SECTION 233416 - 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. Section Includes: For each product.
   1. HVAC 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.
   7. Fan speed controllers.

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

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

1.5 MAINTENANCE MATERIAL SUBMITTALS

A. Belts: One set(s) 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. Balance Quality:
   1. All wheels (rotors/impellers) shall be factory statically and dynamically balanced on precision electronic balancers to a Balance Quality Grade G6.3 per ANSI/AMCA Standard 204-05 or better.

C. Vibration Levels:
   1. Each fan assembly shall be vibration tested before shipping in accordance with AMCA 204-05.
   2. Each assembled fan shall be test run at the factory at the specified fan RPM and vibration signatures shall be taken on each bearing in three planes - horizontal, vertical, and axial.
   3. Unless otherwise indicated, the maximum allowable factory fan vibration shall be less than 0.15 in./sec peak velocity for rigidly mounted fans and 0.20 in./sec peak velocity for flexibly mounted fans. Values are peak velocity values, filter-in, at the fan rotational speed.

D. 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.

E. Capacities and Characteristics: Refer to drawings.

2.2 HIGH-PLUME DILUTION LABORATORY EXHAUST SYSTEM

A. Basis-of-Design Product: Subject to compliance with requirements, provide Greenheck Vektor-CH or comparable product by one of the following:
   1. Greenheck Fan Corporation
   2. Loren Cook Company
   3. New York Blower Company (The)
   4. Twin City Fan & Blower

B. General
   1. Base fan performance at standard conditions (density 0.075 Lb. /ft3).
   2. Fans selected shall be capable of accommodating static pressure and flow variations of +/- 15% of scheduled values.

3. Each fan shall be belt driven in AMCA arrangement 10 according to drawings.
4. Each fan to be equipped with 316 stainless steel lifting lugs for corrosion resistance.
5. Fasteners exposed to corrosive exhaust shall be 316 stainless steel.
6. Fan assemblies that use flexible connectors that can fail and cause loss of laboratory containment shall not be acceptable.
7. Fan assembly shall be designed for a minimum of 125 mph wind loading, without the use of guy wires.

C. Corrosion Resistant Coating
1. All fan and system components (fan, nozzle and plenum) shall be corrosion resistant coated with a two part electrostatically applied and baked, sustainable, corrosion resistant coating system. Standard finish color to be white.
2. All parts shall be cleaned and chemically prepared for coating using a multi-stage wash system which includes acid pickling that removes oxide, increases surface area, and improves coating bond to the substrate.
3. The first powder coat applied over the prepared surface shall be a zinc rich epoxy primer (no less than 70% zinc) and heated to a gelatinous consistency (partial cure) at which the second powder coat of polyester resin shall be electrostatically applied and simultaneously be cured at a uniform temperature of 400°F.
4. The coating system, a total thickness of up to 6 mils, shall not be affected by the UV component of sunlight, and has superior corrosion resistance to acid, alkali, and solvents.
5. Coating system shall exceed 4000 hour ASTM B117 Salt Spray Resistance.

D. Fan Housing and Outlet
1. Fan housing to be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.
2. Fan housing shall be centrifugal involute scroll, allowing all drive components including the motor to be serviced without contact of the contaminated airstream, and manufactured of welded steel. Housing to be corrosion resistant coated.
3. Fan housings that are fabricated of polypropylene or fiberglass that have lower mechanical properties than steel, have rough interior surfaces in which corrosive, hazardous compounds can collect, and / or which chalk and structurally degrade due to the UV component of the sunlight shall not be acceptable.
4. A high velocity discharge nozzle shall be supplied by the fan manufacturer designed to efficiently handle an outlet velocity of up to 7000 FPM. Discharge stack caps or hinged covers, impeding exhaust flow shall not be permitted.
5. An integral fan housing drain shall be used to drain rainwater when the fan is de-energized.
6. A bolted housing access door shall be supplied for impeller inspection.
7. Fan assembly shall be AMCA type C spark resistant construction minimum or as noted on the schedule.

E. Fan Impeller
1. Fan impeller shall be centrifugal, single width single inlet, backward inclined airfoil blade design with non-stall characteristics. The impeller shall be electronically balanced both statically and dynamically exceeding AMCA Standards.
2. Fan impeller shall be manufactured of welded steel and meet specification section 2.3.C for corrosion resistant coating.

3. Fan impellers that are fabricated of polypropylene or fiberglass that have lower mechanical properties than steel, and lower maximum tip speeds are not acceptable.
4. Vacuum Seal: Fan impeller shall include a secondary fan blade located on the impeller back plate. This secondary impeller shall create a negative pressure at the shaft opening; preventing hazardous or toxic exhaust fumes from escaping through the housing shaft opening. Mechanical shaft seals that wear out and need to be replaced or seal systems that use hoses or tubes that can leak, are not acceptable.

F. Bypass Air Plenum
1. For variable volume systems, the fan manufacturer shall provide a bypass air plenum as shown on drawings. The plenum shall be provided with bypass air damper(s) for introducing outside air at roof level upstream of the fan, complete with bypass air weatherhood and bird screen.
2. The plenum shall be constructed of welded steel and meet specification for corrosion resistant coating. Plenums that are fabricated of plastics or resins that are combustible and have mechanical properties less than steel shall not be acceptable.
3. The bypass air plenum shall be mounted on an insulated curb.
4. Fan designs that use inlet flexible connectors that can leak causing loss of lab exhaust shall not be permitted.
5. Bypass air damper(s) shall be opposed-blade design for airflow control, airfoil design, fabricated of 304 stainless steel for structural rigidity as standard. Bypass damper(s) shall have plated steel damper rods, stainless steel sleeved bearings, 301 stainless steel jamb seals and the blades shall have polymer edge seals. Damper model shall be equal to or exceed a heavy duty control damper, Greenheck HCH-130. Damper blade drive linkage shall be set by manufacturer and welded to eliminate linkage slippage. All damper access and service (drive actuators) shall be performed outside of the contaminated airstream.
6. An integral bypass air packed acoustic attenuator fabricated of stainless steel shall be provided by the fan manufacturer.
7. Fan isolation damper(s), shall be parallel-blade design, airfoil design, fabricated of 304 stainless steel construction for structural rigidity as standard. Damper(s) shall be coated up to 4 mils of chemically resistant Hi-Pro Polyester resin, electrostatically applied and baked. Isolation damper(s) shall have plated steel damper rods (if specified as 304 stainless steel damper, stainless steel damper rods will be provided), stainless steel sleeved bearings, 301 stainless steel jamb seals and the blades shall have polymer edge seals. Damper model shall be equal to or exceed a heavy duty control damper, Greenheck HCH-130. Damper blade drive linkage shall be set by manufacturer and welded to eliminate linkage slippage. All damper access and service (drive actuators) shall be performed outside of the contaminated airstream.
8. Isolation damper actuator(s), if scheduled shall be factory mounted and shall be wired to a step-down transformer. Actuator and transformer are located in a weatherproof enclosure.
9. Blower / Plenum vibration isolation shall be limited to neoprene / cork vibration pads.
10. Plenum shall include a removable bypass air weatherhood that is properly sized for low inlet velocity of the bypass air, minimizing the possibility of moisture entrainment.

G. Bypass Air Plenum Curb
1. Exhaust system manufacturer shall supply a structural support curb for the plenum of specified height as shown on the drawings.

2. Curb shall be fabricated of a minimum of 12 gauge corrosion-resistant coated steel and structurally reinforced.
3. Curb shall be insulated.
4. When properly anchored to the roof structure, the standard curb / plenum / blower assembly shall withstand wind loads of up to 125 mph without additional structural support.

H. Fan Motor and Drive
1. Motors shall be premium efficiency, standard NEMA frame, 1800 or 3600 RPM, TEFC with a 1.15 service factor. A factory-mounted NEMA 4X disconnect switch shall be provided for each fan.
2. Motor maintenance shall be accomplished without fan or fan impeller removal, or requiring maintenance personnel to access the contaminated exhaust components.
3. Belt drive configuration shall be AMCA arrangement 10.
4. Drive belts and sheaves shall be sized for 200% of the fan operating brake horsepower, and shall be readily and easily accessible for service, if required. Drive shall consist of a minimum of two belts under all circumstances.
5. Fan shaft to be turned and polished of 316 stainless steel as standard, coated with corrosion resistant coating.
6. L-10 life of no less than 200,000 hours.
7. All shaft bearings and non-permanently lubricated motors shall have stainless steel braided extended lube lines with Zerk fittings.
8. Motor, coupling, and bearing shall all be outside the contaminated exhaust, and be capable of replacement without disassembling fan and accessing hazardous and contaminated fan components.

2.3 MODULAR PLENUM FAN ARRAY, DIRECT DRIVE (TYPE B)

A. Basis-of-Design Product: Subject to compliance with requirements, provide Twin City MPQN or comparable product by one of the following:
1. Climate Craft
2. LAU
3. Greenheck Fan Corporation
4. Huntair; Nortek Air Solutions, LLC
5. Loren Cook Company
6. TMI Climate Solutions;
7. Twin City Fan & Blower

B. Description:
1. Factory-fabricated, -assembled, -tested, and -finished, housed direct-driven plenum fan consisting of wheel, fan shaft, motor, drive assembly, and support structure.
2. Fan plate shall be aerodynamically designed with high-efficiency inlet, engineered to reduce incoming air turbulence.

C. Fan Wheels:
1. Non-tapered wheel with twelve airfoil-shaped extruded aluminum blades, and non-tapered style blade retaining ring on inlet side.
2. Hollow die-formed, airfoil-shaped blade wheels with continuous welds around edges.

D. Inlet Cone: Heavy-gauge, spun steel inlet cones, closely matched to wheel intake rim.

E. Housing: Steel structural housing which allows fans to be bolted together in multiple fan array configurations.

1. Heavy gauge galvanized steel panels and framework to provide a rigid structure to support the shaft and bearings and reduce low frequency vibration.

2. Minimum 2" insulated enclosure with perforated lining.

F. Motor Pedestal: Heavy-duty motor mounting platform.

G. Vibration Isolation:

1. Drive assembly including the inlet cone, wheel and motor assembly shall be isolated from the insulated enclosure with integral neoprene or spring isolators.

2. For multi-fan (bolted together) installation, provide rubber gasketing between fan mounting surfaces to mitigate vibration transfer.

H. Finishes:

1. After fabrication, deburr, clean and chemically pretreat metal parts by phosphatization.

2. Apply two coats of manufacturer's air-dried enamel.

I. Accessories:

1. Shaft Grounding Ring: Conductive ring to stay in continuous contact with motor shaft, designed to collect stray currents and shunt them to frame ground.

2. Acoustic Diffuser: Provide to reduce discharge sound power level by up to 3 dBA while increasing aerodynamic static efficiency by up to 4 percent.

a. Fabricate of galvanized steel, mounts at front and back of fan wheel. Include acoustic attenuating material inserted within solid housing and perforated frontplate that directs airflow across diffuser.

b. Mounting brackets constructed of galvanized steel mount directly to framework allowing for mounting within existing fan framework.

c. Provide diffuser factory mounted.

3. Piezometer Ring: Provide piezometer ring type differential pressure sensor with nylon tubing to connections for field-installed flow measuring instrumentation.

4. Backdraft Damper:

a. Backdraft dampers shall be provided for automatic isolation of individual fans.

b. Maximum 0.10 in. wc air static pressure drop while fans and motors are operating.

c. Low leakage rate of 3.5 cfm/sq. ft. at 4" static pressure. AMCA certified back draft damper pressure drop ratings shall be based on being located within 12" from the plane in which the fan inlet cone is located, or discharge dampers located within a distance of two fan wheel diameters from the plane of the back plate of the plenum fan wheel.

2.4 MOTORS

A. Comply with NEMA designation, temperature rating, service factor, and efficiency requirements for motors specified in Section 230513 "Common Motor Requirements for HVAC Equipment."

2.5 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 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.

D. Equipment Mounting:
   1. Install fans on cast-in-place concrete equipment base(s). Comply with requirements for equipment bases and foundations specified in Division 03.
   2. Comply with requirements for vibration isolation and seismic control devices specified in Section 230548 "Vibration Controls for HVAC."

E. Curb Support: Install roof curb on roof structure, level and secure, according to "The NRCA Roofing and Waterproofing Manual," Low-Slope Membrane Roofing Construction Details Section, Illustration "Raised Curb Detail for Rooftop Air Handling Units and Ducts." Install and secure fans on curbs, and coordinate roof penetrations and flashing with roof construction. Secure units to curb support.

F. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch. Vibration-control devices are specified in Section 230548 "Vibration and Seismic Controls for HVAC."

G. Install units with clearances for service and maintenance.

H. Label fans according to requirements specified in Section 230553 "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

A. 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."

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

C. Ground equipment according to Section 260526 "Grounding and Bonding for Electrical Systems."

D. Connect wiring according to Section 260519 "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

A. Perform the following 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.
3. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
4. Verify that cleaning and adjusting are complete.
5. 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.
6. Trim balance assembled fans to reduce vibration to acceptable operation in-situ START-UP vibration levels in accordance with AMCA Standard 204-05. The final assembly test run shall be provided BEFORE commissioning for service.
7. Adjust belt tension.
8. Adjust damper linkages for proper damper operation.
9. Verify lubrication for bearings and other moving parts.
10. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
11. See Section 230593 "Testing, Adjusting, and Balancing For HVAC" for testing, adjusting, and balancing procedures.
12. 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 fans.

END OF SECTION 233416