SECTION 233413 - AXIAL HVAC FANS

Revise this Section by deleting and inserting text to meet Project-specific requirements.

Verify that Section titles referenced in this Section are correct for this Project's Specifications; Section titles may have changed.

1. GENERAL
	* + 1. RELATED DOCUMENTS

Retain or delete this article in all Sections of Project Manual.

* + - * 1. Drawings and general provisions of the Contract, including General and Supplementary Conditions and Division 01 Specification Sections, apply to this Section.
			1. SUMMARY
				1. Section Includes:

Tubeaxial fans.

Vaneaxial fans.

Mixed-flow fans.

* + - 1. SUBMITTALS
				1. Submittals for this section are subject to the re-evaluation fee identified in Article 4 of the General Conditions.
				2. Manufacturer’s installation instructions shall be provided along with product data.
				3. Submittals shall be provided in the order in which they are specified and tabbed (for combined submittals).
				4. Product Data: For each type of product.

Include rated capacities, furnished specialties, and accessories for each fan.

Certified fan performance curves with system operating conditions indicated.

Certified fan sound-power ratings.

Motor ratings and electrical characteristics, plus motor and electrical accessories.

Material thickness and finishes, including color charts.

Dampers, including housings, linkages, and operators.

Fan speed controllers.

* + - * 1. Shop Drawings:

Include plans, elevations, sections, and attachment details.

Include details of equipment assemblies. Indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.

Include diagrams for power, signal, and control wiring.

Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.

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.

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 installation of products and materials by separate installers. Preparation of coordination drawings requires the participation of each trade involved in installations within the limited space.

* + - * 1. 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.

Retain "Seismic Qualification Data" paragraph below if required by seismic criteria applicable to Project. Coordination with Section 230548 "Vibration and Seismic Controls for HVAC." See ASCE/SEI 7 for certification requirements for equipment and components.

* + - * 1. Seismic Qualification Data: Certificates, for fans, accessories, and components, from manufacturer.

Basis for Certification: Indicate whether withstand certification is based on actual test of assembled components or on calculation.

Dimensioned Outline Drawings of Equipment Unit: Identify center of gravity and locate and describe mounting and anchorage provisions.

Detailed description of equipment anchorage devices on which the certification is based and their installation requirements.

Retain "Field quality-control reports" paragraph below if Contractor is responsible for field quality-control testing and inspecting.

* + - * 1. Field quality-control reports.
			1. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: For fans, include the following:

Operation in normal and emergency modes.

Operation and maintenance manuals.

* + - 1. MAINTENANCE MATERIAL SUBMITTALS
				1. Furnish extra materials that match products installed and that are packaged with protective coverage for storage and identified with labels describing contents.

Belts: [**One**] <**Insert number**> set(s) for each belt-driven unit.

1. PRODUCTS

Manufacturers and products listed in SpecAgent and MasterWorks Paragraph Builder are neither recommended nor endorsed by the AIA or Deltek. Before inserting names, verify that manufacturers and products listed there comply with requirements retained or revised in descriptions and are both available and suitable for the intended applications.

* + - 1. PERFORMANCE REQUIREMENTS
				1. 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. NFPA Compliance: Comply with NFPA 90A for design, fabrication, and installation of unit components.

"ASHRAE Compliance" paragraph below may be required to comply with Project requirements or authorities having jurisdiction. Sustainable design may require compliance with requirements in ASHRAE 62.1, including requirements for controls, surfaces in contact with the airstream, and equipment access. Verify, with manufacturers, the availability of units with components and features that comply with these requirements.

* + - * 1. ASHRAE Compliance:

ASHRAE Compliance: Applicable requirements in ASHRAE 62.1, Section 5 - "Systems and Equipment" and Section 7 - "Construction and Startup."

"ASHRAE/IES 90.1 Compliance" paragraph below may be required to comply with Project requirements or authorities having jurisdiction. Sustainable design may require minimum efficiency equal to requirements in ASHRAE/IES 90.1.

* + - * 1. ASHRAE/IES 90.1 Compliance: Applicable requirements in ASHRAE/IES 90.1, Section 6 - "Heating, Ventilating, and Air-Conditioning."

Retain "Seismic Performance" paragraph below with "Seismic Qualification Data" paragraph in "Informational Submittals" Article for projects requiring seismic design. Delete paragraph if performance requirements are indicated on Drawings. Model building codes and ASCE/SEI 7 establish criteria for buildings subject to earthquake motions. Coordinate requirements with Structural Engineer.

* + - * 1. Seismic Performance: Axial HVAC fans shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

Retain first subparagraph below to define the term "withstand" as it applies to this Project. Definition varies with type of building and occupancy and is critical to valid certification. Option is used for essential facilities where equipment must operate immediately after an earthquake.

The term "withstand" means "the unit will remain in place without separation of any parts from the device when subjected to the seismic forces specified[**and the unit will be fully operational after the seismic event**]."

For life-safety components required to function after an earthquake (such as fire-sprinkler systems, components that contain hazardous content, and storage racks in structures open to the public), the Component Importance Factor is 1.5. For other components, the Component Importance Factor is 1.0 unless the structure is in Seismic Use Group III and component is necessary for continued operation of facility or failure of component could impair continued operation of facility, in which case the Component Importance Factor is 1.5.

Component Importance Factor: [**1.5**] [**1.0**].

See ASCE/SEI 7, Coefficients for Architectural Component Table and Seismic Coefficients for Mechanical and Electrical Components Table for requirements to be inserted in subparagraph below.

<**Insert requirements for Component Amplification Factor and Component Response Modification Factor**>.

* + - 1. CAPACITIES AND CHARACTERISTICS

If Project has more than one type or configuration of fan, delete this article and schedule fans on Drawings.

* + - * 1. Airflow: <**Insert number**> cfm.
				2. External Static Pressure: <**Insert number**> inches wg.
				3. Fan Diameter: <**Insert number**> inches.
				4. Brake Horsepower: <**Insert number**>.
				5. Drive Type: [**Direct**] [**Belt**].
				6. Fan Rpm: <**Insert number**>.
				7. Motor:

Verify enclosure types with manufacturer of specified equipment. Delete "Motor Enclosure" subparagraph below if included in schedule on Drawings.

Motor Enclosure: [**Open, dripproof**] [**Totally enclosed, fan cooled**] [**Totally enclosed, air over**] [**Totally enclosed, nonventilated**] [**Explosion proof**].

Retain "Enclosure Materials," "Motor Bearings," "Efficiency," "NEMA Design," and "Service Factor" subparagraphs below if options are available from equipment manufacturers and are different from default requirements specified in Section 230513 "Common Motor Requirements for HVAC Equipment." Consider each subparagraph and retain only those that vary from default requirements.

Enclosure Materials: [**Cast iron**] [**Cast aluminum**] [**Rolled steel**].

Motor Bearings: <**Insert requirements**>.

Efficiency: Premium efficiency.

NEMA Design: <**Insert designation**>.

Service Factor: <**Insert number**>.

Retain "Electrical Characteristics" subparagraph below if characteristics are not indicated on Drawings or in schedules.

Electrical Characteristics:

Motor Size: <**Insert horsepower**>.

Motor Rpm: <**Insert number**>.

Volts: [**120**] [**208**] [**230**] [**460**] <**Insert number**> V.

Phase: [**Single**] [**Three**].

Hertz: 60 Hz.

Full-Load Amperes: <**Insert number**> A.

Minimum Circuit Ampacity: <**Insert number**> A.

Maximum Overcurrent Protection: <**Insert number**> A.

* + - * 1. Sound Power:

1st Octave: <**Insert dB**>.

2nd Octave: <**Insert dB**>.

3rd Octave: <**Insert dB**>.

4th Octave: <**Insert dB**>.

5th Octave: <**Insert dB**>.

6th Octave: <**Insert dB**>.

7th Octave: <**Insert dB**>.

8th Octave: <**Insert dB**>.

* + - * 1. Vibration Isolators: [**Spring**] [**Restrained spring**] <**Insert type**> isolators with a static deflection of [**1**] <**Insert deflection**>inch(es).

Spark-resistant construction is required when airstream may contain flammable or explosive gases.

* + - * 1. Spark Resistance:

[**Class A**] [**Class B**] [**Class C**].

* + - * 1. Service Conditions:

Ambient Temperature: <**Insert number**> deg F.

Altitude: <**Insert number**> feet above sea level.

Humidity: <**Insert number**> deg F wet bulb.

* + - 1. TUBEAXIAL FANS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

American Fan Company.

Greenheck Fan Corporation.

Rupp Air Management Systems.

Trane Inc.

Approved equivalent.

* + - * 1. Source Limitations: Obtain tubeaxial fans from single manufacturer.
				2. Description: Fan wheel and housing, factory-mounted motor with [**belt**] [**or**] [**direct**] drive, an inlet cone section, and accessories.
				3. Housings: [**Steel**] [**Galvanized steel**] [**Aluminum**] [**Fiberglass-reinforced plastic**] [**Stainless steel**] with flanged inlet and outlet connections.

Retain one of three "Wheel Assemblies" paragraphs below.

* + - * 1. Wheel Assemblies: Cast or extruded aluminum with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.
				2. Wheel Assemblies: Fiberglass-reinforced plastic cured under pressure with airfoil-shaped blades keyed to stainless-steel shaft.
				3. Wheel Assemblies: Cast aluminum; machined and fitted to shaft.

Retain "Belt Drives" paragraph below for belt-driven fans.

* + - * 1. Belt Drives:

Factory mounted, with adjustable alignment and belt tensioning.

Service Factor Based on Fan Motor Size: [**1.2**] [**1.3**] [**1.4**] [**1.5**].

Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

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

5-hp limit in "Motor Pulleys" subparagraph below is standard with many manufacturers but is designer's choice.

Motor Pulleys: Adjustable pitch for use with motors through [**5**] <**Insert number**> hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

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

Belt Guards: Fabricate of prime-coated steel to comply with OSHA and SMACNA requirements for motors with exposed drive belt. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.

Motor Base: Adjustable rail mount motor base with adjustment screw to set belt tension.

Shaft Bearings: Radial, self-aligning bearings.

Retain "Ball-Bearing Rating Life" or "Roller-Bearing Rating Life" subparagraph below.

Ball-Bearing Rating Life: ABMA 9, [**L10 of 50,000 hours**] <**Insert life**>.

Roller-Bearing Rating Life: ABMA 11, [**L10 of 50,000 hours**] <**Insert life**>.

Extend lubrication lines to outside of casing and terminate with grease fittings.

* + - * 1. Accessories:

Retain applicable accessories below; verify availability with manufacturers.

Companion Flanges: Rolled flanges of same material as housing.

Inspection Door: Bolted door allowing limited access to internal parts of fan, of same material as housing.

Propeller Access Section Door: Short duct section bolted to fan [**inlet**] [**and**] [**outlet**] allowing access to internal parts of fan for inspection and cleaning, of same material as housing.

Swingout Construction: Assembly allowing entire fan section to swing out from duct for cleaning and servicing, of same material as housing.

Mounting Clips: [**Horizontal ceiling**] [**Vertical mounting**] clips welded to fan housing, of same material as housing.

Horizontal Support: Pair of supports bolted to fan housing, of same material as housing.

Vertical Support: Short duct section with welded brackets bolted to fan housing, of same material as housing.

Inlet Screen: On unducted fan inlet - wire-mesh screen, of same material as housing.

Outlet Screen: On unducted fan outlet - wire-mesh screen, of same material as housing.

Backdraft Dampers: Butterfly style, for bolting to fan discharge or outlet cone, of same material as housing.

Shaft Seal: Elastomeric seal and PTFE wear plate, suitable for up to 300 deg F.

Motor Cover: Cover with side vents to dissipate motor heat, of same material as housing.

Inlet Vanes: Adjustable; with peripheral control linkage operated from outside of airstream, bronze sleeve bearings on each end of vane support, and provision for manual or automatic operation, of same material as housing.

Inlet Bell: Curved inlet for when fan is not attached to duct[**, of same material as housing**] [**; aluminum**].

Inlet Cone: Round-to-round transition, of same material as housing.

Outlet Cone: Round-to-round transition, of same material as housing.

Stack Cap: Vertical discharge assembly with backdraft dampers, of same material as housing.

Direct-Driven Units: Encase motor in housing outside of airstream. Extend lubrication lines to outside of casing and terminate with grease fittings.

[**Factory-wired motor disconnect switch located on outside of fan housing.**]

* + - * 1. Factory Finishes:

Delete "Sheet Metal Parts" and "Exterior Surfaces" subparagraphs below for non-steel housing construction.

Sheet Metal Parts: Prime coat before final assembly.

Exterior Surfaces: Baked-enamel finish coat after assembly.

Retain "Coatings" subparagraph below for special protection applications. Review manufacturer's data for specific trade names and literature.

Coatings: [**Epoxy**] [**Zinc**] [**Phenolic**] [**Powder-baked enamel**]; <**Insert manufacturer's name and trade name**>.

Apply to finished housings.

Apply to fan wheels.

* + - 1. VANEAXIAL FANS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Greenheck Fan Corporation.

Rupp Air Management Systems.

Trane Inc.

Approved equivalent.

* + - * 1. Source Limitations: Obtain vaneaxial fans from single manufacturer.
				2. Description: Fan wheel and housing, straightening vane section, factory-mounted motor with belt or direct drive, an inlet cone section, and accessories.

Variable-Pitch Fans: Internally mounted [**electric**] [**electronic**] actuator, externally mounted positive positioner, and mechanical-blade-pitch indicator.

* + - * 1. Housings: [**Steel**] [**Aluminum**] [**Fiberglass-reinforced plastic**] [**Stainless steel**] <**Insert material**>.

Inlet and Outlet Connections: Flanges.

Guide Vane Section: Integral guide vanes downstream from fan wheel designed to straighten airflow.

Retain one of three "Wheel Assemblies" paragraphs below.

* + - * 1. Wheel Assemblies: Cast aluminum with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.
				2. Wheel Assemblies: Fiberglass-reinforced plastic cured under pressure with airfoil-shaped blades keyed to stainless-steel shaft.
				3. Wheel Assemblies: Cast-aluminum hub assembly, machined and fitted with threaded bearing wells to receive blade-bearing assemblies with replaceable, cast-aluminum blades; factory mounted and balanced.

Retain "Belt Drives" paragraph below for belt-driven fans.

* + - * 1. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

Service Factor Based on Fan Motor Size: [**1.2**] [**1.3**] [**1.4**] [**1.5**].

Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

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

5-hp limit in "Motor Pulleys" subparagraph below is standard with many manufacturers but is designer's choice.

Motor Pulleys: Adjustable pitch for use with motors through [**5**] <**Insert number**> hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

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

Belt Guards: Fabricate of steel for motors mounted on outside of fan cabinet.

Motor Base: Adjustable rail mount motor base with adjustment screw to set belt tension.

Shaft Bearings: Radial, self-aligning bearings.

Retain "Ball-Bearing Rating Life" or "Roller-Bearing Rating Life" subparagraph below.

Ball-Bearing Rating Life: ABMA 9, [**L10 of 100,000 hours**] <**Insert life**>.

Roller-Bearing Rating Life: ABMA 11, [**L10 of 100,000 hours**] <**Insert life**>.

Extend lubrication lines to outside of casing and terminate with grease fittings.

* + - * 1. Accessories:

Retain applicable accessories below; verify availability with manufacturers.

Companion Flanges: Rolled flanges of same material as housing.

Inspection Door: Bolted door allowing limited access to internal parts of fan, of same material as housing.

Propeller Access Section Door: Short duct section bolted to fan [**inlet**] [**and**] [**outlet**] allowing access to internal parts of fan for inspection and cleaning, of same material as housing.

Swingout Construction: Assembly allowing entire fan section to swing out from duct for cleaning and servicing, of same material as housing.

Mounting Clips: [**Horizontal ceiling**] [**Vertical mounting**] clips welded to fan housing, of same material as housing.

Horizontal Support: Pair of supports bolted to fan housing, of same material as housing.

Vertical Support: Short duct section with welded brackets bolted to fan housing, of same material as housing.

Inlet Screen: On unducted fan inlet - wire-mesh screen, of same material as housing.

Outlet Screen: On unducted fan outlet - wire-mesh screen, of same material as housing.

Backdraft Dampers: Butterfly style, for mounting with flexible connection to fan discharge or direct mounted to discharge diffuser section, of same material as housing.

"Stall Alarm Probe" subparagraph below may be used to activate an alarm, to activate controls, to adjust blade pitch, or to shut down fan.

Stall Alarm Probe: Sensing probe capable of detecting fan operation in stall and signaling control devices. Control devices and sequence of operation are specified in Section 230923.23 "Pressure Instruments" and Section 230993.11 "Sequence of Operations for HVAC DDC."

Flow Measurement Port: Pressure measurement taps installed in fan inlet to detect and signal airflow readings to temperature-control systems. Control devices and sequence of operation are specified in Section 230923.14 "Flow Instruments" and Section 230993.11 "Sequence of Operations for HVAC DDC."

Shaft Seal: Elastomeric seal and PTFE wear plate, suitable for up to 300 deg F.

Motor Cover: Cover with side vents to dissipate motor heat, of same material as housing.

Inlet Bell: Curved inlet for when fan is not attached to duct, of same material as housing.

Inlet Cone: Round-to-round transition, of same material as housing.

Outlet Cone: Round-to-round transition, of same material as housing.

Stack Cap: Vertical discharge assembly with backdraft dampers, of same material as housing.

Direct-Driven Units: Encase motor in housing outside of airstream. Extend lubrication lines to outside of casing and terminate with grease fittings.

[**Factory-wired motor disconnect switch located on outside of fan housing.**]

* + - * 1. Factory Finishes:

Delete "Sheet Metal Parts" and "Exterior Surfaces" subparagraphs below for non-steel housing construction.

Sheet Metal Parts: Prime coat before final assembly.

Exterior Surfaces: Baked-enamel finish coat after assembly.

Retain "Coatings" subparagraph below for special protection applications. Review manufacturer's data for specific trade names and literature.

Coatings: [**Epoxy**] [**Zinc**] [**Phenolic**] [**Powder-baked enamel**]; <**Insert manufacturer's name and trade name**>.

Apply to finished housings.

Apply to fan wheels.

* + - 1. MIXED-FLOW FANS
				1. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

Greenheck Fan Corporation.

Howden.

Approved equivalent.

* + - * 1. Source Limitations: Obtain mixed-flow fans from single manufacturer.
				2. Description: Fan wheel and housing,[**straightening vane section,**] factory-mounted motor with [**belt drive**] [**or**] [**direct drive**], and accessories.
				3. Housings: [**Steel**] [**Galvanized steel**] [**Aluminum**].

Inlet and Outlet Connections: Outer mounting frame and companion flanges.

Guide Vane Section: Integral guide vanes downstream from fan wheel designed to straighten airflow.

Retain "Mixed-Flow Outlet Connection" subparagraph below only for fans configured this way.

Mixed-Flow Outlet Connection: [**One**] [**Two**] flanged discharge(s) perpendicular to fan inlet.

* + - * 1. Wheel Assemblies: Cast aluminum with airfoil-shaped blades mounted on cast-iron wheel plate keyed to shaft with solid-steel key.

Retain "Belt Drives" paragraph below for belt-driven fans.

* + - * 1. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.

Service Factor Based on Fan Motor Size: [**1.2**] [**1.3**] [**1.4**] [**1.5**].

Fan Shaft: Turned, ground, and polished steel designed to operate at no more than 70 percent of first critical speed at top of fan's speed range.

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

5-hp limit in "Motor Pulleys" subparagraph below is standard with many manufacturers but is designer's choice.

Motor Pulleys: Adjustable pitch for use with motors through [**5**] <**Insert number**> hp; fixed pitch for use with larger motors. Select pulley so pitch adjustment is at the middle of adjustment range at fan design conditions.

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

Motor Base: Adjustable rail mount motor base with adjustment screw to set belt tension.

Shaft Bearings: Radial, self-aligning bearings.

Retain "Ball-Bearing Rating Life" or "Roller-Bearing Rating Life" subparagraph below.

Ball-Bearing Rating Life: ABMA 9, [**L10 of 100,000 hours**] <**Insert life**>.

Roller-Bearing Rating Life: ABMA 11, [**L10 of 100,000 hours**] <**Insert life**>.

Extend lubrication lines to outside of casing and terminate with grease fittings.

* + - * 1. Accessories:

Retain applicable accessories below; verify availability with manufacturers.

Mounting Clips: [**Horizontal ceiling**] [**Vertical mounting**] clips welded to fan housing, of same material as housing.

Inlet and Outlet Screens: On unducted fan inlet and outlet - wire-mesh screen, of same material as housing.

Backdraft Dampers: Butterfly style, for mounting with flexible connection to fan discharge or direct mounted to discharge diffuser section, of same material as housing.

Motor Cover: Cover with side vents to dissipate motor heat, of same material as housing.

Inlet Bell: Curved inlet for when fan is not attached to duct, of same material as housing.

Inlet Cones: Round-to-round transition, of same material as housing.

Outlet Cones: Round-to-round transition, of same material as housing.

Stack Cap: Vertical discharge assembly with backdraft dampers, of same material as housing.

Direct-Driven Units: Encase motor in housing outside of airstream.

[**Factory-wired motor disconnect switch located on outside of fan housing.**]

* + - * 1. Factory Finishes:

Delete "Sheet Metal Parts" and "Exterior Surfaces" subparagraphs below for non-steel housing construction.

Sheet Metal Parts: Prime coat before final assembly.

Exterior Surfaces: Baked-enamel finish coat after assembly.

Retain "Coatings" subparagraph below for special protection applications. Review manufacturer's data for specific trade names and literature.

Coatings: [**Epoxy**] [**Zinc**] [**Phenolic**] [**Powder-baked enamel**]; <**Insert manufacturer's name and trade name**>.

Apply to finished housings.

Apply to fan wheels.

* + - 1. SOURCE QUALITY CONTROL

AMCA compliance may not be available on all fans. Verify applicability with manufacturer and adjust this article where necessary.

* + - * 1. 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. AMCA Compliance:

Comply with AMCA performance requirements and bear the AMCA-Certified Ratings Seal.

Sound-power rating information may only be available from manufacturers on request. See discussion on sound and vibration control in the Evaluations.

* + - * 1. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans in accordance with AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
				2. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings in accordance with AMCA 210/ASHRAE 51, "Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating."
1. EXECUTION
	* + 1. INSTALLATION
				1. Install axial fans level and plumb.
				2. Disassemble and reassemble units, as required for moving to the final location, in accordance with manufacturer's written instructions.
				3. Lift and support units with manufacturer's designated lifting or supporting points.
				4. Equipment Mounting:

Retain first subparagraph below to require equipment to be installed on cast-in-place concrete equipment bases.

Install fans on cast-in-place concrete equipment bases. Comply with requirements for equipment bases and foundations specified in Section 033000 "Cast-in-Place Concrete."

Retain one of two subparagraphs below. Retain first for projects in seismic areas; retain second for projects not in seismic areas. Indicate vibration isolation and seismic-control device and minimum deflection in supported equipment schedule on Drawings.

Comply with requirements for vibration isolation and seismic-control devices specified in Section 230548 "Vibration and Seismic Controls for HVAC."

Comply with requirements for vibration isolation devices specified in Section 230548.13 "Vibration Controls for HVAC."

* + - * 1. Install units with adequate clearances for service and maintenance.
				2. Label fans in accordance with requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

Coordinate duct installations and specialty arrangements with Drawings and with requirements specified in duct systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Section 233300 "Air Duct Accessories."
			1. ELECTRICAL CONNECTIONS
				1. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
				2. Ground equipment in accordance with Section 260526 "Grounding and Bonding for Electrical Systems."
				3. Install electrical devices furnished by manufacturer, but not factory mounted, in accordance with NFPA 70 and NECA 1.
				4. Install nameplate for each electrical connection, indicating electrical equipment designation and circuit number feeding connection.

Retain one of two subparagraphs below. First subparagraph cross-references Section 260553 "Identification for Electrical Systems" and should be retained for consistent electrical identification. Second subparagraph is an abbreviated version of the product specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs, as specified in Section 260553 "Identification for Electrical Systems."

Nameplate shall be laminated acrylic or melamine plastic signs with a black background and engraved white letters at least 1/2 inch high.

* + - 1. CONTROL CONNECTIONS
				1. Install control and electrical power wiring to field-mounted control devices.
				2. Connect wiring in accordance with Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
			2. FIELD QUALITY CONTROL

Retain one of first four paragraphs below. Retain first "Testing Agency" paragraph below if Owner will hire an independent testing agency.

Retain "Testing Agency" paragraph below to require Contractor to hire an independent testing agency.

* + - * 1. Testing Agency: Engage a qualified testing agency to perform tests and inspections.

Retain "Manufacturer's Field Service" paragraph below to require a factory-authorized service representative to perform tests and inspections.

* + - * 1. Manufacturer's Field Service: Engage a Company Service Advisor to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform tests and inspections" paragraph below to require Contractor to perform tests and inspections and retain option to require Contractor to arrange for the assistance of a factory-authorized service agent.

* + - * 1. Perform tests and inspections [**with the assistance of a Company Service Advisor**].

Fan Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.

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

* + - * 1. Fans and components will be considered defective if they do not pass tests and inspections.
				2. Prepare test and inspection reports.
			1. STARTUP SERVICE:
				1. [**Engage a Company Service Advisor to perform**] [**Perform**] startup service.

Complete installation and startup checks in accordance with manufacturer's written instructions.

Verify that shipping, blocking, and bracing are removed.

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.

Verify that cleaning and adjusting are complete.

For direct-drive fans, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation.

For belt-drive fans, 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.

Adjust belt tension.

Adjust damper linkages for proper damper operation.

Verify lubrication for bearings and other moving parts.

Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.

Disable automatic temperature-control operators, energize motor and confirm proper motor rotation and unit operation, adjust fan to indicated rpm, and measure and record motor voltage and amperage.

Shut unit down and reconnect automatic temperature-control operators.

Remove and replace malfunctioning units and retest as specified above.

* + - 1. ADJUSTING
				1. Adjust damper linkages for proper damper operation.
				2. Adjust belt tension.
				3. Lubricate bearings.
				4. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC."
			2. CLEANING
				1. After completing system installation and testing, adjusting, and balancing and after completing startup service, clean fans internally to remove foreign material and construction dirt and dust.
			3. DEMONSTRATION
				1. [**Engage a Company Service Advisor to train**] [**Train**] Director’s Representative's maintenance personnel to adjust, operate, and maintain axial HVAC fans.

END OF SECTION 233413