PART 1 GENERAL

1.1 RELATED DOCUMENTS

A. The requirements of the General Conditions, Supplementary Conditions and the following Specification sections apply to all Work herein:
1. Section 23 00 10 - General Requirements
2. Section 23 00 20 - HVAC Scope of Work
3. Section 23 05 07 - Design Conditions
4. Section 23 05 13 - Motor Requirements for HVAC Equipment
5. Section 23 05 30 - Miscellaneous Equipment
6. Section 23 05 48 - Vibration Isolation
7. Section 23 05 93 - Testing, Balancing, and Adjusting
8. Section 23 31 00 - Ductwork and Sheet Metal
9. Section 23 40 00 - Air Filtering

1.2 SUMMARY

A. Furnish and install all factory-built fan coil units herein specified and as indicated on the Drawings.

1.3 REFERENCE STANDARDS

A. All factory-built fan coil units and accessories shall be designed, manufactured and tested in accordance with the latest applicable industry standards including the following:
1. ASTM B-88-72 H23.1-59, E84, C423-90a and E795-83
2. NFPA 90A, 90B and 255
3. UL 723
4. AHRI Standard 410, 440 and 350
5. Mechanical Power Transmission Association and the Rubber Manufacturers Association, Inc. – “Engineering Standards for Multiple V-Belt Drives - 1972”
6. AMCA 210-85, 211, 300 and 311
7. ISO BS-848-1980 and 1940 G6.3
8. IEEE 444 and 519-1992
9. NEMA ICS-3-303

B. All equipment and material to be furnished and installed on this Project shall be UL or ETL listed, in accordance with the requirements of the authorities having jurisdiction and suitable for its intended use on this Project.

1.4 SUBMITTALS

A. The following submittal data shall be furnished according to the General Conditions and Section 23 00 10 and shall include, but not be limited to:
1. Fan Coil Units* complete with fan and coil selection data, calculations, physical dimensions, horsepower, starting requirements, motor details, etc. Shop Drawings shall indicate specifically that the construction, fabrication, etc., of the units to be furnished complies with these Specifications.
2. Acoustical and Performance Mock-Up Test Details complete with mock-up drawings and description of scope of work. Indicate fan coil unit lead time required, coordination requirements with Division 25, and name and location of the laboratory conducting the testing for approved by the Owner.
3. Coil Pressure Test Logs listing the fan coil unit coils tested, date of test, pressure at start of each test, pressure at the end of each test, duration time for the test and the name of the test supervisor for each test.
4. Quality Assurance Test Report complete with a written inspection report for each unit signed and dated by the factory test technician verifying all fan coil unit wiring and testing has been performed per the manufacturer’s testing and quality assurance requirements.
5. Prior to execution of factory testing and lab testing, submit test procedures, recording forms, and test equipment cut sheets to Engineer for review. Refer to Section 23 00 20 titled “Scope of Work” for “Scheduling Procedures”.
6. Factory Test Schedule.

7. Factory Test Reports.
8. Lab Test Schedule.
9. Lab Test Reports.

B. All items or equipment listed above with asterisks (*) shall be certified by the manufacturer using Manufacturer Certification "MCA" as set forth in Section 23 00 10. See Section 23 00 10 for certification requirements.

1.5 WARRANTY

A. Comply with the requirements of the General Conditions and Section 23 00 10.

PART 2 PRODUCTS

2.1 ACCEPTABLE MANUFACTURERS

A. If it complies with these Specifications, factory-built horizontal ceiling fan coil units manufactured by one of the following manufacturers will be acceptable:
1. Aaon, Inc.
2. Carrier
3. Dunham-Bush
4. Greenheck
5. International Environmental
6. McQuay
7. Nailor Industries
8. Trane
9. Williams

B. If it complies with these Specifications, fan sheaves manufactured by one of the following manufacturers will be acceptable:
1. Browning
2. Eaton Yale and Towne
3. Dodge Manufacturing Company
4. Fort Worth Steel and Machinery Company
5. T. B. Woods

C. If it complies with these Specifications, belts manufactured by one of the following manufacturers will be acceptable:
1. Gates
2. Durkee-Atwood
3. Goodyear
4. Uniroyal
5. Browning

D. If it complies with these Specifications, chilled water coils manufactured by one of the following manufacturers will be acceptable:
1. Aerofin
2. International Environmental
3. Great American Coil Co
4. Carrier
5. Heatcraft
6. McQuay
7. Nailor Industries
8. Trane
9. York

E. If it complies with these Specifications, hot water heating coils manufactured by one of the following manufacturers will be acceptable:
1. Aerofin
2. International Environmental

3. Great American Coil Co
4. Carrier
5. Heatcraft
6. McQuay
7. Nailor Industries
8. Trane
9. York

2.2 FACTORY-BUILT HORIZONTAL CEILING FAN COIL UNITS ("FCU")

A. Ceiling fan coil type air handling units shall be horizontal type as indicated on the Mechanical and Architectural Drawings and shall meet the capacity and damper requirements specified in the schedules on the Contract Documents. All units shall be tested in accordance with AHRI Standard 440-93. Above the ceiling mounted horizontal type fan coil units shall be factory-built not to exceed dimensions (length, width and height) as indicated on the Drawings.

B. Fan coil unit casing shall be single or double wall construction with the outer sheet constructed of high quality 20 gauge galvanized steel. Double wall construction fan coil units shall have a minimum 22 gauge perforated inner sheet with twenty five percent (25%) openings and minimum ¾" thick, minimum 1 ½ lb. density fiber glass insulation with reinforced foil (FSK) facing over the insulation. Single wall casings shall be internally insulated with 3/4" or 1" thick glass fiber, 1-1/2lb. density insulation similar to Certain Teed Tough Gard Water Repellent enhanced glass fiber insulation fully secured to the casing with waterproof adhesive. No exposed fiberglass will be allowed. The adhesive shall fully cover the entire surface to be insulated. Insulation, adhesives, coating, etc., shall meet NFPA flame spread and smoke development rating of 25/50. Discharge flanges shall be supplied with the unit for mating to the discharge duct as indicated on the Mechanical and Architectural Drawings. The return air side of the fan coils shall be equipped with a filter rack suitable for holding the filter in place and providing easy change out of the filter. The fan coil units depth shall not exceed 19".

C. The stainless steel drain pan shall be rigid and watertight and shall be sized and equipped with baffles to preclude condensate carryover. An auxiliary drain pan shall be provided in the piping end pocket under the coil drain valves and control valves. Pan shall be completely insulated on the underside of the pan with 1/2 inch thick elastomer foam insulation similar to Armstrong Type AT Armaflex. The gravity condensate removal system shall be designed to eliminate standing water and be internally graded within the unit as required to allow the drain pans and condensate troughs to drain completely upon unit shutdown. If the horizontal fan coil units, as installed in the field, are not graded to permit complete condensate drainage, the entire unit shall be adjusted in the field to permit complete condensate drainage.

D. Water coils shall be two (2) pipe for cooling only and four (4) pipe for heating and cooling having at least three (3) rows of copper tubes mechanically expanded into aluminum plate fins. Coils shall have manual air vent and drain connections. Coils shall be pressure tested at 1.5 times operating pressure classification indicated on the Drawings, but the test pressure shall in no case be less than 250 psig nor more than 500 psig. Water velocity in the tubes shall not exceed 5.0 feet/sec and coil face velocity shall not exceed 500 fpm.

E. Fan motor assembly shall be a forward curved centrifugal fan with a direct drive motor. Fan motors shall be General Electric ECM or Nailor EPIC variable speed DC brushless motors specifically designed for use with a single phase, 277 Volts, 60 hertz electrical input. Motor shall be complete with and operated by a single phase integrated controller/inverter that operates the wound stator and senses rotor position to electrically commutate the stator. All motors shall be designed for synchronous rotation. Motor rotor shall be permanent magnet type with near zero (0) rotor losses. Motor shall have built-in soft start and slowed speed change ramps. Motor shall be permanently lubricated with ball bearings. Motor shall be direct coupled to the blower. Motor shall maintain a minimum of sixty-five (65%) percent efficiency over its entire operating range. Provide isolation between fan motor assembly and unit casing in at least four (4) locations to eliminate any vibration from the fan to the terminal unit casing. Provide isolation between the motor and blower as well as between the blower and casing.

F. The manufacturer of the fan coil units, which operate at constant fan discharge volume shall set the fan discharge air volume at the factory. If the constant volume fan coil unit manufacturer cannot factory set the fan air volume they shall send factory technicians to the field to adjust the GE ECM or Nailor EPIC motor

and the associated controller/inverter to the discharge air volume indicated in the schedules in the Contract Documents at no additional cost to the Owner. Fan air volume shall be constant within ±5% regardless of changes in static upstream (air filter loading) and downstream of the fan coil unit after it is installed in the field. Fan air volume to be set with a potentiometer and/or digital meter. Neither SCRs nor rheostats shall be an acceptable means of setting the fan air volume. The fan coil unit manufacturer shall provide one (1) speed adjustment device to the Owner for field adjustment of the fan speed should construction or design changes become necessary. A witnessed test shall be conducted by the fan coil unit manufacturer in a testing laboratory approved by the Owner to confirm that the fan coil unit and the fan motor, as an assembly, performs in accordance with this Specification. If the fan coil unit and DC motor as an assembly fails to perform as specified and as scheduled on the Drawings, the terminal unit manufacturer shall make adjustments and take all corrective action as necessary at the terminal unit manufacturer's sole expense with no additional cost to the Owner.

G. For fan coil units with dynamic volume control sequences as specified in the Division 25, the fan coil unit manufacturer shall provide an algorithm to the Division 25 subcontractor that will allow the Division 25 DDC controller to directly reset the fan discharge volume. The Division 25 subcontractor shall field program the setpoints as indicated in the schedules in the Contract Documents. A witnessed test shall be conducted by the fan coil unit manufacturer in an independent testing laboratory to confirm that the fan coil unit and the fan motor and the Division 25 DDC controller, as an assembly, perform in accordance with this Specification. If the fan coil unit and DC motor, as an assembly, fail to perform as specified and as scheduled on the Drawings, the terminal unit manufacturer shall make adjustments and take all corrective action as necessary as the terminal unit manufacturer's sole expense with no additional cost to the Owner.

H. The fan coil unit air filters shall be throw away pleated type, 1 inch thick Type "D". Filters shall be easily removable from either end of the unit. Refer to Section 23 40 00 titled "Air Filtering" for additional requirements. The fan coil unit manufacturer shall configure the integral motor control microprocessor to provide an indication to the Division 25 BMCS digital control system that the return air filters are dirty and require changing. The dirty filter set point shall be adjustable.

I. Limit the fan coil unit radiated noise to the maximum sound level indicated by a NC 40 curve in the occupied space when the fan coil unit is installed above the ceiling as specified for this Project.

J. Fan coil unit design and acoustical treatment shall limit the discharge noise to an amount that will not produce more than a NC 40 sound curve in the occupied tenant space when installed above the ceiling as indicated on the Drawings.

K. Each size of fan coil unit installed on this Project shall be completely laboratory tested for air performance and acoustics. The acceptability of the independent testing laboratory is subject to review by the Owner, Project Acoustical Consultant and the Engineer. The fan coil unit manufacturer shall submit complete details, brochures, instrumentation information, etc., for review. The laboratory shall be capable of properly testing the largest fan coil unit on the Project. The air volume listed on the Drawings or in the schedules for the fan coil units shall be tested at minimum twenty-five (25%) percent, fifty (50%) percent, seventy-five (75%) percent and maximum fan flow. Operation of the fan flow and motor speed control device shall be demonstrated to repeat under all conditions of operation and static pressures as specified hereinbefore. If the fan coil unit manufacturer has conducted the hereinbefore specified air performance and acoustical tests and has demonstrated to the Engineer and Owner compliance with the specified criteria the previous testing will be accepted and will not need to be repeated. See Section 23 05 07 titled "Design Conditions".

L. The manufacturer shall submit six (6) certified copies of the laboratory air performance and acoustical performance test results to the Engineer and the Project Acoustical Consultant. See Section 23 00 10 titled "General Requirements" for additional submittal and certification requirements.

M. All above the ceiling mounted fan coil units shall be identified on the bottom of the above ceiling type FCU (minimum ½ inch high letters) and on the shipping carton with the floor and box number that identifies it along with the air flow settings. Every unit shall have a unique number combination that matches numbers on the Coordination Drawings as to its location and capacity and is coordinated with the DDC controller and the Division 25 Shop Drawings.

N. The FCU manufacturer will verify at the manufacturer's factory the operation of each fan coil before shipment. Testing shall include at least the following:

1. Apply electric power to the unit.
2. Start the fan and verify fan rotates properly.
3. The FCU manufacturer shall set the brushless DC "ECM" motor and associated controller/inverter to the discharge air volume indicated in the Schedules.
4. Energize the electric two (2) way modulating chilled and hot water heating control valves or the electric heating coils and verify satisfactory performance.
5. Provide a written inspection report for each unit signed and dated by the factory test technician verifying all fan coil unit wiring and testing has been performed per the manufacturer's testing and quality assurance requirements.

PART 3 EXECUTION

3.1 INSTALLATION

A. All factory-built fan coil units shall be installed in accordance with the latest industry standards, per the manufacturer's recommendations and as indicated on the Drawings.

B. All factory-built fan coil units shall be installed to allow for proper cooling coil condensate drainage through the traps.

C. Prior to the installation of multiple fan coil units, the Contractor shall install one of each size of the fan coil units as mock-up conditions generally representative of the typical ceiling plenum installation. The mock-up condition shall be complete with piping, condensate piping ductwork, fan coil unit hangers, control, electrical connections and code clearances. The mock-up installations shall be located within one of the typical ceiling plenum areas of the project. The Contractor shall advise the appropriate Local Code Field Inspector, Engineer, and Owner's representative after the mock-up is complete and ready for review and inspection. The Contractor shall arrange a time mutually agreeable to these parties so they can meet at the project site, review the mock-up installation, and determine any changes that need to be made for the installation to be acceptable to the Local Code Field Inspector. Issues regarding access and code NEC clearances plus obstructions and conflicts with other trades within the ceiling plenum will be discussed and mutually agreed upon. The mock-up condition, review of the mock-up condition by the appropriate parties, and the necessary modifications for the mock-up to become code compliant in the opinion of the Local Field Code Authority shall be completed prior to the installation of additional fan coil units. The Contractor shall account for this requirement in the schedule of construction so this procedure does not delay the construction progress. If multiple fan coil units are installed prior to the mock-up approval, the Contractor shall be responsible for the remedial work required to comply with the approved mock-up condition at no additional cost to the Owner. The Contractor shall provide advance notice to the appropriate parties of the fan coil units mock-up inspection a minimum of seven working days prior to the meeting. If additional or follow-up field inspections of the mock-up modifications are required to establish the approval of the Local Field Code Authority, the Contractor shall provide these modifications and additional follow-up field inspections as required without additional cost to the Owner.

3.2 FACTORY TESTING

A. All factory-built fan coil units shall be tested in accordance with the latest applicable industry standards as specified herein and be UL or ETL listed.

B. The Owner and/or Engineer may observe the air handling units for this Project under manufacture at the factory prior to shipment, if he so desires. The Mechanical Subcontractor shall notify the Owner and Engineer in writing at three (3) weeks prior to the first fan coil units production date.

3.3 FIELD TESTING

A. Prior to execution of field testing, submit test procedures, recording forms, and test equipment cut sheets to Engineer for review. Refer to Section 23 00 20 titled "Scope of Work" for "Scheduling Procedures".

B. Refer to Section 23 05 93 for additional testing requirements for factory-built fan coil units.

END OF SECTION