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| Section 23 73 10  2013-11-06 Packaged Modular Indoor Air Handling Units |

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## Scope

### Provide modular type indoor air handling units designed and manufactured specifically to the requirements of this project.

### Overall dimensions and configuration are defined in the Contract Documents.

## related work in other sections

### Refer to and comply with the following sections:

#### Shop Drawings, Product Data, and Section 01 33 23 Samples

#### Systems Demonstration and Owner’s Section 01 79 00 Instruction

#### General Mechanical Requirements Section 20 00 13

#### Vibration Isolation Section 20 05 48

#### Ductwork Cleaning Section 23 01 30

#### Equipment Testing and Startup Section 23 08 23

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#### Electrical Division 26

## Quality Assurance

### Electrical installation shall comply with the requirements of Division 26, and the Canadian Electrical Code.

### Provide unit produced by a recognized manufacturer who maintains a local service agency and parts stock.

### Equivalent selections must have air flow rates, external static pressures, water flow rates, coil face velocities, filter face velocities, and water and air side pressure drops that equal or exceed specified performance.

### Startup of unit shall be executed by manufacturer's personnel. Submit a complete manufacturer's check list of field start-up tests.

### Certify that the unit has been field tested and ready for start-up, including sign-off by the manufacturer’s field representative.

## REFERENCE STANDARDS

### AMCA Standards

### AHRI 410 – Forced Circulation Air Cooling and Air Heating Coils

### ANSI/AHRI 610 – Performance Rating of Central System Humidifiers

### AHRI 1060 – Heat Wheel Performance Certification

### CSA – labeled (ETL Certification)

### NFPA 90A – Flame Spread and Smoke Ratings

### SMACNA – HVAC Duct Construction Standards – Metal and Flexible

### ANSI/ASHRAE/ESNA Standard 90.1 – Energy Standard for Buildings Except Low Rise and Residential Buildings

## Delivery, storage and handling

### Deliver, store, protect and handle products to the site as defined in Section 01 65 00, Product Delivery Requirements.

### Prior to shipment, comply with the following procedures to ensure equipment delivered to site is clean and protected.

#### Thoroughly clean interior and exterior of the unit and/or modules.

#### Vacuum interior of unit to remove all dust, metal shavings and debris.

#### Wipe down all surfaces with isopropyl alcohol, removing excess caulking.

#### Place a 500 g “Cargo-Drypak” desiccant by Dessicaire Inc. onto a 304 stainless steel tray into each module.

#### Protect unit and materials from rain and other sources of moisture during shipping and on-site storage with a clear shrink-wrap or stretch-wrap.

#### Identify each module with permanent marker to indicate project, work order number and section identification for staging and installation.

### Store components in a clean, dry space until site construction is ready for installation. Protect from weather and construction work. Handle with care to protect from damage to components, enclosure and finish.

## Submittals

### Comply with the requirements of Section 01 33 23, Shop Drawings, Product Data and Submittals.

### Submit shop drawing including the following information. Shop drawings submitted without this information will be rejected.

#### Submit unit construction drawings for each modular section.

#### Details of module components, including access doors, hinges, latches, drain pans, pipe penetrations through casings, fan mounting and vibration isolation.

#### Indicate material and gauge of all construction components.

#### Show point loads, and recommended method of unit installation.

#### Submit fan performance curves as well as performance tables.

#### Make, model, selection criteria, and pressure drop for air blenders.

#### Coil selection criteria indicating air side and fluid side capacities, inlet and outlet conditions, velocities, pressure drops and fouling factors. Submit a drawing showing headers, circuiting arrangement, connection sizes, and materials of construction. Refer to Section 23 82 10, Coils.

#### Indicate air filter media, MERV rating, velocity, pressure drop charts and capacities. Indicate mounting method and arrangement.

#### Humidifier performance and capacities. Refer to Section 23 84 14, Steam Grid Humidifier.

#### Heat recovery wheel.

#### Table indicating pressure drops through each unit.

#### Damper shop drawings.

#### Detailed composite wiring diagrams showing factory installed wiring, including wiring of the control components.

#### Submit sound power levels generated by the air handling unit at the inlet and outlet of the unit and outside the fan section. List for individual octave bands from 125 HZ to 8000 HZ in dB referenced to A rating.

# Products

## Acceptable Manufacturers

### Trane, Carrier, York, McQuay.

## casing

### Construct panels on each module using minimum 1.6 mm G90 galvanized steel, double wall construction, 50 mm between double walls.

### Insulate panels to completely fill the panel cavities. Insulation to provide a thermal resistance of 13 ft2/h/°F/BTU. Insulating material shall comply with NFPA 90A.

### Construct casing to withstand up to 2000 Pa positive or negative pressure.

### Comply with ASHRAE 111 Standard (leak Class 6) for casing leakage, achieving less than 1% leakage rate of 2000 Pa positive or negative pressure.

### Construct the floor in each module using stainless steel or aluminum construction, capable of withstanding a 136 kg load with deflection less than 0.0042 inch per inch of panel span.

## access doors

### Construct hinged access doors using the same construction as modular panels with surface mounted door handles. **[**Provide shatterproof viewing window, capable of withstanding unit operating pressure.**]**

### Provide gasketing around the full perimeter of the access panels to prevent air leakage.

### Refer to and comply with Section 23 31 30B, Ductwork Accessories for details of access door construction.

### Provide an access door in each module, minimum 1500 mm high, minimum 500 mm wide, but increased as required to suit removal of component.

## Drain Pan

### Construct drain pan using double wall stainless steel with foamed in place insulation, double sloped to stainless steel pipe drain.

### Extend drain pipe a minimum of 60 mm beyond the base.

## coil module – hydronic

### Refer to and comply with Section 23 82 10, Coils, for all hydronic coils and direct expansion cooling coils.

### Mount coils in modular sections with access doors.

### Provide a drain plan in all coil modules.

## coil module – direct expansion cooling

### Refer to Section 23 63 13, Air Cooled Condensing Units, for remote condenser specifications.

### Mount direct expansion evaporator coil in modular unit.

#### Rated to ARI Standard 210-75.

#### Staggered seamless copper tubes expanded into aluminum fins complete with drain pan and coil slide-out rails.

#### Alternate row circuiting for multi-compressor system, with each compressor on a totally independent refrigeration circuit complete with independent expansion valve.

### Refer to and comply with Section 20 20 40, Refrigeration Specialties.

### Provide a drain pan in this module.

## marine lights and electrical work

### Install a factory mounted, weather resistant (enclosed and gasketed) LED fixture in each module to provide instant-on white light, minimum 50,000 h life.

### Wire lights to a switch on each module. Switch to include a GFCI receptacle. All wiring in steel conduit, comply with Division 26 standards.

SPEC NOTE: Choose Article 2.8 or Article 2.9.

## fan section – centrifugal

### Acceptable Fan Manufacturers:

Trane, Chicago, Northern, Loren Cook, Twin City, Barry Blower, CES Group.

### Fans to be **[**single width,**] [**double width,**]** **[**backward inclined airfoil,**]** centrifugal type. Fan to be both statically and dynamically balanced.

SPEC NOTE: Choose option to suit project.

### **[**Provide a complete airflow measuring station in each fan inlet cone, with static pressure taps and total pressure tubes. Flow measuring station to provide an analog to digital CFM readout using a 4-20 mA output control signal for BAS interface.**]**

### Fan selection shall be based on actual air conditions at the geographical location of the unit. Select fans in the midrange of their performance capabilities such that increasing the RPM of the fan to achieve an additional 15% air flow delivery through the specified unit will not change the fan Class or require an increase in motor horsepower.

### Fan shafts are to be solid, ground and polished, carbon steel, SAE 1045 material, machined to close tolerances, keyed to the fan wheel. Coat the fan shaft with rust inhibitor after machining. Hollow shafts will not be acceptable.

### Fan bearings shall be in self-aligning pillow block, grease lubricated, extra heavy duty spherical roller type, selected for an L10 life of 200,000 hours at design operating conditions. Bearings are to be mounted on the fan structural bracing. Provide extended lubrication lines to permit lubrication for both bearings to be performed at the access door side.

### Provide variable sheaves for motors 11 kW and under and fixed sheaves for motors 15 kW and over. Exchange sheaves as necessary during balancing.

SPEC NOTE: Edit if variable frequency drive not required, or if VFD is to be supplied by mechanical trade or vendor.

### **[**Mechanical trade to provide variable frequency drives.**]** **[**Provide variable frequency drives as part of the air handling unit components.**]** Comply with Section 26 29 23, Variable Frequency Drives.

### Entire fan assembly including fan scroll, wheel and motor to be integrally mounted on an inertia base and to be separated from unit casing with flexible connections and spring isolators. Concrete may be poured into steel base on site but fan and base must be factory mounted.

### Belt guards shall have sides of galvanized steel and faces of expanded metal. Provide a face on both the outside and the inside of the drive assembly. Provide openings in the faces for fan and motor tachometer readings. Belt guard shall be sized to allow either sheave to be increased by two sizes. Belt guards shall be in accordance with OSHA guidelines.

### Fan drives shall be of a multiple V-belt banded configuration. The drive system combination shall be of one manufacturer and shall be suitable for a centrifugal fan application and shall be rated by the drive manufacturer for the motor horsepowers and fan and motor RPMs provided by the Air Handling Unit manufacturer. Selection of the drive system shall be made by a synchronous drive system manufacturer regularly engaged in the manufacturer of these drive components.

## Fan array and related components

### Fan Array System

#### The fan array system shall consist of multiple, direct driven, arrangement 4 Class III plenum fan, certified for the duty specified in accordance with ANSI/AMCA Standard 210 for air delivery and in accordance with AMCA Standard 300 for sound power levels and shall bear the AMCA Seal.

#### The air flow capacity of the fan array system shall provide 100% redundancy when one fan fails.

#### Unless otherwise noted, each air handling unit fan array shall consist of [two (A’ and ‘B’)] [three (A’, ‘B’ and ‘C’)] controlled fan arrays which are either equally split or controlled in a “checkered board” arrangement. Each [A’ and ‘B’] [A’,‘B’ and ‘C’] fan array shall be controlled by its own VFD. All fans shall be selected to deliver the specified airflow quantity at the specified operating total static pressure and specified motor speed. The fan array shall be selected to operate at a system total static pressure that does not exceed 90% of the specified fan’s peak static pressure producing capability at the specified fan/motor speed.

#### Each fan/motor “cube” shall include an 11 gage; A60 galvanized steel motor support plate and structure. The fan air inlet cone, and motor support structure shall be powdered coated for corrosion resistance.

#### Submit acoustical data as outlined in Article 1.9, Acoustic Testing and Performance Criteria, for review and approval prior to bid indicating the equipment can meet all specified performance requirements.

#### The fan array shall consist of multiple fan and motor assemblies, spaced in the air way tunnel cross section to provide uniform airflow and velocity profile. Wire each individual fan motor individually to a power disconnect located in the fan array panel.

#### The manufacture of the array is responsible to determine if the addition of vibration isolators are required to meet the vibration requirements within this specification.

#### Provide each fan assembly with an AMCA certified backdraft damper designed and rated for close coupled to fan outlets to isolate the fan/motor assembly that is failed on standby or being removed from the fan array. Function is to prevent air bypass through a fan assembly when not in operation.

#### Each fan array shall include at least one fan assembly with a complete airflow measuring station to indicate airflow in CFM. The flow measuring system shall consist of a flow measuring station with static pressure taps and total pressure tubes located at the fan inlet cone. The flow measuring station shall provide an analog to digital CFM readout using a 4-20ma or 0-10 volt output control signal for use in the BAS.

#### Vibration levels at the AHU unit base structure shall not exceed 55 db re 1 micro G at 1/3 octave band readings from 5 Hz to 100 Hz, natural frequency. Submit testing results confirming compliance.

#### Fan, motor, and mounting rail shall be dynamically balanced to meet AMCA Standard 204-96 at the design operating RPM to Fan Application Category BV-3, Balance Quality Grade G6.3.C, with a rotational imbalance for the fan/motor/structural support assembly not to exceed 0.022 in/s peak, filter in.

#### Provide a motor removal rail fastened to the structure of the unit to facilitate a pulley/chain lift to remove a fan motor.

### Fan Array Panel

#### The fan array volume delivery will be controlled by the BAS. The panel will contain only the basic electrical components. It shall not execute any programmed logic specified in the sequence of operation. The panel shall provide terminal strips necessary for connection to VFD’s.

#### General

##### Comply with all applicable codes and regulations.

##### DDC or PLC controllers shall not be utilized.

##### Short circuit and over current protection shall be manually reset.

##### All safeties, relays, and field wiring shall be fail-safe.

##### Provide electrical disconnect means for each fan in the fan array.

##### Current sensors shall be split core with LED indicator and field adjustable per fan.

##### Plug in pin relays with status LED shall be provided.

##### Provide “Lamp Test” push button.

##### Panduit or equivalent shall be utilized for panel wiring.

##### Termination strips, contactors, relays, current sensors, switches, and any other apparatus shall be labeled in approved manner as deemed by the Owner.

#### Panel Termination Strip

##### Provide termination strips for Section 20 30 (Series), Controls, BAS field control wiring. Termination strips shall have but not limited to a VFD Start/stop input, VFD speed input, VFD speed feedback output, VFD fault output, VFD control apparatus outputs and inputs. Section 20 30 (Series), Controls, shall supply, install and wire to the terminal strip the VFD control apparatus outputs and inputs. Provide one termination strip for “A” and “B” from assemblies.

##### Each fan motor in the fan array shall have a current sensor wired to the BAS field wiring terminal strip. Section 20 30 (Series), Controls, shall series all current sensor at the termination strip to create one BAS fan status input or series specific fans as necessary to comply with the sequence of operation.

## motors

### Motors shall be premium efficiency type. All motors to be by the same manufacturer.

### Factory mount motors and wire to an external disconnect switch. Disconnect switch by air handling unit manufacturer. Run wiring in EMT liquid-tight conduit/raceways.

SPEC NOTE: Do not include Article 2.11, Vibration Isolation, if Fan Array is used.

## Vibration Isolation

### Each fan and motor are to mounted on an all welded, structural steel, prime coated, internal isolation base, completed with open spring isolators with an internal isolation efficiency of at least 99% from the building structure. Isolators shall be free standing with sound deadening pads and levelling bolts. Spring diameter to compressed operating height ratio shall be 1 to 1. Spring deflection shall be 50 mm. The outlet of the fan shall be separated from the unit casing by means of a factory installed flexible fabric connection.

### Manufacturer to provide independent data for internal isolation bases. If 99% efficiency cannot be met, cost of inertia bases shall be the responsibility of supplier.

## mixing module

### Provide dampers to modulate the volume of outdoor, return or exhaust air.

### Construct dampers with double skin air foil design, including compressible jamb seals and extruded vinyl blade edge seals.

### Mount damper blades to rotate on stainless steel sleeve bearings.

### Comply with ASHRAE 90.1 standard defining the maximum leakage rate at 3 cfm/ft2 at 1 inch W.G.

### Provide a drain plan in the mixing section module.

## air blender module

### Provide static air blenders downstream of mixing section to eliminate air stratification.

### Fixed curved blades with no moving parts.

### Blades fabricated from 1.6 mm satin coated galvanized steel.

## filter module

SPEC NOTE: Select option.

### Filters containing urea formaldehyde or fiberglass are not acceptable.

### 50 mm, pleated summer pre-filter, average efficiency MERV A8 on ASHRAE Test Standard 52.2-2007, Addendum B, Appendix J. Comply with Section 23 42 00, Particulate Air Filters, for detailed filter specifications.

### Frame only for winter pre-filter, same as summer filter frame.

### [305 mm, deep pleated final filter, average efficiency MERV A13 on ASHRAE Test Standard 52.2-2007, Addendum B, Appendix J]. Comply with Section 23 42 00, Particulate Air Filters.

### Galvanized mounting racks to suit specified filter type.

### Limit filter velocity based on face area to less than 2.5 m/s.

### Provide one Dwyer 2000 magnehelic filter gauge for each bank of filters, including for each position of pre-filter. Flush mount gauge on the exterior of the unit.

## humidifier module

### Provide steam grid humidifier. Comply with Section 23 84 14B, Steam Grid Humidifiers.

### Provide pre-piped and supported steam distribution manifold piped to exterior of casing.

### Steam valve shall be modulating **[**pneumatic**]** **[**electric**]** **[**electronic**]** normally closed type.

### Provide humidifier separator for field mounting exterior to the unit, complete with a steam trap and strainer.

### Provide a drain pan in the humidifier module.

## gas heat module

### The gas heat section construction shall match the rest of the air handling unit and be an integral part of the unit. All burner and control components shall be housed in a burner vestibule with a large access door.

### Indirect-fired gas heaters shall be completely factory assembled, piped and operationally fire tested at the factory prior to shipment.

### The heat exchanger primary drum and secondary tubes shall be constructed from 14 gauge, 409 stainless steel.

### The industrial/commercial burner shall be UL listed, forced draft, and fully modulating.

### The control panel shall be equipped with flame management controls and appropriate safeties.

### The entire section shall bear a UL or CUL label for Commercial-Industrial Gas Heating Equipment (ANSI/UL Standard 795) and Industrial Gas-Fired Package Furnaces (CGA Standard 3.2-1976).

## silencer module

### Provide a rectangular silencer to reduce airborne sound transmitted through the air handler.

### The silencer ratings for dynamic insertion loss and pressure drop shall be in accordance with ASTM E-477 for forward flow (air and noise in the same direction) or reverse flow (air and noise in the opposite direction) per the project’s requirements.

### Acoustical performance within the air handler unit assembly shall be in accordance with AHRI 260.

## enthalpy heat recovery wheel

### Acceptable enthalpy heat recovery wheel manufacturers are SG (Seibu Giken) America, Semco.

### Provide an enthalpy heat recovery wheel sized per the ventilation requirement of the unit. Construct the module with internal bypass dampers to relieve the pressure drop across the wheel when the wheel is not operating.

### The enthalpy heat recovery wheel shall be ARI 1060 certified. The air-handling unit nameplate shall bear the ARI 1060 certification label. The energy recovery cassette shall be an Underwriters Laboratories (UL) Recognized Component certified for mechanical, electrical and fire safety in accordance with UL Standard 1812. The calculated total net effectiveness of the recovery device shall be not less than 70% when the specified ventilation flow rate equals the exhaust flow rate.

### The enthalpy heat recovery module shall incorporate a rotary wheel with all necessary seals, drive motor, and drive belts. The enthalpy heat recovery wheel shall incorporate a desiccant without the use of binders or adhesives. Coated segments shall be washable using standard detergent or alkaline-based coil cleaners. The desiccant shall not dissolve in the presence of water or high humidity.

### The rim shall be of continuous rolled stainless steel and forms an even concentric circle, preventing leakage around the rim and minimizing the wear of components.

### All diameter and perimeter seals shall be provided as part of the cassette assembly. Perimeter seals shall be self-adjusting; diameter seals are adjustable. Seals shall be factory set.

### Wheel bearings shall be permanently sealed and lubricated and have a minimum L-10 life of 400,000 hours.

### Mount the wheel drive motor in the cassette frame. The wheel drive motor shall be thermally protected and UL Component Recognized. Drive belts shall not require belt tensioners.

### Construct the energy recovery wheel in the form of removable segments. The segments shall be removable without the use of tools to facilitate maintenance and cleaning as required. The cassette shall be removable through the energy recovery section side panel.

### Provide access doors immediately upstream and downstream of the energy recovery wheel cassette. Provide adequate space for cleaning, service and maintenance of the wheel, motor, bearings and belt.

### Provide frost control prevention by air preheat. Winter design supply and exhaust air conditions leaving the energy wheel provided by the unit manufacturer shall include any derate in performance due to frost protection measures.

# Execution

## Assembly

### Modules are to be constructed factory assembled and tested. Dismantle for shipping if required. Clearly label all parts for assembly.

### Pipe units to permit coil removal.

### Seal piping or conduit passing through the unit casings to prevent air or water leakage, and isolate to prevent vibration transfer.

### Install units on 100 mm housekeeping pad.

## Packaged modular Indoor Air Handling Unit Schedule

### Refer to drawings for performance schedules.

END OF SECTION