish floor surfaces as specified.
11. Perform electrical resistance test to verify product integrity again.
12. Connect thermostat to heating cable power leads, floor sensor, and power source. Test system briefly and shut down,
13. Do not place system into full operation until floor mortars are fully cured per mortar manufacturer specifications.

3.3 FIELD QUALITY CONTROL AND TESTING

A. Site tests:

1. To ensure system integrity, do not damage the system or cut heating cable for any reason. Cover heating mat/cable against site damage if there is a delay between product installation and floor covering installation.
2. Perform electrical resistance measurements and record in the mat/cable installation manual as required before, during, and after product installation.
3. If LoudMouth monitor device is used, secure before installation begins and remove only after final coverings are finished including grout application.
4. Test system briefly after installation for function and integrity but do not place system into full operation until mortars or other coverings as applicable are fully cured per manufacturer specifications.
5. Keep records of system products, test results, and photographs for inspection.

3.4 CLEANING

- A. Remove temporary coverings and protection of adjacent work areas.
- B. Repair or replace damaged installed products.
- C. Clean installed products in accordance with manufacturer's instructions prior to Owner's acceptance.
- D. Remove construction debris from project site and legally dispose of debris.

3.5 DEMONSTRATION

A. Electric Radiant Floor Heating System

1. Demonstrate operation of system to Owner or Owner's personnel.
2. Advise Owner or Owner's personnel about the required cure time for mortar or other covering as applicable before putting system into full operation.
3. Provide Owner or Owner's personnel with manufacturer's installation, operation, and maintenance instructions for installed components within the system.

3.6 PROTECTION

- A. Protect installed work from damage caused by subsequent construction activity on the site. Provide Owner with copy of photos and drawings of product locations to assist.