

SECTION 15700

ENVIRONMENTAL EQUIPMENT

PART 1 GENERAL

1.1 SUMMARY

- A. Scope
 - 1. Provide labor materials and equipment to provide environmental equipment installation, as shown or specified, and as required for fully operational, complete installations.
- B. Description Of System
- C. Related Work Specified Under Other Sections
 - 1. Division 15 Section "General Mechanical Requirements."
 - 2. Division 15 Section "Thermal Insulation."
 - 3. Division 15 Section "Aboveground Piping Systems."
 - 4. Division 15 Section "Steam and Condensate Specialties and Equipment."
 - 5. Division 15 Section "Air Distribution and Exhaust."
 - 6. Division 16 Section "Electrical Work."

1.2 QUALITY ASSURANCE

- A. Vibration Control Design
 - 1. Under installed, operating conditions, equipment and piping vibration measured at specified or approved points in mils peak-to-peak displacement or velocity in inches/second shall not exceed the following:
 - a. Limits specified under specific equipment.
 - b. Limits specified in the latest edition of ASHRAE Handbook: HVAC Applications, Sound and Vibration Control Section.
 - c. Limits for motors shall be per NEMA MG-1 standards.
 - d. Limits specified by Owner's standards.
 - 2. Provide vibration isolation according to ASHRAE Handbook: HVAC Applications or Owner's standards.
 - 3. Provide shop and field balancing and testing as required to show compliance.
- B. Noise Control Design
 - 1. Equipment noise in this section shall not exceed 80 level in dBA five feet from the unit measured in the free field per applicable standards.
 - 2. The intent is to meet OSHA requirements and space requirements according to the noise criteria.
 - a. Refer to Division 13 Section "Noise Control" for other specific noise criteria.

1.3 SUBMITTALS

- A. Refer to Division 15 Section “General Mechanical Requirements.” for applicable requirements.
- B. Submit shop drawings showing details of unit construction, supports, reinforcement, access doors, configuration and accessory installation for construction where these are field conditions.
- C. Submit shop drawings for fans with complete information on fan construction and performance. Include a complete set of performance curves for each fan.
- D. Submit shop drawings for coils which show coil compliance with specified and indicated requirements, which include actual air leaving conditions compared to indicated requirements and applicable drawings showing installation position for coil to be drainable as specified.
- E. Submit shop drawings which include tabular or graphic performance covering usable range for the system unit filters provided.
- F. *Test report [R]*: Submit three copies of final belt tension tabulation for belt drives.

1.4 RECORD DOCUMENTS

- A. Refer to Division 15 Section “General Mechanical Requirements.” for applicable requirements.

1.5 OPERATION AND MAINTENANCE DATA

- A. Refer to Division 15 Section “General Mechanical Requirements.” for applicable requirements.

1.6 PROJECT CONDITIONS

- A. Delivery Of Materials
 - 1. If helicopters are used as the lifting means when placing roof mounted units, make arrangements, obtain approvals, schedule the work to preclude interference with other work, take necessary safety precautions, and assume complete responsibility for the results of this activity.

PART 2 PRODUCTS

2.1 FAN POWER TRANSMISSION

- A. General
 - 1. *Fan drives [D]*: V-belt type per Engineering Standard Specification for Drives Using Multiple V-Belts, sponsored by the Mechanical Power Transmission Association and the Rubber Manufacturer’s Association.
 - 2. A given manufacturer’s V-belt drive, as applied to specific equipment provided under the SPECIFICATION, shall conform to that manufacturer’s published recommendations, except as otherwise provided herein.

3. Base horsepower rating of drive on minimum pitch diameter of smaller sheave.
4. For drives with motors up to and including 10 horsepower, use “STANDARD” belt section, adjustable or variable sheave type, with a service factor of not less than 1.4. For drives with motors over 10 horsepower up to and including 40 horsepower use “STANDARD” section, fixed sheave or variable sheave type, with a service factor of not less than 1.5. Drives with motors over 40 horsepower shall be fixed sheave, high capacity “SUPER” belt section with a service factor of not less than 1.25.
5. Locate belt drives outboard of bearings. Align drive and driven shafts by the four-point method.
6. Adjust belt tension per the manufacturer’s recommendations.
7. Furnish power transmission equipment complete with OSHA compliant guards and screens.

B. Sheaves

1. Sheaves: Machined cast iron or carbon steel, bushing type of fixed bore, secured to the shaft by key and keyway.
2. Set pitch diameters of fixed pitch and adjustable or variable pitch sheaves when adjusted as specified herein, at not less than that recommended by NEMA Standard MG1-14.42.
3. For companion sheaves for adjustable or variable pitch drives, furnish wide groove spacing to match driving sheaves except that standard fixed pitch spacing may be used for two-groove and three-groove drives whose center to center distances equal or exceed the following:

<u>BELTS</u>	<u>DISTANCE INCHES</u>
A and B	20
C	28
D	36

C. Belts

1. Endless type of dacron reinforced elastomer construction, with cross-section to suit sheave grooves. Determine the number of V-belts from the motor horsepower to apply the service factor to obtain the design horsepower. Divide the design horsepower by the corrected horsepower per belt to obtain the number of belts required. In any case, furnish not less than two belts for each drive.
2. Furnish belts, factory or factory-authorized distributor matched and measured on a belt-matching machine. Selection by “code numbers”, “sag numbers” or “match numbers” is not acceptable. Bind each belt set with wire and tag with equipment identification.

D. V-Belt Drive Motor Bases

1. Furnish adjustable pivoted bases with fan motors wherever equipment configuration permits proper installation. Otherwise, provide adjustable slide bases.

E. Air Handling System Balancing Provisions

1. Provide facilities for the adjustment of fan speed for each air handling system during air quantity balancing operations. Furnish any of the following:
 - a. A variable-pitch drive of variability range to produce the fan speed necessary for proper air balance.

- b. A continuously variable drive or power unit to produce the fan speed necessary for proper air balance.
- c. A series of fixed-pitch pulleys which can be interchanged until the proper fan speed has been determined.

F. Flexible Coupling (Direct Drive)

1. Flexible coupling: Use to connect fan shaft to the motor shaft. The flexible member shall be a tire shape, in shear, or a solid mass serrated edge disc shape, made of chloroprene materials and retained by fixed flanges. Flexible coupling shall act as a dielectric connector and shall not transmit sound, vibration or end thrust.
 - a. Dodge "Paraflex".
 - b. Koppers "Elastomeric".
 - c. T. B. Woods "Sureflex".

G. Motor Requirements

1. Motors: Furnish per Division 15 Section "General Mechanical Requirements." for applicable requirements.
2. Motors located in airstream shall be totally enclosed.
3. Brake horsepower input shall not exceed rated motor horsepower.
4. Manual disconnect switches shall be provided for all motors. Switches shall be of visible blade type, with padlocking handles.

2.2 FANS

A. General

1. *Fans [D]*: Comply with the following:
 - a. Performance Data - AMCA Standard 210.
2. Sound Power Level Ratings:
 - a. Ducted Fans: Rate per AMCA 301, when tested per AMCA 300.
 - b. Nonducted Fans: Rate in Sonas at 5 feet from acoustic center of fan rated per AMCA 301, tested per AMCA 300 and converted per AMCA 302.
3. Sound power for fans: Not to exceed values listed on the DRAWINGS by more than 3 dBA.
4. Unit Construction: AMCA Standards and Seals.
5. Safety Provisions: Include guards and screens for power transmission equipment, but do not negate vibration isolation provision. Refer to "DRIVE AND COUPLING GUARDS".
6. Nameplate: Affix metallic, corrosion-resistant data plate for each fan in a conspicuous location. Include selection point capacity conditions.
7. Field Rigging: Do not negate balancing. Do not bend shaft. Use lifting eyes.
8. Bearings: Anti-friction ball or roller type with provision for self-alignment and thrust load. Made in U.S.A. with L10 minimum life of 50,000 hours for low pressure fans (under 1-1/2" S.P.) and 120,000 hours for fans with static pressures greater than 1-1/2" at maximum operating conditions. Use cast iron housings and dusttight seals for lubricant pressures.
 - a. Lubrication Provisions - Use surface ball check type supply fittings. Provide extension tubes to allow safe maintenance while equipment is operating. Provide

manual or automatic pressure relief fittings to prevent overheating or seal blow-out due to excess lubricant or pressure. Arrange relief fittings opposite supply but visible for normal maintenance observation.

- b. Bearings on Equipment with less than 1/2 horsepower rating - Permanently sealed, prelubricated anti-friction bearings per specified materials and L10 life requirements.
9. Bird Screens: Of material to match adjacent contact construction, 1/2 inch mesh or equal expanded metal. Use on inlet or outlet of each fan if not ducted.
10. Manual Disconnects: On Roof Mounted Supply or Exhaust Fans; Mount on casing exterior. Use on motors up to and including 10 HP with provision for padlocking in open position. Disconnect switch shall be visible blade type. Use for single or three phase motors, single or three pole. Mount in NEMA 12 for indoor locations or NEMA 4 for outdoor. Use Type XHHW stranded conductors in flexible metallic, liquid-tight conduit and extend to four feet below underside of roof for power supply connection.
11. Roof Curb Sealant Tape: Sealant tape, one inch wide minimum, 1/8 inch thick, applied at loads not exceeding 5 PSI.
 - a. 3M "Weatherban 1201T".

B. Power Wall Ventilator (EF-2)

1. *Wall ventilator [D]*: Propeller type, constructed of heavy gauge steel, with square panel, spun inlet venturi to wheel, and baked enamel finish. Fan inlet guard shall be constructed of heavy duty zinc-plated steel rings and conform to OSHA standards. Provide flanging and reinforcing to stiffen panel. Weld corners. Phosphatize panel and stiffeners and finish with manufacturer's standard finish.
2. Propeller shall be cast aluminum or steel construction. Belt drives shall be sized for a minimum of 150 percent of driver horsepower. Belts shall be nonstatic oil-resistant type. Motor shall be mounted on sliding mounts.
3. Fan shall be complete with motor side guard, wall collar, closure angles, motorized low leakage damper with end switch to open damper before fan is energized, factory-mounted and-wired nonfused disconnect switch.
4. Manufacture:
 - a. Aerovent Model "BP".
 - b. Greenheck "Sidewall Propeller Fans" Model "SBE".
 - c. Penn Ventilator "Breezeway" Model "FB".
 - d. American Coolair "PFB".
 - e. Acme "Propeller Fans".
 - f. Hartzell "Propeller Fans" Series.
 - g. Cook "Propeller Fans" Model "SWB".

C. Roof Exhaust Fans (EF-6)

1. *Centrifugal roof type ventilator [D]*: Direct or belt-drive as indicated, nonoverloading backward inclined wheel with drive vibration isolated with elastomer.
2. Mount drive components in a compartment isolated from airstream.
3. Fabricate weather exposed housing materials of aluminum. Provide hood type weatherproof housing with integral deep flange curb flashing and manufacturer's standard gravity back draft dampers and bird screen.

4. Manufacture,
 - a. Penn Ventilator, Domex
 - b. Acme, PNN
 - c. Cook, ACE
 - d. Hartzell, BDD
 - e. Greenheck, GB Series
 - f. Aerovent, FACX

D. Tubeaxial Fan (EF-7 and EF-8)

1. Tubeaxial fan [D]: Provide AMCA certified and UL listed inline fans of the axial type with fabricated steel airfoil propellers with belt drive and capacity as scheduled. Fan tube and curb cap shall be constructed of heavy gauge steel with heavy gauge welded steel reinforcing gussets. Curb cap shall have prepunched mounting holes. Windband shall be constructed of heavy gauge painted steel with reinforced edges. Bearing support, and motor base shall be constructed of structural members to prevent vibration and rigidly support the shaft, bearings, and motor. Steel housings, propellers, and structural components shall be protectively coated with minimum 1.5 mil thickness electrostatically applied thermosetting polyester urethane.
2. Propeller blades shall be airfoil design. Blade gussets shall be die formed and welded to the blade stem. Propellers shall be statically and dynamically balanced to G6.3. A standard square key or tapered bushing shall lock the rotor to the fan shaft. Bearings shall be cast iron pillow block, grease lubricated and self aligning, air handling quality and tested for reduced swivel torque, bore size, noise, and vibration. Bearings shall be selected for an L(10) life of 40,000 hours.
3. Turned, precision ground and polished steel shafts shall be sized so the first critical speed is at least 125% of the maximum operating speed for each level of construction.
4. Manufacture:
 - a. Greenheck, TBI-FS.
 - b. Aerovent.
 - c. Joy.
 - d. Hartzell.
 - e. Woods.

E. Axial Vertical Discharge Exhausters (EF-9 and EF-10)

1. *Up-blast belt-drive propeller type fans [D]*: For noncorrosive service with gravity butterfly dampers and a flanged cylindrical casing with provisions for support requirements indicated.
 - a. Fabricate throat and curb assembly as a one piece spinning or a continuously welded assembly with stiffeners continuously welded to curb and throat.
 - b. Fabricate wind band joints either continuously welded, flanged and bolted, spot welded or riveted on 3 inch centers minimum.
 - c. Construct the unit to permit easy removal of the wind band and access from roof to fan and motor unit for servicing and removal. Bottom of wind band shall be 24 inches minimum above finished roof.

2. *Butterfly gravity dampers [D]*:
 - a. Construct of galvanized carbon steel, 20 gage minimum, stiffen by cross-braking, with beading reinforced to prevent oil-canning and excessive vibration during operation.
 - b. Extend damper axle shaft the full width of damper and securely fasten by rolling or riveting.
 - c. Furnish shaft bearings of oil impregnated, bronze, nylon or tetrafluorethylene located out of airstream.
 - d. Furnish spring or counterweight loaded dampers with a 165 deg F fusible link release to open in event of fire. Aluminum dampers are unacceptable.
3. Propeller: Provide with a minimum of four blades, V-belt drive, adjustable motor sheave and adjustable motor base mounted outside the air stream.
 - a. Construct propeller of one piece aluminum casting or of die formed sheet steel, or continuously welded or riveted construction and with taper-lock bushings.
 - b. The propeller shall be statically and dynamically balance in accordance to AMCA Standard 204-05.
 - c. The propeller and fan inlet shall be matched and shall have precise running tolerances for maximum performance and operating efficiency.
4. *Unit [D]*: Fabricate of sheet metal and structural parts of galvanized iron or steel. Paint areas burned by welding and exposed raw edges with a two coat application of inorganic zinc rich protective coating.
5. *Motor [D,P]*: TEAO type two speed motor, 460 VAC, 3 phase, 60 hertz with heavy duty sealed bearings containing a lubricant suitable for continuous service and temperatures up to 150 degF. Refer to Division 15 Section "General Mechanical Requirements" for additional requirements. Securely bolt motor to its mounting, using lock washers, locking nuts or castellated nuts and cotter keys. Use largest diameter bolts that can be used with holes in motor frame feet. If frame feet are slotted, elongated or out-of-round, dowel motor feet in at least two places on a diagonal.
6. *Manual disconnects [D]*: Provide as specified under "GENERAL".
 - a. Aerovent Fan Company, Inc.
 - b. Penn Ventilator Hi-Ex.
 - c. Greenheck Model RBU.
 - d. Hartzell Series 63.
 - e. Cook Model LEU.

2.3 FAN DRIVE AND COUPLING GUARDS

A. General

1. Guards: Furnish mechanical power transmission apparatus per applicable requirements of OSHA except where superseded by other governing codes, and except as modified and supplemented herein. Requirements specified herein apply to all types of fans.
2. Fabricate mechanical power transmission device guards such that the completed structure is capable of withstanding a load of at least 200 pounds applied in any direction.
3. Furnish a guard enclosure for each V-belt drive, coupling and rotating component. Secure guards in place, easily removable for maintenance. For guard fasteners used for maintenance access furnish "captive type". Locate holes on each guard for tachometer

readings on both the motor and fan shafts. Fabricate guard of 16 gage sheet metal with hemmed edges at openings for shafts. Weld four mounting lugs or feet of 10 gage material to the guard. Fabricate guards for couplings five inches in diameter and larger of 12 gage sheet metal. Furnish holes in mounting feet sized for suitable machine screws.

B. Belt Drive Guards

1. Belt drive guards: Fabricate guards to completely enclose moving parts of the particular drive. Design and construct guards of such rigidity as to contain a belt which breaks during operation. Minimum material thickness, 16 gage sheet metal. Where ventilation is required, perforated metal as described below shall be used for the sides. Fabricate top of solid sheet metal.

C. Perforated Metal Panels

1. Perforated metal panels: Construct panels of a minimum of 16 gage sheet steel with staggered 0.375 inch round holes on 0.531 inch centers; openings not to exceed 46% of the panel area. Reinforce edges with 1/8 x 1 inch flat iron on both sides of the perforated panels, welded or bolted together on 10 inch centers.

2.4 ROOF CURBS

- A. *Roof curb [D]*: Factory fabricated, fan matched 14 inches high or more, 14 gage steel, with cant strip, gravity damper, wood nailer, and 2 inch thick mineral fiber insulation for sound attenuation. Install per manufacturer's instructions.

1. Penn "Unibeam".
2. Jenn-Air "AC Series".
3. Greenheck "Model GPR".
4. Aerovent.
5. Pate.

2.5 ELECTRIC UNIT HEATER (EUH-3 THRU EUH-6)

- A. *Electric unit heater (EUH-3 and EUH-4) [D]*: Remote thermostat; Heavy gage bonderized steel casing with baked enamel finish, direct drive aluminum fan, prewired and resiliently mounted fan motor, heating elements and mounting devices. Power supply voltage/24 V control transformer, magnetic contactor, automatic reset high temperature limit and motor winding temperature limit and prewired terminal board for field wiring space thermostat. Thermostat furnished and installed under Division 13 Series Sections.

1. Markel Electric.
2. Modine.
3. Qmark.

2.6 STEAM UNIT HEATER (SUH-7 THRU SUH-12)

- A. *Steam unit heater (SUH-7 thru SUH-12) [D]*: Suspended vertical type steam unit heaters arranged for discharge of air with adjustable outlet as indicated, rated per AMCA Standards. Manufacturer's standard nonferrous construction heating element, rated for service at not less than 300 degF at 75 psig. Construct casings of not less than 20 gage cold rolled black carbon

steel. Casing surface finish shall include phosphate pretreatment, prime coating and baked enamel finish. Furnish propellers, manufacturer's standard, dynamically balanced. Provide and resiliently mount motors per Division 15 Section "General Mechanical Requirements."

1. Trane, P Series.
2. Modine.
3. Air Therm.
4. Sterling.

2.7 STEAM FINNED TUBE RADIATION

A. Finned Tube Radiation

1. Furnish with heating elements and supports.
2. Rate finned tube assemblies for not less than indicated capacity per IBR "Testing and Rating Code for Finned Tube Radiation", and CS-140-47.
3. Rate system pressure components including heating elements for the service expansion. Rate accessories for service at not less than 300 degF and 50 PSIG.
4. Steel single row 1-1/4" heating element with steel fins shall deliver heat output as indicated; fins 3-1/4 x 3-1/4 inch with thickness of 0.032-inch minimum and spaced 20 fins per foot minimum. Length as shown on DRAWINGS.
5. Provide minimum 18 gauge cold rolled steel enclosures with sloped top and electrostatically applied, baked enamel finish, color as selected by the architect from the manufacturer's standard color schedule. Discharge openings shall be die cut into the enclosure. Review drawings to identify where wall-to-wall cover is required. Field measure actual construction prior to manufacturing enclosure to assure good fit. Field cutting to fit will not be permitted. For finished end installations, provide necessary end caps for a complete installation. Include access doors in the enclosure as necessary to allow ready access to manual and automatic valves for maintenance and inspection.
6. Refer to 13800 Series Sections for control valves and thermostats.
 - a. Sterling, JVA-S-14 with S-132 element.
 - b. Dunham-Bush.
 - c. Standard.
 - d. Webster.
 - e. Vulcan.

2.8 HEATING VENTILATING AND AIR CONDITIONING UNIT (ACU-2)

A. General

1. ACU-2 [D]: "Packaged" central station type, air handling unit, factory fabricated and sectionally or fully assembled, including components and auxiliaries as indicated and specified elsewhere herein, and classified and defined, as applicable, under ARI Standard 430-66 Section 3, 4 and 5.
 - a. Trane "Climate Changer" T Series.
 - b. McQuay.
 - c. TMI.
2. Performance test and rate air handling unit and components, where applicable, per AMCA Bulletin 211a and AMCA Bulletin 210, except as otherwise specified. Provide air handling

ratings per Section 7 of ARI 430 and classify total static pressure per AMCA Standard 1401.

3. Provide auxiliary equipment including but not limited to: Piping, coils, fan, motors, variable frequency drives where indicated, motor starters where indicated, disconnect switches in NEMA 1 enclosures, drives, filters, thermal insulation and dampers, per CONTRACT DOCUMENTS.
- B. Unit panels shall be solid double-wall construction. All exterior wall panels shall be made of galvanized steel. The casing shall be able to withstand up to 1.5 times design static pressure, or 8" WC, whichever is less, with no more than 0.005 inch deflection per inch of panel span. The unit base design shall allow unit to rest on top of roof curb when field installed.
 - C. Unit shall be factory insulated. Panels and unit roof shall be of double-wall construction with interior and exterior panels and insulation. Panel insulation system shall provide a minimum R value of 12. Insulation shall conform to NFPA 90 requirements.
 - D. Unit roof shall be constructed of two pieces. Inner roof shall be installed in such a manner as to prevent air bypass between internal components. Outer roof shall be sloped a minimum .25" per foot either from one side of unit to other, or from center to sides of the unit.
 - E. Access doors shall be constructed with a double-wall of solid G90 galvanized steel interior panel. Automotive style gasketing around the full perimeter of the access door shall be used to prevent air leakage. Door gasketing shall be mounted to the perimeter of the door and shall seal against a raised door frame. Door frame shall channel water away from gasket. Door shall have a protective flange to shield gasket from exposure. Preferred door handle shall not penetrate door casing. Door shall have a single handle latch.
 - F. Fan Section
 1. Fan shall be double-width, double-inlet, multiblade type minimum class II regardless of static pressure. Fan shall be curved, backward inclined, as required for stable operation and optimum energy efficiency. Fan shall be equipped with self-aligning, antifriction bearings with an L-10 life of 200,000 hours. Fan performance shall be certified as complying with ARI Standard 430-89.
 2. The vibration levels of the complete fan assembly shall be checked and excessive vibration shall be eliminated in the factory. Fan shaft shall be properly sized and protectively coated with lubricating oil. Fan wheels shall be keyed to fan shaft to prevent slipping. Fan shafts shall be solid and designed so that fan shaft does not pass through its first critical speed as the unit comes up to its rated rpm. Fan shafts shall not exceed 75 percent of their first critical speed at any cataloged rpm. Fan shall be provided with an access door on the drive side of the fan.
 3. Fan connection shall be isolated from unit casing by a flexible canvas duct. One-Inch Spring Isolators — Fan and motor assembly shall be internally isolated from the unit casing with 1-inch deflection spring isolators, furnished and installed by the unit manufacturer.

G. Cooling Section

1. Coils shall be installed such that headers and return bends are enclosed by unit casings. Coils shall be removable by unbolting the wall panels in the coil section. Coil connections shall be clearly labeled on outside of units. Coils shall have aluminum plate fins and seamless copper tubes. Fins shall have collars drawn, belled and firmly bonded to tubes by mechanical expansion of the tubes. Soldering or tinning shall not be used in the bonding process. Fin surfaces shall be cleaned prior to installation in the unit to remove any oil or dirt that may have accumulated on the fin surfaces during manufacturing of the coil. Capacities, pressure drops and selection procedure shall be certified in accordance with ARI Standard 410. Coil casing shall be a minimum 16-gauge 304 stainless steel with formed end supports and top and bottom channels. If two or more coils are stacked in the unit, intermediate drain channels shall be installed between coils to drain condensate to the main drain pans without flooding the lower coils or passing condensate through the airstream of the lower coil.
2. Coils shall be burst tested to 450 psig and proof tested to 300 psig air pressure under water. After testing, coil circuiting will be air dried, charged with dry nitrogen, and sealed to ensure that circuiting is free of any water or contaminants. Liquid and suction headers shall be constructed of copper and shall penetrate unit casings to allow for sweat connections to refrigerant lines. Coils shall have equalizing vertical distributors sized according to the capacities of the coils.
3. Cooling coils and moisture eliminators shall be provided with a galvanized or stainless steel, two-way sloping IAQ drain pan to allow for proper condensate removal. Access or blank sections may be provided with an IAQ drain pan when specified.

H. Heating Section

1. Steam heating coils shall be of the nonfreeze inner steam distributing type permitting counter flow of steam and condensate. Outer tubes to be a minimum of 1 inch OD x 0.035 inch wall thickness; inner tubes to be of minimum 5/8 inch OD x 0.025 inch copper. The headers shall be constructed of Schedule 40 steel. The casings shall be of heavy gage hot rolled steel with adequate space for expansion and contraction of the coil, flanged and punched for easy mounting in the air handling unit. The coil face velocity shall not exceed 700 FPM. Horizontally mounted steam coils shall have the supply and return connections on one end and shall be limited to a maximum coil length of six feet. The tubes shall be fitted with pure copper or aluminum extended fins. Spiral fins shall be copper soldered to tubes. Plate type fin coils may have tubes mechanically expanded into fins or may be soldered.
2. Provide ultra low-leakage face and bypass dampers with minimum 14-gauge galvanized steel double-skin airfoil blades and minimum 16-gauge galvanized steel damper frames. Blades shall be of opposed blade action, with metal compressible jamb seals and extruded vinyl blade edge seals. Blades shall rotate on stainless steel sleeve bearings. Face damper and bypass damper shall be mechanically linked together and provide end driven control shafts.

I. Filter Section

1. Filter section shall have filter racks, an access door for filter removal and block-offs as required to prevent air bypass around filters.

2. Provide viscous impingement type filters with filtering media of nominal 2 inch thickness industrial type glass fiber with an initial resistance of no more than 0.28" WG, rated at MERV 7 with face velocity of 500 FPM when tested per ASHRAE Standard 52.2, 1999. Furnish filtering media in filter manufacturer furnished galvanized steel, 16 gage holding frames with a UL Class 2 rating.
3. Filter Gauge:
 - a. Filter bank shall be equipped with a 0 to 2 inch W.G. pressure differential gauge connected across each filter media to provide a visual check of the filter loading.
 - 1) Dwyer Magnehelic.

J. Dampers

1. Dampers shall modulate the volume of outside, return or exhaust air. Dampers shall be double-skin ultra low-leak airfoil design or equivalent with metal compressible jamb seals and extruded blade edge seals on all blades. The dampers shall be rated for a maximum leakage rate of less than 1 percent of nominal airflow at 1 inch wg. Blades shall rotate on stainless steel sleeve bearings. Dampers shall be arranged in opposed blade configuration.

K. Electrical Provisions

1. Mount the main electrical panel directly on the unit or in a service compartment and include motor starters, fused disconnect switches, transformers, and the like.
2. Provide power wiring in conduit from main cabinet through floor and terminate with screwed caps. Install steel sleeves to accommodate conduit entry. Where unit construction is such that wiring must be disconnected for shipment, provide terminal blocks in an accessible enclosure at the sectional points for field wiring.
3. Completely interwire the electrical cabinet and properly wire all connections to the equipment. Extend wiring to properly coded terminal strips with all wires identified with approved marking strips.
4. Provide a factory mounted, 120 volt, weather resistant, UL listed wet location fluorescent light fixture in each section. Fixture shall be complete with junction box, Lexan housing and lens, magnetic ballast and 70 watt bulb. Provide lighting circuit in conduit from main cabinet to a single switch, and GFI weatherproof convenience outlet, mounted on the unit exterior.

2.9 ROOF MOUNTED HEATING AND VENTILATING UNIT (AHU-3 AND AHU-4)

A. General

1. *AHU-3 AND AHU-4 [D]*: Provide factory assembled, packaged, self-contained, factory built air handling units consisting of indicated components including: Complete insulated and weatherproofed housing on a base; dampers; filter section; steam coil heating section; supply fan section; return fan section where indicated; main fusible disconnect switch; variable frequency drives; disconnect switches; transformers. Units shall be arranged for roof top curb mounting.
 - a. Trane "Climate Changer" T Series.
 - b. TMI.
2. Each unit section shall be shipped complete with all interconnecting piping, wiring, and accessories, necessary for final installation and requiring minimal field terminal

connections. Design and fabricate the units to provide mating of sections with proper structural and service reconnection considerations.

3. Fabricate units of sizes, capacities, and configuration as indicated.
- B. Unit panels shall be solid double-wall construction. All exterior wall panels shall be made of galvanized steel. The casing shall be able to withstand up to 1.5 times design static pressure, or 8" WC, whichever is less, with no more than 0.005 inch deflection per inch of panel span. The unit base design shall allow unit to rest on top of roof curb when field installed.
 - C. Unit shall be factory insulated. Panels and unit roof shall be of double-wall construction with interior and exterior panels and insulation. Panel insulation system shall provide a minimum R value of 12. Insulation shall conform to NFPA 90 requirements.
 - D. Unit roof shall be constructed of two pieces. Inner roof shall be installed in such a manner as to prevent air bypass between internal components. Outer roof shall be sloped a minimum .25" per foot either from one side of unit to other, or from center to sides of the unit.
 - E. Access doors shall be constructed with a double-wall of solid G90 galvanized steel interior panel. Automotive style gasketing around the full perimeter of the access door shall be used to prevent air leakage. Door gasketing shall be mounted to the perimeter of the door and shall seal against a raised door frame. Door frame shall channel water away from gasket. Door shall have a protective flange to shield gasket from exposure. Preferred door handle shall not penetrate door casing. Door shall have a single handle latch.
 - F. Fan Sections
 1. Fans shall be double-width, double-inlet, multiblade type as produced by the unit manufacturer. Fan shall be forward curved or backward inclined, as required for stable operation and optimum energy efficiency. Fan shall be equipped with self-aligning, antifriction bearings with an L-50 life of 200,000 hours. Fan performance shall be certified as complying with ARI Standard 430-89.
 2. The vibration levels of the complete fan assembly shall be checked and excessive vibration shall be eliminated in the factory. Fan shaft shall be properly sized and protectively coated with lubricating oil. Fan wheels shall be keyed to fan shaft to prevent slipping. Fan shafts shall be solid and designed so that fan shaft does not pass through its first critical speed as the unit comes up to its rated rpm. Fan shafts shall not exceed 75 percent of their first critical speed at any cataloged rpm. Fan shall be provided with an access door on the drive side of the fan.
 3. Fan connection shall be isolated from unit casing by a flexible canvas duct. Two-Inch Spring Isolators — Fan and motor assembly shall be internally isolated from the unit casing with 2-inch deflection spring isolators, furnished and installed by the unit manufacturer.
 - G. Variable Frequency Drives
 1. Provide separate electronic variable frequency drives for supply and return air fans. Each unit shall consist of an adjustable frequency controller, three contactor bypass with a key operated drive-off-bypass selector switch, and fusible disconnect switch, complete with

control transformer and control devices as indicated and specified, with all power and control wiring and mounted in a common NEMA 1 enclosure.

2. Include the following features of self-protection and reliable operation:
 - a. Pulse Width Modulated Drive w/IGBT transistors
 - b. LCD display and keypad
 - c. English language electrical values, parameters, self test, faults and diagnostics
 - d. Power, pending fault, and fault LED indicator lights
 - e. Form C fault contacts
 - f. 4-20 mA or 0-10 V speed input signal
 - g. Hand-Off-Auto (HOA) selector switch
 - h. Current limiting NEMA Class T fuses
 - i. Auto restart after momentary power loss
 - j. Critical frequency avoidance
 - k. Voltage and FLA shall be factory-set for the exact motor used in the air handler

H. Filter Section

1. Filter section shall have filter racks, an access door for filter removal and block-offs as required to prevent air bypass around filters.
2. Provide viscous impingement type filters with filtering media of nominal 2 inch thickness industrial type glass fiber with an initial resistance of no more than 0.28" WG, rated at MERV 7 with face velocity of 500 FPM when tested per ASHRAE Standard 52.2, 1999. Furnish filtering media in filter manufacturer furnished galvanized steel, 16 gage holding frames with a UL Class 2 rating.
3. Filter Gauge:
 - a. Filter bank shall be equipped with a 0 to 2 inch W.G. pressure differential gauge connected across each filter media to provide a visual check of the filter loading.
 - 1) Dwyer Magnehelic.

I. Motorized Damper

1. Dampers shall modulate the volume of outside, return or exhaust air. Dampers shall be double-skin ultra low-leak airfoil design or equivalent with metal compressible jamb seals and extruded blade edge seals on all blades. The dampers shall be rated for a maximum leakage rate of less than 1 percent of nominal airflow at 1 inch wg. Blades shall rotate on stainless steel sleeve bearings. Dampers shall be arranged in opposed blade configuration.

J. Heating Section

1. Steam coils shall be of the nonfreeze inner steam distributing type permitting counter flow of steam and condensate. Outer tubes to be a minimum of 1 inch OD x 0.031 inch wall thickness; inner tubes to be of minimum 5/8 inch OD x 0.031 inch copper. The headers shall be constructed of seamless copper. The casings shall be of minimum 16 gage G-90 galvanized steel with adequate space for expansion and contraction of the coil, flanged and punched for easy mounting in the air handling unit. The coil face velocity shall not exceed 700 FPM. Horizontally mounted steam coils shall have the supply and return connections on one end and shall be limited to a maximum coil length of six feet. The tubes shall be fitted with aluminum extended fins. Plate type fin coils may have tubes mechanically expanded into fins or may be soldered.

2. Where Scheduled on the DRAWINGS, furnish coil complete with face and bypass dampers.
3. Provide extended pipe cabinet for steam and chilled water coil piping.

K. Electrical Provisions

1. Mount the main electrical panel directly on the unit or in a service compartment and include fused disconnect switches, transformers, and the like.
2. Provide power wiring in conduit from main cabinet through floor and terminate with screwed caps. Install steel sleeves to accommodate conduit entry. Where unit construction is such that wiring must be disconnected for shipment, provide terminal blocks in an accessible enclosure at the sectional points for field wiring.
3. Completely interwire the electrical cabinet and properly wire all connections to the equipment. Extend wiring to properly coded terminal strips with all wires identified with approved marking strips.
4. Provide a factory mounted, 120 volt, weather resistant, UL listed wet location fluorescent light fixture in each section. Fixture shall be complete with junction box, Lexan housing and lens, magnetic ballast and 70 watt bulb. Provide lighting circuit in conduit from main cabinet to a single switch, and GFI weatherproof convenience outlet, mounted on the unit exterior.

- L. Automatic temperature controls will be field installed as part of the Work furnished under Division 13 Series Sections.

PART 3 EXECUTION

3.1 INSTALLATION

A. General

1. Furnish, install and apply equipment and materials per the manufacturer's published instructions, and approved shop drawings.

B. Lubrication

1. Lubricate equipment and fill lubrication systems per manufacturer's published instructions.
2. Roof Mounted Fans And Hoods

C. Start-Up Service

1. Provide a field engineer for air conditioning units for start-up service for temporary construction use, final inspection and adjustment and instruction of the OWNER'S personnel regarding operation and maintenance of the units. Include labor, materials, travel, per diem and any other costs as part of the "field engineer" work. Provide copies of operation and maintenance manuals as specified.

3.2 FIELD QUALITY CONTROL

- A. Test units per manufacturer's published data.

END OF SECTION

Revision History	
Date	Rev. No.
A	0
B	0
C	0
D	0
E	0
F	0
02-19-09	0

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