SECTION 15762 – TERMINAL HEAT TRANSFER UNITS

PART 1 - GENERAL

1.1 RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

1.2 WORK INCLUDED

A. Furnish and install all terminal heat transfer units of the type, size and capacity as scheduled.

B. Units shall be UL and AGA listed in accordance with the specific unit's heat transfer design and construction.

1.3 RELATED SECTIONS

A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

1.4 REFERENCES

A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.

B. Material standards shall be as specified or detailed hereinafter and as following:

1. UL 1025-89 – Electric Air Heaters.
2. UL 1042-86 – Electric Baseboard Heating Equipment.
3. ASHRAE 90.1 – Energy Efficient Design of New Buildings Except Low-Rise Residential Buildings.
4. NFPA 54 – National Fuel Gas Code.
5. NFPA 90A – Installation of Air Conditioning and Ventilating Systems.
6. NFPA 90B – Installation of Warm Air Heating and Air Conditioning Systems.
7. NFPA 211 – Chimneys, Fireplaces, Vents and Solid Fuel Burning Appliances.

1.5 SYSTEM DESCRIPTION

A. Furnish and install all radiation, unit heaters, radiant panels, controls, piping, wiring, enclosures, access doors, etc. to make a complete and operational system.

B. All enclosures shall be installed with aligning strips, plaster frames and end trims so as to provide a neat architectural finish.

C. All equipment shall be new and shall be of the type, style, size and capacities as scheduled. All radiation enclosures shall be continuous and of the same finish and style as adjacent enclosures.

1.6 SUBMITTALS

A. See Section 15050 and general conditions for additional requirements.

B. Product Data: Provide typical catalog of information including arrangements.

C. Shop Drawings:

1. Submit schedules of equipment and enclosures typically indicating length and number of pieces of element and enclosure, corner pieces, end caps, cap strips, access doors, pilaster covers and comparison of specified heat required to actual heat output provided.

    a. Indicate cross sections of cabinets, grilles, bracing and reinforcing, mounting details and insulation if required and typical elevations.
    b. Indicate flows, pressure drops (including interconnecting piping for radiant panels), heat outputs and mean temperatures.
    c. Indicate mechanical and electrical service locations and requirements.

D. Manufacturer's Instructions: Indicate installation instructions and recommendations.

E. Project specific installation instructions and details.

F. Project Record Documents: Record actual locations of components and locations of access doors in radiation cabinets and ceiling panels required for access or valving.

G. Operation and Maintenance Data: Include manufacturer's descriptive literature, operating instructions, installation instructions, maintenance and repair data and parts listings.

H. Warranty: Submit manufacturer's warranty and ensure forms have been completed in Owner's name and registered with manufacturer.

1.7 QUALITY ASSURANCE

A. Manufacturer Qualifications: Company specializing in manufacturing the Products specified in this section with minimum ten (10) years of documented experience.

B. Products Requiring Electrical Connection: Listed and classified by Underwriter's Laboratories Inc. testing firm acceptable to the authority having jurisdiction and suitable for the purpose specified and indicated.

1.8 PRODUCT, STORAGE AND HANDLING

A. Delivery of materials shall be made to the project by the materials supplier in accordance with the instructions to the Contractor.

B. The Contractor shall provide adequate locked storage space with shelving for the materials, shall be responsible for all items of materials after receipt from the supplier, and shall replace all materials lost or damaged after delivery and receipt.

C. The Contractor shall furnish the materials supplier with receipts for all materials and accessory items received and shall send copies of these receipts to the Architect.

1.9 WARRANTY

A. See General Conditions for additional warranty requirements.

PART 2 - PRODUCTS

2.1 UNIT HEATERS

A. General

1. All type heaters, as applicable, shall be hung with vibration spring isolators as hereinbefore specified.
2. The Contractor shall provide control valves and unit or remote mounted thermostats and wire to fan, to cycle fan "on/off."
3. The Contractor shall make provisions to "open/close" the steam or water control valves when heaters are "on/off", as indicated hereinafter.
4. Unit manufacturer shall provide starters and disconnect switches.
5. Thermostats used with all type heaters shall be coordinated with the unit manufacturer for compatibility with equipment.
6. Heater colors, where applicable, shall be as provided as standard by the unit manufacturer.
7. Heater finish color shall be as determined by the Architect during shop drawings from the colors provided as standard by the unit manufacturer.

8. Temperature Control

    a. Thermostat control shall be provided on floor and wall mounted units, consisting of factory built-in thermostat or wall-mounted thermostat of fully enclosed and snap acting to prevent radio or TV interference. The thermostat shall have a temperature adjustment range between 45°F and 95°F. Integral thermostats shall have tamperproof adjustment through the discharge grille by means of a hex wrench. Ceiling and inverted mounted units shall be provided with wall mounted MHT 4015E-1007 thermostat.
    b. If not indicated on the plans the unit shall have a unit mounted return airside thermostat.
    c. Thermostat shall operate the single-phase holding coil circuit of the integrally mounted power control relay(s). This single-phase relay holding coil circuit shall either be powered from the cabinet unit heater main power supply or from a separate 120V or 24V single-phase circuit.
    d. An integral fan delay switch shall be provided to prevent discharge of cold air, by delaying start-up of the fan motor until heating elements have warmed up. This same fan delay switch shall maintain motor operation after heating elements have been de-energized to dissipate any residual heat.
    e. Floor, wall and inverted mounted units shall be equipped as standard with a 2-speed/2-heat selector switch which will permit simultaneous tamperproof "high/low" adjustment of fan speed and heat output by means of a hex wrench through the discharge grille. Ceiling mounted units shall be wired for medium speed.

B. Hot water or steam propeller type unit heaters

1. Provide unit heaters of arrangement (floor or ceiling mounted, exposed or recessed) as indicated on the drawings.
2. Acceptable manufacturers subject to compliance with the specifications shall be as follows.

    a. Sterling
    b. Trane
    c. Modine
    d. Vulcan
    e. Airtherm

3. Casing shall be 2-piece with "picture frame" front formed into wrap-around sides, top and bottom with horizontal louvers and louver keepers. Back panel shall be 18 gauge with deep draw fan orifice for extreme rigidity. Heaters shall have cast brass coil supply and return pipe tap connectors bolted to back corners and casings phosphatized to prevent corrosion.
4. Fans shall have aluminum blades and shall be factory balanced for standard application.
5. Coils shall be one-row deep in the direction of flow, headerless, single tube, single serpentine type. Fins shall be aluminum Sigma-Flo, mechanically bonded to seamless

copper tubing. Coils shall be one-row deep in airflow direction and shall be tested at 300-psig air, under water.

6. Motors shall be totally enclosed, insulated, shaded pole. Motors shall have built-in overload protection and shall be permanently lubricated.
7. Provide four (4) direction control louvers with lateral diffusion and clips suitable for support off louvers.

C. Electric propeller type unit heaters shall be as follows:

1. Provide electric unit heaters of the type, size, capacity and voltage as specified on the drawings.
2. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

    a. Trane
    b. Chromalox
    c. Q'Mark
    d. Raywall
    e. Markel
    f. Berko

3. Enclosures shall be fabricated from heavy gauge zinc coated steel, finished in high gloss beige enamel. Enclosures shall contain heating elements, contactors and control transformers where required. Air shall be drawn in the back of the heater and discharged through independently adjustable horizontal louvers on the front. In the low portion of the front, a large hinged access door extending the width of the heater shall be provided for easy wiring and inspection of controls. Heater and supply wiring diagram shall be attached permanently to the inside of this door. Motor shall be mounted on a heavy gauge formed wire protective guard. A castle nut with cotter key shall be supplied on the top of the unit at center of gravity to allow easy support and adjustment.
4. Elements shall consist of helically coiled nickel chromium alloy resistance wire embedded and completely surrounded in magnesium oxide, enclosed and swaged into corrosion resistant sheaths to which are permanently attached corrosion resistant steel fins. Element assemblies shall be circular in shape and enclosed in a closely fitting cylinder creating a pressure chamber to assure uniform airflow.
5. Motors shall be totally enclosed industrial rated single-phase, permanently lubricated and equipped with thermal overload protection with automatic reset. Units rated 20 KW and less shall have shaded pole motors. Those over 20 KW shall have permanent split capacitor motors.
6. Fan blade shall be of the axial flow type designed for high efficiency and quiet operation. Fan speed shall not exceed 1700 rpm.
7. All heaters shall be equipped with a manual reset thermal cutout which disconnects elements and motors in the event normal operating temperatures are exceeded.
8. Heaters shall be designed for a single supply circuit, with elements, motor and control circuits subdivided and fused to conform to the National Electric Code, Occupational Safety and Health Act (OSHA) and Underwriters' Laboratories, Inc., Standard 573-1968. All 3-phase heaters shall have balanced phases.

9. Contactors and control circuit transformers, where required, shall be factory assembled and wired with only direct line supply and thermostat connections required in the field.
10. Heaters are to be listed under the Re-Examination Service of Underwriters' Laboratories, Inc. Heaters shall be guaranteed to be free from defective material and workmanship for a period of one (1) year, with the exception of the heating elements which shall be guaranteed for five (5) years.

2.2 CABINET UNIT HEATERS

A. Steam or Hot water

1. Acceptable manufacturers subject to compliance with the specifications shall be as follows.

    a. Sterling
    b. Trane
    c. Modine
    d. Vulcan
    e. Airtherm

2. Units shall include chassis with galvanized steel wrap-around structural frame with all edges flanged. Insulation shall be faced, heavy density glass fiber. Where applicable, cabinet unit heaters shall be suitable to be installed in a manner to receive ductwork (supply and/or return).
3. Cabinets shall have a minimum 16 gauge steel front panels, 18 gauge steel end and top panels and channel formed edges around entire panel perimeters. Front panel shall be insulated over the entire coil section. Integral stamped outlet grilles shall be with 15-degree deflection from vertical. Provide stamped lattice discharge grilles, access door on coil connection side of unit filter and front panel removable without tools.
4. Cabinet finish shall be cleaned, bonderized, phosphatized and flow coated with baked-on primer and final paint finish as directed by the Architect in the field.
5. Coils shall have 5/8 inch O.D. seamless copper tubes bonded to configured aluminum fins with continuous fin collars and sleeved coil and supports. Maximum working pressure shall be 300 psig, factory burst test, 450 psig (air) and leak test 300 psig (air under water).
6. Fan wheels shall be centrifugal, forward curved, double width of non-corrosive, molded, fiberglass reinforced thermoplastic material. Fan housings shall be of formed sheet metal.
7. All motors shall have integral thermal overload protection and start at 78% of rated voltage. Motors shall operate satisfactorily at 90% of rated voltage on all speed settings and at 10% overvoltage without undue magnetic noise.

B. Electric cabinet type unit heaters shall be of the size and capacity as scheduled.

1. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

   a. Marley
   b. Q Mark
   c. Trane
   d. Singer
   e. Vulcan
   f. Raywall

2. Provide electric unit heaters cabinet type of arrangement (floor or ceiling mounted, exposed or recessed) as indicated on the drawings.
3. Unit shall be flow-thru design with motor and fans in the airstream below the electric heating bank. Fan discharge shall be baffled to ensure even airflow through entire area of heating bank for even outlet temperatures. Leveling bolts shall be provided on floor models. Unit types shall be provided with suitable arrangements to receive ductwork where applicable and shall be recessed, surface mounted or ceiling hung, as scheduled on the drawings and as required by job conditions.
4. All solid panels of the front, top and bottom panels shall be internally insulated to provide quiet operation and low surface temperatures. Complete unit assembly shall be UL listed and approved.
5. Base color shall be light neutral gray. Casing shall be given a 5-stage phosphatizing treatment prior to application of high gloss baked enamel finish. Casing top and front shall be 16 gauge with 18-gauge front accent panel. Discharge grille shall be a continuous stamped louver. Front access panel fasteners shall be Phillips head.
6. The electric heating coil shall consist of metal sheath heating elements. The elements shall have a copper clad steel sheath for strength and corrosion resistance, and aluminum fins for faster heat transfer. Fintubes shall be installed or removed individually, and shall be center anchored to ensure noiseless expansion and contraction. Automatic reset snap action type thermal protection shall be furnished through holding coil circuit of the control system relay(s) for protection in the event of overheating due to air blockage from any cause. Thermal protector shall be linear type to sense temperatures the entire length of heating elements, to detect localized overheating from partial air blockages.
7. Motor and fan assembly shall be direct drive on all unit sizes, using extended motor shaft on single-fan unit, double extended motor shafts on 2-fan units and coupling with hollow steel shafts and end bearings on 3-fan, 4-fan and 5-fan units. Two-speed permanent split capacitor type motors with built-in automatic reset motor overload protection shall be standard.
8. Fans shall be forwardly curved, double inlet, centrifugal type, aluminum construction, and shall be modular in design.
9. Motor and fans shall be mounted on an extra heavy 14 gauge galvanized mounted plate, forming an easily removable assembly. Motor leads shall be plug-in type for easy removal of the motor and fan assembly. Combination 2-speed, 2-heat

tamperproof switch shall be located with access through discharge air grille, using a hex wrench for adjustment.

10. Units shall be provided with throwaway type filters. Filter access shall be through removable front access panel.
11. All recessed units shall have wall guard type recess flanges which will protect the wall (or ceiling) from direct contact and damage when access panels are removed or replaced for normal maintenance. Recess depths shall be available from 1" minimum to 9 1/2" maximum on all floor, wall or ceiling recessed units. Recess flanges shall be factory assembled to depth specified, but can be field adjusted for greater recess depth if necessary.

2.3 FINNED TUBE RADIATION

A. General

1. Provide finned tube radiation of size, capacity, location and enclosure style as shown and scheduled on the drawings and as hereinafter specified.
2. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

    a. Vulcan
    b. Sterling
    c. Sigma

3. Radiation shall have net I=B=R approved ratings in accordance with the Hydronics Institute "Testing and Rating Standard for Finned Tube Radiation".

B. Heating Elements (Typical All Radiation Types)

1. Heating elements shall be steel or copper/aluminum supported at 4'-0" intervals with a wall mounted slide-cradle type hanger. Provide additional horizontal pipe hangers as required.
2. All hangers for heating elements shall be of the ball bearing or nylon coated slide-cradle type, galvanized die formed. Hanger shall provide for lengthwise movement of element during expansion and contraction, as well as alignment of element to prevent contact with bracket, wall or enclosure. Hangers shall allow a minimum of 1 1/2" of vertical adjustment.
3. Steel heating elements shall have steel fins permanently bonded to steel tube and guaranteed for working pressures up to 125 psi at 330°F. The bond of fin to tube shall be guaranteed under normal operating conditions for the life of the installation. Minimum tube wall thickness shall be 0.125". Minimum fin thickness shall be 0.032". Tube size, fin size and fin spacing shall be as indicated on the drawings. Elements shall be painted black with NPT threaded ends.
4. Copper/aluminum heating elements shall have aluminum fins collared and mechanically bonded to copper tubes and guaranteed for working pressures up to 100 psi at 330°F. The bond of fin to tube shall be guaranteed under normal operating

conditions for the life of the installation. Minimum tube wall thickness shall be 0.025". Tube size, fin size and fin spacing shall be as indicated on the drawings.

C. Enclosures

1. General

a. Enclosures shall be of the types shown on the drawings, manufactured of 16-gauge steel. Joining of enclosures shall be accomplished with interlocking slip joints to provide rigidity. All enclosures shall be chemically phosphatized before priming with baked primer. Finish painting shall be manufacturer standard color as selected by the Architect. Accessories shall be die formed with beaded or flanged edges. Access doors shall be provided where shown on the drawings and where required for access to valves, vents, etc. Access doors shall be hinged with tamperproof latch. No sheet metal screws or other fastening or joining device shall be visible when enclosure is installed below eye level.

b. Provide all end caps, corner pieces, seams and accessories as required for a complete radiation installation. Enclosures shall be wall-to-wall, except where otherwise specifically noted on the drawings. Where not wall-to-wall, provide minimum of 12" cover each side of fin tube to allow for installation of valves and other accessories. Ordering and installation of all radiation related accessories and exact lengths of radiation covers shall be based on the actual job conditions.

c. Provide partial backplate die formed for rigidity. Plate shall be off-the-wall allowing for removal of enclosure without wall scratching. Provide rubber gasket at wall for complete air seal.

d. Brackets shall be die formed for rigidity and must be designed to support the partial backplate at the top, as well as the front skirt of the enclosure. Brackets shall incorporate a tamperproof system for fastening the enclosure, eliminating removal of enclosure without the use of tools.

e. Radiation enclosure shall be suitable for installing return pipe main under fin tube or double finned elements, where applicable and shown on the drawings.

2. Radiation Enclosure Types

a. Type "A" radiation type shall have slope top style enclosure, manufactured of 16-gauge steel with stamped, pencilproof outlet grille.

b. Type "B" radiation shall have extruded aluminum top outlet grille and 16 gauge steel front plate.

1) Aluminum grille shall be of pencilproof design, formed from a continuous extrusion with vanes directed toward room. Grille shall have hard coat with clear anodized finish.

2) Steel front plate shall have baked primer and finish painting with manufacturer’s standard color as selected by the Architect.

c. Type "C" radiation shall have floor mounted pedestal type enclosure with extruded aluminum top outlet grille and 16 gauge steel side plates.

1) Aluminum grille shall be of pencilproof design, formed from a continuous extrusion with vanes directed toward room. Grille shall have hard coat with clear anodized finish.
2) Steel side plate shall have baked primer and finish painting with manufacturer's standard color as selected by the Architect.
3) Floor mounted pedestal bracket shall provide rigid support for heating element and enclosure.

d. Type "D" radiation shall be bare element finned tube with custom enclosure provided by others. Provide slide-cradle type heating element hanger as herein specified.

e. Type "E" radiation shall be bare element finned tube with no enclosure, for installation in concealed ceiling or soffit space as shown on the drawings. HVAC Contractor shall provide all pipe hangers and supports.

2.4 DOOR HEATERS

A. General

1. Provide door heaters of capacity, quantity and characteristics, as shown and scheduled on the drawings.
2. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

a. Dynaforce Corp.
b. Air King
c. Wing
d. Mars

3. Air curtains shall be performance rated in accordance with test methods defined in AMCA Standard 220.
4. Air curtain ratings shall be certified by AMCA. Air curtains shall bear the AMCA seal.
5. Where indicated on the contract drawings provide air curtains with heating coils having capacity scheduled.
6. Air curtains shall be factory assembled and functionally tested prior to shipment to job site.
7. IR curtains shall be complete with all parts, components and accessories UL listed for application and installation as shown.
8. Air curtains shall provide a single point power connection. Power source shall be 480 volt, 3 phase, 60 hertz.
9. The maximum noise level measured 10 feet from the air curtain in free field shall not exceed 73 dBA.

10. Air curtain shall be provided with internal vibration isolation.
11. Motors serving fan(s) shall be TEFC. Refer to Motor Section for additional requirements.

B. Housing

1. Housing panels shall be constructed of not less than 16 gauge ASTM A 653/A653M phosphatized galvanized steel with a minimum G90 finish. Zinc coating weight of 0.90 ounces per square foot when tested in accordance with ASTM A 90.
2. Housing shall be provided with a structural frame and reinforced to limit panel deflection to 1/360 of the span. Maximum deflection across the unit length shall not exceed 0.25 inches.
3. Housing shall be designed for field support at ends only. No intermediate field supports will be provided.
4. Housing panels and frame shall be finished with two coats of primer and two coats of enamel. Minimum air-dried film thickness for primer shall be 2 mils per coat. Minimum air-dried film thickness of enamel shall be 5 mils.
5. Housing shall be provided with access doors or removable panels for access to fans, bearings, motor and all other internally mounted and serviceable components. Size of access shall allow for repair or replacement of internally mounted components.
6. Air curtains without heating coils shall be provided with a removable heavy gauge expanded metal inlet grille painted to match the housing panels.

C. Discharge Nozzle

1. Discharge nozzle shall be provided with adjustable louvers.
2. Discharge nozzle shall provide adjustable directional air pattern control of minimum plus or minus 15 degrees.
3. The discharge nozzle shall be provided with an adjustable damper to modulate airflow from scheduled flow to at least 50 percent of scheduled airflow.

D. Electrical

1. Electrical work shall be in accordance with the National Electrical Code, NFPA 70.
2. Wiring shall be 600 volt rated type THWN stranded copper. Minimum wire size shall be 14 AWG for control and 12 AWG for power.
3. Provide a unit mounted control panel to house all electrical components and control circuitry. The enclosure shall conform to NEMA Standard Type 12 (industrial use) and J.I.C. standard E.G.P.-1-1967.
4. The control panel shall include:

    a. Starter.
    b. One overload block for each motor.
    c. A transformer with fused primary and secondary providing 120 volts for the control circuitry.
    d. Provide a ground wire for each circuit.
    e. All components shall be factory wired to a terminal strip for field connection.
    f. All components including control panel shall be UL listed.

E. Control

1. Provide air curtain complete with Hand-Off-Auto switch. With the switch in the auto position the air curtain shall energize and de-energize based on the door operation switch. When the door open switch is depressed the fan is energized first and then the door is energized to open. When the door close switch is depressed the door shall close fully then the fan shall be de-energized. Coordinate with door supplier.

F. Hot Water Door Heaters.

1. The heating element shall consist of fin and tube extended surface with aluminum fins mechanically bonded to 5/8" seamless copper tubing, same end connections. The heating element shall be brazed tube construction. Each unit shall be factory tested at 400-psig hydrostatic pressure prior to shipment.

2.5 RADIANT HEATING PANELS

A. General

1. Provide a radiant heating panel system as indicated on the drawings and connect to hot water piping.
2. Acceptable manufacturers subject to compliance with the specifications shall be as follows:

   a. Aero Tech
   b. Sun-El
   c. Sterling
   d. Airtex

3. Performance data and dimensional specifications shall be available from the manufacturer for all products. Performance and capacity data shall be based on testing performed by the manufacturer or confirmed by a testing laboratory recognized in the Industry.
4. The manufacturer shall demonstrate his capability in engineering, manufacturing and financial resources to the satisfaction of the Architect and Engineer.
5. The panel manufacturer shall furnish and install the panels; hot water supply and return piping to the panel system shall be provided by the HVAC Contractor. The "Radiant Panel Contractor" shall refer to the radiant panel manufacturer.

B. Radiant Panel Performance Requirement

1. Panel thermal performance shall be as specified herein and on the mechanical drawings.

   a. The radiant panels will have a minimum heating output as scheduled on the drawings

2. Panel widths shall be as indicated or scheduled on the drawings.

C. Radiant Panels/Extrusions

1. Radiant panel shall be manufactured utilizing extruded aluminum strips of approximately 0.115 overall thickness. The strips shall have a minimum 0.495 I.D. copper tube firmly attached to aluminum extrusion under all operating temperature conditions. Ends of tubes shall be swaged to 0.569 I.D. for proper soldering fit of ½ inch Type "L" soft copper tubing.
2. Panel sizes shall fit into a ceiling inverted T-bar linear system and as called for in the drawings and specifications. Lengths shall be as shown on the drawings. Finish on the face of the panel shall be of a color selected by the Architect. Finish shall be powder coated and suitable for temperatures up to 350°F.
3. Face configuration shall be fluted, with recessed 1/8 inch linear flutes on 1/2 inch centers.
4. Circuiting of the tubes on the back of the panel shall be straight tubes with ends slightly pulled up for ease of soldering.
5. The panel manufacturer shall provide a 2 inch thick glass fiber pad insulation on the upper side of the radiant panels to minimize heat loss to the ceiling plenum.
6. Insulation shall be attached to the panel.

PART 3 - EXECUTION

3.1 INSTALLATION

A. Install in accordance with manufacturer's instructions.

B. Install equipment exposed to finished area after walls and ceiling are finished and painted. Do not damage equipment or finishes.

C. Protection: Provide finished cabinet units with protective covers during balance of construction.

D. Radiation: Locate on outside walls and run cover continuously wall-to-wall unless otherwise indicated. Center elements under windows. Where multiple windows occur over units, divide element into equal segments centered under each window. Install end caps where units butt against walls or have exposed ends. Align cabinet joints with window mullions. Install wall angles where units butt against walls.

E. Unit Heaters: Hang from building structure and not from piping, with gas pipe hangers anchored. Mounts as high as possible to maintain greatest headroom unless otherwise indicated.

F. Cabinet Unit Heaters: Install as indicated. Coordinate to assure correct recess size for recessed units.

G. Install electric heating equipment including devices furnished by manufacturer but not factory-mounted. Furnish copy of manufacturer's wiring diagram submittal. Install electrical wiring in accordance with manufacturer's submittals and Section 16050.

3.2 FINNED TUBE RADIATION INSTALLATION

A. Finned tube radiation shall be installed in accordance with manufacturer recommendations, Contract Drawings, and reviewed submittals.

B. Pitch heating elements in direction of flow. Provide manual air vent at high point and drain valve at low point.

C. Provide access to all valves, vents, drains, etc., for all radiation types as required. Install control valves in ceilings above radiation where valves do not fit within enclosure or as indicated on the drawings.

D. Height of installed radiation shall be a minimum of 4" above finished floor. Final location shall be determined and approved by the Architect prior to installation.

E. Ordering and installation of all radiation related accessories and lengths of radiation enclosures shall be based upon actual job conditions.

3.3 DOOR HEATERS INSTALLATION

A. Door heaters shall be installed in accordance with manufacturer recommendations, Contract Drawings, and reviewed submittals.

B. Door heaters shall be installed so as to ensure easy accessibility for service.

C. Door heaters with water coils shall be installed such that coils can be completely drained and shall have a vent at coil high point.

3.4 RADIANT CEILING PANEL INSTALLATION

A. Radiant Ceiling Contractor Qualifications

1. Installation of the radiant panel system shall be performed by a qualified Contractor appointed by the manufacturer, and installed as recommended and directed by the radiant panel manufacturer. Contractor shall demonstrate his competence in ceiling installation before his appointment by the manufacturer. The Contractor shall be experienced in the installation of radiant ceilings and shall provide all labor, materials, tools, service and supervision for a complete, functional system as shown on the mechanical and Architectural plans. The Radiant Ceiling Contractor shall coordinate his work with the Acoustical Ceiling Contractor and Construction Manager.

2. Contractor Responsibilities

a. Install the extruded radiant ceilings complete in accordance with the manufacturer's recommendations and to the satisfaction of the Architect.

b. The Contractor shall abide by the Architectural and mechanical drawings, room finish schedule and Architectural details for correct size and placement of all panels.

c. The extruded radiant ceiling shall be a completely pre-engineered, designed and tested system installed in an exposed inverted "T" suspension system, and shall be complete with interconnecting piping and required trim.

1) The suspension system may consist of main inverted "T's" of 0.030 inch minim steel thickness accurately leveled and installed per drawings. Cross-tees shall be 0.021 inch minimum steel thickness installed per drawings, and cut with proper tools to produce clean edges. Hangers shall be installed at not over 3'-0" on centers.
2) Insulation on top of the panel shall be 2 inches thick, 0.75 lb./sq.ft. glass fiber pads.

d. Panel Installation

1) Interference between the radiant panel ceilings and any other item shall be resolved by the Radiant Ceiling Contractor and the Trade in question.
2) All metal moldings and exposed surfaces visible in the room shall have a two-coat baked enamel finish as on the radiant ceiling panels.
3) Shop drawings to ¼ inch scale shall be submitted by the Contractor, showing layouts and details of all areas where radiant ceilings are indicated, and any interferences with other Trades resolved.
4) All interconnection of radiant panels shall be made with ½ inch Type "L" soft copper tubing.
5) Radiant Ceiling Contractor's responsibility shall terminate at the supply and return point to each room or zone. Interconnecting piping between the supply and return points shall be joined and tested by the Radiant Panel Contractor. Panels shall be leak tested in accordance with piping testing requirements in Part 3 Execution.
6) Runout connections shall end at the supply and return points shown on the drawings with the HVAC Contractor furnishing all supply and return piping, runout valves, air vents and any other heating and zone control items.
7) The HVAC Contractor shall be responsible for thoroughly cleaning out all system piping, flushing, draining and refilling system before radiant panels are connected into the supply and return lines. No radiant panel shall be filled or put into operation without having a representative of the Radiant Ceiling Contractor present.

8) No installation of radiant ceiling panels will commence, without exception, until all glazing has been completed, and exterior openings cleaned in, and all wet work of cementing, plastering or other has been dried out to the satisfaction of the Radiant Ceiling Contractor. Damage to radiant ceiling panels by unauthorized removal of panels, once installed by the Radiant Ceiling Contractor, shall be the responsibility of the Trade causing such damage.

9) The Radiant Ceiling Contractor shall furnish the services of a qualified Engineer to advise the HVAC Contractor in filling, starting, balancing and adjustment procedures of the hydronic heating or cooling system.

3.5 CLEANING

A. After construction is completed, including painting, clean exposed surfaces of units. Vacuum clean coils and inside of cabinets.

B. Touch-up marred or scratched surfaces of factory-finished cabinets, using finish materials furnished by manufacturer.

C. Install new filters at all cabinet unit heaters prior to completion of the project.

END OF SECTION