

SECTION 23 34 00
HVAC FANS

PART 1 - GENERAL

1.1 DESCRIPTION

- A. Fans for heating, ventilating and air conditioning.
- B. Product Definitions: AMCA Publication 99, Standard 1-66.

1.2 RELATED WORK

- A. Section 01 00 00, GENERAL REQUIREMENTS.
- B. Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, AND SAMPLES.
- C. Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- D. Section 23 05 12, GENERAL MOTOR REQUIREMENTS FOR HVAC AND STEAM GENERATION EQUIPMENT.
- E. Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- F. Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.
- G. Section 23 09 23, DIRECT-DIGITAL CONTROL SYSTEM FOR HVAC.
- H. Section 23 73 00, INDOOR CENTRAL-STATION AIR-HANDLING UNITS.
- I. Section 23 82 16, AIR COILS.
- J. Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS.

1.3 QUALITY ASSURANCE

- A. Refer to paragraph, QUALITY ASSURANCE, in Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION.
- B. Fans and power ventilators shall be listed in the current edition of AMCA 261, and shall bear the AMCA performance seal.
- C. Operating Limits for Centrifugal Fans: AMCA 99 (Class I, II, and III).
- D. Fans and power ventilators shall comply with the following standards:
 - 1. Testing and Rating: AMCA 210.
 - 2. Sound Rating: AMCA 300.
- E. Vibration Tolerance for Fans and Power Ventilators: Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.
- F. Performance Criteria:
 - 1. The fan schedule shall show the design air volume and static pressure. Select the fan motor HP by increasing the fan BHP by 10 percent to account for the drive losses and field conditions.
 - 2. Select the fan operating point as follows:
 - a. Forward Curve and Axial Flow Fans: Right hand side of peak pressure point

- b. Air Foil, Backward Inclined, or Tubular: At or near the peak static efficiency
- G. Safety Criteria: Provide manufacturer's standard screen on fan inlet and discharge where exposed to operating and maintenance personnel.
- H. Corrosion Protection:
 - 1. All steel shall be mill-galvanized, or phosphatized and coated with minimum two coats, corrosion resistant enamel paint. Manufacturers paint and paint system shall meet the minimum specifications of: ASTM D1735 water fog; ASTM B117 salt spray; ASTM D3359 adhesion; and ASTM G152 and G153 for carbon arc light apparatus for exposure of non-metallic material.

1.4 SUBMITTALS

- A. Submit in accordance with Section 01 33 23, SHOP DRAWINGS, PRODUCT DATA, and SAMPLES.
- B. Manufacturers Literature and Data:
 - 1. Fan sections, motors and drives.
 - 2. Centrifugal fans, motors, drives, accessories and coatings.
- C. Certified Sound power levels for each fan.
- D. Motor ratings types, electrical characteristics and accessories.
- E. Belt guards.
- F. Maintenance and Operating manuals in accordance with Section 01 00 00, GENERAL REQUIREMENTS.
- G. Certified fan performance curves for each fan showing cubic feet per minute (CFM) versus static pressure, efficiency, and horsepower for design point of operation.

1.5 APPLICABLE PUBLICATIONS

- A. The publications listed below form a part of this specification to the extent referenced. The publications are referenced in the text by the basic designation only.
- B. Air Movement and Control Association International, Inc. (AMCA):
 - 99-86.....Standards Handbook
 - 210-06.....Laboratory Methods of Testing Fans for Aerodynamic Performance Rating
 - 261-09.....Directory of Products Licensed to bear the AMCA Certified Ratings Seal - Published Annually
 - 300-08.....Reverberant Room Method for Sound Testing of Fans
- C. American Society for Testing and Materials (ASTM):

B117-07a.....Standard Practice for Operating Salt Spray (Fog) Apparatus

D1735-08.....Standard Practice for Testing Water Resistance of Coatings Using Water Fog Apparatus

D3359-08.....Standard Test Methods for Measuring Adhesion by Tape Test

G152-06.....Standard Practice for Operating Open Flame Carbon Arc Light Apparatus for Exposure of Non-Metallic Materials

G153-04.....Standard Practice for Operating Enclosed Carbon Arc Light Apparatus for Exposure of Non-Metallic Materials

D. Underwriters Laboratories, Inc. (UL):

181-2005.....Factory Made Air Ducts and Air Connectors

1.6 EXTRA MATERIALS

A. Provide one additional set of belts for all belt-driven fans.

PART 2 - PRODUCTS

2.1 AIR HANDLING UNIT FAN SECTION (MULTIPLE STACKED FAN ARRAY)

A. Fans Sections:

1. Fan Assembly: Provide supply air fan sections consisting of multiple, stacked direct drive centrifugal plenum fan modules spaced in the air way tunnel cross section to provide a uniform air flow and velocity profile across the entire air way tunnel cross section and components contained therein. Provide the following accessories
 - a. Coplanar Silencers: Designed to reduce the bare fan discharge sound power levels a minimum of 15 db, re 10^{-12} watts across the seven frequency bands from 125 to 8000 HZ.
 - b. Inlet Airflow Straightener: Designed to reduce the bare fan inlet and discharge sound power levels.
 - c. Backdraft Dampers: Provide for each fan/motor module. Ruskin BD6 or approved equal.
2. Fan and Drive Assemblies: Statically and dynamically balanced and designed for continuous operation at maximum-rated fan speed and motor horsepower.
3. Allowable vibration tolerances for fan shall not exceed a self-excited vibration maximum velocity of 0.005 m/s (0.20 inch per second) RMS, filter in, when measured with a vibration meter on

bearing caps of machine in vertical, horizontal and axial directions or measured at equipment mounting feet if bearings are concealed. After field installation, compliance to this requirement shall be demonstrated with field test in accordance with Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT and Section 23 05 93, TESTING, ADJUSTING, AND BALANCING FOR HVAC.

4. The Discharge sound levels at floor openings for each individual octave band shall **NOT** exceed 81/78//87/80/72/72/70/64.

Alternate manufacturers must use sound attenuating devices to achieve without impacting the equipment performance or design features including duct connection location, unit weights, acoustical performance, or specified total fan HP for each FWT Array. Proposals submitted which indicate a higher connected fan HP and higher sound power levels than specified or scheduled will NOT be accepted.

NOTE: If alternate direct driven fan systems are proposed by the contractor it shall be the responsibility of the contractor proposing the alternate fan system(s) to guarantee that the sound (Noise Criteria) levels in the occupied space will **NOT** exceed those per the basis of design system. Any acoustical treatment for alternate fan system(s) must be approved by the engineer and architect prior to installation, and any such acoustical treatment, or subsequent treatment, will be done at the sole expense of the contractor proposing the alternate fan system(s).

B. Fan Motor, Drive and Mounting Assembly:

1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, for additional requirements.
2. Fan Motor and Drive: Motors shall be premium energy efficient type with efficiencies as specified and suitable for use in variable frequency drive applications where this type of drive is indicated. Each motor shall be inverter duty rated and shall be provided with an AEGIS bearing protection ring to prevent electrical discharge machining damage to the motor bearings. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, for additional motor and drive specifications. Provide Shaft grounding kits for each fan motor. Provide variable speed drives that are compatible with fan and motor. Refer to Specification Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for other variable speed drive requirements.

3. Fan array unit motors to be served by multiply variable frequency drives. Each VFD controls 50% of the fans and 50% of the maximum airflow rate capacity. Refer to schedules and drawings for parings. Provide motor and drive assembly with factory wiring and controls so there is only a single point power field connection to this multiple fan assembly. Provide individual wiring, from each motor to a control panel with individual disconnects and motor overload protection for each motor housed in a separate control panel. Electrical wiring and controls shall conform to NEC requirements. Provide motor status indication using individual motor current sensors wired in series.. Provide control systems so only one field signal (4-20 mA or 0-10V) is required to control fan speed. Also provide factory wiring so only one set of factory provided terminals will interface with shut-down signal from the building automation system no matter what drive is in operation. Similarly provide factory wiring so only one set of factory provided terminals will interface with either drive safety circuit for connection of the unit smoke detectors and freezestats provided by the building automation system to shut down either drive no matter what drive is in operation. The Variable Frequency Drives shall be sized accordingly to start and hold all motors in the fan array. Provide service disconnect with fuses or circuit breaker.

2.2 CENTRIFUGAL FANS

- A. Standards and Performance Criteria: Refer to Paragraph, QUALITY ASSURANCE. Record factory vibration test results on the fan or furnish to the Contractor.
- B. Fan arrangement, unless noted or approved otherwise:
 1. DWD1 fans: Arrangement 3.
 2. SWS1 fans: Arrangement 1, 3, 9 or 10.
- C. Construction: Wheel diameters and outlet areas shall be in accordance with AMCA standards.
 1. Housing: Low carbon steel, arc welded throughout, braced and supported by structural channel or angle iron to prevent vibration or pulsation, flanged outlet, inlet fully streamlined. Provide lifting clips, and casing drain. Provide manufacturer's standard access door. Provide 12.5 mm (1/2 inches) wire mesh screens for fan inlets without duct connections.
 2. Wheel: Steel plate with die formed blades welded or riveted in place, factory balanced statically and dynamically.

3. Shaft: Designed to operate at no more than 70 percent of the first critical speed at the top of the speed range of the fans class. Provide Shaft grounding kits for each fan motor.
 4. Bearings: Heavy duty ball or roller type sized to produce a B10 life of not less than 50,000 hours, and an average fatigue life of 200,000 hours. Extend filled lubrication tubes for interior bearings or ducted units to outside of housing.
 5. Belts: Oil resistant, non-sparking and non-static.
 6. Belt Drives: Factory installed with final alignment belt adjustment made after installation.
 7. Motors and Fan Wheel Pulleys: Adjustable pitch for use with motors through 15HP, fixed pitch for use with motors larger than 15HP. Select pulleys so that pitch adjustment is at the middle of the adjustment range at fan design conditions.
 8. Motor, adjustable motor base, drive and guard: Furnish from factory with fan. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION for specifications. Provide protective sheet metal enclosure for fans located outdoors.
 9. Furnish variable speed fan motor controllers where shown on the drawings. Refer to Section, MOTOR STARTERS. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION for controller/motor combination requirements.
- D. Fan Motor, Drive and Mounting Assembly:
1. Refer to Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT, for additional requirements.
 2. Fan Motor and Drive: Motors shall be premium energy efficient type with efficiencies as specified and suitable for use in variable frequency drive applications where this type of drive is indicated. Each motor shall be inverter duty rated and shall be provided with an AEGIS bearing protection ring to prevent electrical discharge machining damage to the motor bearings. Refer to Section 23 05 11, COMMON WORK RESULTS FOR HVAC AND STEAM GENERATION, for additional motor and drive specifications. Provide Shaft grounding kits for each fan motor. Provide variable speed drives that are compatible with fan and motor. Refer to Specification Section 26 29 11, LOW-VOLTAGE MOTOR STARTERS for other variable speed drive requirements.
- E. In-line Centrifugal Fans: In addition to the requirements of paragraphs A, D and 2.2.C3 thru 2.2.C9, provide minimum 18 Gauge galvanized steel

housing with inlet and outlet flanges, backward inclined aluminum centrifugal fan wheel, bolted access door and supports as required. Motors shall be factory pre-wired to an external junction box. Provide factory wired disconnect switch.

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install fan, motor and drive in accordance with manufacturer's instructions.
- B. Align fan and motor sheaves to allow belts to run true and straight.
- C. Bolt equipment to curbs with galvanized lag bolts.
- D. Install vibration control devices as shown on drawings and specified in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

3.2 PRE-OPERATION MAINTENANCE

- A. Lubricate bearings, pulleys, belts and other moving parts with manufacturer recommended lubricants.
- B. Rotate impeller by hand and check for shifting during shipment and check all bolts, collars, and other parts for tightness.
- C. Clean fan interiors to remove foreign material and construction dirt and dust.

3.3 START-UP AND INSTRUCTIONS

- A. Verify operation of motor, drive system and fan wheel according to the drawings and specifications.
- B. Check vibration and correct as necessary for air balance work.
- C. After air balancing is complete and permanent sheaves are in place perform necessary field mechanical balancing to meet vibration tolerance in Section 23 05 41, NOISE AND VIBRATION CONTROL FOR HVAC PIPING AND EQUIPMENT.

- - - E N D - - -