

SECTION 23 30 00 – UNDERFLOOR AIR DISTRIBUTION SYSTEM

PART 1 – GENERAL

1.1 SUMMARY

- A. The Contractor shall furnish and install a complete access floor air distribution system as shown on the drawings, including all wiring, controls and other accessories required for a complete system. Contractor shall provide submittals, samples, and operation and maintenance documentation. Specific equipment includes:
1. MIT-CS, MIT-CR, MIT-CN, MMIT-C variable-air-volume diffuser terminal unit.
 2. Élan – Diffusers – adjustable round floor diffuser terminal unit with sliding manual damper.
 3. PDD – Diffusers – adjustable round floor diffuser terminal unit with sliding manual damper.
 4. PCD-10R, PCD-10S– adjustable round or square floor diffuser terminal unit with sliding manual damper.
 5. LMIT-C-XX, LMIT-CL-XX – Non-directionally adjustable linear grille floor diffuser
 6. CLWMIT, Continuous Linear Water Heat Modular Trough.
 7. CLEMIT, Continuous Linear Electric Heat Modular Trough.
 8. UFE, underfloor fan-powered terminal unit with electric heat.
 9. UFW, underfloor fan-powered terminal unit with heating hot water heat.
 10. SoHo, Ultra Low profile heating cooling electric/hot/chilled water fan coil units
 11. AVT, airvalve tile assembly.
 12. TEC-3620, wall mounted controller / space thermostat.
 13. PM, underfloor supply power module.
 14. PAP Plug and Play modular control wiring
- B. The Access Floor Contractor shall furnish and install all floor panels, structural supports, underfloor Airway barriers, floor cutout openings and any other floor-related components and accessories necessary for a complete raised access floor system.
- C. The General Contractor shall be responsible for sealing the access floor system and all penetrations through the building wall and floors that occur below the raised floor elevation. Each sub contractor (trade) will seal any penetration made in the UFAD supply plenum at the

time of penetration. If you make a hole, seal a hole. The GC shall be responsible to assure that the trades seal their penetrations.

- D. All openings in access floor panels required for installation of diffusers and terminals shall be coordinated with the Access Floor Contractor who shall also be responsible for providing the factory cut holes for diffusers (or cutting the panel openings only if such factory cutting is not available) and installing panels as indicated on the drawings.
- E. The Electrical Contractor shall furnish and install all electric power-related materials above 24vac and components necessary for system operation. Electrician shall provide power to control transformers to provide control power to the HVAC system, whether or not they are shown on the plans. Every connection shall have a ground connection available, (1 phase 3 wire, 3 phase 5 wire).
- F. The Controls Contractor shall furnish and install all control system interfaces, Building Automation System (BAS) integration, and other control system-related materials and accessories. The Controls Contractor shall install the factory furnished PAP wiring to the tstats and underfloor temperature controllers.

1.2 QUALITY ASSURANCE

- A. All equipment and components shall be suitable for use in an Environmental Airway space.
- B. All components within the air stream including underfloor terminals shall conform to the NFPA 90A Standard for Flame/Smoke/Fire contribution of 25/50/0. Dampers, electrical enclosures, dust pans, and duct connecting plenums shall be metal. Plastic (polycarbonate) is not permitted for these components unless specifically called for in detailed product description.
- C. All units shall be the product of a single manufacturer who is regularly engaged in the production of underfloor air distribution system.
- D. Units shall be specifically designed for installation in an underfloor air distribution system and shall be furnished complete with all necessary controls and wiring to provide operation according to manufacturer's recommendations.
- E. Terminal operation shall be coordinated with the air-handling system and control system to assure complete compatibility and proper operation.
- F. Equipment shall be listed under and conform to appropriate sections of U.L., CSA, E.T.L. and other testing laboratory requirements as required by local building codes.

1.3 SUBMITTALS

- A. Submit dimensioned drawings, performance and product data for approval. Include listing of discharge and radiated sound power level for the second, third, fourth, fifth and sixth octave bands for fan-powered terminal units. Data shall include all wiring diagrams, control sequences and power requirements as applicable to the product and coordination with other systems.

1.4 OPERATION AND MAINTENANCE DATA

- A. Quantity: [3]
- B. Maintenance and Service Contracts: Provide a list for each product and include the name, address and telephone number of:
 - 1. Subcontractor or installer.
 - 2. Local Maintenance Contractors, as appropriate. Identify responsibility of each.
 - 3. Local source of supply for parts and replacement.
- C. Table of Contents: List all products in the order in which they appear in the specifications and label accordingly.
- D. Sections: All sections shall be separated with an appropriate tabbed section divider with the appropriate specification section number. Provide the manufacturer's written installation and maintenance instructions for all items supplied.
- E. Routine Maintenance: Provide a list indicating all routine maintenance procedures and recommended intervals.
- F. Contents: Include copies of approved submittal data, installation instructions, operation and maintenance instructions and parts lists.

1.5 WARRANTY

- A. The underfloor Airway distribution system components, materials and workmanship shall be guaranteed to be free from defects for a period of one year after start-up or 18 months from date of shipment from the factory, whichever occurs first.
- B. Contractor and/or vendor shall maintain availability of replacement parts compatible with the terminals for no less than ten years after acceptance.

PART 2 – PRODUCTS

2.1 GENERAL DESCRIPTION

- A. The Contractor shall furnish a pre-engineered, prefabricated, access floor air terminal system that includes all necessary components from a single manufacturer. All components, including controls and wiring, shall be furnished as a “plug-and-play” system of modular and interchangeable components that are factory prepared to operate as a complete system.
- B. Supply Terminals
 - 1. Construction of unit shall permit easy cleaning and prevent dirt and debris from entering system; and no plastic dampers, grilles, dust pans or other parts shall be exposed to the Airway space or air stream whether or not in accordance with NFPA 90A.
 - 2. Constant Volume diffuser terminal unit shall include a dirt catch pan. The pan shall be minimum 18-gauge galvanized steel pre painted flat black. The grille, damper assembly, and dirt catch pan are shipped fully assembled and can be securely installed in floor tile by turning the center screw and allow retention bar to clip to bottom side of floor tile. CV

diffuser face shall not be removable by user. The diffuser face shall be secured to the floor to prevent a dangerous condition (hole in the floor) when the diffuser face is removed by an unauthorized party.

3. Variable Air Volume diffuser terminal unit shall include an integral sound boot. The sound boot shall be minimum 20-gauge galvanized steel pre-painted flat black and shall enclose and support all components. Chassis construction shall admit underfloor air from only one direction to control sound transmission. Airflow volume control shall be pressure independent with airflow sensor and controller, to provide true linear control; or time modulation control.
4. Supply air terminals shall have grilles made of die cast aluminum material (extrusions not permitted) that matches the trim ring in color. Grilles shall include a means for adjusting air throw direction and pattern, and shall fit securely within the trim ring and chassis without mechanical fasteners. Grilles shall be rated for 1,250 pounds. No grille openings shall be larger than 0.30 inches (7.6 mm) for shoe heel penetration protection.
5. Grille trim rings shall be die-cast aluminum designed to engage the chassis and floor to provide complete support for the air grilles. Trim ring color shall match the grille color. Plastic or any Non-Metallic parts in diffusers are not acceptable.
6. Panel Size: Unless noted otherwise, the nominal dimensions of all floor-mounted system components shall be suitable for installation in a standard 24-inch by 24-inch (610-mm by 610-mm) raised access floor suspension grid.
7. Airflow Performance: The manufacturer shall provide published airflow data for the all supply and return terminals in accordance with ANSI/ASHRAE Standard 70-1991.
8. Variable-Air-Volume Controls: MIT-CS, MIT-CR or any diffuser with the –VAV suffix. Terminals specified for Variable-Air-Volume service shall incorporate the following requirements:
 - a. Terminal construction shall include an integral time-modulation damper and motor (air valve) that is specifically designed for low static pressure air distribution to maintain a constant throw height and distance at all load conditions. The damper motor shall be a 90-degree stepper type motor having no stops, springs, gears, belts or linkages, and shall rotate continuously in one direction (not reversing) to minimize wear. The motor shall directly drive the damper blade. The damper assembly shall be rated and tested for a life of 100 million cycles (factory tests of at least 20 million cycles at normal operating speeds are required). A warranty of up to 10 years shall be available at a cost of 1% of the cost of the VAV box cost, per year of extended warranty. Modulation shall involve the timed duty cycle of fully open and closed periods to produce an average open time corresponding to the average terminal air volume required. If this time modulation strategy is not used, (2) VAV diffusers of ½ size (of the scheduled cfm per diffuser) shall be provided and installed, for each time modulated diffuser shown on the plans. The first diffuser will modulate 100% to 0 while the second will remain at 100%. When the load falls below 50%, the first diffuser shall shut off completely and the second shall modulate from 100% to a field adjustable minimum cfm via pressure independent control with airflow sensor and controller. This strategy will prevent pooling of cold air at floor levels and insure delivery of conditioned air to the breathing zone (up to 6 ft) at all load conditions. If the 2 for 1 diffuser strategy of control is employed, the diffuser

construction specification shall be die cast aluminum and the mechanical contractor will be responsible to coordinate with all other trades; including but not limited to carpenters, electricians, raised floor installer, carpet installer and controls contractor.

- b. Terminal shall include a microprocessor controller (pressure independent or time modulation) that controls the damper movement in response to a remote digital signal. The digital signals and power shall be delivered to the device through a 4-conductor, minimum 25 foot length, plenum-rated modular minimum 18 gage cable furnished with the terminal. Stress relief shall be provided at each plug to prevent conductor damage. A "daisy-chain" output port shall be furnished that repeats the digital signals with a nominal 6 second delay, and provides parallel connection of the 24 volts ac control power supply to other connected terminals. This 6 second delay prevents all the air terminals in a zone from actuating at the same time.
 - c. The damper and motor shall be designed for continuous use with a nominal design life of 100,000,000 cycles. The installed damper and motor operation shall be inaudible with a background sound level of 30 dbA and shall be tested to be quieter than NC-17 with full airflow. The unit shall feature all solid-state electronics, self-contained within a housing using printed circuit board mounted components with no relays, mechanical switches, or other analog devices required for operation of the device.
 - d. The terminal shall not require periodic lubrication or other maintenance. The device shall be delivered to the job site fully assembled and operational, needing no programming, setup or adjustment.
1. MIT-C: Type-CS, Type-CN, Type-CR, Type MMIT-C; VAV Diffusers
- a. Type-C Grille: nominal 10 inch by 10 inch (254 mm by 254 mm)
 - b. Type-CN Grille: nominal 5 inch by 10 inch (127 mm by 254 mm)
 - c. Type-CR Grille: Nominal 10 inch round (254mm, round)
 - d. Type MMIT-C: Nominal 5 inch x 5 inch (127mm by 127mm)
 - e. Type-C Supply Rating: variable-air-volume, 150 cfm (71 L/sec) at 0.05 inches w.g. (12.5 Pa) static pressure. Each grille shall be provided with PAP-1 25' ft plug and play cable.
 - f. Type-CN Supply Rating: variable-air-volume, 100 cfm (47 L/sec) at 0.05 inches w.g. (12.5 Pa) static pressure. Each grille shall be provided with PAP-1 25' ft plug and play cable.
 - g. Type-CR Supply Rating: variable-air-volume, 130 cfm (47 L/sec) at 0.05 inches w.g. (12.5 Pa) static pressure. Each grille shall be provided with PAP-1 25' ft plug and play cable.
 - h. Type-MMIT-C Supply Rating: variable-air-volume, 45 cfm (23 L/sec) at 0.05 inches w.g. (12.5 Pa) static pressure. Each grille shall be provided with PAP-1 25' ft plug and play cable.
 - i. The diffuser air pattern shall throw the air no higher than 4.5ft with a terminal velocity of 50 ft/minute. This allows for a V_E , (Ventilation efficiency) of 1.2 according to ASHRAE 62.1. Diffusers with concentric circles or other shapes that throw the air higher than 4.5ft at

50ft/min are not permitted because they will not conform to the ventilation calculation and will require up-sizing of the outdoor air preconditioning unit.

- j. Grille shall be solid cast aluminum and rated for 1,250 pounds in a 1 inch square anywhere on the grille face. The grille shall be adjustable to provide a 2, 3 or 4 way throw pattern while still conforming to the throw heights required by ASHRAE 62.1. The 2 way throw pattern provides throw in a 180 degree opposing (north – south) direction to allow placement of diffusers in aisle ways between workstations. Extruded or linear grilles are not permitted because of lower load ratings and high velocity throw patterns.
 - k. Grille Color: Special colors as shown on the finish schedule and submittal data. Color shall be factory applied, powder coated, and baked.
2. Élan Diffusers – Type Élan-04R-180, Élan-06R-180, Élan-08R-180, Élan-08R-360, Élan-08R-720, Élan-10R-360.
- a. Nominal 4, 6, 8 or 10 inch round (100,150,203 or 255 mm).
 - a. Supply Rating: variable-air-volume, 25, 45, 82 cfm or 100cfm at 0.05 inches w.g. static pressure.
 - b. The diffuser air pattern shall throw the air no higher than 4.5ft with a terminal velocity of 50 ft/minute. This allows for a V_E , (Ventilation efficiency) of 1.2 according to ASHRAE 62.1. Diffusers with concentric circles or other shapes that throw the air higher than 4.5ft at 50ft/min are not permitted because they will not conform to the ventilation calculation and will require up-sizing of the outdoor air preconditioning unit.
 - c. Includes a manual adjustable slide plate at the face of grille to limit airflow. This manual adjustable feature shall be included whether or not the diffuser has optional VAV and sound boot.
 - d. Élan-4, 6, 8-180 diffusers allow for directional adjustability of the airflow.
 - e. VAV diffusers shall include a PAP-1- 25' ft plug and play cable when VAV.
 - f. Grille shall be solid cast aluminum and rated for 1,250 pounds in a 1 inch square anywhere on the grille face.
 - g. Installation of grille shall occur from top of floor access floor only. Provisions shall be made to secure the grille in the floor so it cannot be lifted or removed by users.
 - h. Grille Color: Special colors as shown on the finish schedule and submittal data. Color shall be factory applied, powder coated, and baked.
3. PDD Displacement flow Diffusers – Type PDD-08R, PDD-10R
- b. Nominal 8 or 10 inch round (203 or 255 mm).
 - a. Supply Rating: Manual adjustable air-volume 50, 75 cfm at 0.05 inches w.g. static pressure.

- b. The diffuser air pattern shall throw the air no higher than 1.5ft with a terminal velocity of 50 ft/minute. This allows for a V_E , (Ventilation efficiency) of 1.2 according to ASHRAE 62.1. Diffusers that throw the air higher than 4.5ft at 50ft/min are not permitted because they will not conform to the ventilation calculation and will require up-sizing of the outdoor air preconditioning unit.
- c. Includes a manual adjustable slide plate at the face of grille to limit airflow. This manual adjustable feature shall be included whether or not the diffuser has optional VAV and sound boot.
- d. VAV diffusers shall include a PAP-1- 25' ft plug and play cable when VAV.
- e. Grille shall be solid cast aluminum and rated for 1,250 pounds in a 1 inch square anywhere on the grille face.
- f. Installation of grille shall occur from top of floor access floor only. Provisions shall be made to secure the grille in the floor so it cannot be lifted or removed by users.
- g. Grille Color: Special colors as shown on the finish schedule and submittal data. Color shall be factory applied, powder coated, and baked.

4. PCD Diffusers – Type PCD-10R, PCD-10S

- c. Nominal 10 inch round (255 mm) or 10x10 inch square (255x255mm).
 - a. Supply Rating: variable-air-volume, 100 cfm (round) or 130cfm (square) at 0.05 inches w.g. static pressure.
 - b. The diffuser air pattern shall throw the air no higher than 4.5ft with a terminal velocity of 50 ft/minute. This allows for a V_E , (Ventilation efficiency) of 1.2 according to ASHRAE 62.1. Diffusers with concentric circles or other shapes that throw the air higher than 4.5ft at 50ft/min are not permitted because they will not conform to the ventilation calculation and will require up-sizing of the outdoor air preconditioning unit.
 - c. Includes a manual adjustable slide plate at the face of grille to limit airflow. This manual adjustable feature shall be included whether or not the diffuser has optional VAV and sound boot.
 - d. PCD-10S diffusers allow for directional adjustability of the airflow.
 - e. VAV diffusers shall include a PAP-1- 25' ft plug and play cable when VAV.
 - f. Grille shall be solid cast aluminum and rated for 1,250 pounds in a 1 inch square anywhere on the grille face.
 - g. Installation of grille shall occur from top of floor access floor only. Provisions shall be made to secure the grille in the floor so it cannot be lifted or removed by users.
 - h. Grille Color: Special colors as shown on the finish schedule and submittal data. Color shall be factory applied, powder coated, and baked.

5. LMIT-C-XX, LMIT-CL-XX – Non-directionally adjustable linear floor grilles
 - a. Nominal 8x16 inch (LMIT-C) rectangular floor diffusers. The –XX denotes custom dimensions.
 - b. Supply Rating: variable-air-volume, 150 cfm (-C) or (-CL) 300(24 inch length) or (-CL) - 340cfm (48 inch length) at 0.05 inches w.g. static pressure.
 - c. The diffuser air pattern will throw the air higher than 4.5ft with a terminal velocity of 50 ft/minute in the standard lengths (8x16 and 8x24) and should be used in applications where the desired V_E , (Ventilation efficiency) is 1.0 according to ASHRAE 62.1. Custom sizes can be specified with a face velocity below 90ft/min. This allows for a V_E , (Ventilation efficiency) of 1.2 according to ASHRAE 62.1. These sizes specified in the schedule or on the plans are a minimum to achieve the low velocity needed for a V_E of 1.2. Diffusers with concentric circles or other shapes that throw the air higher than 4.5ft at 50ft/min are not permitted because they will not conform to the ventilation calculation and will require up-sizing of the outdoor air preconditioning unit.
 - d. Includes a manual adjustable damper in the throat of the inlet of the diffuser limit airflow. This manual adjustable feature shall be not included if the diffuser has optional VAV and sound boot.
 - e. VAV diffusers shall include a PAP-1- 25' ft plug and play cable when VAV.
 - f. Grille shall be solid extruded aluminum and rated for 1,250 pounds in a 1 inch square anywhere on the grille face.
 - g. Installation of grille shall occur from top of floor access floor only. Provisions shall be made to secure the grille in the floor so it cannot be lifted or removed by users.
 - h. Grille Color: Special colors as shown on the finish schedule and submittal data. Color shall be factory applied, powder coated, and baked.
6. CLWMIT - Continuous Linear Water Heat Modular Trough.
 - a. ETL listed variable air volume heating and cooling linear trough system, factory assembled to include; trough housing, fin-pack coil, fin pack support brackets, integral baffle separator (where applicable), air valve(s), wall angle, pedestal brackets, associated modular power cables, and grille sections. The unit shall be factory rated and performance tested as an assembly. Field assembled components are not acceptable.
 - b. Trough shall be load bearing, self-supporting without installing access floor panels in place and shall provide means of positioning support pedestals without the use of tools or hardware. Trough and linear grille shall be rated to 1250 lbs. load strength without transferring load to the outside wall or inside raised floor tile. This construction permits installation of the trough prior to installation of the raised floor making piping, insulation and wiring easier. Floor pedestals are provided with each trough by the trough manufacturer in the appropriate height for the project.

- c. Trough housing shall be 10" wide by 10" deep with 7/8" flange on long side for self-supporting. It features 20 gauge pre-painted galvanized steel construction. Trough length shall be as specified on drawings.
- d. Trough to include factory installed integral pressure independent (with flowstar) or time-modulation dampers and motors (air valve) each rated for 150 cfm @ 0.05" w.c. or more. Number of air valves to match specified design cooling airflow scheduled on drawings.
- e. Fin-pack coil shall be factory assembled inside trough and includes support brackets. Fin-pack coil trough assembly shall provide heating output rating as scheduled on drawings with the specified low entering water temperature and water flows. Heating capacity shall be rated in accordance with ARI Standard 410 certification program. Fin-tube shall be made of 12200 seamless copper tubing conforming to ASTM B75 & ASTM B251 standards, (minimum 0.016 inch thick wall), with aluminum fins (minimum 0.0075 inch thick), mechanically bonded to the tubes, suitable for 250+ psig working pressure. Tested hydrostatically at 320 psig. Elements shall be positively positioned front to back with provisions for silent horizontal expansion and contraction. Provide coil connections with specified outside diameter soldered (sweat) connections. Extend piping connections outside the trough's housing front side for ease of installation to field routed piping below the raised access floor.
- f. Piping specialties including shut-off valves, terminal connections, control valve, manual air vent shall be provided by others. Trough's thermostat shall control operation of control water valve (2-position or modulating). Control water valve to open in heating mode and close in cooling mode.
- g. Grille shall be mill finish extruded aluminum with fixed deflection bars parallel to the long side. Grille shall have a load rating of 1250 lbs in a 1 inch square anywhere on the grille face suitable for floors application. Core style, frame, subframe, and grille lengths shall be as specified by Architect and Engineer. Bar spacing shall be pencil proof.
- h. Grille Color: Special colors as shown on the finish schedule and submittal data. Color shall be factory applied powder coated, and baked.

7. CLEMIT - Continuous Linear Electric Heat Modular Trough.

- a. UL or ETL listed variable air volume heating and cooling linear diffuser system, factory assembled to include; trough housing, heating element, integral electrical disconnect, safety cutoff switches, control panel, control transformer, air valve(s), wall angle, pedestal brackets, associated modular power cables, and grille sections. Trough shall have a single point electrical power connection. Power voltage and phase shall be as specified on drawings.
- b. Trough shall be load bearing, self-supporting without installing access floor panels in place and shall provide means of positioning support pedestals without the use of tools or hardware. Trough and linear grille shall be rated to 1250 lbs. load strength without transferring load to the outside wall or inside floor tile.
- c. Trough housing shall be 6" wide by 10" deep with 7/8" flange on long side for self-supporting. It features 20 gauge pre-painted galvanized steel construction. Trough length shall be as specified on drawings.

- d. Trough to include factory installed integral pressure independent (with flowstar) or time-modulation damper and motor (air valve) each rated for 150 cfm @ 0.05" w.c. or more. Number of air valves shall match specified design cooling airflow scheduled on drawings. Airvalve(s) shall modulate cooling air based on 0-10 vdc signal from the thermostat or controller. Airflow throw shall be consistent regardless of airvalve position.
 - e. Heater shall be UL listed sheathed type low temperature finned heating element capable to provide heating output as schedule on drawings. Heater assembly to include factory installed high limit temperature sensor to limit grille surface temperature to about 125°F and a high-high limit temperature sensor to de-energize if heater element gets too hot. Electric heater shall utilize silent solid state contactors to pulse heat based on 0-10 vdc signal from the thermostat or controller to maintain space setpoint.
 - f. Grille shall be mill finish extruded aluminum with fixed deflection bars parallel to the long side. Grille shall have a load rating of 1250 lbs in a 1 inch square anywhere on the grille face suitable for floors application. Core style, frame, subframe, and grille lengths shall be as specified by Architect and Engineer. Bar spacing shall be pencil proof.
 - g. Grille Color: Special colors as shown on the finish schedule and submittal data. Color shall be factory applied powder coated, and baked.
8. Underfloor Fan Terminal Units with electric heat - UFE
- a. Construction of unit shall permit easy installation between access floor pedestals. Unit casing shall be minimum 22-gauge galvanized steel pre painted flat black and shall enclose and support all components. Chassis construction shall admit underfloor air from only one direction to permit adjusting delivery volume independent of underfloor air velocity pressure and to control sound transmission. Each fan terminal shall have a field programmable microprocessor based control board to permit change of control sequence in the field by connecting an electronic programming tool. Non-adjustable relay logic is not acceptable. Connection to the thermostat shall be via externally mounted 4 pin Molex connectors and factory supplied and tested plug and play cables.
 - b. Casing shall be lined with 1" dual density insulation. Insulation shall meet the following Standards and Classifications:
 - c. Fungi Resistance Test Standards ASTM C-1071 & ASTM G21.
 - d. NFPA 90A, and UL181.
 - e. Fire classification of 25/50 Per ASTM E-84 & UL723.
 - f. Bacteriological Test Standards ASTM C-665 & ASTM G22
 - g. UFE-AE shall be a fan powered terminal unit with an ECM motor designed to deliver variable airflow as indicated on the drawings. Shaded-pole, split capacitor or other standard fixed speed AC motor with speed control is not acceptable. UFE-A shall be constant speed fan powered terminal unit designed to deliver airflow as indicated on the drawings.
 - h. UFE unit shall include modulating "Dark Heat" UL listed sheathed type finned heater sized up to 9 KW. The finned heating elements shall utilize silent solid state contactors to

modulate with 0-10 VDC signal from associated space thermostat when unit is in heating mode. The fan speed shall modulate with 0-10 VDC signal from associated space thermostat when unit is in cooling mode on AE units. Nickel chromium wire heating elements, or any other type operating above 700 °F are not permitted

- i. Each UFE shall include a 90VA transformer for 24 VAC to power time modulation air valves and thermostats.

9. Underfloor Fan Terminal Units with Heating hot water - UFW

- a. Construction of unit shall permit easy installation between access floor pedestals. Unit casing shall be minimum 22-gauge galvanized steel pre-painted flat black and shall enclose and support all components. Chassis construction shall admit underfloor air from only one direction to permit adjusting delivery volume independent of underfloor air velocity pressure and to control sound transmission. Each fan terminal shall have a field programmable microprocessor based control board to permit change of control sequence in the field by connecting an electronic programming tool. Non-adjustable relay logic is not acceptable. Connection to the thermostat shall be via externally mounted 4 pin Molex connectors and factory supplied and tested plug and play cables.
- b. Casing shall be lined with 1" dual density insulation. Insulation shall meet the following Standards and Classifications:
- c. Fungi Resistance Test Standards ASTM C-1071 & ASTM G21.
- d. NFPA 90A, and UL181.
- e. Fire classification of 25/50 Per ASTM E-84 & UL723.
- f. Bacteriological Test Standards ASTM C-665 & ASTM G22
- g. UFW-AE shall be a fan powered terminal unit with an ECM motor designed to deliver variable airflow as indicated on the drawings. Shaded-pole, split capacitor or other standard fixed speed AC motor with speed control is not acceptable. UFW-A shall be constant speed fan powered terminal unit designed to deliver airflow as indicated on the drawings.
- h. Heating coil shall be integral with the fan powered terminal unit in a blow thru configuration, with the piping connections extended beyond the unit casing, the supply and return connections shall be on the same side. Heating capacity shall be as scheduled on drawings. coil shall be made of seamless copper tubing conforming to ASTM B75 & ASTM B251 standards, (minimum 0.016 inch thick wall), with brazed return bends. Aluminum fins shall mechanically bonded to the tubes, suitable for 225 psig working pressure at 325F.
- i. Each UFW shall include a 90VA transformer for 24 VAC to power time modulation air valves.

10. Air Valve Tile Assembly;

Provide Air Valve Tile Assembly for use under gaming slot machines in casino applications with single, or dual, or triple airvalves to meet design airflow density. With the following features;

- a. 24"x24" panel with 14 gauge (2mm) galvanized steel construction, welded and riveted, pre-painted flat black floor tile designed to fit in raised access floor supporting system with or without stringers. Floor pedestals, screws, and stringers by others. Specify when ordering support system and pedestal heads configuration.
- b. Designed to replace an existing raised floor tile underneath a gaming machine in a casino installation.
- c. Tile include factory installed extended airvalves;
 - a. AVT-1 – single airvalve supplying 380 cfm @ 0.05 in. H₂O (646 m³/hr @ 12.5 Pa).
 - b. AVT-2 – dual airvalve supplying 645 cfm @ 0.05 in. H₂O (1097 m³/hr @ 12.5 Pa)
 - c. AVT-3 – triple airvalve supplying 780 cfm @ 0.05 in. H₂O (1326 m³/hr @ 12.5 Pa)
- d. Discharge air from underfloor supply plenum into slot machine bases common void. Airflow is then supplied into place by perforated holes or grilles installed in bases.

11. Space Thermostat

Provide wall mounted thermostat device for seamlessly controlling FlexSys underfloor vav terminal diffuser units and underfloor fan terminal units. Thermostat shall include the following features:

- a. Building Automation System (BAS) BACnet MS/TP communication capability that enables remote monitoring and programmability for efficient space temperature control. Thermostat shall be compatible with other BACnet device, or BACnet network or BACnet BAS. RS-485 twisted pair shall be field provided by control Contractor for networking to BACnet. Wall mounted controller shall have at least 10 I-O points available for transmitting or receiving BAS communication
- b. Thermostat shall include user interface with backlit temperature display in Degree F or C temperature.
- c. Factory pre-wired plug and play pigtail. Include (1) 10 foot PAP-7 for connection to FlexSys terminal units.
- d. Set points shall be permanently held in memory with no batteries used. Retain setpoint during power outages.
- e. Thermostat shall be rated for 24 VAC operation with plug and play cabling.
- f. Thermostat shall employ a unique, Proportional-Integral (PI) time-proportioning algorithm that eliminates temperature offset associated with traditional, differential-based thermostats.
- g. Thermostat model 3620, DDC space thermostat shall be used for underfloor fan terminal unit signal control in cooling and in heating, or to control modulating heating hot water valve.

12. PM, Power Module

- a. Input power: [120], [240] or [277] volts ac, single-phase, 60 [50] Hertz.

- b. Transformer Output Rating: 90 volt-ampere class 1 transformer, 24 volts ac, with load side circuit breaker or fuse.
- c. Output connection: Molex modular “plug-and-play” connector with 25'-0” PAP-5 power cable.
- d. Housing: steel junction box with knockouts for conduit shall completely enclose the control transformer.

13. Modular Control System Cables

Modular control cables shall be rated for plenum service and shall be equipped (unless indicated otherwise) with Molex modular plug-and-play electrical connectors with strain relief at connectors. RJ-11 cables are not acceptable. Each Cable shall be factory-tested for continuity, shorts, opens and proper impedance. Each cable shall bear evidence tag of QC testing. Plug and play cables shall be color coded as follows to distinguish them from other communication cabled used under floor. The specific colors below must be used.

- a. PAP-1, General purpose cable: 4-conductor, 18-gauge, and 25 feet (7.6 m) long, with Molex modular receptacle at both ends. Identification color: blue.
- b. PAP-2, External device (whip) cable: 4 conductor, 18 gauge, 50 feet (15.2 m) long, with Molex modular receptacle on one end and pig tail on the other. Identification color: yellow.
- c. PAP-3, Extension cable: 4-conductor, 18-gauge, 25 feet (7.6 m) long, with Molex modular receptacle on one end and plug on the other end. Identification color: blue.
- d. PAP-5, Power only cable: 2-conductor, 18-gauge, and 25 feet (7.6 m) long, with receptacles at both ends. One end shall have an additional short 4 conductor jumper with a plug to permit daisy-chaining one power distribution cable to another. For 24 volts ac, single-phase, 60 hertz power only. Identification color: green.
- e. PAP-6, Heating cable: 2 conductor, 22-gauge, 50 feet (15.2 m) long, with receptacle at one end and both receptacle and plug on the other end. Identification color: orange.
- f. PAP-7, Thermostat cable: 8 conductor, 18-gauge shielded, 10 feet (9.1 m) long, with 2 plugs on one end, and 2 receptacles on the other end. Identification color: white.

PART 3 – EXECUTION

3.1 INSTALLATION

- A. Prior to installing underfloor Airway distribution components, verify that all penetrations and openings in the area under the raised access floor have been sealed.
- B. Verify that the building area under the raised access floor has been cleaned and is free of dust, dirt, debris, standing water and other contaminants.

- C. Install all underfloor air distribution system components, including supply air terminals, fan-powered terminals and controls in accordance with the manufacturer's instructions.
- D. Prior to installation, all components shall be stored in a clean, dry location that is protected from weather and damage from other construction activities.
- E. Coordinate installation of underfloor Airway distribution components with the Access Floor Contractor, who is responsible for erection of the raised access floor.
- F. Coordinate location and size of all cut openings in raised access floor panels with the Access Floor Contractor.
- G. Install supply air terminals, fan-powered terminals and other components in the locations indicated on the drawings.
- H. All power and control wiring shall be installed in accordance with the requirements of specification Section [???].
- I. All power and control wiring for the underfloor Airway distribution system components shall be installed in a neat and workmanlike manner.
- J. Line voltage and sensor wiring shall not be installed in the same harness.
- K. Low voltage and communication wiring (less than 30 volts) may be installed in the same wiring harness.

3.2 MANUFACTURER'S FIELD PROJECT MANAGEMENT SERVICES

- A. The manufacturer shall provide the services of a Registered Professional Engineer with at least 5 years experience with VAV underfloor air systems, plenum construction and the control systems. This engineer shall make at least 3 trips of 1 day each to the project in to meet with construction and design personnel.
 - 1. The first meeting shall be occur after the general and subcontracts are decided to instruct the construction team on proper installation of the underfloor air devices and proper plenum construction methods. A detailed conversation with all trades present shall establish the construction sequence related to the raised floor and its systems. Site observation report shall be made and emailed to the HVAC engineer for approval. If approved he shall forward the report to the construction team as appropriate.
 - 2. The second trip to the job shall occur shortly before the raised floor installation begins. The engineer will inspect all plenum penetrations and construction to see that proper methods are being used. Any deficiencies found shall be brought to the general contractor's attention on site that day. Site observation report shall be made and emailed to the HVAC engineer for approval. If approved he shall forward the report to the construction team as appropriate.
 - 3. The third trip to the job shall occur during the building commissioning process. Communication shall occur with all associated trades to solve any problems that prevent contract completion. The engineer shall assist with system testing and verify proper

functioning of the UFAD system. Any deficiencies found shall be brought to the general contractor's attention on site that day. Site observation report shall be made and emailed to the HVAC engineer for approval. If approved he shall forward the report to the construction team as appropriate

3.3 TESTING

- A. Upon completion of all installation activities, perform the manufacturer's pre-start checkout instructions.
- B. Start-up and operate underfloor Airway distribution system components to demonstrate functional operation and compliance with specifications.

END OF SECTION