SECTION 233416 - CENTRIFUGAL HVAC FANS

1. PART 1 – GENERAL

1.1. RELATED DOCUMENTS

A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.

1.2. SUMMARY

A. This Section includes the following:

1. Airfoil centrifugal fans
2. Backward-inclined centrifugal fans
3. Plug fans

1.3. PERFORMANCE REQUIREMENTS

A. Project Altitude: Base fan performance ratings on sea level.

B. Operating Limits: Classify according to AMCA 99.

1.4. SUBMITTALS

A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:

1. Certified fan performance curves with system operating conditions indicated
2. Certified fan sound-power ratings.
3. Motor ratings and electrical characteristics, plus motor and electrical accessories.
4. Material thickness and finishes, including color charts.
5. Dampers, including housings, linkages, and operators.

B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

1. Wiring Diagrams: Power, signal, and control wiring.
2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.

C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.

D. Field quality-control test reports.

E. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.

1.5. QUALITY ASSURANCE

A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.

B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.

C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.

1.6. DELIVERY, STORAGE, AND HANDLING

A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.

B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

C. Lift and support units with manufacturer's designated lifting or supporting points.

1.7. COORDINATION

A. Coordinate size and location of structural-steel support members.

B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.

C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8. EXTRA MATERIALS

A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.

1. Belts: One set for each belt-driven unit.

2. PART 2 - PRODUCTS

2.1. AIRFOIL CENTRIFUGAL FANS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. York Fans as Basis of Design

2. Approved Equal, Approved by Engineer

D. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.

E. Housings: Formed panels to make curved-scroll housings with shaped cutoff, with doors or panels to allow access to internal parts and components.

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.

2. Horizontally split, bolted-flange housing.

3. Spun inlet cone with flange.

4. Outlet flange.

F. Airfoil Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange; heavy backplate; hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate; and cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws. Wheel cone shall be matched to the inlet cone providing the exact overlap to maximize the fan efficiency.

G. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.

2. First critical shaft speed on Class I and II fans is at least 125% of the fan's maximum operating speed. For all Class III and IV fans the first critical speed is at least 142% of the originally specified operating speed.

H. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.

1. ABMA L10 bearing life on Class I and II fans shall be 20,000 hours

2. ABMA L10 bearing life in Class III and IV fans shall be 40,000 hours

I. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.

1. ABMA L10 bearing life on Class I and II fans shall be 20,000 hours

2. ABMA L10 bearing life in Class III and IV fans shall be 40,000 hours

J. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

1. ABMA L10 bearing life on Class I and II fans shall be 20,000 hours

2. ABMA L10 bearing life in Class III and IV fans shall be 40,000 hours

K. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.5.

2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.

3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

6. Motor Mount: Adjustable for belt tensioning.

L. Accessories:

1. Scroll Access Doors: Shaped to conform to scroll, designed to provide easy inspection or cleaning of the fan interior and wheel.

2. Cleanout Door: Quick-opening, latch-type gasketed door allowing access to fan scroll, of same material as housing.

3. Scroll Drain Connection: Drains shall be located at the lowest point of the scroll. Connection type shall be 3/4" NPT external threads.

4. Companion Flanges: Rolled flanges for duct connections of same material as housing.

5. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.

6. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.

7. Inlet Screens: Grid screen of same material as housing.

8. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.

9. Spark-Resistant Construction: AMCA 99.

10. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.

11. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

M. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: Totally enclosed, fan cooled.

N. Capacities and Characteristics: See mechanical equipment schedule on Drawings.

2.2. BACKWARD-INCLINED CENTRIFUGAL FANS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

1. York Fans as Basis of Design

2. Approved Equal, Approved by Engineer

D. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor, drive assembly, and support structure.

E. Housings: Formed panels to make curved-scroll housings with shaped cutoff, with doors or panels to allow access to internal parts and components.

1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.

2. Horizontally split, bolted-flange housing.

3. Spun inlet cone with flange.

4. Outlet flange.

F. Backward Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with heavy backplate; solid, single thickness blades welded to the backplate. Spun wheel cone shall be welded to the blades; and cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws. Wheel cone shall be matched to the inlet cone providing the exact overlap to maximize the fan efficiency.

G. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.

2. First critical shaft speed on Class I and II fans is at least 125% of the fan's maximum operating speed. For all Class III and IV fans the first critical speed is at least 142% of the originally specified operating speed.

H. Prelubricated and Sealed Shaft Bearings: Self-aligning, pillow-block-type ball bearings.

1. ABMA L10 bearing life on Class I and II fans shall be 20,000 hours

2. ABMA L10 bearing life in Class III and IV fans shall be 40,000 hours

I. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.

1. ABMA L10 bearing life on Class I and II fans shall be 20,000 hours

2. ABMA L10 bearing life in Class III and IV fans shall be 40,000 hours

J. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.

1. ABMA L10 bearing life on Class I and II fans shall be 20,000 hours

2. ABMA L10 bearing life in Class III and IV fans shall be 40,000 hours

K. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

1. Service Factor Based on Fan Motor Size: 1.5.

2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.

3. Motor Pulleys: Adjustable pitch for use with motors through 5 hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.

5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

6. Motor Mount: Adjustable for belt tensioning.

L. Accessories:

1. Scroll Access Doors: Shaped to conform to scroll, designed to provide easy inspection or cleaning of the fan interior and wheel.

2. Cleanout Door: Quick-opening, latch-type gasketed door allowing access to fan scroll, of same material as housing.

3. Scroll Drain Connection: Drains shall be located at the lowest point of the scroll. Connection type shall be 3/4" NPT external threads.

4. Companion Flanges: Rolled flanges for duct connections of same material as housing.

5. Variable Inlet Vanes: With blades supported at both ends with two permanently lubricated bearings of same material as housing. Variable mechanism terminating in single control lever with control shaft for double-width fans.

6. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.

7. Inlet Screens: Grid screen of same material as housing.

8. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.

9. Spark-Resistant Construction: AMCA 99.

10. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.

11. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

M. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."

1. Enclosure Type: Totally enclosed, fan cooled.

N. Capacities and Characteristics: See mechanical equipment schedule on Drawings.

2.3. PLUG FANS

A. Available Manufacturers: Subject to compliance with requirements, manufacturers offering products that may be incorporated into the Work include, but are not limited to, the following:

B. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

C. Basis-of-Design Product: Subject to compliance with requirements, provide the product indicated on Drawings or a comparable product by one of the following:

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G. Shafts: Statically and dynamically balanced and selected for continuous operation at maximum rated fan speed and motor horsepower, with final alignment and belt adjustment made after installation.

1. Turned, ground, and polished hot-rolled steel with keyway. Ship with protective coating of lubricating oil.
2. First critical shaft speed on Class I and II fans is at least 125% of the fan's maximum operating speed. For all Class III and IV fans the first critical speed is at least 142% of the originally specified operating speed.

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K. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor Size: 1.5.
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4. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
5. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
6. Motor Mount: Adjustable for belt tensioning.

L. Accessories:
1. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
2. Spark-Resistant Construction: AMCA 99.
3. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
4. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

M. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Enclosure Type: Totally enclosed, fan cooled.

N. Capacities and Characteristics: See mechanical equipment schedule on Drawings.

2.4. SOURCE QUALITY CONTROL

A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.

B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

3. PART 3 - EXECUTION

3.1. INSTALLATION

A. Install centrifugal fans level and plumb.

B. Support floor-mounting units using spring isolators having a static deflection of 1 inch. Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.

C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."

E. Support suspended units from structure using threaded steel rods and elastomeric hangers, spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

F. Install units with clearances for service and maintenance.

G. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2. CONNECTIONS

A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."

B. Install ducts adjacent to fans to allow service and maintenance.

C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.

D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."

E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3. FIELD QUALITY CONTROL

A. Perform the following field tests and inspections and prepare test reports:

1. Verify that shipping, blocking, and bracing are removed.

2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

3. Verify that cleaning and adjusting are complete.

4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
5. Adjust belt tension.
6. Adjust damper linkages for proper damper operation.
7. Verify lubrication for bearings and other moving parts.
8. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
9. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
10. Remove and replace malfunctioning units and retest as specified above.

B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4. DEMONSTRATION

A. Engage a factory-authorized service representative to train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION 233416