

SECTION 23 34 16 - 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. Laboratory exhaust fans

1.3 PERFORMANCE REQUIREMENTS

- A. Project Altitude: Base fan performance ratings on sea level.
- B. Operating Limits: Classify according to AMCA 99.

1.4 SUBMITTALS

- A. Product Data: Include rated capacities, furnished specialties, and accessories for each type of product indicated and include the following:
 - 1. Certified fan performance curves with system operating conditions indicated.
 - 2. Submit the family of rpm curves indicating operating point relative to fan class.
 - 3. Drive construction and rating.
 - 4. Catalog cuts and dimension drawings.
 - 5. Submit all selected sheave (fan and motor) calculations.
 - 6. Correction chart for fans equipped with variable inlet vanes indicating performance at various percentage of opening.
 - 7. VFD application: Submit fan selection with system curve indication, operating point, family of all rpm curves in fan class and the "DO NOT SELECT TO THE LEFT OF THIS CURVE". The minimum rpm shall be indicated.

8. Certified fan sound-power ratings.
 9. Motor ratings and electrical characteristics, plus motor and electrical accessories.
 10. Material thickness and finishes, including color charts.
 11. Dampers, including housings, linkages, and operators.
 12. Roof curbs
- B. Shop Drawings: Detail equipment assemblies and indicate dimensions, weights, loads, required clearances, method of field assembly, components, and location and size of each field connection.
1. Wiring Diagrams: Power, signal, and control wiring.
 2. Design Calculations: Calculate requirements for selecting vibration isolators and seismic restraints and for designing vibration isolation bases.
 3. Vibration Isolation Base Details: Detail fabrication, including anchorages and attachments to structure and to supported equipment. Include auxiliary motor slides and rails, and base weights.
- C. Coordination Drawings: Show fan room layout and relationships between components and adjacent structural and mechanical elements. Show support locations, type of support, and weight on each support. Indicate and certify field measurements.
- D. Field quality-control test reports.
- E. Operation and Maintenance Data: For centrifugal fans to include in emergency, operation, and maintenance manuals.
- 1.5 QUALITY ASSURANCE
- A. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70, Article 100, by a testing agency acceptable to authorities having jurisdiction, and marked for intended use.
 - B. AMCA Compliance: Products shall comply with performance requirements and shall be licensed to use the AMCA-Certified Ratings Seal.
 1. Test and rate all fans in accordance with the standards of AMCA. All fans shall bear the AMCA rating and seal.
 - C. NEMA Compliance: Motors and electrical accessories shall comply with NEMA 1.
- 1.6 DELIVERY, STORAGE, AND HANDLING
- A. Deliver fans as factory-assembled units, to the extent allowable by shipping limitations, with protective crating and covering.
 - B. Disassemble and reassemble units, as required for moving to the final location, according to manufacturer's written instructions.

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

1.7 COORDINATION

- A. Coordinate size and location of structural-steel support members.
- B. Coordinate size and location of concrete bases. Cast anchor-bolt inserts into bases. Concrete, reinforcement, and formwork requirements are specified in Division 03.
- C. Coordinate installation of roof curbs, equipment supports, and roof penetrations. These items are specified in Division 07 Section "Roof Accessories."

1.8 EXTRA MATERIALS

- A. Furnish extra materials described below that match products installed and that are packaged with protective covering for storage and identified with labels describing contents.
 - 1. Belts: One set(s) for each belt-driven unit.
 - 2. Sheaves : One set(s) for each unit

PART 2 - PRODUCTS

2.1 GENERAL

- A. Make appropriate allowances for the effects on fan performance of all installation conditions including plenum enclosures and inlet and discharge arrangements so that actual installed fan performance equals that specified.
- B. Fans shall be non-overloading and operate stably without surging at design conditions.
- C. Fan characteristic curves provided by manufacturer must be such that that the fan operating point:
 - 1. Is to the right of peak efficiency.
 - 2. Is on the steep part of the fan curve such that an increase in static pressure over the specified duty results in not more than the same percent decrease in volume (CFM) and does not affect the stability of fan operation.
 - 3. Is no greater than 60 to 70 percent of the peak static pressure.
 - 4. Has the ability to provide an allowable increase in fan speed of 15 percent above the design point without surging or increasing the class of fan.

- D. Provide non-overloading design, except as noted with minimum capacities as noted and with certified ratings by AMCA.
- E. Wheel shall be factory balanced statically and dynamically. Brake horsepower ratings shall be 5 percent maximum above those noted and published for a minimum of two (2) years.
- F. Motor pulley shall be variable pitch diameter, for fans up to 25 hp and 1000 rpm, except fans with variable inlet vanes and VFD's use fixed pitch, and fixed pitch diameter, over 25 hp or 1000 rpm. Supply and install one fixed pitch pulley change, as required, per fan to balance systems. Companion sheaves shall maintain belts parallel. Belt guards shall be in compliance with OSHA regulations and with tachometer opening for fan speed measurements. Manufacturer shall provide replacement fixed pitched sheaves where needed to balance system.
- G. Provide removable flanged screens at inlets or outlets where no connecting ductwork is indicated, including inlets to fans in field erected casings.
- H. Bearings shall be ball, roller or taper. Provide pressure type lubricating fittings with pressure relief fittings extended to accessible locations. Lubricating fittings shall be similar to Alemite. Pressure relief fittings shall be similar to Keystone. For fans 27 inch and larger, provide housings horizontally split, roller bearings.
- I. Split construction: Provide split construction for fans too large for available doorways or passageways. Split in half along center of shaft with angles, etc., to allow removal of section without disturbing inlet and discharge connection; arranged for bolting. Provide bolts with lockwashers and nuts. Construction shall be inspected by manufacturer after field assembly and certified that they have been properly assembled and ready for proper operation.
- J. The drive end of the fan shaft shall be countersunk for tachometer readings.
- K. For all fans located outdoors, except roof ventilators exposed to the weather, provide custom fitted weather guards completely enclosing the fan motor, drive and bearings. Provide weatherproof louvers in the enclosure to permit circulation of air but to exclude rain and snow. Arrange one side of the enclosure to be completely removable for access to motors, drives, bearings and other equipment located within requiring maintenance. Construct the enclosure of 16 gauge aluminum, braced with aluminum angles. Paint the fan exterior with two coats of weatherproof aluminum paint.

2.2 AIRFOIL CENTRIFUGAL FANS

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

- B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- a. The fan shall be of welded construction utilizing corrosion resistant fasteners. The scroll wrapper and scroll side panels shall be minimum 12 gauge steel (minimum 8 gauge steel for Class III).
- C. Housings: Formed panels to make curved-scroll housings with shaped cutoff, with doors or panels to allow access to internal parts and components.
1. The entire fan housing shall have continuously welded seams for leak proof operation and shall have a minimum 1-1/2 inch outlet discharge flange. A performance cut-off shall be furnished to prevent the recirculation of air in the fan housing. Bearing support shall be minimum 1/4 inch steel. Lifting lugs shall be provided for ease of installation. Unit shall bear an engraved aluminum nameplate and shall be shipped in ISTA certified transit tested packaging.
 2. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 3. Spun inlet cone with flange.
 4. Outlet flange.
- D. Airfoil Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange; heavy backplate; hollow die-formed, airfoil-shaped blades continuously welded at tip flange and backplate; and cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- E. 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.
- F. Grease-Lubricated Shaft Bearings for fans less than 1500 rpm: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- G. Grease-Lubricated Shaft Bearings for fans greater than 1500 rpm: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.

2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- H. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor Size: 1.5.
 2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.
 3. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
 4. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
 5. Motor Mount: Adjustable for belt tensioning.
- I. Accessories:
1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
 2. Cleanout Door: Quick-opening, latch-type gasketed door allowing access to fan scroll, of same material as housing.
 3. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
 4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
 5. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
 6. Inlet Screens: Grid screen of same material as housing.
 7. Kitchen exhaust fans are to be arrangement #10, UL762 rated, provide grease drain, grease collector, high temperature resistant paint
 8. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft. (kitchen exhaust only)
 9. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
 10. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing.
- J. Motors: Comply with requirements in Division 23 Section "Common Motor Requirements for HVAC Equipment."
1. Enclosure Type: Totally enclosed, fan cooled.
- 2.3 BACKWARD-INCLINED CENTRIFUGAL FANS
- A. Manufacturers: Subject to compliance with requirements, provide products by one of the following:

1. Aerovent; a Twin City Fan Company.
 2. Loren Cook Company.
 3. Greenheck
- B. Description: Factory-fabricated, -assembled, -tested, and -finished, belt-driven centrifugal fans consisting of housing, wheel, fan shaft, bearings, motor and disconnect switch, drive assembly, and support structure.
- C. Housings: Formed panels to make curved-scroll housings with shaped cutoff; with doors or panels to allow access to internal parts and components.
1. Panel Bracing: Steel angle- or channel-iron member supports for mounting and supporting fan scroll, wheel, motor, and accessories.
 2. Spun inlet cone with flange.
 3. Outlet flange.
- D. Backward-Inclined Wheels: Single-width-single-inlet and double-width-double-inlet construction with curved inlet flange, backplate, backward-inclined blades welded or riveted to flange and backplate; cast-iron or cast-steel hub riveted to backplate and fastened to shaft with set screws.
- E. 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 a 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.
- F. Grease-Lubricated Shaft Bearings for fans less than 1500 rpm: Self-aligning, pillow-block-type, tapered roller bearings with double-locking collars and two-piece, cast-iron housing.
1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- G. Grease-Lubricated Shaft Bearings for fans greater than 1500 rpm: Self-aligning, pillow-block-type, ball or roller bearings with adapter mount and two-piece, cast-iron housing.
1. Ball-Bearing Rating Life: ABMA 9, L10 at 120,000 hours.
 2. Roller-Bearing Rating Life: ABMA 11, L10 at 120,000 hours.
- H. Belt Drives: Factory mounted, with final alignment and belt adjustment made after installation.
1. Service Factor Based on Fan Motor Size: 1.5.
 2. Fan Pulleys: Cast iron or cast steel with split, tapered bushing; dynamically balanced at factory.

3. Belts: Oil resistant, nonsparking, and nonstatic; matched sets for multiple belt drives.
4. Belt Guards: Fabricate to comply with OSHA and SMACNA requirements of diamond-mesh wire screen welded to steel angle frame or equivalent, prime coated. Secure to fan or fan supports without short circuiting vibration isolation. Include provisions for adjustment of belt tension, lubrication, and use of tachometer with guard in place.
5. Motor Mount: Adjustable for belt tensioning.

I. Accessories:

1. Scroll Access Doors: Shaped to conform to scroll, with quick-opening latches and gaskets.
2. Cleanout Door: Quick-opening, latch-type gasketed door allowing access to fan scroll, of same material as housing.
3. Scroll Drain Connection: NPS 1 (DN 25) steel pipe coupling welded to low point of fan scroll.
4. Companion Flanges: Rolled flanges for duct connections of same material as housing.
5. Discharge Dampers: Assembly with opposed blades constructed of two plates formed around and to shaft, channel frame, and sealed ball bearings; with blades linked outside of airstream to single control lever of same material as housing.
6. Inlet Screens: Grid screen of same material as housing.
7. Shaft Cooler: Metal disk between bearings and fan wheel, designed to dissipate heat from shaft. (kitchen exhaust only)
8. Shaft Seals: Airtight seals installed around shaft on drive side of single-width fans.
9. Weather Cover: Enameled-steel sheet with ventilation slots, bolted to housing
10. Kitchen exhaust fans are to be arrangement #10, UL762 rated, provide grease drain, grease collector, high temperature resistant paint.

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

1. Enclosure Type: Totally enclosed, fan cooled.

2.4 SOURCE QUALITY CONTROL

- A. Sound-Power Level Ratings: Comply with AMCA 301, "Methods for Calculating Fan Sound Ratings from Laboratory Test Data." Factory test fans according to AMCA 300, "Reverberant Room Method for Sound Testing of Fans." Label fans with the AMCA-Certified Ratings Seal.
- B. Fan Performance Ratings: Establish flow rate, pressure, power, air density, speed of rotation, and efficiency by factory tests and ratings according to AMCA 210, "Laboratory Methods of Testing Fans for Rating."

PART 3 - EXECUTION

3.1 INSTALLATION

- A. Install centrifugal fans level and plumb.
- B. Support floor-mounting units using spring isolators having a static deflection of 1 inch (25 mm). Vibration- and seismic-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
 - 1. Secure vibration and seismic controls to concrete bases using anchor bolts cast in concrete base.
- C. Install floor-mounting units on concrete bases. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- D. Install floor-mounting units on concrete bases designed to withstand, without damage to equipment, the seismic force required by authorities having jurisdiction. Concrete, reinforcement, and formwork requirements are specified in Division 03 Section "Cast-in-Place Concrete."
- E. Support suspended units from structure using threaded steel rods and spring hangers having a static deflection of 1 inch (25 mm). Vibration-control devices are specified in Division 23 Section "Vibration and Seismic Controls for HVAC Piping and Equipment."
- F. Install units with clearances for service and maintenance.
- G. Label fans according to requirements specified in Division 23 Section "Identification for HVAC Piping and Equipment."

3.2 CONNECTIONS

- A. Duct installation and connection requirements are specified in other Division 23 Sections. Drawings indicate general arrangement of ducts and duct accessories. Make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 Section "Air Duct Accessories."
- B. Install ducts adjacent to fans to allow service and maintenance.
- C. Install line-sized piping from scroll drain connection, with trap with seal equal to 1.5 times specified static pressure, to nearest floor drain.
- D. Ground equipment according to Division 26 Section "Grounding and Bonding for Electrical Systems."
- E. Connect wiring according to Division 26 Section "Low-Voltage Electrical Power Conductors and Cables."

3.3 FIELD QUALITY CONTROL

- A. Perform the following field tests and inspections and prepare test reports:
1. Verify that shipping, blocking, and bracing are removed.
 2. Verify that unit is secure on mountings and supporting devices and that connections to ducts and electrical components are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.
 3. Verify that cleaning and adjusting are complete.
 4. Disconnect fan drive from motor, verify proper motor rotation direction, and verify fan wheel free rotation and smooth bearing operation. Reconnect fan drive system, align and adjust belts, and install belt guards.
 5. Adjust belt tension.
 6. Adjust damper linkages for proper damper operation.
 7. Verify lubrication for bearings and other moving parts.
 8. Balance all fan wheels and all other moving components statically and dynamically. Where a coating is specified and it affects the balance of the fan wheel, perform the balancing after the coating has been applied.
 9. Verify that manual and automatic volume control and fire and smoke dampers in connected ductwork systems are in fully open position.
 10. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
 11. 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.
 12. For units with variable frequency drives lock out critical frequencies before initial start.
 13. Operational Test: After electrical circuitry has been energized, start units to confirm proper motor rotation and unit operation.
 14. Replace fan and motor pulleys as required to achieve design airflow.
 15. Shut unit down and reconnect automatic temperature-control operators.
 16. Remove and replace malfunctioning units and retest as specified above.
- B. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.

3.4 ADJUSTING

- A. Adjust damper linkages for proper damper operation.
- B. Adjust belt tension.
- C. Lubricate bearings
- D. Refer to Division 23 Section "Testing, Adjusting, and Balancing for HVAC" for testing, adjusting, and balancing procedures.
- E. Replace fan and motor pulleys as required to achieve design airflow.

Maine Medical Center
Bean 2 Roof Addition
For Construction
ADDENDUM No. 3
Issued for Permit

PERKINS+WILL
C140135461 (MMC) /152168.00 (P+W)
June 14, 2013
January 17, 2014
February 07, 2014

3.5 DEMONSTRATION

- A. Train Owner's maintenance personnel to adjust, operate, and maintain centrifugal fans. Refer to Division 01 Section "Demonstration and Training."

END OF SECTION