SECTION 233439 - HIGH-VOLUME, LOW-SPEED 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 high-volume, low-speed fans.
			2. DEFINITIONS
				1. HVLS - High volume, low speed.
			3. SUBMITTALS
				1. Submittals for this section are subject to the er-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.

Fan speed controllers.

* + - * 1. Sustainable Design Submittals:

Retain subparagraphs below to require supporting documentation specific to individual prerequisites and credits.

* + - * 1. Shop Drawings:

Include plans, elevations, sections, and mounting details.

Include details of equipment assemblies. Show 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.

Retain "Delegated-Design Submittal" paragraph below if design services have been delegated to Contractor.

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. 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.

* + - * 1. Coordination Drawings: Floor plans and details, drawn to scale and coordinated with each other, using input from installers of the items involved.

Coordinate "Qualification Data" paragraph below with qualification requirements in Section 014000 "Quality Requirements" and as may be supplemented in "Quality Assurance" Article.

* + - * 1. Qualification Data:

For Installer: Certificate from HVLS fan manufacturer certifying that Installer has successfully completed prerequisite training administered by manufacturer for proper installation of systems, including but not limited to, equipment, controls, and accessories indicated and furnished for installation.

Retain "Seismic-Restraint Details" subparagraph below only if seismic design requirements apply, but calculations have not been made, and Drawings do not describe seismic restraints in detail. Retaining subparagraph requires Contractor to submit seismic-restraint, delegated-design Drawings prepared by a professional engineer. Revise to suit requirements of authorities having jurisdiction.

* + - * 1. Seismic-Restraint Details:

Design Analysis: To support selection and arrangement of seismic restraints.

Details: Indicate fabrication and arrangement. Detail attachments of restraints to the restrained items and to the structure. Show attachment locations, methods, and spacings. Identify components, list their strengths, and indicate directions and values of forces transmitted to the structure during seismic events. Indicate association with vibration isolation devices.

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 HVLS fans to include in emergency, operation, and maintenance manuals.
			2. QUALITY ASSURANCE
				1. Manufacturer Qualifications: Provide certification that manufacturer complies with [**UL/ CSA**] requirements[**the most recent edition of ISO 9001**] <**Insert requirement**>.
				2. Installer Qualifications: An entity that employs installers and supervisors who are trained and approved by HVLS fan manufacturer.

Each employee shall be certified by manufacturer for proper installation of systems, including, but not limited to, equipment, controls, and accessories indicated and furnished for installation.

Installer certification shall be valid and current for duration of Project.

Retain copies of Installer certificates on-site and make available on request.

Each person assigned to Project shall have demonstrated past experience.

Demonstrated past experience with products being installed for period within [**three**] [**five**] <**Insert number**> consecutive years before time of bid.

Demonstrated past experience on [**five**] <**Insert number**> projects of similar complexity, scope, and value.

* + - 1. DELIVERY, STORAGE, AND HANDLING
				1. Deliver and store products in a clean and dry place.
				2. Comply with manufacturer's written rigging and installation instructions for unloading and moving to final installed location.
				3. Handle products carefully to prevent damage, breaking, denting, and scoring. Do not install damaged products.
				4. Protect products from weather, dirt, dust, water, construction debris, and physical damage.

Retain factory-applied coverings on equipment to protect finishes during construction and remove just prior to operating unit.

Cover unit openings before installation to prevent dirt and dust from entering inside of units. If required to remove coverings during unit installation, reapply coverings over openings after unit installation and remove just prior to operating unit.

* + - * 1. Replace installed products damaged during construction.
			1. WARRANTY

When warranties are required, verify with Director’s Representative's counsel that warranties stated in this article are not less than remedies available to Director’s Representative under prevailing local laws. Warranty terms vary from one manufacturer to another. Selection of particular warranty terms in the following paragraph may limit competition. Verify that each manufacturer retained in this Section offers the warranty coverage selected.

* + - * 1. Warranty: Manufacturer and Installer agree to repair or replace components of fans that fail in materials or workmanship within specified warranty period.

Verify available warranties and warranty periods for units and components.

Warranty Period:

For Motor, Including Controls: [**Five**] [**Seven**] [**10**] <**Insert number**> year(s) from date of Substantial Completion.

For Parts, Including Blades and Hub: [**Five**] [**Seven**] [**10**] <**Insert number**> year(s) from date of Substantial Completion.

For Labor: [**One**] [**Two**] <**Insert number**> year(s) from date of Substantial Completion.

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. For definitions of terms and requirements for Contractor's product selection, see Section 016000 "Product Requirements."

* + - 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.

Compliance with UL and CSA standards is not available for all fans, or from all manufacturers. Verify that the options retained are available from each manufacturer retained in this Section.

UL 507 is a standard for electric fans. It has been adopted by the Canadian Standards Association as CSA C22.2, No. 113.

* + - * 1. UL Compliance: Listed and labeled to UL 507.
				2. CSA Compliance: Listed and labeled to CSA C22.2, No. 113.

NFPA 13 has specific requirements for HVLS fans: Maximum allowable fan diameter is 24 feet (7.3 m). HVLS fans need to be approximately centered between four adjacent sprinklers. Vertical clearance from the HVLS fan to the sprinkler deflection needs to be a minimum of 3 feet (0.9 m). According to NFPA 72, all HVLS fans need to be interlocked to shut down immediately upon receiving a waterflow signal from the fire alarm system.

* + - * 1. Comply with NFPA 13 requirements for HVLS fans.
				2. AMCA Compliance:

Test HVLS fans according to AMCA 230.

Certify HVLS fan performance according to AMCA 211.

* + - * 1. Performance Data: Comply with ANSI 230 test procedure standard, based on five rating points: 20-, 40-, 60-, 80-, and 100-percent of maximum speed. Comply with AMCA 211 for publication of performance data.

Retain "Delegated Design" Paragraph below if Contractor is required to assume responsibility for design.

* + - * 1. Delegated Design: Engage a qualified professional engineer, as defined in Section 014000 "Quality Requirements," to design HVLS ceiling fans.

Retain "Seismic Performance" Paragraph below with "Seismic-Restraint Details" 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: HVLS ceiling fans shall withstand the effects of earthquake motions determined according to [**ASCE/SEI 7**] <**Insert requirement**>.

Retain 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 HVLS fans will remain in place without separation of any parts when subjected to the seismic forces specified[**and the units 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, schedule HVLS fans on Drawings.

* + - * 1. Fan:

Type: HVLS [**Upflow**] [**Downflow**] [**Selectable**].

Number of Fan Blades: <**Insert number**>.

Fan Diameter: <**Insert value**> feet (m).

Maximum Fan Speed: <**Insert rpm**>.

Fan Airflow at AMCA Rating Points cfm (L/s):

Airflow at 20 Percent: <**Insert value**>.

Airflow at 40 Percent: <**Insert value**>.

Airflow at 60 Percent: <**Insert value**>.

Airflow at 80 Percent: <**Insert value**>.

Airflow at 100 Percent: <**Insert value**>.

Fan Discharge Sound Power at Maximum Speed, dB:

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

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

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

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

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

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

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

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

* + - * 1. Motor:

Size: <**Insert horsepower**>.

Speed: <**Insert rpm**>.

Volts: [**120**] [**208**] [**230**] [**277**] [**460**] <**Insert value**> V.

Phase: [**Single**] [**Three**] <**Insert number**>.

Hertz: [**60**] <**Insert number**> Hz.

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

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

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

* + - 1. MANUFACTURERS

* + - * 1. [Manufacturers:](http://www.specagent.com/Lookup?ulid=13449) Subject to compliance with requirements, provide products by one of the following:

[Big Ass Fans](http://www.specagent.com/Lookup?uid=123457150801).

[Hunter Fan Company; Industrial & Commercial Division](http://www.specagent.com/Lookup?uid=123457150809).

[Thermotek](http://www.specagent.com/Lookup?uid=123457150808).

Approved equivalent.

* + - * 1. Source Limitations: Obtain HVLS fans from single source from single manufacturer.
			1. HIGH-VOLUME, LOW-SPEED FANS
				1. Description: Factory-assembled and -tested horizontal, non-ducted fan unit, consisting of large-diameter blade set, direct-drive electric motor, with [**speed-reducing gearbox**] [**variable-speed motor controller**].

Provide fan designed to circulate large air volume, vertically, at low velocity.

Most manufacturers produce fans rated for 140 deg F (60 deg C). Consult retained manufacturers.

Maximum Operating Temperature: [**122 (50)**] [**140 (60)**] <**Insert value**> deg F (deg C).

Verify, with manufacturers, that options retained are available from each manufacturer and for each product retained in this Section.

Frame:

Material: [**Aluminum**] [**Galvanized steel**] [**Stainless steel**] <**Insert metal**>.

Finish: [**Paint**] [**Powdercoat**] [**Thermoset, polyester powder paint**] [**Anodized**] <**Insert finish**>.

Not every manufacturer produces a fan with every diameter listed in "Diameter" Subparagraph below. Verify, with manufacturers, that options retained in subparagraph below are available from each manufacturer and for each product retained in this Section.

Diameter: [**8 (2.4)**] [**10 (3.0)**] [**12 (3.7)**] [**14 (4.3)**] [**16 (4.9)**] [**18 (5.5)**] [**20 (6.1)**] [**24 (7.3)**] <**Insert diameter**> feet (m).

Not every manufacturer produces a fan with every combination of blade quantity, blade material, and finish listed in "Blades" Subparagraph below. Verify, with manufacturers, that options retained are available from each manufacturer and for each product retained in this Section.

Blades: Airfoil type.

Quantity: [**3**] <**Insert number**>.

Material: [**Aluminum**] <**Insert material**>.

Blade Finish: [**Anodized**] <**Insert finish**>.

Verify that options retained in "Motor" Subparagraph below are available for each manufacturer and product retained in this Section.

Motor: [**Squirrel cage**], [**integral to fan frame**] [**totally enclosed fan cooled**] [**ODP**] [**explosion proof**] <**Insert motor enclosure class**>.

For general commercial applications, NEMA 1 enclosures are usually sufficient. For fans exposed to moisture conditions or washdown, consider NEMA 4 enclosure. For fans exposed to moisture conditions or washdown, and to corrosive conditions, consider NEMA 4X enclosure.

Wiring and Controls Enclosure:

NEMA 250, [**Class 1**] [**Class 4**] [**Class 4X**] <**Insert NEMA enclosure class**>.

Retain one option in "Material" and "Enclosure Finish" subparagraphs below. Typically, stainless steel is not painted or coated. Aluminum may be painted, anodized, or polished.

Material: [**Aluminum**] [**Galvanized steel**] [**Stainless steel**] <**Insert metal**>.

Enclosure Finish: [**Paint**] [**Powdercoat**] [**Thermoset**] [**Polyester powder paint**] [**Anodized**] [**Polished**] <**Insert finish**>.

Grounded.

Most manufacturers offer a wall-mounted keypad as standard equipment. Some manufacturers offer interface components to allow a facility building automation system to control the fan and other digital thermostat control options.

Controls: Provide [**wall-mounted keypad**] <**Insert controlling device**>.

Verify, with manufacturers, that options retained in first subparagraph below are available from each manufacturer and for each product retained in this Section.

Provide [**fixed**] [**automatic**] [**manual**] [**variable speed motor controller**] [**Insert speed control component here**] **speed control**.

The sound-power level (noise) varies widely based on blade quantity, rotation rate, length of blade, and blade profile. Insert sound performance criteria, and verify that products of retained manufacturers can achieve the required sound performance.

Maximum Sound Power Level: <**Insert value**> dBA.

Standard Mounting Bracket: Steel beam/steel angle.

Most fan manufacturers offer optional mounting brackets and hardware for the mounting conditions in "Mounting Bracket" Subparagraph below.

Mounting Bracket: [**Large beam**] [**Solid beam**] [**Z-purlin**] <**Insert mounting bracket type**>.

Not all manufacturers offer each optional accessory listed in "Accessories" Subparagraph below. Verify, with manufacturers, the accessories available for products retained in this Section.

Accessories:

Mounting extension tube.

<**Insert accessory option here**>.

1. EXECUTION
	* + 1. EXAMINATION
				1. Examine conditions for compliance with requirements for installation tolerances and other conditions affecting HVLS fan performance, maintenance, and operations.

Fan locations indicated on Drawings are approximate. Determine exact locations before roughing-in for mounting, control, and electrical connections.

* + - * 1. Examine roughing-in for mounting location, anchor-bolt sizes, and locations, to verify actual locations for mounting connections before installation of fan.
				2. Examine areas for suitable conditions where fan will be installed.
				3. Proceed with installation only after unsatisfactory conditions have been corrected.
			1. INSTALLATION OF HIGH-VOLUME LOW-SPEED FANS
				1. Install fan according to manufacturer's published instructions.
				2. Comply with NECA 1 and NFPA 70.
				3. Comply with NFPA 13 for installation of HVLS fans and maximum allowable fan diameter. Center HVLS fans between four adjacent sprinklers. Minimum vertical clearance from HVLS fan to sprinkler deflector is 3 feet (0.9 m).
				4. Comply with NFPA 72 and interlock HVLS fans to shut down upon receiving an alarm from fire alarm system.
				5. Equipment Mounting:

Retain second option in first subparagraph below when a delegated-design submittal has been submitted and approved.

Anchor fan to building structure [**with manufacturer's recommended mounting bracket**] [**as shown in approved delegated design**] for installed condition.

Consult a licensed professional Structural Engineer for mounting methods and approval for mounting to the structure. Structure must be able to withstand the torque and forces generated by the fan.

Comply with requirements for hangers and supports specified in Section 230529 "Hangers and Supports for HVAC Piping and Equipment."

Retain one of or both subparagraphs below, based on project requirements. Verify that the Sections referenced in below subparagraphs are included in Project Manual.

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 unit to permit access for maintenance.
				2. Install parts and accessories shipped loose.
			1. ELECTRICAL CONNECTIONS
				1. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."
				2. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."
				3. Install electrical devices furnished by manufacturer, but not factory mounted, according to 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 (13 mm) high.

* + - * 1. Install power wiring to field-mounted electrical devices, furnished by fan manufacturer, but not factory mounted.
			1. CONTROL CONNECTIONS
				1. Connect control wiring to field-mounted control devices.
				2. Connect control wiring according to Section 260523 "Control-Voltage Electrical Power Cables."
				3. Connect control interlock wiring between HVLS fan and other equipment to provide a complete and functioning system.

Retain first paragraph below to connect fans to control system for remote control and monitoring by the building management system.

* + - * 1. Connect control wiring between fan unit control interface and control system to provide remote control and monitoring.
				2. Install control devices furnished by manufacturer, but not factory mounted.
				3. Install control wiring to field-mounted control devices, furnished by fan manufacturer, but not factory mounted.
				4. Protect installed units from damage caused by other work.
			1. FIELD QUALITY CONTROL

Retain one of first four paragraphs below. Retain first "Testing Agency" Paragraph below if Director’s Representative will hire an independent testing agency.

* + - * 1. Testing Agency, Director’s Representative Engaged: Director’s Representative will engage a qualified testing agency to perform tests and inspections.

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

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

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

* + - * 1. Manufacturer's Field Service: Engage a factory-authorized service company field advisor to test and inspect components, assemblies, and equipment installations, including connections.

Retain "Perform the following 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 Company Service factory-authorized service agent.

* + - * 1. Perform the following tests and inspections[**with the assistance of a factory-authorized service company field 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.

See Section 014000 "Quality Requirements" for retesting and reinspecting requirements and Section 017300 "Execution" for requirements for correcting the Work.

* + - * 1. Fan or components will be considered defective if fan or components do not pass tests and inspections.
				2. Prepare and submit test and inspection reports.
			1. STARTUP SERVICE
				1. [**Engage a factory-authorized service company field advisor to perform**] [**Perform**] startup service.

Complete installation and startup checks according to manufacturer's written instructions.

Verify that fan is secure on mountings and supporting devices and that connections to electrical systems are complete. Verify that proper thermal-overload protection is installed in motors, controllers and switches.

Verify proper motor rotation direction and free fan rotation.

Retain option in first subparagraph below for fans equipped with speed reducing gearboxes. Otherwise delete the option.

Check bearing [**and gearbox**] lubrication.

Retain option in subparagraph below for fans equipped with a selector switch for fan rotation.

Verify proper fan rotation. [**Set rotation selector to blow vertically downward during heating season, and vertically upward during cooling season.**]

* + - 1. ADJUSTING
				1. Comply with requirements in Section 230593 "Testing, Adjusting, and Balancing for HVAC" for air-handling system testing, adjusting, and balancing.
			2. CLEANING
				1. Clean equipment externally; remove coatings applied for protection during shipping and storage, foreign material, and oily residue according to manufacturer's written instructions. Following manufacturer's cleaning procedures, and clean with manufacturer-recommended cleaning products.
			3. DEMONSTRATION
				1. [**Engage a factory-authorized service company field advisor to train**] [**Train**] Facility’s Director’s Representative's maintenance personnel to adjust, operate, and maintain HVLS fans.

Retain paragraph below for video training session.

* + - * 1. Video training sessions, and provide electronic copy of video to Director’s Representative.

END OF SECTION 233439