

## SECTION 23 34 16 - CENTRIFUGAL FANS

### PART I - GENERAL

#### 1.1 WORK INCLUDES

- A. Ventilation Contractor provides:
  - 1. Airfoil Centrifugal Fans
  - 2. Plenum Fans
  - 3. Mixed Flow Fans
  - 4. Direct Drive Fans
  - 5. Fan Arrays (bank of plug or plenum fans). *[Note to AE: This application must first be pre-approved by the Engineer and F&S Engineering Services.]*

#### 1.2 QUALITY ASSURANCE

- A. Performance Ratings: Bear the AMCA Certified Rating Seal - Air Performance.
- B. Fabrication: Conform to AMCA 99.

#### 1.3 SUBMITTALS

- A. Submit shop drawings per *Section 01 33 23 – Shop Drawings, Product Data, and Samples*. Include all centrifugal fans and accessories. Provide fan curves with specified operating point clearly plotted. Submit sound power levels for both fan inlet and outlet at rated capacity. Submit motor ratings and electrical characteristics, plus motor and electrical accessories.
- B. Submit operation and maintenance data. Include instructions for lubrication, motor and drive replacement, and spare parts list.

#### 1.4 DELIVERY, STORAGE, AND HANDLING

- A. Protect motors, shafts, and bearings from weather and construction dust.

#### 1.5 EXTRA STOCK

- A. Provide one extra belt set for each fan unit.

### PART 2 - PRODUCTS

#### 2.1 FANS - ALL / GENERAL:

*[Note to AE: Special applications requiring the use of Fan Arrays and any associated VFDs shall be fully pre-designed in accordance with F&S Engineering Services' recommendations for the Project-specific parameters. Manufacturer assistance and pre-engineering are required to be accepted by F&S Engineering Services before finalizing Project-specific specifications. Fan Arrays shall not be sole-sourced.]*

- A. Tested and Certified: Fans shall be tested and certified in accordance with applicable AMCA test codes. All fans shall be certified AMCA Class II or higher. Units shall arrive at the project bearing certification seal.
- B. Furnished Complete: Fan(s) and assemblies shall be furnished complete with motors, wheels, drive assemblies, bearings, coating(s) and accessories as hereinafter specified. Motors/assemblies using V-belt drives shall be furnished with adjustable rails or bases.
- C. One Operating Point: Select fan to operate at single stable operating point as predicted by fan curve. Any fan having 2 potential simultaneous operating points on fan curves is not acceptable.
- D. 60 To 75 Percent WOCFM: All fans shall be selected at design conditions with the design CFM falling in the range of at least 60 percent, but no greater than 75 percent, of Wide

Open CFM “WOCFM” for the design rpm. This range helps avoid the unstable region left of the peak efficiency system curve.

- E. Maximum RPM: All fan selections shall conform to all criteria listed in this section. Additionally, the design point RPM for each selection shall be at least 40 percent less than the maximum RPM for the respective fan. AMCA Class selection may require the next higher class should the above combination of criteria force a new selection.
- F. Efficiency Curve: For units compatible with variable frequency drives, the design operating point shall be at or to the right of the peak efficiency point or peak efficiency system curve. Total Efficiency (TE) of the fan selection shall equal or exceed 55 percent at the design point.
- G. All Bearings: Shall be “Heavy Duty” rated, grease lubricated, ball or roller self-aligning, pillow block type housing with grease seal. Bearings shall be selected for a minimum (AFBMA L-10) life of not less than 200,000-hrs operation at maximum cataloged operating speed based on AFBMA 9 and 11. Furnish bearings with pressure relief type external grease fittings. Bearings shall be factory lubricated. Both unit bearings shall have the same bore, type and manufacturer. At least one of the bearings shall be fixed. The bearing supports shall be removable for access to and removal of the fan wheel.
- H. Centrifugal Fan Shaft Bearings: In addition to respective fan type bearing criteria, provide “Lube-Lite” or equal auto-greasers on all applications in which bearings are inaccessible due to being platform mounted or physically located in a remote location, which would otherwise require special OSHA regulated access. Extended copper lube lines may be used to allow “line of sight” connection between bearing and Lube Lite style auto-greaser.
- I. Shaft: Shaft shall be manufactured AISI 1040 or 1045 hot rolled steel shaft, turned, precision ground and polished steel shafts shall be sized (and ring gauged for accuracy) so the first critical speed is at least 25 percent over the maximum operating speed for each pressure class. Close tolerances shall be maintained where the shaft makes contact with the bearing.
- J. Belt Driven Fans and Motors: Unless otherwise indicated, original equipment manufacturer (OEM) Serial number – matched V-belt drive set(s) shall be selected and provided. Belts shall be applied in matched sets. V-belts shall be Gates, Vulco Ropes or Falk, matched multiple A, B or C belts having a rating of not less than 150 percent of the motor nameplate horsepower. (Multi-groove pulleys using 2, 3 or 4 grooves shall be provided with matching companion pulleys such that the belts are properly aligned).
  - 1. As an alternate, flat / synchronous or “Cog” style belts and matching sheaves may be provided in accordance with Manufacturer design selection assistance and provided documentation with “For Approval” submittal to AE & Owner.
    - a. Designs provided must be biddable from at least (2) independent Manufacturers. Unique or otherwise sole-source Synchronous or “Cog” or herringbone or other patterns are not allowed.
    - b. This type of belt drive design can only be provided on VFD applications.
  - 2. All flat / synchronous or “Cog” belt designs shall include all exchanges for final field TAB work and then (1) one additional spare belt set per assembly for immediate stock all at no additional cost to the project or Owner.
- K. Direct Drive Fans: Direct drive fans are approved for use in conjunction with UIUC approved motors not to exceed 10 BHP nameplate rating.
- L. OSHA approved protective housings/screenings for rotating devices (including, but not limited to, fan wheels and drive assemblies): Use only OSHA approved housings or guards as per standard 1910.219 or current standard. Fan capacity shall account for restrictions caused by protective housing/screening. Each motor and drive shall have an OSHA approved guard arranged to permit easy removal for replacement of belts. Guards shall be rigidly installed to prevent noise from vibration and shall have 3-inch diameter hole with finished collar opposite fan shaft for use in taking fan rpm readings without removing the guard.

- M. Vibration: Fan/drive assemblies shall be factory run tested and dynamic balanced. Vibration signatures shall be taken on each bearing in horizontal, vertical and axial direction. Filter-in reading as measured over full spectrum of fan operating speeds shall not exceed following values:
1. Belt Drive (except Vane Axial) 0.15 in/sec peak velocity
  2. Belt Drive Vane Axial 0.10 in/sec peak velocity
  3. Direct Drive 0.10 in/sec peak velocity
- N. OSHA Compliant Belt Guards: Provide OSHA compliant belt and shaft guards to enclose entire drive. Construct face of guards of expanded metal having minimum 60% free area to allow for ventilation; provide speed test openings at shaft locations.
- O. Sound Power Levels: Shall be based on tests performed in accordance with AMCA Standards 300 and 301 and shall not exceed the lower of that listed by AMCA or as otherwise specified on the Drawings.
- P. 110% Air Quantity Scheduled: Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. Motor furnished with fan shall not operate into motor service factor in any of these cases.

## 2.2 MIXED FLOW FAN

- A. In addition to the requirements listed above for FANS – ALL /GENERAL, adhere to the following:
1. Mixed flow in-line fan with enclosure, connecting flanges, drives and motor.
  2. Wheel: Wheel shall be steel, non-overloading, high efficiency mixed-flow type. Contoured single thickness blades shall incorporate 3-D curvature for maximum efficiency across the entire surface of the blade. Blades shall be continuously welded to the backplate and inlet shroud. Hubs shall be keyed and securely attached to the fan shaft. Wheel shall overlap an aerodynamic aluminum inlet cone to provide maximum performance and efficiency.
  3. Provide fan mounted in either vertical or horizontal arrangement and ceiling or floor mounted as shown on the drawings.
  4. Belt drive with 1.5 design factor. Key and lock drives and driver sheaves to their shafts. Provide adjustable sheaves for 5 HP and below, and fix sheaves above 5 HP. Contractor shall provide replacement sheaves and belts as required for final air balance.
  5. The motor shall be mounted external to the fan on an adjustable base. Motor shall incorporate a universal mounting system that allows for field rotation of the motor in 90 degree increments. See Section 23 05 13 for motor requirements.
  6. Fans shall have self-aligning, grease-packed, pillow block bearings with a grease seal to prevent loss of lubricant and exclude dirt. Bearings shall absorb all the fan thrust. Extend grease fittings outside the fan. Bearings rated for 200,000 L-10 life at specified operating point
  7. Provide hanger rods to mount the fans complete with vibration isolators as scheduled in Specification Section 23 34 16.
  8. Fans shall be statically and dynamically balanced per general section above.
  9. Provide inlet and outlet screens where unit is not attached to ductwork or does not have inlet or outlet cones. Attach screens directly to the fan.
  10. Provide guard for the portion of the drive belt that is external to the fan.
  11. Acceptable Manufacturers: Loren Cook QMX, Greenheck QEI, Twin City QSL.

## 2.3 AIRFOIL PLENUM FANS

- A. In addition to the requirements listed above for FANS – ALL /GENERAL, adhere to the following:

1. Single width, single inlet non-overloading centrifugal fan with airfoil blades.
2. Deep contoured, spun or die-formed inlet cone.
3. Die formed, airfoil blades with moisture relief holes in the trailing edge. Formed from a single sheet of steel and welded at the trailing edge. Continuously weld blades to rim and bolt wheel to hub. Statically and dynamically balanced.
4. Cast iron hub with oversize flange, keyed to shaft.
5. ANSI 1040 or 1045 cold rolled solid steel shaft, accurately turned, ground and polished. Shaft shall be a constant diameter.
6. Shaft shall be straightened before and after cutting the keyways to maintain a maximum T.I.R. of .002".
7. First shaft critical speed at least 20% above maximum AMCA class speed.
8. Ball or roller bearings, grease packed or oil reservoir type.
9. Bearing L-10 life of at least 200,000 hours at specified operating conditions.
10. Extend lubrication lines beyond belt guards.
11. Provide inlet screen. Inlet screen shall be bolted to the fan for easy removal. Screens shall comply with OSHA opening size regulations.
12. Provide OSHA compliant safety screen enclosure around entire fan wheel. Enclosure shall be expanded metal screen bolted to heavy steel frame.
13. Prime all fan parts after cleaning, but prior to assembly. Apply a second finish coat to all exterior surfaces and all accessible interior surfaces after assembly. Apply rust preventative coating to shafts.
14. Belt drive selected for 1.5 times the brake horsepower. Adjustable pitch sheaves for 2 HP and below. Fixed sheaves above 2 HP. Contractor shall provide replacement sheaves and belts for final air balancing.
15. Mount fan and motor on a common vibration isolation base.
16. Install removable belt guard with shaft holes for tachometer. Construct from expanded metal or heavy gauge wire mesh with minimum 70% free area.
17. Fans shall operate with variable speed drives. Balance fans to operate at all speeds from zero RPM to full design speed. Motors shall be "Variable Frequency Drive Rated" when controlled by VFDs. See *Section 26 60 00 – Common Motor Requirements*.
18. Acceptable Manufacturers: Aerovent, Twin City, Greenheck, Chicago Blower, Cook, Peerless, or Barry Blower.

### PART 3 - EXECUTION

#### 3.1 INSTALLATION

- A. Do not operate fans for any purpose until ductwork is clean, filters are in place, bearings lubricated, and fan has been test run under observation.
- B. Install flexible connections between fan and ductwork. Install metal bands of connectors parallel with minimum 1" flex between ductwork and fan while running.
- C. Provide safety screen where inlet or outlet is exposed and an enclosure when fan wheel is exposed. Screens shall meet OSHA regulations for size of openings.
- D. Balance to 0.15 in/sec

END OF SECTION 23 34 16

This section of the *U of I Facilities Standards* establishes minimum requirements only. It should not be used as a complete specification.