SECTION 237300 -- AIR HANDLING UNITS

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SECTION 237300 -- AIR HANDLING UNITS

PART 1 GENERAL

1. SUMMARY
2. General
3. Read this Section in conjunction with other related Sections, Division 01 General Requirements, the Design Drawings, the Contract Conditions and must comply with BOQ.
4. Refer also to the Technical Reference Sheet (TRS) which lists the reference codes and accompanying descriptions used to reference and identify systems/ components/ products indicated on the Design Drawings.
5. Performance Specified Work
6. Refer to the Contractor's Responsibilities in Division 01 General Requirements, Section 011000 Summary for specific requirements.
7. Supply, deliver, install and warrant the work in strict compliance with the materials and workmanship requirements of the Specification.
8. Where required to prepare Shop Drawings, these shall be limited to final detailing of components, systems indicated on the Design Drawings, necessary to demonstrate their safe installation.
9. Where products are offered by the Contractor for acceptance by the Engineer, provide full supporting documentation in respect of the complete system or installation.
10. Included Systems/ Products
11. Air handling units and components.
    1. SUBMITTALS
12. General: Comply with the requirements of Division 01 General Requirements, Section 013300 Submittal

Procedures and submit the following.

Post Contract Submittals

1. Shop Drawings
2. Unit Model: Unit arrangement and information on all external connections. Provide information on overall sizes, overall operating weight, and sizes, sections weight, point of supported weight load, unit construction details, true thermal break unit construction detail.
3. Fan Selection:
4. Fan type.
5. Wheel type.
6. Fan class.
7. Arrangement.
8. Size.
9. Air flow capacity.
10. Static pressure and total pressure.
11. Drive.
12. Motor HP (kW) and Fan BHP (kW).
13. Cooling Section:
14. Fin Series.
15. Type.
16. Height.
17. Width.
18. Rows.
19. Capacity (kW, l/ s, kg/ s).
20. Air entering, dry bulb and wet bulb temperatures.
21. Air leaving, dry bulb and wet bulb temperatures.
22. Air pressure drop.
23. Unit Casing:
24. Frame and panel construction and materials.
25. Insulation data.
26. Vibration isolation provision or requirement.
27. Access and clearances.
28. Coating and finishes.
29. Connections: Size, Type and Location:
30. Refrigerant piping.
31. Condensate drain.
32. Power.
33. Controls.
34. Product Data: Indicate centers of gravity for the assembled unit(s), dimensions, weights, coil performance, fan performance, motor electrical characteristics, finishes of materials, filter media, filter sizes and filter quantities.
35. Submit fan curves showing fan performance with system operating point plotted on curves. Fan curves shall indicate air volume, static pressure, fan speed and brake horsepower.
36. Submit detail information on internal component pressure drops, fan pressure allowance for dirty filter pressure drops and available external static pressure at unit discharge and unit intake.
37. Submit factory test reports and certificates of completing all factory quality control programs.
38. Submit sound power levels by octave band for air handling units at scheduled design conditions. Provide predicted sound power levels for all cabinet airway openings including OSA intake, supply air, return air and exhaust air openings and casing radiated noise as indicated per the unit drawings and equipment schedules. Sound power levels shall be measured using procedures in accordance with aMCa 320 standard and per the testing procedure specified in Division 23 Heating, Ventilating and Air Conditioning (HVAC) Sections. If unit submitted sound power levels exceed values scheduled as defined in the specification, submit detailed plan outlining steps to meet design noise levels without added cost to the Employer for review and approval.
39. Submit sound power levels by octave band for air handling units at scheduled design conditions. Provide sound power levels for "discharge" and "inlet plus cabinet" sound paths in accordance with ANSI/ AMCA 300 and AMCA 301. If unit sound power levels exceed values scheduled on drawings, Contractor shall submit detailed plan outlining steps to meet design noise levels.
40. Submit maximum vibration levels for the assembled units at the points indicated for each unit where the unit structure integrates with the building support structure. At a minimum, vibration levels shall not exceed 50dB re 1 micro G at 1/ 3 octave band readings from 5HZ to 100Hz frequency. Testing shall be conducted in accordance with Division 23 Heating, Ventilating and Air Conditioning (HVAC) Sections. If predicted vibration levels at the base structure of the assembled AHU units exceed the specified maximum level of 50dB re 1 micro G, the Contractor shall, at no added cost to the Employer or changes to the building structure, submit for review and approval the method(s) necessary to meet the maximum vibration levels specified.
41. Submit details of Variable Speed Drive units including manufacturer's details.
42. Supplementary Product Literature: Include a statement from the manufacturer for the design life of the system.
43. List of tests included.
44. Certified test data.
45. Outline technical specifications reflecting proposed materials and systems.
46. A list of proposed suppliers and Subcontractors intended to be used.
47. Method Statement.
48. Quality Plan.
49. Summary of deviations from the Specification.
50. CLOSEOUT SUBMITTALS

A. General: Comply with the requirements of Division 01 General Requirements, Section 017800 Closeout Submittals and submit the following.

1. Warranties.
2. Provide minimum \*\*\*5\*\*\* years warranty for 100% parts and labor.
3. Operation and Maintenance (O&M) Manuals:
4. Include component list with manufacturer's reference numbers, descriptions of materials and procedures for repairing and cleaning of finishes and cleaning frequency.
5. Include recommendations for unit maintenance.
6. Include instructions for lubrication, filter replacement, motor and drive replacement, belt tension adjustments, wiring diagrams, and preventive/ routine maintenance check list.
7. QUALITY ASSURANCE
8. Product of manufacturer regularly engaged in production of components who issues complete catalogue data on total product offering. Air volume, static pressure, fan speed, brake horsepower and selection procedures shall be certified in accordance with AHRI 430. If air handling units are not certified in accordance with AHRI 430, the Contractor shall be responsible for all expenses associated with testing of units after installation to verify capacities of fan(s). Any costs incurred to adjust the fans to meet the scheduled capacities shall be the sole responsibility of the Contractor.
9. Eurovent Certifications for the complete range of AHU's with recirculated air and FAHUs: Units should be certified and labeled with Eurovent Certification. AHUs must be manufactured at locations mentioned on the Eurovent certificate. Semi knocked down or completely knocked down AHUs for assembly at site are not acceptable. Local assembly hub shall be acceptable if it is Eurovent certified. One unit to be run tested as per FAT and Visual inspection of all AHUs prior to shipment.et the scheduled capacities shall be the sole responsibility of the Contractor.
10. AHRI Certification/ Eurovent: In the case of AHRI certified AHUs, the Coils shall be AHRI certified according to the applicable portions of AHRI 410, and shall be listed and bear the label of the Air­Conditioning Heating and Refrigeration Institute (AHRI).
11. Provide motors required as part of air-handling units that are listed and labeled by CE and comply with applicable standards in accordance with IEC. Indicate motor efficiency IE2 on selection data sheets.
12. Manufactured in facility registered to ISO 9001:2008/ EN ISO 9001:2000/ ANSI/ ASQC Q9001:2000/ ISO 14001: OHSAS 18001.
13. Provide fans bearing AMCA certified rating seal.
14. Standards: In addition to the requirements indicated on the Design Drawings, or specified in Division 01 General Requirements and Specification, the Work shall be in accordance with the following standards, codes and relevant statutory requirements.
15. American Society for Testing and Materials, ASTM International Standards.
16. American Society of Heating, Refrigerating and Air-Conditioning Engineers, ASHRAE Standards.
17. American Bearing Manufacturers Association, AFBMA Standards:
18. ANSI/ AFBMA 9 - Load Ratings and Fatigue Life for Ball Bearings.
19. Air Movement and Control Association International, AMCA Standards:
20. AMCA 300 Reverberant Method for Sound Testing of Fans.
21. AMCA 320 Sound Intensity Method for Sound testing of Fans.
22. AMCA 301 Method for Publishing Sound Ratings for Air Moving Devices.
23. Air-Conditioning, Heating and Refrigeration Institute, AHRI Standards:
24. AHRI 410 Standard for Forced-Circulation Air-Cooling and Air-Heating Coils.
25. Underwriters' Laboratories, UL Standards:
26. ANSI/ UL 900 Test Performance of Air Filter Units.
27. Sheet Metal and Air-Conditioning Contractors' National Association, SMACNA Standards: a) SMACNA HVAC Duct Construction standards.
28. National Fire Protection Association, NFPA Standards:

a) NFPA 90A Standard for the Installation of Air-Conditioning and Ventilating Systems.

1. International Electrotechnical Commission, IEC Standards.
2. Provide testing and inspections in accordance with Division 01 General Requirements, Section 014000 Quality Requirements.
3. Preconstruction Testing/ Reports
4. Submit reports of independent tests demonstrating that the products and systems comply with the specified performance requirements.
5. Where test results for a material or product are not available, undertake testing to show compliance with the Specification at an independent testing laboratory acceptable to the Engineer.
6. The provision of testing data or the carrying-out of tests does not relieve the Contractor of his responsibilities regarding the performance requirements, durability or service life requirements.

PART 2 PRODUCTS

1. DESIGN CRITERIA
2. General
3. Factory-built constant or variable volume air handling units shall be provided as indicated on the Design Drawings.
4. Air handling units shall be designed in accordance with EN 1886 and AHRI 430.
5. Fan performance shall be in accordance with DIN or AMCA 301 Method for Publishing Sound Ratings for Air Moving Devices. AMCA 300 Reverberant Method for Sound Testing of Fans.
6. AHUs shall be entirely of double skin construction with Aluminum Penta post frame and galvanized steel construction for the outer and inner skins. Self-supported modular panels fixed to the base frame and non-removable panels supported from inside are not acceptable.
7. Air Handling Units (AHU)
8. Casing Construction
9. General
10. Air handling unit's casing construction shall be fabricated from highest grade galvanized steel.
11. Construction of panel and frames are folded to form sturdy side/ top/ bottom panels and a rigid structure Penta post frames.
12. The construction shall serve thermal protection, reducing machine noise, absorbing vibration and avoiding air leakage.
13. Modular sizes of panel and frames shall be easily assemble and re-assemble.
14. The construction and material used shall be environment friendly, clean and safe.
15. Frame
16. Heavy-duty formed Penta Post frame shall be designed for rigidity and is made from highest-grade hot-dip galvanized steel with minimal spangle finish grade G90 galvanized coating in accordance with ASTM A653/ A653M in accordance with UL 465.
17. Frames shall be painted for extra protection.
18. \*\*\*Double Skin Panel\*\*\*
19. Modular panel shall be designed to be rigid and sturdy.
20. Double skin construction and sandwiched with superior 60mm thickness polyurethane insulation between the panel interior and exterior skins to furnish compressive strength up to 207kPa.
21. Polyurethane insulation shall be 60mm thickness and non-combustible, K-value 0.019 W/ M.C with 40kg/ m3 that shall provide superior thermal resistance across the panel.
22. Panel exterior skin shall be made from highest-grade pre-coated galvanized steel with
23. 6mm thickness, a minimal spangle grade G90 coating
24. Panel interior skin shall be made from pre-painted galvanized steel with 0.6mm thickness for extra protection.
25. Indoor Air Quality
26. The unit casing shall have double skin construction to avoid material insulation expose to conditioned area and to allow access in the air-handling unit without damaging the insulation.
27. Panel and Frames
28. Panels and frames shall be assembled with a closed cell self-adhesive neoprene foam gasket layer installed in between them to prevent air leakage, reduce vibration noise, minimized thermal losses.
29. A closed cell self-adhesive neoprene foam gasket layer shall avoid external water to penetrate inside the unit and shall block infiltration of heat and external contamination into the conditioned space area inside the unit.
30. A closed cell self-adhesive neoprene foam gasket is with K-value of 0.04 W/ M.C, flammability Class HB in accordance with UL 94, working temperature reaching 120°C and maximum water absorption 5%.
31. The final color of the equipment shall be subjected to final confirmation from the Engineer however, the Contractor should allow on his costs a range of standard RAL colors which is able to offer.
32. \*\*\*Casing Assembly, Air Leakage\*\*\*
33. The construction of panels to the frames shall provide minimum air leakage Class B in accordance with EUROVENT Standard EN 1886 or ASHRAE.
34. The deflection of the panel shall not exceed 4mm per meter under maximum fan operating pressure (EN 1886 D1 Class). Documentation shall be provided from an independent laboratory.
35. Thermal Conductance: Maximum overall thermal conductance of casing (panel and structure) shall be (EN 1886 Class T2).
36. Condensation Requirements: Provide cold bridge free construction with thermal break profile to protect the unit against condensation. The casing shall meet the requirements of EN Class TB2.
37. Access Panels
38. The fixing of panel to the frames with bolts shall provide additional access to ease mobility for major service work on large and heavy component such as coil, fan and motor.
39. All panels shall be easily removable. Self-supported modular panels fixed to the base frame and non removable panels supported from inside are not acceptable.
40. Access door panel equipped with hard nylon hinges and metal lock, accessible internally and externally for safety release. This access door type shall be at the fan section and the mixing box section.
41. Quick release and totally removable access door shall be at filter section with side rail mounting.
42. Air Mixing Section
43. General
44. Dampers shall be fabricated from galvanized steel for sturdy and rigid structure. The damper construction shall operate with minimal torque and minimal pressure losses.
45. Blades
46. Standard damper' blades shall be a single skin type, made from galvanized steel and can operate in parallel or oppose blades position at minimal pressure losses.
47. Blades shall be equipped with rubber seal and fitted close gap within blades allowing a minimum air leak Class-IV in accordance with UL555S.
48. Side seal damper blades with air leakage Class-II is available as an option.
49. Shafts shall be 12mm diameter; seated on non-corrosive bronzed or nylon bushing for less resistance, free maintenance and lowest torque.
50. Extended shaft length shall be provided for provision to electrical motor actuator to regulate damper blades opening and closing.
51. Frames shall be made from galvanized steel, reinforced at every 1200mm and flanged at both ends to facilitate external ductwork or sand trap louvers connection.
52. Metal linkage made from steel pushrods shall be installed for dampers assembled in top- rear position to allow damper to interconnected at open and closed position.
53. Damper blade's quadrant shall be assembled to guide blades opening and closing position.
54. Flexible damper connections shall be assembled externally to the casing's frame to disconnect potential vibration transmitted to/ from the building.
55. Hinged type access door shall be assembled at mixing box section.
56. \*\*\*Air Filter Section\*\*\*
57. General
58. Air filter section shall accommodate standard filters media to deliver clean air requirements for occupants, machines, indoors environment and ventilation system.
59. All air filters with dust spot efficiency up to 98% the performances shall be tested in accordance with ASHRAE Standard 52-76 or EUROVENT Standard 4/ 5.
60. Preliminary Filter
61. Synthetic filter thickness shall be up to 50mm depth, 73% Gravimetric Efficiency (Average Weight Arrestance, between 80 to 90) equivalent to EU3 (G3).
62. Secondary Filter
63. Soft bag filters shall be up to 630mm depth synthetics bag media and supported with galvanized steel frames.
64. Soft bag filter shall be flame resistance Class-I in accordance with UL 900.
65. Air filter efficiency ranged up to 90% Opacimetric Efficiency F7.
66. Filter Mounting Frame
67. Mounting frame shall be made from galvanized steel and filter can be accessed.
68. Frame mounting frame or rails shall be sealed for a minimal air leak Class F5-7 in accordance with EUROVENT Standard EN 779 or ASHRAE.
69. REFRIGERNAT Coil Section
70. General
71. Coils shall be of the cartridge type, and shall be selected so that the face velocity across the coil does not exceed 2.5 m/ s.
72. Coils are mounted on a condensate \*\*\*stainless steel\*\*\*\* drain pan (for cooling coil) with a slide in-out coil track so that the complete assembly is wholly removable for easy maintenance.
73. Coil shall be manufactured in accordance with ANSI or DIN Standard and coil's performance shall be rated in accordance with AHRI 410.
74. Coil Construction
75. Standard coil fins material shall be aluminum.
76. Fin's density min. 12 FPI.
77. Fins shall be a collar type, assembled with 5.9mm OD copper pipes and mechanically bonded to copper pipe for greater heat transfer coefficient.
78. Coil frames shall be made from galvanized steel and painted for additional protection.
79. Coil assembly shall sit within coil section face area and seal to the casing wall to avoid air by-pass.
80. Refrigerants coil-headers shall be made from seamless copper pipe and extended to outside pipe connection with threaded end (11 TPI) steel tube.
81. Coils shall be "counter" flow and equipped with vent and drain.
82. Coils shall be tested at 450psig submerged under water, designed to operate up to 230psig (16 bar).
83. Extended header connections outside the coil section shall be protected with metal shield to avoid any damage during transportation.
84. Provide an optional price for treatment of FAHU cooling coils to limit corrosion and enhance coil resistivity to coastal and saline environments. The treatment shall be by post coating, dipped curing and shall be factory made.
85. Condensate Drain Pan
86. Drain pan shall be mounted in slanted angle for complete and positive drainage.
87. Drain connection shall be at one side of the drain pan.
88. Drain pan shall be of \*\*\*stainless steel, Grade 304.\*\*\*
89. Bottom of the drain pan shall be insulated to avoid condensation.
90. Access Panel
91. Removable panels shall be assembled at coil section's casing wall.
92. Panels shall be bolted externally for air-tightness, easy removal and quick reassembly to facilitate access for servicing and maintenance.
93. Moisture Eliminator: Plastics eliminator shall be installed downstream of the coil whenever face velocity approaches 2.5m/ s (2.3m/ s for fresh air coil at highly humid condition).
94. Fan and Drive Section
95. General
96. Fan shall be \*\*\*direct drive fan array type\*\*\*.
97. Fan performance shall be rated in accordance with DIN EN ISO 5801 in reference to AMCA Standard 210-99.
98. Sound level shall be rated in accordance with DIN 45635 Pad 38 "Noise Measurement of Machine: Fan" in reference to AMCA Standard 300-96.
99. Fan Construction
100. Blades of the fans shall be from galvanized steel.
101. Wheels shall be statically and dynamically balanced within fan operating speed in accordance with DIN IS0 Standard 1940.
102. Standard fan bearings shall be "eccentric clamp bearing" type, single row ball bearing, mounted in pressed steel housing, pre-lubricated and sealed for life.
103. Reinforced fan bearings shall be "self-aligning double rows ball bearing", mounted in cast iron housing and re-greaseable.
104. Efficiency: Energy-efficient motors shall have a minimum efficiency as scheduled according to IEEE 112, Test Method B. If efficiency is not specified, motors shall have a higher efficiency than "average standard industry motors" according to IEEE 112, Test Method B (Premium Efficiency motors). Motor shall be IE2 rating or higher.
105. Fan Motor
106. Design and performance shall be in accordance with IEC Standards.
107. Fan motor shall be suitable to operate with Variable Frequency Drive (VFD) and fan array technology.
108. Standard fan's motor shall be a Totally Enclosed Fan Cooled type (TEFC).
109. Motor's frame shall be from aluminum or cast iron.
110. "Index of Protection" shall be in accordance with IP55; motor shall be protected against dust and protected against jets of water from all direction.
111. Insulation Class F (Tmax 155°C) and Temperature Rise Class B (AT 80K).
112. Motor shall have a 50°C operating temperature.
113. Motor shall have a thermal reserve to spare for overheating when induced by voltage fluctuation at ±10%; in accordance with IEC 60034-1.
114. Thermal Overload Protection "Normally Closed Thermostat" (PTO) shall be a standard accessory.
115. Fan and Motor Mounting Frame (FMB)
116. Fan and motor shall be installed on a common base frame.
117. FMB shall be fabricated from heavy gauge galvanized steel.
118. FMB shall be isolated from floor panel with anti-vibration spring isolator.
119. Fan shall be isolated to discharge panel with flexible fan connection.
120. Access Door

1. Fan Section access shall be with hard nylon hinges and metal lock, accessible internally and externally for safety release.

1. Safety Grate

1. Galvanized steel safety grates provided over air inlet and outlet openings located at the floor.

1. Cabinet Safety Relief Discharge

1. Discharge plenum shall be provided with knock-out panel for pressure relief between 76mm and 178mm pressure. Knock-out panel shall be similar to Ruskin #PRD18 or acceptable equivalent. Knock-out panel shall relieve excess pressure to the service vestibule.

1. Painting, Finish and Corrosion Resistance
2. All wall, roof, interior divider walls, racks, blank-offs and the base structure shall be coated with a dry powder coat, baked on polyester coating. The coating process shall be completed prior to assembly of the unit to assure all joined surfaces (panels and joints) are coated. Spray or brush applied coatings on the exterior of the unit cabinet shall not be acceptable. The baked on powder coating shall pass the ASTM B117 Minimum 7000 Hours Salt Spray Resistance Test, ASTM D2794 Impact Test up to 72.6kg and ASTM D2247 Minimum 7000 Hours Humidity Resistance Test with maximum blister of 1mm. Manufacturer shall submit documentation detailing how the specification shall be met including all pertinent ASTM test reports.
3. Exterior color finish shall be in accordance with the Engineer's requirements.
4. Submit color samples to the Engineer for acceptance.
5. Service Lighting and Convenience Outlet

1. Provide vaporproof service light fixture in each accessible section; wire to a common switch located

adjacent to a fan access door. Lights shall be factory-wired to separate junction box for field connection. Light switches shall be factory wired with 60-minute timer.

1. Electrical
2. All electrical installations shall be in accordance with IEC and in accordance with the Local Authority requirements. Refer also to Division 26 Electrical Sections of the Specification.
3. Provide electrical conduit chases located within unit at locations near VFDs to minimize electrical conduit penetrations. All electrical wiring shall be in conduit in accordance with Division 26 Electrical Work of the Specification. Conduits power and control wiring for fans and VFDs, lights, safety interlocks and temperature control shall be factory furnished with connectors at split units supplied by factory.
4. Main control panel/ variable speed drives shall be surface mounted on outer surface of the cabinet with control interfaces, disconnects shall be readily accessible and in accordance with local code requirement.
5. VFDs shall be installed and wired at the factory.
6. Motors: Provide with equipment in accordance with Division 26 Electrical Work to ensure compliance with ASHRAE 90.1.
7. Motor Starters: Provided under Division 27 Communications Work and Division 28 Electronic Safety and Security except when a variable frequency drive is required. Refer to Division 26 Electrical Work.
8. Provide switched lighting in all sections of the unit. Light fittings and switches used shall be in accordance with IP54.
9. Provide small power outlets (sockets) in accordance with Division 26 Electrical Work, Division 27 Communications Work and Division 28 Electronic Safety and Security requirements.
10. Sound Level
11. Maximum allowable sound levels for both casing radiated noise levels and in duct levels shall be as provided in Section 230548 Vibration and Seismic Controls for HVAC.

MATERIALS

2.3

1. Air Coils: Certify capacities, pressure drops and selection procedure in accordance with AHRI 410.
2. Adhesives and insulation materials shall have a composite fire and smoke hazard rating per NFPA 90A and UL 181, manufacturer labeled accordingly.
3. Insulation and seal shall be in accordance with NFPA 90A.
4. Casing shall withstand 500 hours salt spray exposure in accordance with ASTM B117.
5. Air filters performance in accordance with ASHRAE Standard 52 or Eurovent Standard 5/ 6.
6. Fan motor shall be in accordance with IEC Standard.

2.4 \*\*\*SOURCE QUALITY CONTROL\*\*\*

1. Standard Factory Tests: Standard factory tests shall be performed on each unit required by the project

and shall be completed and factory certified. The fans shall be factory run tested to ensure structural

integrity and proper RPM. All electrical circuits shall be tested to ensure correct operation before shipment of unit. Units shall pass factory quality control and testing and be thoroughly cleaned prior to shipment.

1. All sections of the units, including those that are split for shipment, shall be thoroughly cleaned externally and internally prior to wrapping for shipment. All surfaces shall be wiped down with Isopropyl Alcohol to remove any excess caulking from the caulked seams. All scratches to painted surfaces both inside and out shall be cleaned and repainted and the interior of the unit shall be completely vacuumed to remove all dust, metal shavings or other debris. Wrap each section shipment with suitable protection to ensure delivery free from deterioration.

PART 3 EXECUTION

1. EXAMINATION

A. Verification of Conditions

1. Examine areas for compliance with requirements for installation and conditions affecting performance of the Work. Identify conditions detrimental to a proper and timely completion. Proceed with installation only after unsatisfactory conditions have been corrected.

1. INSTALLATION

A. General

1. Install air handling units and all necessary accessories in accordance with the manufacturer's recommendations. Unit shall be installed plumb and level.
2. Coordinate work with other trades for external connections to units including but not limited to electrical and temperature control.
3. Units shall be installed on concrete frames or steel sub frames, or as indicated on the Design Drawings.
4. Unless otherwise indicated, there shall be a clearance between the underside of the AHU and its base or the plant room floor. The bottom of the unit shall be located at such a height that an adequate water seal, to suit the air pressure inside the unit, can be provided on coil drains.
5. Supplementary steelwork necessary to support the unit shall be provided by the installer. The steelwork shall be galvanized after manufacture and painted to match the air handling unit.
6. Pipework and electrical cable entry points to the unit shall be sealed after installation to maintain the airtightness of the unit.
7. Airtight sleeves shall be provided for control sensors, instruments and test holes.
8. SITE QUALITY CONTROL

A. General

1. Testing shall be in accordance with the relevant commissioning Sections of Division 23 Heating, Ventilating and Air Conditioning (HVAC).

DEMONSTRATION AND TRAINING

3.4

1. Demonstration
2. Demonstrate to the Engineer, the features and functions of the system and subsystems, including the labeling process.
3. Furnish the necessary trained personnel to perform the demonstration and instructions and arrange to have the manufacturer's representatives present to assist with the demonstrations.
4. Training
5. Instruct the Employer and designated representatives in the proper operation and maintenance of the system.
6. Conduct a training course for members of the operating and maintenance staff as designated by the Engineer.
7. The training course shall be given at the installation during normal working hours and shall start after the system is functionally complete but prior to final acceptance tests.

END OF SECTION