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## SECTION 235523.13 - LOW-INTENSITY, GAS-FIRED, RADIANT HEATERS

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.

If applying for LEED certification, LEED Prerequisite EA 2 requires compliance with ASHRAE/IESNA 90.1, in which Section 6.5.8 - "Radiant Heating Systems" requires that radiant heat be used to heat unenclosed spaces except loading docks equipped with air curtains.

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

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

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

#### 1.2 SUMMARY

See "Design Considerations" Article in the Evaluations for an explanation of the different heater configurations.

- A. Section includes low-intensity, gas-fired, [**forced-draft**] radiant heaters.

#### 1.3 ACTION SUBMITTALS

- A. Product Data: For each type of product.

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

B. Shop Drawings:

Retain first subparagraph below if equipment is required to withstand specific design loads and design responsibilities have been delegated to Contractor or if structural data is required as another way to verify equipment's compliance with performance requirements. Professional engineer qualifications are specified in Section 014000 "Quality Requirements."

1. Signed, sealed, and prepared by or under the supervision of a qualified professional engineer.
2. Include plans, elevations, sections, and [mounting] [attachment] details.
3. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
4. Detail fabrication and assembly of high-intensity, gas-fired, radiant heaters, as well as procedures and diagrams.

Retain option in subparagraph below if thermostat is specified in this Section; delete if thermostats for these units are specified in Section 230900 "Instrumentation and Control for HVAC."

5. Include diagrams for power[, signal, and control] wiring.

#### 1.4 INFORMATIONAL SUBMITTALS

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.

- A. Coordination Drawings: Plans, elevations, and other details, drawn to scale, on which the following items are shown and coordinated with each other, using input from installers of the items involved:
1. Structural members to which equipment will be attached.
  2. Gas piping to heater installations

Retain first subparagraph below if thermostats are not specified in Section 230900 "Instrumentation and Control for HVAC."

3. Thermostats and wiring to heaters.
  4. Heater locations and clearance requirements.
  5. Other suspended ceiling components including the following:
    - a. Lighting fixtures.
    - b. Air outlets and inlets.
    - c. Sprinklers.
    - d. <Insert item>.
- B. Field quality-control reports.
- C. Sample Warranty: For manufacturer's special warranties.

## 1.5 CLOSEOUT SUBMITTALS

- A. Operation and Maintenance Data: For gas-fired, radiant heaters to include in emergency, operation, and maintenance manuals.

## 1.6 WARRANTY

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

- A. Manufacturer's Special Warranty: Manufacturer's standard, published warranty agrees to provide replacement components of radiant heaters that fail in materials or workmanship within specified warranty period.

See the [Forced-Draft Radiant Heater Product Comparison Matrix in the Evaluations](#) for a comparison of warranties offered among manufacturers listed. Verify available warranties and warranty periods.

- 1. Warranty Period: All warranty periods listed below are from date of Substantial Completion.
  - a. Burner Cup Internal component: Three years.
  - b. Combustion and Emitter Tubes: Three years.
  - c. Heater Controls (Gas and Electrical Components): One year.

## PART 2 - PRODUCTS

See [Editing Instruction No. 1 in the Evaluations](#) for cautions about named manufacturers and products. For an explanation of options and Contractor's product selection procedures, see Section 016000 "Product Requirements."

### 2.1 PERFORMANCE REQUIREMENTS

Retain one of first two paragraphs below.

- A. CSA certified, with CSA Seal and certification number clearly visible on units indicating compliance with ANSI Z83.20/CSA 2.34.
- B. UL listed and labeled, with UL label clearly visible on units indicating compliance with ANSI Z83.20/CSA 2.34.
- C. 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.

### 2.2 FORCED-DRAFT HEATERS

Copy this article and re-edit for each product.

Retain "Basis-of-Design Product" Paragraph and list of manufacturers below to identify a specific product or a comparable product from manufacturers listed. Retain option and delete insert note if manufacturer's name and model number are indicated on Drawings.

- A. Basis-of-Design Product: Subject to compliance with requirements, provide CALCANA USA LTD: **[SR-Series (Industrial, Commercial and Agricultural Heaters)] [CAL-Series (Residential Garage Heaters)] [PH-SERIES (Patio Heaters)]** or comparable product by one of the following:

Calcana Industries Ltd. listed below is based in Canada and manufactures the SUNRAY brand of forced draft heaters.

1. Calcana Industries Ltd.
  2. Combustion Research Corporation.
  3. Solaronics, Inc.
  4. Space-Ray; Division of Gas Fired Products, Inc.
  5. Sterling Heating, Ventilation & Air-Conditioning Products; a Mestek company.
  6. <Insert manufacturer's name>.
- B. Description: Factory-assembled, **[indoor] [outdoor]**, overhead-mounted, electrically controlled, low-intensity, infrared radiant heating units using gas combustion. Heater to have all necessary factory-installed wiring and piping required prior to field installation and startup.
- C. Fuel Type: Design burner for **[natural] [propane]** gas having characteristics same as those of gas available at Project site.
- D. Burner Assembly:

Retain one of three "Combustion-Air Inlet" subparagraphs below. Heaters built to work indoors can be ducted to receive outdoor air if needed.

1. Combustion-Air Inlet: Non-ducted, unvented.
2. Combustion-Air Inlet: Ducted horizontal to outdoors through sidewall with vent caps.
3. Combustion-Air Inlet: Ducted vertical to outdoors through roof with vent caps.

Choosing **tailess steel** option may limit the number of qualified manufacturers.

4. Burner Control Housing, Totally Enclosed: **[Stainless-steel] [Corrosion-resistant, aluminized-steel] [Steel]** exterior. A sight glass is supplied for visual inspection of the burner.

Retain "Finish" Subparagraph below if material chosen in "Burner Control Housing, Totally Enclosed" subparagraph above is steel.

- a. Finish: **[Enameled finish] [or] [powder-coated finish]**.

Retain "Power Burner," "Ignition System," and "Combustion Blower Fan" subparagraphs below if these are critical Project requirements. Including these requirements may limit competition.

5. Power Burner: Forged or one-piece cast iron burner cup with stainless steel mixing-flame screen.
  6. Ignition System: Electronic, direct spark **[24/25-V ac] [115/120-V ac]** with combination spark and flame rod sensing capabilities (local sense), three try and self-diagnostic control module.
  7. Combustion Blower Fan: Dynamically balanced, direct-driven, forward-curved fan.
  8. Motor: Resilient-mounted, totally enclosed, non-ventilated type with internal thermal protection.
- E. Combustion Chamber: **4-inch- (100-mm-)** diameter, 16-gage, **[aluminized] [stainless]-steel** tubing.

See "Emitter Tubing Material" Article in the Evaluations for an explanation of pros and cons of various emitter tube materials in use. Also see manufacturer's documentation to determine which materials best suit specific application requirements.

- F. Emitter Tube: **4-inch- (100-mm-)** diameter, 16-gage, **[aluminized] [stainless]-steel** tubing.

1. Tubing Connections: Compression couplings made from aluminized or stainless steel.

Retain the "Flue Gas Optimizer" Paragraph below for emitter tube lengths equal to or less than 70 ft (21 m). Units with emitter tube lengths 80 ft (24 m) and longer do not require Flue Gas Optimizers.

- G. Flue Gas Optimizer: Turbulator or baffles of a Z configurations to be installed in the last (exhaust end) 10 ft (3 m) of the emitter tubes.

Retain "Exhaust Vent Termination" Paragraph below if emitter tubes are to be vented outdoors. Venting emitter tubes is not necessary as long as a minimum of 4 CFM/1000 Btu/h (1.8L/s/293 W) are maintained in the space where the radiant heater is utilized.

- H. Exhaust Vent Termination: [**Vertical through roof**] [**Horizontal though side-wall**] with vent caps.

High-wind design vent terminal reduces back pressure on burner.

- a. Horizontal Vent Terminal: High wind design.

- I. Reflector: Polished 22-gage [**aluminum**] [**stainless steel**], 97 percent minimum reflectivity, with end caps and eight reflective sides. Shape to control radiation from tubing for uniform intensity at floor level with the lowest portion of the reflector extending a minimum of 2 inches (50 mm) below the lowest portion of the radiant tube, on a horizontal plane, for maximum control of radiant output and minimum convection loss. Inside reflective surface area shall be not less than 3200-sq in (20,645-sq cm) per 10-ft (3-m) section of reflector length. Reflectors or entire heater shall accommodate rotational adjustment from horizontal to a minimum 25-degree tilt from vertical.

- J. Accessories:

Verify that required accessories retained in subparagraphs below are available from manufacturers retained in "Manufacturers" or "Basis-of-Design Product" Paragraph above. See the Forced-Draft Radiant Heater Product Comparison Matrix in the Evaluations for more information.

1. Reflector Extension Shields: Same material as reflectors, arranged for fixed connection to lower reflector lip and rigid support to provide 100 percent cutoff of direct radiation from tubing at angles greater than 25 degrees from vertical.
2. Wave Concentrator Protective Grilles: Aluminum egg-crate style mounted to reflectors. Grid pattern to be 0.5-inches by 0.5-inches (13-mm by 13-mm) openings.
3. Stainless-steel flexible connector for gas supply.
4. Chain Kit: Provide hanger chain kit consisting of chain and "S" hooks.
5. Tube and Reflector Hangers: [**Galvanized**][**Aluminized**] integral style forming an individual dead air space under the reflector.
6. Rigid mounting kits.
7. Outdoor use conversion kit.
8. Clearance warning plaque.

If Project has more than one type or configuration of forced-draft, low-intensity, gas-fired, radiant heater, delete "Capacities and Characteristics" Paragraph below and schedule radiant heaters on Drawings.

- K. Capacities and Characteristics:

Retain one of ten "SR-Series" subparagraphs below if SR-Series product designation is retained in "Basis-of-Design Product" Paragraph above.

1. SR-Series: 40,000 BTU/HR (12 kW) with [10 foot (3 m)] [20 ft (6 m)] emitter tubing.
2. SR-Series: 50,000 BTU/HR (15 kW) with 20 ft (6 m) emitter tubing.

3. SR-Series: 60,000 BTU/HR (18 kW) with [20 ft (6 m)] [30 ft (9 m)] [40 ft (12 m)] emitter tubing.
4. SR-Series: 75,000 BTU/HR (22 kW) with [20 ft (6 m)] [30 ft (9 m)] [40 ft (12 m)] emitter tubing.
5. SR-Series: 80,000 BTU/HR (24 kW) with [20 ft (6 m)] [30 ft (9 m)] [40 ft (12 m)] emitter tubing.
6. SR-Series: 100,000 BTU/HR (30 kW) with [30 ft (9 m)] [40 ft (12 m)] [50 ft (15 m)] emitter tubing.
7. SR-Series: 125,000 BTU/HR (34 kW) with [40 ft (12 m)] [50 ft (15 m)] emitter tubing.
8. SR-Series: 150,000 BTU/HR (44 kW) with [40 ft (12 m)] [50 ft (15 m)] [60 ft (18 m)] emitter tubing.
9. SR-Series: 175,000 BTU/HR (51 kW) with [50 ft (15 m)] [60 ft (18 m)] [70 foot (21.34 m)] emitter tubing.
10. SR-Series: 200,000 BTU/HR (59 kW) with [60 ft (18 m)] [70 ft (21 m)] [80 ft (24 m)] emitter tubing.

Retain one of three "CAL-Series" subparagraphs below if CAL-Series product designation is retained in "Basis-of-Design Product" Paragraph above.

11. CAL-Series: 40,000 BTU/HR (12 kW) with 10 ft (3 m) emitter tubing.
12. CAL-Series: 50,000 BTU/HR (15 kW) with 15 ft (5 m) emitter tubing.
13. CAL-Series: 75,000 BTU/HR (22kW) with 20 ft (6 m) emitter tubing.

Retain one of three "PH-Series" subparagraphs below if PH-Series product designation is retained in "Basis-of-Design Product" Paragraph above.

14. PH-Series: 40,000 BTU/HR (12 kW) with [60 inches (1500 mm) HO Series] [10 ft (3 m)] emitter tubing.
15. PH-Series: 50,000 BTU/HR (15 kW) with 15 ft (5 m) emitter tubing.
16. PH-Series: 75,000 BTU/HR (22 kW) with [10 ft (3 m) HO Series] [20 ft (6 m)] emitter tubing.
17. Electrical Power Requirements:
  - a. Volts: 120 Vac.
  - b. Phase: [Single] [Three].
  - c. Hertz: 60.

For "Full-Load Amperes" subparagraph below choose 1 Amp for 40,000 to 80,000 Btu/Hr input and choose 2.25 Amp for 100,000 to 200,000 Btu/Hr gas input.

- d. Full-Load Amperes: [1 A] [2.25 A] <Insert value>.

### 2.3 CONTROLS AND SAFETIES

- A. Gas Control Valve: [Single-stage, SR-Series] [Two-stage, CAL-Series] [Modulating CAL-Series] [PH-Series], regulated redundant 24-V ac electric gas valve, pressure regulator and manual shutoff all in one body.
- B. Failure Safeguards: 100 percent shutoff of gas flow in the event of flame or power failure.
- C. Prepurge of [15] [30] [45] seconds of air control system prior to burner ignition.
- D. 100 percent safety electronic flame supervision. Lockout burner after three consecutive ignition failures with re-try every hour. Ignition module shall have diagnostic LED.

- E. Blocked Vent Safety: Differential pressure switch in burner safety circuit to stop burner operation with high discharge or suction pressure.

Retain one of two "Thermostat" paragraphs below. Note that thermostats may not be supplied with some units.

- F. Thermostat: Devices and wiring are specified in Section 230900 "Instrumentation and Control for HVAC."
- G. Thermostat: Single-stage, wall-mounted type with 50 to 90 deg F (10 to 32 deg C) operating range with individual heaters having built-in capability to operate with either a low-voltage thermostat or 120-V thermostat without additional relays or transformers.
  - 1. Control Transformer: Integrally mounted.
- H. Hi/Lo Control: Manual override to provide ultimate operator control for increased comfort.
- I. Modulating Control: To be of manual type to provide ultimate operator control for increased comfort.

## PART 3 - EXECUTION

### 3.1 EXAMINATION

- A. Examine structures, substrates, areas and conditions, with Installer present, for compliance with requirements for installation tolerances, required clearances, and other conditions affecting performance of the Work.
- B. Examine roughing-in for fuel-gas piping to verify actual locations of piping connections before equipment installation.
- C. Prepare written report, endorsed by Installer, listing conditions detrimental to performance of the Work.
- D. Proceed with installation only after unsatisfactory conditions have been corrected.

### 3.2 INSTALLATION

- A. Equipment Installation: Install gas-fired, radiant heaters and associated gas features and systems according to [NFPA 54] [CSA B149.1].
- B. Tube and Reflector Hangers: Install every 60 inches (1500 mm) or 10 ft (3 m), physically forming an individual dead air space under each 60-inch (1500-mm) or 10-ft (3-m) section of reflector
- C. Suspended Units: [**Suspend from substrate using chain hanger kits and building attachments**] [**Mount to substrate using manufacturer's rigid mounting kits or custom fabricated brackets**].

Retain first subparagraph below if Project site is in a seismic area.

- 1. Restrain the unit to resist seismic acceleration. Comply with requirements for seismic-restraint devices specified in Section 230548 "Vibration and Seismic Controls for HVAC Piping and Equipment."
- 2. Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

- D. Maintain manufacturers' recommended clearances for combustibles.

### 3.3 CONNECTIONS

Coordinate piping installations and specialty arrangements with Drawings and with requirements specified in piping systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

- A. Gas Piping: Comply with [Section 231123 "Facility Natural-Gas Piping."] [Section 231126 "Facility Liquefied-Petroleum Gas Piping."] Connect gas piping to gas train inlet; provide union with enough clearance for burner removal and service.
1. Gas Connections: Connect gas piping to radiant heaters according to [NFPA 54] [CSA B149.1].
- B. Where installing piping adjacent to gas-fired, radiant heaters, allow space for service and maintenance.
- C. Vent Connections: Comply with Section 233113 "Metal Ducts" and with Section 235100 "Breechings, Chimneys, and Stacks."
- D. Electrical Connections: Comply with applicable requirements in Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
1. Install electrical devices furnished with heaters but not specified to be factory mounted.

### 3.4 FIELD QUALITY CONTROL

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

- A. Manufacturer's Field Service: Engage a factory-authorized service representative 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.

- B. Perform the following tests and inspections[ **with the assistance of a factory-authorized service representative**]:
1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
  2. Verify bearing lubrication.
  3. Verify proper motor rotation.
  4. Test Reports: Prepare a written report to record the following:
    - a. Test procedures used.
    - b. Test results that comply with requirements.
    - c. Test results that do not comply with requirements and corrective action taken to achieve compliance with requirements.

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

- C. Gas-fired, radiant heaters will be considered defective if they do not pass tests and inspections.



- D. Prepare test and inspection reports.

Retain "Adjusting" and "Demonstration" articles below for multiple-burner systems.

### 3.5 ADJUSTING

- A. Adjust initial-temperature set points.
- B. Adjust burner and other unit components for optimum heating performance and efficiency.

### 3.6 DEMONSTRATION

- A. **[Engage a factory-authorized service representative to train]** **[Train]** Owner's maintenance personnel to adjust, operate, and maintain gas-fired, radiant heaters.

END OF SECTION 235523.13