**SECTION 23 73 13**

**MODULAR INDOOR CENTRAL-STATION AIR-HANDLING UNITS**

**BASED ON DFD MASTER SPECIFICATION DATED 04/12 /2022**

***This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.***

**P A R T 1 - G E N E R A L**

**SCOPE**

This section includes specifications for indoor central station package air handling units. Included are the following topics:

PART 1 - GENERAL

 Scope

 Related Work

 Reference

 Reference Standards

 Quality Assurance

 Submittals

 Operation and Maintenance Data

 Design Criteria

PART 2 - PRODUCTS

 Manufacturers

 Casing

 Access Doors

 Electrical and Lights

 Fan Sections

 Fan Inlet Air Flow Stations

 Coil Sections

 Humidifier Sections

 Air to Air Energy Recovery Sections

 Filter Sections

 Access Sections

 Filter/Mixing Box Sections

 Damper Sections

 Diffuser Sections

 Face and Bypass Sections

 Air Blender Sections

***Edit scope index and delete air handling unit sections that are not applicable to this project. Where required, add accessories to specification that are not listed .***

PART 3 - EXECUTION

 Installation

 Leakage Test

 Construction Verification

 Functional Performance Testing

 Agency Training

 Leakage Test Report

**RELATED WORK**

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 23 05 13 - Common Motor Requirements for HVAC Equipment

Section 23 05 14 - Variable Frequency Drives

Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

Section 23 08 00 – Commissioning of HVAC

Section 23 31 00 – HVAC Ducts and Casings

Section 23 41 00 - Particulate Air Filtration

Section 23 33 00 - Air Duct Accessories

Section 23 34 00 – HVAC Fans

Section 23 72 00 – Air to Air Energy Recovery Equipment

Section 23 73 12 - Air Handling Unit Coils

Section 23 84 13 - Humidifiers

Division 26 – Electrical

**REFERENCE**

Applicable provisions of Division 1 govern work under this section.

**REFERENCE STANDARDS**

ARI 430 (latest edition) Standard for Central Station Air Handling Units

NFPA 70 National Electrical Code

NFPA 90A Standard for Installation of Air Conditioning and Ventilation Systems

**QUALITY ASSURANCE**

Refer to division 1, General Conditions, Equals and Substitutions.

**SUBMITTALS**

Refer to division 1, General Conditions, Submittals

Submit shop drawings including the following information: specific manufacturer and model numbers, submittal equipment identification corresponding to project drawings and schedules, unit dimensional and weight data, materials of construction, capacities and ratings, fan curves, fan type, drive and motor information, vibration isolation, coil performance data, sound power levels, filter information, information for all accessories.

Provide final reviewed submittal information to Division 26 contractor for coordination of motor protection and disconnects.

# OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

***Delete the following if there are no additional requirements.***

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. ***[A/E and commissioning provider to define detailed operation and maintenance data requirements for equipment specifications added to this section.]***

**DESIGN CRITERIA**

Furnish factory fabricated modular indoor central-station air handling units complete meeting the configuration shown on drawings and/or as scheduled.

Units to be tested, rated and certified in accordance with ARI Standard 430 and bear ARI certification label.

Units to conform with NFPA 70.

All material shall meet NFPA 90A flame spread and smoke develop rating requirements.

Any revisions made by the Contractor to the inlet and outlet ductwork conditions from that shown on the drawings shall not increase system effect and/or static pressure and shall not decrease mixing efficiencies.

**P A R T 2 - P R O D U C T S**

**MANUFACTURERS**

Carrier, Daikin, Trane, York.

**CASING**

WALL/ROOF CONSTRUCTION

Construct walls and roof from 2”thick double wall panel assemblies. Panels shall be injected with polyurethane foam insulation and shall have a minimum thermal conductivity (R) of at least 12.5. The outer shell shall be constructed of solid G90 galvanized steel with baked enamel or mill galvanized finish or G40 galvanized steel with gardobond finish. The inner liner shall be constructed of solid G90 galvanized steel or G40 galvanized steel with gardobond finish. Panels shall be gasketed with permanently applied bulb-type gaskets and able to be removed without affecting the integrity of casing structure.

Under 55°F supply air temperature and design conditions on the exterior of the unit of 91°F dry bulb and 74°F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying or replacing units should external condensate form on them.

Wall/Roof panel deflection shall not exceed L/240 ratio at a maximum +/- 5 inches of static pressure. Deflection shall be measured at the midpoint of the panel.

FLOOR CONSTRUCTION

Construct floors from 2”thick double wall panel assemblies. Panels shall be injected with polyurethane foam insulation and shall have a minimum thermal conductivity (R) of at least 12.5. The outer shell shall be constructed of solid G90 galvanized steel with baked enamel or mill galvanized finish or G40 galvanized steel with gardobond finish. The inner liner shall be constructed of solid G90 galvanized steel or G40 galvanized steel with gardobond finish. Panels shall be gasketed with permanently applied bulb-type gaskets.

Under 55°F supply air temperature and design conditions on the exterior of the unit of 91°F dry bulb and 74°F wet bulb, condensation shall not form on the casing exterior. The AHU manufacturer shall provide tested casing thermal performance for the scheduled supply air temperature plotted on a psychrometric chart. The design condition on the exterior of the unit shall also be plotted on the chart. If tested casing thermal data is not available, AHU manufacturer shall provide, in writing, a guarantee against condensation forming on the unit exterior at the stated design conditions above. The guarantee shall note that the AHU manufacturer will cover all expenses associated with modifying or replacing units should external condensate form on them.

Floor panel deflection shall not exceed L/240 ratio based upon a 300 lb concentrated load at the mid-span of the panel.

A full perimeter base rail shall be installed at each air handling unit. The base rail shall be constructed from a minimum of 16 gauge G90 galvanized steel and shall be at least [XX”] high. Panels shall be able to be removed without affecting the integrity of casing structure.

***Verify base rail height required and edit the aforementioned paragraph. The base rail must be high enough to properly drain cooling coil condensate and steam condensate.***

LEAKAGE RATE

Leakage rate shall not exceed 1% of the total system air quantity when subjected to +/- 5” static pressure.

CASING PENETRATIONS

Install sealing collars to the interior and exterior of each penetration to prevent air leakage where coil piping, humidifier piping, air vents, drain piping, and electrical conduits penetrate air handling unit casing. Silicone sealants and duct sealants are not acceptable to seal pipe and conduit penetrations of the air handling unit casing.

Duct sealant and/or gaskets as indicated in specification section 23 31 00 may be utilized to seal duct connections to the air handling unit casing. Silicone sealants are not acceptable.

**ACCESS DOORS**

Access doors shall be double wall, of same construction and thickness as casing, hinged, continuously gasketed with bulb type gaskets, reinforced nylon handles with cam type latches, and inspection windows. Door swing shall open in direction against pressure of the section. If not possible, safety chains or secondary latches shall be provided along with labels indicating that the access door opens with the pressure of the unit/section. Provide access doors on both sides of casing for fan sections, access sections, air to air energy recovery sections, filter sections, damper sections, air blender sections and upstream and downstream of every coil and humidifier.

**ELECTRICAL AND LIGHTS**

***Electrical and lighting will be installed by the Division 26 contractor. Coordinate all electrical and lighting requirements with the Electrical Engineer during the design phase. Refer to the following minimum requirements for electrical and lighting design.***

***Provide a marine grade gasketed light fixture in all fan sections and a light switch for each fan section located on the exterior wall of each fan section. Sections wider than 6 feet shall have multiple marine grade light fixtures with maximum spacing of 6 feet.***

***Provide a marine grade gasketed light fixture for each accessible section on units above 10,000 CFM and a light switch located on the exterior wall on both sides of each fan section and filter section. No more than three light switches per side of AHU. All light switches shall be capable of switching all lights within the air handling units. Do not wire the lights separately per switch. Sections wider than 6 feet shall have multiple marine grade light fixtures with maximum spacing of 6 feet.***

***Provide a GFI receptacle on either side of the exterior of the air handling unit where the air handling unit is less than 10’-0” in length. Provide two GFI receptacles spaced at least 5’-0” apart on either side of the exterior of the air handling unit where the air handling unit exceeds 10’-0” in length.***

***Provide separate junction box or packaged control motor protection panel for each engineered supply and return/relief/exhaust fan system at exterior wall of air handling unit.***

***Provide local disconnect in each fan section containing a motor.***

***All lights and receptacles shall be wired to a single junction box located on the exterior of the air handling unit to serve as a single point connection. Each set of lights and receptacles must remain on if the air handling unit fan’s disconnects are switched off.***

Electrical receptacles, switches and unit lighting shall be provided by the Division 26 contractor. Wiring and conduit for receptacles, motors, and unit lighting shall be field installed by the Division 26 contractor. Coordinate openings in the casing with the Division 26 contractor. Sealing of openings shall be the responsibility of the Division 26 contractor.

**FAN SECTIONS**

Double width, double inlet, housed centrifugal type or single width single inlet plenum type, statically and dynamically balanced fans. For variable speed applications, fan shall be dynamically balanced through entire range of operation. Fan wheels shall be backward inclined, forward curved or airfoil type as specified or required by performance characteristics.

***Verify fan types on a case by case basis. Plenum fans may be utilized if the system effect is found to increase the BHP of a housed centrifugal type fan above that of a similarly sized plenum fan for the same application.***

Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.

Fans to be fastened to hollow or solid steel shafts and designed for continuous operation at maximum rated static pressure.

Fan bearings shall be self-aligning, pillow block, regreasable ball type selected for a minimum average L-50 life of 200,000 hours.

Furnish extended grease lines from bearings to allow servicing without entering the unit. Grease lines can be terminated within the unit as long as they are able to be easily serviced by opening the access door.

Furnish variable pitch sheaves for drives 3 hp and smaller, fixed pitch sheaves for drives 5 hp and larger. Drives shall be designed for 150% of motor rating. Furnish OSHA approved belt guards for all fans.

Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.

Furnish a metal access guard at the access door of all plenum fan sections. A wheel guard may be substituted if a metal access guard is not available from the manufacturer.

Fan, drive and motor assembly shall be mounted inside fan casing section and integrally isolated within unit. Vibration isolation shall be in compliance with section 23 05 48. Provide flexible connection and thrust restraints at fan discharge connection to casing.

Furnish galvanized mesh inlet screens for fans without inlet ductwork connections.

Furnish a label inside the fan section that identifies the specifications of the v-belt drive kit. Include motor sheave, drive sheave and belt data.

Fan motors shall be provided in accordance with section 23 05 13.

**FAN INLET AIR FLOW STATIONS**

For fans that are specified or scheduled to have fan inlet air flow station, provide a piezometer ring air flow station mounted on the fan inlet bell housing. Pressure tubes from the piezometer ring shall be extended to a termination plate labeled with the high and low pressure connections. Provide an initial flow rate coefficient that will be adjusted by the balancing contractor for measured flow reading. Piezometer ring air flow station shall measure static pressure drop through the fan inlet cone to provide an overall air flow measurement to within +/- 5% accuracy. In lieu of a piezometer ring air flow station, a fan inlet probe air flow stations as specified under Section 23 09 14 may be furnished and factory mounted in the fan inlet. Differential pressure transducers for measuring the velocity pressure for air flow measurement shall be supplied under Section 23 09 14 and be mounted in the temperature control panel.

**COIL SECTIONS**

Coils shall be provided in accordance with section 23 73 12.

Air handling unit coils mounted in casing shall be accessible for removal from either side of unit casing without disturbing adjacent sections.

Entire coil frame, headers and U-bends shall be enclosed within air handling unit casing. Extend coil piping connections, air vent and drain connections to exterior of casing.

Support coils along entire length within casing and pitch coil for proper drainage.

Blank off space between coil frames and air handling unit casing.

Fabricate cooling coil drain pans from type 304 stainless steel. Install a drain pan under each cooling coil. Extend drain pans the entire width of each coil, including the header, and from the upstream face of each coil to a distance ½ of the vertical coil height of the bottom coil or 6”, whichever is greater, downstream from the downstream face. Pitch drain pans in two directions towards the outlet. Pipe drain pans individually down to the drain pan below using a minimum 1” type 304 stainless steel piping. The bottom drain pan shall be piped to the exterior of the unit base using a minimum of 1.25” type 304 stainless steel piping.

**HUMIDIFIER SECTIONS**

Humidifiers shall be provided in accordance with section 23 84 13.

Blank off space between humidifier and air handling unit casing.

Fabricate humidifier drain pans from type 304 stainless steel. Install a drain pan under each humidifier. Extend drain pans the entire width of each humidifier and 18” downstream from the downstream face of the humidifier. Pitch drain pans in two directions towards the outlet. Pipe drain pans to the exterior of the unit using a minimum of 1.25” type 304 stainless steel piping.

**AIR TO AIR ENERGY RECOVERY SECTIONS**

Air to air energy recovery shall be provided in accordance with section 23 72 00.

**FILTER SECTIONS**

Filter box section may be furnished by air handling unit manufacturer in accordance with specification requirements of section 23 41 00. Provide static pressure tips that are arranged to prevent damage to the filter elements during replacement. Provide minimum 2” gap between final and prefilters for static pressure probes*.*

**ACCESS SECTIONS**

Provide access sections where shown on drawings.

**FILTER/MIXING BOX SECTIONS**

***Wherever possible locate outside air and return dampers directly adjacent to one other and as far upstream of the connection to the AHU as possible to facilitate mixing. Do not use packaged mixing sections on modular AHU’s unless reviewed and approved by the DFD HVAC Reviewer.***

Filters shall be horizontal V-bank arrangement and shall meet specification requirements of section 23 41 00.

The damper blades shall be arranged so that the air streams are directed at one another to facilitate mixing.

Damper linkage shall be extended outside the unit for external actuator mounting. Internal actuator mounting is not acceptable.

Reference drawings for damper arrangement [top and rear] or [rear and bottom].

Reference Sections 23 09 14 and 23 09 15 for damper construction and damper actuation requirements.

**DAMPER SECTIONS**

***Wherever possible locate outside air and return dampers directly adjacent to one another and as far upstream of the connection to the AHU as possible to facilitate mixing. Do not use packaged mixing sections on modular AHU’s unless reviewed and approved by the DFD HVAC Reviewer.***

Damper linkage shall be extended outside the unit for external actuator mounting. Internal actuator mounting is not acceptable.

Reference drawings for damper arrangement [top and rear] or [rear and bottom].

Reference section 23 09 14 OR 23 09 15 for damper construction and damper actuation requirements..

**DIFFUSER SECTIONS**

Provide perforated diffuser plate at fan discharge to ensure uniform airflow downstream of diffuser plate.

**FACE AND BYPASS SECTIONS**

Damper linkage shall be extended outside the unit for external actuator mounting. Internal actuator mounting is not acceptable.

Reference section 23 09 14 OR 23 09 15 for damper construction and damper actuation requirements..

**AIR BLENDER SECTIONS**

Reference section 23 33 00 for air blender requirements.

**P A R T 3 - E X E C U T I O N**

**INSTALLATION**

Install all air handling units and accessories as indicated on drawings and/or as scheduled and according to manufacturer's installation instructions.

Mount units at appropriate height above floor to insure proper condensate trap depth and condensate drainage.

Install air-handling unit to provide for adequate service access. Coordinate with other trades to assure air handling unit does not infringe upon access or service clearances of other equipment.

Lubricate fan bearings. Verify fan isolators have proper deflection.

Upon completion of installation of air handling units, start-up and operate equipment to demonstrate capability and compliance with requirements. Field correct malfunctioning components, then retest to demonstrate compliance.

Furnish one spare set of fan drive belts and three reinforced nylon access door handles.

**LEAKAGE TEST**

Field test all modular air handling units.

Seal all openings and dampers at the air handling unit to the pressure class listed below before performing the test. A minimal amount of ductwork may be connected to the air handling unit in order to seal off large openings. The ductwork must meet or exceed the larger of the ductwork pressure class or the air handling unit pressure requirement.

Test draw through air handling units at -5” static pressure. The contractor and/or the unit manufacturer may brace the access doors in positive sections of the air handling unit to meet the testing requirements.

***Verify each air handling unit on a case by case basis and edit the Leakage Test requirements accordingly. If half of the air handling unit operates at positive pressure and half at negative pressure the units openings shall be sealed and the unit should be tested as such. This would apply to an air handling unit with an energy recovery device. A typical draw through air handling unit (majority of the unit is under negative pressure) should be tested as indicated above.***

If excessive air leakage is found locate leaks, repair in the area of the leak, seal, and retest.

Leakage rate shall not exceed more that 1% of the total system air quantity when subjected to +/- 5” static pressure.

Submit a signed report to the Division's Construction Representative, indicating test apparatus used, results of the leakage test, and any remedial work required to bring modular air handling units into compliance with specified leakage rates.

**CONSTRUCTION VERIFICATION**

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

**FUNCTIONAL PERFORMANCE TESTING**

Contractor is responsible for utilizing the functional performance test forms supplied under specification Section 23 08 00 in accordance with the procedures defined for functional performance testing in Section 01 91 01 or 01 91 02.

# AGENCY TRAINING

All training provided for agency shall comply with the format, general content requirements and submission guidelines specified under Section 01 91 01 or 01 91 02.

END OF SECTION

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|  |  |  |  | **MODULAR INDOOR CENTRAL- STATION AIR HANDLING UNIT LEAKAGE TEST REPORT** |  |  |  |  |
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| **State of Wisconsin** |  |  |  |  |  |  | **DFD Project Number:\_\_\_\_\_\_\_\_\_** |  |
| **Department of Administration** |  |  |  |  |  |  |  |  |  |  |
| **Division of Facilities Development** |  |  |  |  | **Date Submitted:\_\_\_\_\_\_\_\_\_\_\_\_\_** |  |
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| **Project** |  | **Name:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |
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|  |  | **Contractor:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****Contractor Signature:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_****DFD Signature:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |
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| **System** |  | **AHU No:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** |  | **Test Pressure: +/- 5” S.P.**  |  |
| **Data** |  | **AHU Design CFM:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | **Leakage at 1% of total design CFM (CFM):\_\_**\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_**Test Leakage at +5” S.P. (CFM):\_\_**\_\_**Test Leakage at -5” S.P. (CFM):\_\_**\_\_\_\_\_ |  |
|  |  |  |  |  |  |  |  |  |
| **Test**  |  |  |  |  |  |  |  |  |  |  |  |  |
| **Equipment** |  | **Manufacturer:\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_\_** | **Model No:\_\_\_\_\_\_\_\_\_\_\_** | **Serial No:\_\_\_\_\_\_\_\_\_\_\_\_\_** |
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