SENECA RADIANT TECHNOLOGY

SECTION 238300
RADIANT HEATING UNITS

PART 1 GENERAL

1.1 SECTION INCLUDES:

A. Radiant floor and/or wall heating and snow melting systems for various applications and control strategies, using an oxygen barrier, polyethylene raised temperature (PE-RT) or polyethylene cross linked (PEX) tubing and appropriate fittings.

B. Radiant floor heating systems for various floor and/or wall constructions and control strategies, using modular panel assemblies.

C. Radiant snow melting systems using an oxygen barrier, polyethylene raised temperature (PE-RT) or polyethylene cross linked (PEX) tubing and appropriate fittings embedded in concrete, asphalt, and below pavers.

1.2 RELATED SECTIONS

A. Section 017419 - Construction Waste Management.

B. Section 018109 - Testing for Indoor Air Quality.

C. Section 018113 - Sustainable Design Requirements

D. Section 019100 - General Commissioning Requirements.

E. Section 030000 - Concrete.

F. Section 061000 - Rough Carpentry.

G. Section 061600 – Sheathing (subfloors)

H. Section 072000 - Thermal Insulation.

I. Section 072600 - Vapor Retarders.

J. Section 096000 - Flooring.

K. Section 223000 - Plumbing Equipment.

L. Section 230900 - Instrumentation and Control for HVAC.

M. Section 232100 - Hydronic Piping and Pumps.

N. Section 235200 - Heating Boilers.

O. Section 238316 - Radiant Heating Hydronic Piping.

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. ASTM International (ASTM):

1. Oil Creek Plastics, Inc. HEATFLEX tubing (PE-RT):
   a. ASTM F2623 - 08 Standard Specification for Polyethylene of Raised Temperature (PE-RT) SDR 9 Tubing.

2. SRT Radiant Panel ACI Test Results:
   a. ASTM C-642 – 06: Standard Test Method for Density, Absorption, and Voids in Hardened Concrete.
   b. ASTM C-666/ C666M - 03(2008): Standard Test Method for Resistance of Concrete to Rapid Freezing and Thawing.
   c. ASTM C39 / C39M - 11a: Standard Test Method for Compressive Strength of Cylindrical Concrete Specimens.
   d. ASTM E 84: Standard Test Method for Surface Burning Characteristics of Test Materials.
   e. ASTM C496 / C496M – 11: Standard Test Method for Splitting Tensile Strength of Cylindrical Concrete Specimens.
   f. ASTM C177 – 10: Standard Test Method for Steady-State Heat Flux Measurements and Thermal Transmission Properties by Means of the Guarded-Hot-Plate Apparatus.
   g. ASTM D792 – 08: Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement

3. SRT Radiant Panel DIN Test Methods:
   a. DIN 52612-1: Thermal Conductivity at 140F.
   b. DIN 5375: Thermal Expansion Coefficient (68 ℉ to 158 ℉)
   c. DIN 4726: Oxygen Diffusion Rate with Oxygen Barrier at 100 ℉
   d. DIN 4726: Oxygen Diffusion Rate with Oxygen Barrier at 180 ℉

C. Tile Council of North America (TCNA):
   1. SRT Radiant Panels:
      a. Any applicable standards relating to the installation of tile or stone.
      b. [Interior Floors with Radiant Heat over Concrete]
      c. TCNA #RH110-11 – On-Ground Concrete Encapsulating Hydronic Tubing – Ceramic Tile.
      d. TCNA #RH110A-11 - Above-Ground Concrete Encapsulating Hydronic Tubing – Ceramic Tile.
      e. [Interior Floors with Radiant Heat over Wood]
      f. TCNA #RH117-11 – On-Ground or Above-Ground Concrete Unbonded

Mortar Bed Encapsulating Hydronic Tubing – Ceramic Tile.

g. TCNA #RH123-11 – Joists 16" o.c./Plywood Subfloor Cementicious Self-Leveling Underlayment Encapsulating Hydronic Tubing – Ceramic Tile.

D. Underwriters Laboratory (UL):
1. Referenced for thermostatic controls (by others):
a. UL Standard 508A - Industrial Control Panels.
b. UL Standard 873 - Temperature-Indicating and Regulating Equipment.

E. American National Standards Institute (ANSI)/Underwriters Laboratories, Inc. (UL):
1. SRT Radiant Panels:
a. Any applicable standards relating to the installation of tile, stone, wood, and carpet.

F. Seneca Radiant Technology:
1. SRT Radiant Panel Installation Manual, current edition.

1.4 SYSTEM DESCRIPTION

A. Hydronic System Design Requirements:
1. Oil Creek Plastics HEATFLEX Tubing Pressure Ratings: Tubing shall be rated for continuous working pressures of as high as 200 psi (1370 kPa) at 73 degrees F (23 degrees C), but not less than 100 psi (689 kPa) at 180 degrees F (82 degrees C).
2. Seneca Radiant Technology's SRT Radiant heat panels have been tested and can be expected to provide from 12 btu/hr @ 90 degrees F. up to 42 btu/hr @ 140 degrees F per panel or per square foot.

B. Hydronic System Performance Requirements: Provide hydronic system that is manufactured, fabricated, and installed to comply with regulatory agencies and authorities having jurisdiction, and maintain performance criteria stated by the tubing manufacturer without defects, damage or failure.
1. Oil Creek Plastics HEATFLEX Tubing:
a. Show compliance with ASTM F2623 - 08.
b. Show insert fittings and clamp components are certified to meet ASTM F-877, F-1807, or F-2159.
c. HEATFLEX pipe may also be joined by a heat fusion technique which eliminates the need for fittings.
2. Cross-linked Polyethylene Tubing (PEX):
a. Show compliance with ASTM F877.
b. Show compliance with DIN 4726 regarding oxygen diffusion concerns where applicable.
c. Show compliance with NFPA 90A requirements of flame spread/smoke development rating of 25/50 in accordance with ASTM E84 through certification listings with Intertek.
d. Show compliance with ASTM E119, UL 263, NFPA 251 and CAN/ULC S101 through certification listings with Intertek as follows:
1) Intertek Design No. WR/WA 60-01: 1 hour wood or steel stud/gypsum wallboard wall assembly.
2) Intertek Design No. WR/FCA 60-01: 1 hour wood frame floor/ceiling assembly.
3) Intertek Design No. WR/FCA 120-01: 2 hour concrete floor/ceiling assembly.
3. Cross-linked Polyethylene-Aluminum-Cross-linked Polyethylene Composite

Pipe (PAP):
a. Show compliance with ASTM F1281.

C. Pre-Insulated Piping System Design Requirements: The PEX service tubing is manufactured and tested in accordance with DIN 16892 and 16893. The PEX service tubing has hydrostatic ratings in accordance with the temperatures and pressures listed below. The hydrostatic ratings are:
1. 200 degrees F (93 degrees C) at 80 psi (551 kPa).
2. 180 degrees F (38 degrees C) at 100 psi (689 kPa).
3. 73.4 degrees F (23 degrees C) at 160 psi (1102 kPa).

D. Pre-insulated Piping System Performance Requirements: Provide pre-insulated piping system that is manufactured, fabricated, and installed to comply with regulatory agencies and authorities with jurisdiction, and maintain performance criteria stated by the tubing manufacturer without defects, damage or failure.
1. Show compliance with DIN 16892.
2. Show compliance with DIN 16893.
3. Show compliance with DIN 4726 regarding oxygen diffusion.
4. Insulation of all carrier tubing shall consist of a microcellular, cross-linked polyethylene foam in multi-layer arrangements. The insulation's closed cell structure shall ensure minimal water absorption at all times to preserve insulating effect against thermal loss.
5. Insulation shall not crush, break, or pulverize.
6. All materials shall be CFC free.
7. The outer jacket shall be cast with a corrugated pattern along its entire length. The corrugation pattern shall provide flexibility in the longitudinal direction and rigidity against radial forces.
8. The corrugation shall employ a double-walled closed-cell construction to provide an extra layer of protection from piercing of the outer jacket.
9. Single wall exterior jackets shall be deemed not equal for the long-term protection of the Owner.

E. Hydronic Modular Radiant Panel Floor Warming System Design Requirements:
1. Show compliance with any applicable ANSI or NTCA Standards as they relate to the installation of tile or stone.

F. Hydronic Modular Radiant Panel Floor Warming System Performance Requirements: Provide hydronic radiant floor heating system manufactured, fabricated, and installed to comply with regulatory agencies and authorities having jurisdiction, while maintaining performance criteria stated by the manufacturer without defects, damage, or failure.

G. Hydronic Snow Melting System Design Requirements:
1. Show compliance with UL, CSA Standards
2. Show compliance with any applicable ANSI or NTCA Standards as they relate to the installation of tile or stone.

H. Hydronic Snow Melting System Performance Requirements:
1. Provide electric snow melting 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 013300 - Submittal Procedures Section.

B. Substitutions: Submit substitutions in accordance with Conditions of the Contract and Division 013500 - Substitution Procedures Section.

C. Product Data: Submit manufacturer's product submittal data and installation instructions for each product.

D. Shop Drawings - Hydronic System:
   1. Provide engineering analysis using manufacturer's or engineer's software.
   2. Provide installation drawings indicating tubing layout, manifold locations, zoning requirements, and manifold schedules with details required for installation of the system.
   3. Provide mechanical schematic indicating heat source, mechanical piping, and accessories from heat source to manifolds, circulators, water tempering, and zone controls. Indicate supply water temperatures and flow rates to manifolds.

E. Shop Drawings - Hydronic Snow Melting System:
   1. Provide installation drawings indicating detailed tubing layout for each area, tubing dimensions, snow melting sensor/control locations, zoning requirements, and/or other details required for installation of the system.
   2. Provide mechanical schematics, as needed.

F. Samples: Submit selection and verification samples of primary materials.

G. Documentation:
   1. Provide manufacturer's detailed instructions for site preparation and product installation.
   2. Provide manufacturer's fuel and power requirements, as well as heat output in Btu's/hr. delivered to the structure.
   3. Provide documentation indicating the installer is trained to install the manufacturer's products, as needed.

H. Quality Assurance and Control Submittals:
   1. Test Reports: Upon request, submit test reports from recognized testing laboratories.

I. 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, tubing layout drawing.

1.6 QUALITY ASSURANCE

A. Manufacturer Qualifications:
   1. Manufacturer shall have minimum ten years or more of 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 single manufacturer to ensure consistent quality and compatibility.

B. Installer Qualifications:
   1. Use an installer with demonstrated experience on projects of similar size and complexity and 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.
3. Fuel system rough-in and connections shall be done by a licensed tradesperson for that fuel type (i.e. gas = licensed plumber)

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 - Hydronic Floor Warming Systems: Provide a radiant floor heating system that complies with the following requirements:
1. International Code Council (ICC):
   a. International Mechanical Code (IMC).
   b. International Building Code (IBC).
   c. ICC Evaluation Service (ES) Evaluation Reports.
2. International Association of Plumbing and Mechanical Officials (IAPMO):
   a. Uniform Mechanical Code (UMC).

E. Regulatory Requirements and Approvals - Pre-insulated Piping Systems: Ensure the pre-insulated piping system complies with all applicable codes and regulations.

F. Regulatory Requirements and Approvals - Hydronic Floor Warming Systems: Provide a radiant floor heating system that complies with the following requirements:
1. Floor-sensing thermostats (controls) shall be GFCI Class A (5 mA) protected and listed to UL 873 and CSA C22.2 No. 24.
2. Robinson Floor Test (ASTM C627): To meet Moderate Commercial standards.

G. Regulatory Requirements and Approvals - Hydronic Snow Melting Systems: Provide a hydronic snow melting system that complies with the following requirements:
1. Snow melting sensors shall be UL listed or low-voltage.
2. Snow melting controls shall be listed to UL 508a and CAN/CSA C22.2 No. 14.

H. 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.
3. Coordinate with other trade representatives to verify areas of responsibility.
4. Establish the frequency (during construction phase of the project) the architect and/or engineer intends for site visits and inspections by the manufacturer's representative.

I. 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, joints, connections, and levelness are approved by Architect and/or approval of Manufacturer’s representative having authority.
3. Refinish mock-up area at Contractor’s expense required to produce acceptable work.

1.7 DELIVERY, STORAGE AND HANDLING

A. General: Comply with Division 016000 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 such as rain, ice, hail, snow, and at conditions recommended by the manufacturer.
   1. Hydronic System:
      a. Store tubing in cartons or under cover to avoid dirt or foreign material from entering the tubing.
      b. Do not expose Oil Creek Plastics Inc. HEATFLEX tubing to direct sunlight for more than 10 days. If construction delays are encountered, cover the tubing that is exposed to direct sunlight with dark colored materials.
   2. Insulated Piping Systems:
      a. Store pre-insulated piping coils under cover or supply plugs to prevent dirt or foreign material from entering the service tubing.
      b. Do not expose the PEX service tubing to direct sunlight for more than 10 days. If construction delays are encountered, cover the tubing that is exposed to direct sunlight.

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.

1.9 WARRANTY

A. Project Warranty: Refer to Conditions of the Contract for project warranty provisions.

B. Manufacturer's Warranty - Hydronic Systems: Submit, for Owner's acceptance, manufacturer's standard warranty document executed by authorized company official. Manufacturer's warranty is in addition to, and not a limitation of, other rights Owner may have under contract documents.
   1. Submit, for Owner’s acceptance, 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 tubing or fittings proven defective.
      b. Warranty may transfer to subsequent owners if and only if it is stated on product brochures or other warranty documents.
      c. Warranty Period for Oil Creek Plastics Inc. HEATFLEX Tubing is a Lifetime Limited warranty covering manufacturer related tubing defects. Pre-paid insurance policy covering repairs due to consequential damage, single occurrence, related to defects in material or workmanship, beginning with date of delivery to jobsite. Refer to Oil Creek Plastics Inc. for specific terms and conditions of their warranty.
      d. Warranty Period for Thermostats, Controls, and Accessories: Refer to manufacturer's 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 number of days as specified by mortar,

concrete and/or covering (flooring or wall finish) 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, 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 (panels): Modular Radiant Technology, which is located at: 11411 Route 438, Gowanda, NY 14070; Tel: 855-945-2215 ; Email:info@senecaradiant.com; Website: www.senecaradiant.com

B. Acceptable Manufacturer (tubing): Oil Creek Plastics, Inc., State Highway 27, Titusville, PA 1635. Phone: 814.827.3661 Toll free: 800.537.3661 Fax: 814.827.9599. contacts: http://www.oilcreek.com/contact/ www.oilcreek.com

C. Substitutions: are not permitted.

D. Requests for substitutions will be considered in accordance with provisions of Section 012500.
1. Products, components and services specified are manufactured by and/or available from the specified equipment manufacturer.
2. Alternative equipment manufacturers shall submit required data for all electrical, mechanical, structural, engineering, etc. revisions to the Architect for an equivalent system for approval 15 days prior to bid.
3. Alternative equipment manufacturers shall submit completed design layout to the project engineer for approval.

2.2 HYDRONIC RADIANT SYSTEM HEATING PANELS

A. Modular Radiant Heating Panels:
1. Product: SRT Radiant panels as manufactured by Seneca Radiant Technology.
2. Panels: This radiant product uses a self-consolidating lightweight concrete, patented mix design that contains recycled and post-consumer materials. These materials have a Beneficial Use Determination (B.U.D.) by the United States Environmental Protection Agency (EPA).
3. Dimensions: 24” long, by 6” wide, by 1 ¼” thick. Weight: 8lbs/square foot.
4. Radiant Output: The tested heat transfer to the room, per panel:
   0.5 gpm, 90 ℉ water: 12.1 Btu/hr-ft2-℉ (38 W/m2- ℃)
   0.5 gpm, 140 ℉ water: 41.9 Btu/hr-ft2-℉ (132 W/m2 -℃)
   2.0 gpm, 90 ℉ water: 14.9 Btu/hr-ft2-℉ (47 W/m2-℃)
   2.0 gpm, 140 ℉ water: 42.7 Btu/hr-ft2-℉ (135 W/m2 -℃)
1. Application: Surface/subfloor mounted. Refer to drawings for schedule of sizes and layout.

2. Application: Wall mounted. Product can be used as a wainscoting, or from floor to ceiling if heat loss calculations dictate.
3. Heat transfer on subfloor: One third of the heat is transferred down through the subfloor. Adding insulation to the subfloor will improve the heat rate to the room.
4. Custom panel sizes: In order to use the panels in odd shaped spaces or in rows where the panels do not end in a full module, use a wet tile saw similar to MK Diamond Products, Inc., Model MK-101, to cut radiant panel to size. Use wet cutting techniques to minimize lightweight concrete dust exposure.

2.3 HYDRONIC RADIANT SYSTEM TUBING

A. Recommended Tubing: Oil Creek Plastics, Inc. HEATFLEX pipe.

Oil Creek Plastics, State Highway 27, Titusville, PA 1635. Phone: 814.827.3661 Toll free: 800.537.3661 Fax: 814.827.9599. www.oilcreek.com

1. Material: a premium five layer PE-RT pipe. The pipe consist of a layer of ethylene vinyl alcohol polymer (EVOH), sandwiched between two layers of DOWLEX™ 2344 Polyethylene Copolymer Resin and two layers of adhesive. The outer layer shields the required oxygen barrier. This design eliminates the need for cross-linking.
2. Pressure Ratings: Refer to Design Requirements.
3. Temperature/Pressure Ratings: shall be capable of withstanding temperatures of 0 degrees F (-17 degrees C) to 325 degrees F (163 degrees C) intermittently without delimitation. Tubing shall be listed to 180 degrees F (82 degrees C) at 100 psi (0.69 MPa) and shall remain flexible at temperatures down to 0 degrees F (-17 degrees C).
4. UV Resistance: Tubing shall be UV-resistant, so as not to degrade when exposed to continuous sunlight, but care should be taken to keep out of direct sunlight, and install as soon as possible.
5. Minimum Bend Radius:
   a. 3/8 inch (9.53mm) - 3 inch (76 mm) bend radius.
   b. 1/2 inch (12.7mm) - 4 inch (102 mm) bend radius.
   c. 5/8 inch (15.88mm) - 5 inch (127 mm) bend radius.
   d. 3/4 inch (19.05mm) - 6 inch (152 mm) bend radius.
   e. 1 inch (25.4mm) - 8 inch (203 mm) bend radius.
6. Barrier Tubing Type: Oil Creek Plastics, Inc. HEATFLEX Tubing
   a. Tubing shall have an oxygen permeation inhibitor. The oxygen barrier shall be completely encapsulated in the tubing, protected by the outside layer. The resistance shall be consistent across the entire temperature rating 0 to 180 degrees F (-18 to 82 degrees C).
   b. Nominal Inside Diameter: Provide tubing with the following nominal inside diameters:
      1) 5/16 inch (7.94 mm) = 0.302 inch ID.
      2) 3/8 inch (9.53 mm) = 0.360 inch ID.
      3) 1/2 inch (12.7 mm) = 0.485 inch ID.
      4) 5/8 inch (15.88 mm) = 0.584 inch ID.
      5) 3/4 inch (19.05 mm) = 0.681 inch ID.
      6) 1 inch (25.4 mm) = 0.875 inch ID.

2.4 HYDRONIC RADIANT SYSTEM MANIFOLDS AND FITTINGS

A. Manifolds (residential and light Commercial, stainless steel):
1. For system compatibility, use 1 or 1-1/2 inch (25 mm to 38 mm) stainless steel manifolds offered by the respective PE-RT tubing manufacturer.
2. Manifolds shall provide individual flow control for each loop of the manifold through valve actuators available from the manifold supplier.

3. Manifolds shall feature manual flow balancing capability within the manifold body for balancing unequal loop lengths across the manifold. Balance valves shall not be ball valves.
4. Manifolds should be able to accommodate 3/8 to 3/4 inch OD (9.5 mm to 19 mm) tubing.
5. Each manifold location shall have the ability to vent air manually from the system.
6. Stainless Steel 1 inch (25 mm) Manifolds
    a. Heavy-duty, DIN Standard, 304 stainless steel
    b. Matching fittings and accessories are made of solid brass and are heavily plated with nickel to match the appearance of the manifold trunk.
    c. Internal balancing valves
    d. 0 - 2-1/2 gpm (0 - 0.16 L/sec)flow meters
    e. Manifold brackets
    f. All connections are BSP (British Standard Pipe) or straight thread and require the use of the included gasket.
    g. 2-1/8 inch (54 mm) OC circuit spacing
    h. 12 gpm (.75 L/sec) maximum flow rate
    i. 167 degrees F (75 degrees C) maximum operating temperature
    j. 87 psi (600 kPa) maximum operating pressure
    k. 2 gpm (0.16 L/sec) per circuit maximum flow rate
7. Stainless Steel 1-1/2 inch (38 mm) Manifolds:
    a. Heavy-duty, DIN standard, 304 stainless steel.
    b. Matching fittings and accessories are made of solid brass and are heavily plated with nickel to match the appearance of the manifold trunk.
    c. Internal balancing valves.
    d. 0 - 4 gpm (0 to 0.25 L/sec) flow meters.
    e. Manifold brackets.
    f. All connections are BSP (British Standard Pipe) or straight thread and require the use of the included gasket.
    g. 2-1/8 inch (54 mm) OC circuit spacing.
    h. 22 gpm (1.4 L/sec) maximum flow rate.
    i. 167 degrees F (75 degrees C) maximum operating temperature.
    j. 87 psi (600 kPa) maximum operating pressure.
    k. 4 gpm (0.25 L/sec) per circuit maximum flow rate.

B. Manifolds (commercial, Copper):
1. Provide 1 inch (25 mm) or larger Copper manifolds manufactured from L-copper and offered by the respective tubing manufacturer for system compatibility.
    a. Install manifolds with optional isolation valves located on both the supply and return manifold.
    b. Each manifold location shall have the ability to vent air manually from the system.
2. Provide Copper manifolds approved for use in systems free of ferrous materials, or isolate ferrous material to eliminate corrosion damage due to oxygen diffusion.
3. Balancing
    a. Design individual loop lengths across the manifold within 10 percent of each other in length.
    b. Install supply and return piping to the manifold in a reverse-return configuration to ensure self-balancing.
    c. Where the supply and return piping is in direct-return configuration, use manifolds with balancing valves or balance flow setters on the return

leg of each manifold to the mains.

C. Manifold Mounting Boxes:
   1. Each box shall be designed to be recessed into a 4 inch or 6 inch (102 mm or 152 mm) stud wall.

D. Fittings:
   1. For system compatibility, use fittings recommended by the tubing manufacturer.
   2. HEATFLEX:
      a. When joining HEATFLEX tubing, Oil Creek Plastics recommends the use of insert fittings and clamps that are certified to the following standards: ASTM F-877, F-1807, or F-2159. .
      b. “Sharkbite” types of fittings are not recommended for use with HEATFLEX tubing as it may damage the EVOH (the oxygen barrier) layer.

2.5 HYDRONIC RADIANT SYSTEM SUPPLY AND RETURN PIPING

A. Supply-and-return Piping to the Manifolds (above ground piping):
   1. Properly size supply and return distribution piping for the given volume and velocities required at system design.
   2. Use compatible distribution piping material (Oil Creek Plastics Inc. HEATFLEX) for all supply fluid temperatures and flows in systems with ferrous components.
      a. When using Oil Creek Plastics Inc. HEATFLEX tubing, do not exceed 180 degrees F at 100 psi or 73 degrees F at 200 psi.
   3. Use suitable distribution piping material for systems free of or isolated from ferrous components.
      a. When using HDPE mains, do not exceed 140 degrees F (60 degrees C) at 80 psi (551 kPa).
      b. When using Oil Creek Plastics Inc. HEATFLEX mains, do not exceed 180 degrees F at 100 psi.
   4. Do not expose Oil Creek Plastics Inc. HEATFLEX tubing to direct sunlight. Where PE-RT tubing is exposed, install suitable pipe insulation around the exposed tubing.
   5. Use fittings compatible with piping material. Fittings shall transition from distribution piping to system manifolds.

B. Supply and Return Piping to the Manifolds (below ground piping):
   1. Properly size supply and return distribution piping for the given volume and velocities required at system design.
   2. Use suitable distribution piping material (Oil Creek Plastics Inc. HEATFLEX) for all supply fluid temperatures and flows in systems.
      a. When using Oil Creek Plastics Inc. HEATFLEX PE-RT tubing, do not exceed 180 degrees F at 100 psi.
   3. If copper or black iron piping is embedded in concrete or soil, insulate or protect with sleeves.
   4. Use fittings compatible with piping material. Fittings shall transition from distribution piping to system manifolds.

2.6 HYDRONIC RADIANT FLOOR HEATING ROOM TEMPERATURE CONTROLS

A. Room Temperature Controls:
   1. Thermostat: air/floor, digital, 24V.
   2. Thermostat: air/floor, digital, battery.

3. Thermostat: air/floor, non-digital, 24V.
4. Thermostat: air, digital, programmable, 24V.
5. All thermostats shall operate within a one degree differential temperature incorporating pulse-width modulation action.
6. Install a Thermostat with digital display in each room or zone as required.
    a. The thermostat shall have the ability to sense the temperature of the air, floor or a combination of air and floor.
    b. Each thermostat shall be equipped with an internal air sensor.
7. For multiple-zoning control, install the loop(s) per zone and install the individual valve actuators on the respective loop(s) at the manifold.
    a. Electro Thermal Actuators:
        1) Actuators are a four-wire actuator designed for use with manifolds.
            a) Actuators are normally closed and will open when power is applied.
            b) Actuators shall consume no more than 2.5 watts.
            c) Travel time for the actuators is approximately 90 sec. to close the end switch.
            d) Each actuator consists of 4 wires, 2 for power, and 2 for an end switch.
    b. Zone Valve Actuator Control Module: Zone valve actuator controls operate zone valves or circuit thermal actuators by supplying 24VAC.
        1) No more than three 2.5 VA actuator valves can be connected to any single zone terminal block.
        2) This control system shall be designed for use with the following models of thermostats:
            a) Any two-wire thermostats with internal battery power.
            b) Two-wire thermostats that consume power shall not be used, as damage to either the thermostat or controller may occur.
                1) Never connect a power consuming 2-wire thermostat to the control as damage to the thermostat and/or control may occur.
        3) External 24/120 VAC transformer (not included) is required to operate these controls.
            a) A 40 VA transformer for a maximum of 12 actuators.
            b) A 60 VA transformer for a maximum of 18 actuators.
        4) Master Controls:
            a) Equipped with valve and thermostat terminals.
            b) Incoming 24 volt power connection.
            c) Two 8 amp, dry contact terminals for pump and boiler operation.
                1) With end-switch capability, the Zone Control Module activates other relays or controls as required by system control strategy.
                2) Control does not use the end-switch wires of a 4-wire actuator.
                3) Both 2 wire and 4 wire actuators may be used.
        5) Slave Controls:
            a) The use of Slave units allows the control of more zones utilizing the same pump and boiler.
            b) Up to 2 Slave controls can connect to a Master
                1) Allows for a maximum of 18 separate zones or thermostat connections.
                2) Both 2 wire and 4 wire actuators may be used.

2.7 PRE-INSULATED PIPING SYSTEM DETAILS

A. Insulation:
   1. The insulation shall be cross-linked polyethylene closed cell foam with a water absorption after 28 days of less than 1.04 percent.
   2. All seams of the insulation shall be sealed.
   3. Insulation shall not be bonded to the service tubing.
   4. Insulation shall not crush, break or pulverize.

B. End Seals:
   1. The piping manufacturer will supply all end caps.
   2. End caps are to be installed on each end prior to connecting the service pipes and insulating the field joints.
   3. Where necessary, the end caps will heat shrink onto the piping outer jacket forming a watertight seal.

C. Compression Fittings for PEX Service Tubing:
   1. For system compatibility, use fittings offered by the tubing manufacturer.
   2. Fittings are to be manufactured from brass.

2.8 PRE-INSULATED PIPING SYSTEM ACCESSORIES

A. Use accessories associated with the installation of the pre-insulated piping system as recommended by or available from the piping manufacturer.

B. Protective Casings:
   1. Protective casings will be manufactured of high density polyethylene shells with insulation, bolts, nuts, and a sealant compound.

C. Protective Inspection Chambers:
   1. The piping manufacturer will provide the inspection chambers when required by the project construction.
   2. Inspection chambers shall be constructed of shock-resistant high density polyethylene.
   3. Heat shrink seals as provided by the piping manufacturer shall be installed to prevent introduction of water into the vault.

D. Anchors:
   1. The use of anchors, if required, within the piping system will be determined by the project engineer.

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 HYDRONIC FLOOR HEATING SYSTEMS

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings, including the following:
   1. Installation manuals.
   2. Design software engineering and analysis.

B. Installation of radiant heated Slab-On-Grade:
   1. Fasten the tubing to the welded wire mesh or reinforcing bar in accordance with the tubing manufacturer's installation recommendations.
   2. Use closer tubing on-center distances along exterior walls. Increase tubing on-center distances as the installation moves away from the exterior wall as determined by manufacturer analysis.
   3. Staple the tubing to the insulation board.
   4. Install edge insulation where the heated panel directly contacts an exterior wall or panel.
   5. Install tubing at a consistent depth below the surface elevation. Ensure sufficient clearance to avoid control joint saw cutting.
   6. Where tubing crosses metal expansion joints in the concrete, ensure the tubing passes below the joints or is sleeved through the joint.
   7. For PE-RT tubing that exits the slab in a 90-degree bend, use fabricated bend supports.

C. Installation over wood subfloor:
   1. Install wood sleepers along the room perimeter and between the panels to provide a nailing surface for finished wood floors or carpet tack strips as required. Refer to Section 061000 – Rough Carpentry.
   2. Install insulation in the joist cavity below the floor in accordance with the submitted radiant floor design. Refer to Section 072100 – Thermal Insulation.
   3. Install edge insulation if the heated panel directly contacts an exterior wall or panel. Refer to Section 072100 – Thermal Insulation.
   4. Install Comply with the local Building Codes and tubing manufacturer's installation procedures on proper joist drilling.
   5. Install foil-faced insulation in the lower portion of the joist cavity. Allow an air gap of 2 to 3 inches (51 to 76 mm) between the wood sub-floor and the top of the insulation. Refer to Section 072100.
   6. Install Use the recommended amount of insulation in the joist cavity below the floor in accordance with the submitted radiant floor design. Refer to Section 072100.
   7. Use edge insulation equal to the amount of under floor insulation if the heated panel directly contacts an exterior wall or panel. Refer to Section 072100.

D. Glycol additive and Water Solution used in tubing layout:
   1. Provide premixed glycol additive and water solutions.
   2. Do not use ethylene glycol due to toxicity issues. Provide inhibited propylene glycol additives for hydronic radiant floor heating systems. Refer to the boiler manufacturer's recommendations.

3.3 INSTALLATION OF HYDRONIC SNOW MELTING SYSTEM

A. Radiant heated Slab-On-Grade Installation:
   1. Fasten the tubing to the welded wire mesh or rebar in accordance with the tubing manufacturer's installation recommendations.
   2. Install tubing at a consistent depth below the surface elevation. Ensure sufficient clearance to avoid control joint saw cutting.
   3. Install an extruded polystyrene insulation board at the edge of, and optionally under, the slab, depending on site conditions and all applicable codes.
   4. Where tubing crosses metal expansion joints in the concrete, ensure that the tubing passes below the joints or is sleeved through the joints in accordance with manufacturer's instructions.

5. For PE-RT that exits the slab in a 90-degree bend, use fabricated bend supports.

3.4 INSTALLATION OF HYDRONIC HEATING SYSTEMS

A. radiant heated Slab over Steel Deck Installation:

1. Fasten tubing to either welded wire mesh or rebar, in accordance with manufacturer's installation instructions.
2. If welded wire mesh or rebar is not used, install the tubing perpendicular to the ribbing on the steel deck.
3. Install either spray-on insulation or insulation board under the steel deck as per the manufacturer's directions.

B. Brick Pavers over Concrete Slab Installation:
1. Fasten the tubing to the welded wire mesh or rebar in accordance with the tubing manufacturer's installation recommendations.
2. Fasten Install tubing at a consistent depth below the surface elevation.
3. Fasten Install the brick pavers on top of the concrete according to proper masonry practice and guidelines for this application.

C. Brick Pavers over Sand or Stone Dust Installation:
1. Fasten the tubing to the welded wire mesh or rebar in accordance with the tubing manufacturer's recommendations for installation in base material.
2. Install tubing at a consistent depth below the surface elevation.
3. Place a layer of sand over the tubing to a depth that results in the manufacturer's recommended minimum depth when compacted.
4. Install the brick pavers on the compacted material according to proper masonry practice and guidelines for this application.

D. Under Asphalt Installation:
1. Fasten the tubing to the welded wire mesh or rebar in accordance with the tubing manufacturer's recommendations for installation in sub-base material.
2. Install tubing at a consistent depth below the surface elevation.
3. Ensure that there is a minimum of 2 inches (51 mm) of material covering the installed tubing.

E. Glycol additive and Water Solution
1. Provide premixed glycol additive and water solutions.
2. Do not use ethylene glycol due to toxicity issues. Provide inhibited propylene glycol additive for hydronic radiant heating systems. Refer to the boiler manufacturer's recommendations.

3.5 INSTALLATION OF PRE-INSULATED PIPING SYSTEM

A. Comply with manufacturer's product data, including product technical bulletins, installation instructions and design drawings.

B. Provide Below-grade Installation:
1. Pre-insulated piping shall be installed in accordance with manufacturer's recommendations and the details as shown on the contract drawings.
2. The system will be installed with the fewest number of underground joints as possible.
3. The system does not require expansion loops, expansion joints or compensators of any type.
4. An end cap shall be applied at all terminations of the pre-insulated piping system, including all fitting locations, to form a watertight seal.

5. All buried fittings will be installed, insulated and sealed in accordance with the piping manufacturer's instructions.
6. Protective Inspection Chamber or Protective Casings are required for all below-grade connections.

C. Provide Backfill:
1. The pre-insulated piping will be backfilled with clean sand material.
2. HEATFLEX tubing should always be installed below the frost line.
3. Minimum vertical distance from the bottom of the piping to the trench floor is 4 inches (100 mm).
4. Minimum lateral distance from the side of the piping to the trench wall is 6 inches (150 mm) for 4.9 inch (125 mm) outer jacket; 7.1 inches (180 mm) for 6.3 inch (160 mm) or 7.9 inch (200 mm) outer jacket.
5. Install a minimum of 6 inches (300 mm) of clean fill over the top of the pre-insulated piping.
6. Minimum depth of backfill over the sand is 10 inches (250 mm) for pedestrian traffic or 26 inches (650 mm) for vehicular traffic.
7. The balance of the trench can be backfilled with native soil void of stone greater than 2 inches (51 mm) in diameter.
8. Pre Caution tape shall be installed in the backfill along the entire length of the trench.

3.6 FIELD QUALITY CONTROL AND TESTING

A. Hydronic System:
1. Site Tests:
a. To ensure system integrity, pressure test the system before covering tubing in concrete or when other trades are working in the vicinity of the tubing.
b. Test all electrical controls in accordance with respective installation manuals.
c. The System shall be checked annually after startup operations and every year thereafter. System shall be checked for pH levels to ensure that it is operating within suggested guidelines and/or code requirements.

B. Hydronic Pre-insulated PE-RT Distribution System:
1. Site tests:
a. To ensure system integrity, pressure-test the system before and during backfilling or when other trades are working near the piping.
b. The service tubing will be water-tested at 1-1/2 times the operating pressure for a minimum of 3 hours prior to system burial.

3.7 HYDRONIC SYSTEM ADJUSTING

A. Balancing across the Manifold: Balance all loops across each manifold for equal flow resistance based on actual loop lengths and total manifold flow.

B. Hydronic Balancing between manifolds is accomplished with a flow control device installed on the return piping leg from each manifold when direct return piping is used for the supply and return mains or the circuits deviate by more than 10 percent.

3.8 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 and/or recycle all debris.

3.9 DEMONSTRATION

A. Hydronic Radiant Floor Heating System:
   1. Demonstrate operation of system to Owner or Owner's personnel.
   2. Instruct the Owner or Owner's personnel about the type, concentration and maintenance of the glycol and water solution.
   3. Provide Owner or Owner's personnel with manufacturer's installation, operation, and maintenance instructions for installed components within the system.

B. Hydronic Pre-insulated Piping System
   1. Demonstrate operation of system to Owner or Owner's personnel.
   2. Instruct Owner or Owner's personnel about operation and maintenance of the installed system.
   3. Provide Owner or Owner's personnel with manufacturer's installation, operation, and maintenance instructions for installed components within the system.

3.10 PROTECTION

A. Protect installed work from damage caused by subsequent construction activity on the site.

B. Provide owner with copy of photos and drawings of product locations to assist.

END OF SECTION