

SECTION 233416 - CENTRIFUGAL HVAC FANS

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. Forward-curved centrifugal fans.
 - 4. Plenum fans.
 - 5. Plug fans.

1.3 ACTION SUBMITTALS

- A. Product Data:
 - 1. Include rated capacities, furnished specialties, and accessories for each fan.
 - 2. Certified fan performance curves with system operating conditions indicated.
 - 3. Certified fan sound-power ratings.
 - 4. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 - 5. Material thickness and finishes, including color charts.
 - 6. Dampers, including housings, linkages, and operators.
- B. Shop Drawings:
 - 1. Include plans, elevations, sections, and attachment details.
 - 2. Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
 - 3. Include diagrams for power, signal, and control wiring.
 - 4. 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.

1.4 INFORMATIONAL SUBMITTALS

Retain "Coordination Drawings" Paragraph below for situations where limited space necessitates maximum utilization for efficient installation of different components or if coordination is required for installa-

tion of products and materials by separate installers. Coordinate paragraph with other Sections specifying products listed below. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

- A. 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.
- B. Field quality-control test reports.

1.5 CLOSEOUT SUBMITTALS

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

1.6 MAINTENANCE MATERIAL SUBMITTALS

Direct drive fans are preferred. Use direct drives whenever possible. Edit section for project and remove belt driven reference.

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

PART 2 - PRODUCTS

2.1 PERFORMANCE REQUIREMENTS

- A. AMCA Compliance:
 - 1. Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.
 - 2. Operating Limits: Classify according to AMCA 99.
- B. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, by a qualified testing agency, and marked for intended location and application.

2.2 GENERAL REQUIREMENTS

- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:
 - 1. Aerovent; a Twin City Fan Company.
 - 2. Carrier Corporation.
 - 3. Chicago Blower Corporation.
 - 4. Greenheck Fan Corporation.

5. Huntair Fanwall.
 6. Loren Cook Company.
 7. Daikin
 8. Trane.
 9. Daikin
- B. 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. Designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.
- C. Grease-Lubricated Shaft Bearings: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing, and eccentric collar shaft locking design.
1. Ball-Bearing Rating Life: ABMA 9, L10 at 200,000 hours.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at 200,000 hours.

Direct drive fans are preferred. Use direct drives whenever possible. Edit section for project and remove belt driven reference.

- D. 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; multiple v-belt style with fixed pitch. Do not use small diameter sheaves and notched belts. Approved manufacturers are Browning, Dodge, and Woods.
 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. Utilize pin and clip quick connect mounting. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 6. Motor Mount: Adjustable for belt tensioning.
- E. Characteristics:
1. Class: II or higher.
 2. Housing Material: Reinforced steel.
 3. Special Housing Coating: Powder-baked enamel.
 4. Wheel Material: Steel.
 5. Special Wheel Coating: Powder-baked enamel.
 6. Vibration Isolators: Spring isolators having a static deflection of 1 inch (25 mm).

2.3 AIRFOIL CENTRIFUGAL FANS

Direct drive fans are preferred. Use direct drives whenever possible. Edit section for project and remove belt driven reference.

A. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven (not preferred) or direct driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

B. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.

Split housings are an optional configuration.

3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

C. Airfoil Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange.
2. Heavy backplate.
3. Hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate.
4. Cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

D. Accessories:

Retain applicable accessories below. Verify availability with manufacturers.
Retain "Access for Inspection, Cleaning, and Maintenance" Subparagraph below if applying for LEED certification. LEED Prerequisite EQ 1 requires compliance with ASHRAE 62.1, which includes requirements for equipment access for inspection, cleaning, and maintenance.

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Inlet Screens: Grid screen of same material as housing.
5. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
6. Spark-Resistant Construction: AMCA 99.
7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.4 BACKWARD-INCLINED CENTRIFUGAL FANS

Direct drive fans are preferred. Use direct drives whenever possible. Edit section for project and remove belt driven reference.

A. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven (not preferred) or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

B. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.

Split housings are an optional configuration.

3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

C. Backward-Inclined Wheels:

1. Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades and fastened to shaft with set screws.
2. Welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate.

Retain applicable accessories below. Verify availability with manufacturers.

Retain "Access for Inspection, Cleaning, and Maintenance" Subparagraph below if applying for LEED certification. LEED Prerequisite EQ 1 requires compliance with ASHRAE 62.1, which includes requirements for equipment access for inspection, cleaning, and maintenance.

D. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Inlet Screens: Grid screen of same material as housing.
5. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
6. Spark-Resistant Construction: AMCA 99.
7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

2.5 FORWARD-CURVED CENTRIFUGAL FANS

Direct drive fans are preferred. Use direct drives whenever possible. Edit section for project and remove belt driven reference.

A. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven (not preferred) or direct-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

B. Housings:

1. Formed panels to make curved-scroll housings with shaped cutoff.
2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.

Split housings are an optional configuration.

3. Horizontally split, bolted-flange housing.
4. Spun inlet cone with flange.
5. Outlet flange.

C. Forward-Curved Wheels:

1. Black-enameled or galvanized steel construction with inlet flange, backplate, shallow blades with inlet and tip curved forward in direction of airflow.
2. Mechanically secured to flange and backplate; cast-steel hub swaged to backplate and fastened to shaft with set screws.

Retain applicable accessories below. Verify availability with manufacturers.
Retain "Access for Inspection, Cleaning, and Maintenance" Subparagraph below if applying for LEED certification. LEED Prerequisite EQ 1 requires compliance with ASHRAE 62.1, which includes requirements for equipment access for inspection, cleaning, and maintenance.

D. Accessories:

1. Access for Inspection, Cleaning, and Maintenance: Comply with requirements in ASHRAE 62.1.
2. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
3. Companion Flanges: Rolled flanges for duct connections of same material as housing.
4. Inlet Screens: Grid screen of same material as housing.
5. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft.
6. Spark-Resistant Construction: AMCA 99.
7. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
8. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.

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

2.6 PLENUM FANS

Direct drive fans are preferred. Use direct drives whenever possible. Edit section for project and remove belt driven reference.

A. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven (not preferred) or direct driven centrifugal fans consisting of wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

B. Airfoil Wheels:

1. Single-width-single-inlet construction with smooth-curved inlet flange.
2. Heavy backplate.
3. Hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate.
4. Cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

C. Accessories:

Retain applicable accessories below. Verify availability with manufacturers.

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.

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

2.7 PLUG FANS

Direct drive fans are preferred. Use direct drives whenever possible. Edit section for project and remove belt driven reference.

A. Description:

1. Factory-fabricated, -assembled, -tested, and -finished, belt-driven (not preferred) or direct driven centrifugal fans consisting of wheel, fan shaft, bearings, motor, drive assembly, and support structure.
2. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations.

B. Airfoil Wheels:

1. Single-width-single-inlet construction with smooth-curved inlet flange.

2. Heavy backplate.
3. Hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate.
4. Cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.

Retain applicable accessories below. Verify availability with manufacturers.

C. 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.

2.8 MOTORS

- A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Division 23 Section "Common Motor Requirements for HVAC Equipment."

2.9 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/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- 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.

Retain first "Equipment Mounting" Paragraph below for equipment supported on cast-in-place concrete equipment bases with vibration isolation devices.

- D. Equipment Mounting: Install centrifugal fans on cast-in-place concrete equipment base(s) using restrained spring isolators. Comply with requirements for vibration isolation devices specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

1. Minimum Deflection: 1 inch (25 mm).
2. Coordinate sizes and locations of concrete bases with actual equipment provided. Cast anchor-bolt inserts into bases.

Retain first "Equipment Mounting" Paragraph below for equipment installed on vibration isolation equipment bases.

- E. Equipment Mounting: Install centrifugal fans on vibration isolation equipment base. Comply with requirements specified in Division 23 Section "Vibration Controls for HVAC Piping and Equipment."

Retain "Equipment Mounting" Paragraph below for indoor units suspended from structure.

- F. Equipment Mounting: Support suspended units from structure using threaded steel rods and spring hangers. Comply with requirements for hangers and supports specified in Division 23 Section "Hangers and Supports for HVAC Piping and Equipment."
- G. Install units with clearances for service and maintenance.
- H. 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.

Retain first paragraph below if fans have scroll drains.

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

3.3 FIELD QUALITY CONTROL

Direct drive fans are preferred. Use direct drives whenever possible. Edit section for project and remove belt driven reference.

- A. Perform the following field tests and inspections:
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. Controls and equipment will be considered defective if they do not pass tests and inspections.
- C. Prepare test and inspection reports.

3.4 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans.

END OF SECTION 233416