

## SECTION 15850 – FANS AND ACCESSORIES

### PART 1 - GENERAL

#### 1.1 RELATED DOCUMENTS

- A. Drawings and general provisions of the Contract, including General and Supplementary Conditions and other Division 1 Specification Sections, apply to this Section.

#### 1.2 WORK INCLUDED

- A. Furnish and install all fans of the various types, arrangement and sizes specified herein and as scheduled on the drawings.
- B. Fans shall include all motors, drives, curbs, flashing, special coatings and accessories.
- C. Furnish and install backdraft dampers with all fans.
- D. Furnish and install all roof curbs and automatic dampers.

#### 1.3 RELATED SECTIONS

- A. Examine all drawings and criteria sheets and all other Sections of the Specifications for requirements which affect work under this Section whether or not such work is specifically mentioned in this Section.

#### 1.4 REFERENCES

- A. Applicable provisions of the following Codes and Trade Standard Publications shall apply to the work of this Section, and are hereby incorporated into, and made a part of the Contract Documents.
- B. Material standards shall be as specified or detailed hereinafter and as following:
  - 1. AMCA 99 – Standards Handbook; 1986.
  - 2. AMCA 210 – Laboratory Methods of Testing Fans for Rating Purposes; 1985.
  - 3. AMCA 261 – Directory of Products Licensed to Bear the AMCA Certified Ratings Seal; 1995.
  - 4. AMCA 300 – Test Code for Sound Rating Air Moving Devices; 1994.
  - 5. AMCA 301 – Method of Publishing Sound Rating Air Moving Devices; 1994.
  - 6. NEMA MG 1 – Motors and Generators; 1993 (and Revision 1).

7. NFPA 96 – Installation of Equipment for the Removal of Smoke and Grease Vapors from Commercial Cooking Equipment; 1994.
8. UL 705 – Power Ventilators; 1994.

#### 1.5 SUBMITTALS

- A. See Section 15050 and General Conditions for additional requirements.
- B. Submit certified curves showing fan performance with system operating points plotted on curves.
- C. Submit motor data sheets including motor efficiency and power factor at various loadings of nameplate horsepower. Motor efficiency and power factor shall be shown for 100%, 75% and 50% of nameplate horsepower. Submit data on efficiency and power factor required for motors 1 HP and above only. Motors shall have premium efficiency motors with minimum efficiency on motors listed in specification.
- D. Submit bearing sizing calculations for each similar size and type of fan. Fan bearing calculations shall be based on fan at maximum operating conditions including belt pull. Calculations shall be done for both fan bearings and motor bearings. Calculations required on centrifugal fans, vent sets in-line fans, wall mounted propeller fans and vane axial fans only.
- E. Submit sound power levels for each size and type of fan. Sound levels shall be in all (8) octave bands for discharge of fan, inlet to fan, and radiated noise through casing.
- F. Submit certified shop drawings indicating all dimensional data, and operating and maintenance clearances.

#### 1.6 QUALITY ASSURANCE

- A. Fans shall conform to most recent AMCA Bulletins regarding construction and testing. Fans shall be tested and rated per AMCA and shall be selected in proper operating range without motor overloading and fan surge.
- B. Manufacturers must prove experience in the production of similar products of this type for at least ten (10) years prior.
- C. Fans shall be air and sound certified in accordance with AMCA 210 and 300 and shall bear the AMCA seal.
- D. Kitchen Range Hood Exhaust Fans: Comply with requirements of NFPA 96.
- E. Products Requiring Electrical Connection: Listed and classified by Underwriters Laboratories Inc. and other testing firm acceptable to the authority having jurisdiction and all suitable for the purpose specified and indicated.

1.7 ENVIRONMENTAL REQUIREMENTS

- A. Do not operate fans for any purpose, temporary or permanent, until ductwork is clean, filters are in place, bearings have been lubricated and fan has been test run under observation.

PART 2 - PRODUCTS

2.1 GENERAL

- A. Manufacturers acceptable contingent upon product's compliance with the specifications are as follows:

- 1. Centrifugal Fans
  - a. Loren Cook Co.
  - b. Buffalo Forge Co.
  - c. Greenheck Fan Corp.
  - d. Twin City Fan
- 2. Plenum Fans
  - a. Greenheck Fan Corp.
  - b. Loren Cook Co.
  - c. Twin City Fan
- 3. Belted Fan Vent Sets
  - a. Loren Cook Co.
  - b. Buffalo Forge Co.
  - c. Greenheck Fan Corp.
  - d. Twin City Fan
- 4. Roof Mounted Centrifugal Fans
  - a. Greenheck Fan Corp.
  - b. Loren Cook Co.
  - c. ACME Fan Co.
  - d. Twin City Fan
- 5. Up-Blast Roof Mounted Centrifugal Fans
  - a. Greenheck Fan Corp.
  - b. Loren Cook Co.
  - c. ACME Fan Co.
  - d. Twin City Fan

6. High Pressure Roof Mounted Centrifugal Fans

- a. Loren Cook Co.
- b. Pace
- c. Greenheck Fan Corp.

7. In-Line Tubular Centrifugal Fans

- a. Greenheck Fan Corp.
- b. Loren Cook Co.
- c. Buffalo Forge Co.
- d. New York Blower
- e. Twin City Fan

8. Wall Mounted Propeller Fans

- a. Buffalo Forge Co.
- b. New York Blower
- c. Loren Cook Co.
- d. Greenheck Fan Corp.
- e. Twin City Fan

9. Vane Axial Fans

- a. Manually Adjustable Pitch
  - 1) New Philadelphia Fan Co.
  - 2) Woods Fan Co.
  - 3) Greenheck Fan Corp.
  - 4) Twin City Fan

B. Selection and Balancing

- 1. Provide and install items as listed in equipment schedules, as shown on drawings, and as specified, complete in all respects to the functions intended.
- 2. Provide fans capable of accommodating static pressure variations of  $\pm 10\%$ .
- 3. Provide balanced variable sheaves for motors 15 HP and under, and fixed sheaves for 20 HP and over.
- 4. Statically and dynamically balance fans in the field to eliminate vibration or noise transmission to occupied areas of the building. Provide certificate of compliance from manufacturer.
- 5. Provide OSHA and ANSI approved belt guards on interior mounted belt driven fans. Provide weatherproof ventilated housing for exterior mounted fans.
- 6. Provide special construction fans such as sparkproof, explosionproof, or coated fans as required by the schedule.
- 7. Provide safety, bird or insect screen where inlet or outlet is exposed.
- 8. All fans shall be manufactured in accordance with this specification even where techniques are required which are not considered standard by that manufacturer.

9. Verify fan arrangement with the Contractor including motor location for servicing and discharge arrangements for proper airflow.
10. Where fixed speed sheaves are specified for a particular fan, provide (2) additional sheaves (one motor and one drive) as necessary for final air balancing.

C. Painting

1. Each fan component shall be thoroughly cleaned, degreased and deburred before the application of a rust preventive primer.
2. Two (2) coats of a rust preventive primer shall be applied under a topcoat of air-dried epoxy or enamel. Minimum coating thickness shall be 5 to 6 mils. The final coat shall be applied after final assembly to all surfaces.
3. Special coatings shall be provided for corrosive exhaust systems as specified under the fan specification.

D. Additional Corrosion Protection

1. Fans serving laboratory fume hoods, or as scheduled on the drawings, shall have all components in contact with the airstream provided with a minimum of (2) coats of 5 mil thick air-dried Heresite VR500 coating.

E. Special Fan Construction

1. Fans serving laboratory fume hoods, paint spray booth, or scheduled on the drawings, shall be constructed in accordance with AMCA 99-0401 Type "A" or "B" spark resistant construction.

## 2.2 CENTRIFUGAL FANS

A. General

1. Fan selection and ratings shall be based on tests made in accordance with ASHRAE 51 and AMCA 210 and shall be licensed to bear the AMCA seal.
2. Fans shall be Class I construction and labeled UL 705.
3. Fans shall be backwardly inclined, airfoil, or flat blade type with a minimum of (10) blades.
4. Fans shall have sharply rising pressure characteristics at the operating point specified and shall be quiet and stable in operation. Horsepower characteristics shall be self-limiting and at peak value at the specified operating point.
5. The specified fan RPM, outlet velocity, and tip speed are the maximum acceptable. The motor horsepower, CFM, and static pressure are the minimum acceptable.
6. Fan arrangements shall be minimum AMCA pressure class, single-width, single-inlet or double-width, double-inlet, clockwise or counter-clockwise rotation, shall be as scheduled on the drawings and as coordinated by the Contractors in the field.

7. Each fan shall be fully assembled with motor and drive on a structural steel base and run tested at the factory prior to shipment of the unit. Testing shall be conducted at the operating speed or maximum fan class speed. The total fan assembly shall be checked for balance and compared against the acceptable levels on the Rathbone Chart. The amplitude of vibration (displacement in mils) at operating speed measured at each unit fan bearing shall not exceed the values given in the following table:

Fan RPM	Displacement Mils
500	4.2
800	3.0
1100	2.3
1400	1.9
1700	1.6

**Note:** Displacement shall be peak-to-peak in X, Y and Z directions.

**B. Fan Base**

1. Fan with motor and drive shall be mounted on a structural steel base having a minimum 6" depth.
2. The base shall be electrically welded, and after welding, the base shall be cleaned, primed and painted to match fan coating.
3. Base steel sizing and construction shall be sufficient to allow the entire assembly to withstand the rigors of shipping and rigging.
4. Base shall be provided with lifting lugs and motor slide rails.
5. Fans with inertia bases as indicated in equipment schedules on mechanical drawings shall have structural bases constructed to accommodate concrete after installation. Bases shall be in accordance with Vibration Isolation & Seismic Restraint Section 15241.
6. All bases shall be constructed with gusseted brackets to accommodate field installed spring isolators as specified under Vibration Isolation & Seismic Restraint Section 15241.

**C. Fan Housing**

1. Fan housing shall be heavy gauge continuous welded steel construction with fan scroll and bearings supported from a structural steel framework. Minimum gauge construction shall be as indicated in the material construction schedule.
2. Fan housing shall be suitably braced to prevent vibration and pulsation.
3. Fans having wheel diameters 36" and larger shall have horizontally flanged split housings as required for installation.
4. Fan housing and inlet shall be constructed to allow the fan wheel(s) to be removed through the inlet opening when the inlet cone is removed.
5. A quick opening clean out door, shaped to conform with the scroll contour shall be provided with heavy-duty latches.
6. A 1/2" tapped 3/4" diameter pipe coupling drain connection shall be welded to the fan scroll at the lowest point.

7. Fans shall be convertible to a minimum of (8) standard discharge arrangements.
8. All fans shall be provided with a flanged discharge. The Sheet Metal Contractor shall provide the matching companion flange.
9. Fan cut-off shall be provided to deliver good pressure distribution.
10. A weatherproof housing shall be provided with ventilation grilles to cover motor and drive assembly for exterior mounted fans.
11. Exhaust fans serving kitchen hoods shall be so designed to satisfy NFPA 96, UL 762 and any other local codes required for kitchen hood exhaust system with cleanout door and grease drain with grease containment container.

D. Fan Inlet and Wheel Cone

1. Precision die spun or formed, and matched inlet and wheel cones shall be provided for streamlined airflow into the wheel to ensure full loading of the blades.
2. Inlet and wheel cones shall be hyperbolic. Radial side sheets are not acceptable.
3. Inlet cone shall be heavy gauge steel bolted to fan housing to allow for removal.
4. Fans having duct-connected inlets shall be provided with a flanged inlet collar with matching companion flange.
5. Fans which are not duct connected shall be provided with inlet screen(s). Inlet screen(s) shall be a nominal 1" by 1" mesh fabricated 10-gauge steel.
6. Hubs shall be straight bored, keyed and set screwed to shaft for positive attachment. Hubs shall be securely riveted to the backplate or center plate.
7. Bushed hubs are not acceptable.
8. Double width double inlet fans shall be a single wheel of the common center plate design or (2) single-width single-inlet wheels back to back, each keyed and set screwed to a common shaft.
9. Fan blades shall be continuously welded to the inlet hub and the backplate.
10. Wheel center plate or backplate shall be heavy gauge steel construction with a minimum gauge as indicated in material construction schedule.
11. The fan shaft shall be solid AISI C-1018, 1040 or 1045 hot rolled steel, accurately turned, ground and polished, and ring gauged for accuracy.
12. Recommended bearing manufacturer tolerances must be met in the contact area for bearings.
13. All shafts must be dial indicator inspected for straightness after the keyways are cut.
14. Fan shaft shall be coated with a rust inhibitive coating.
15. Fan wheel shall be statically and dynamically balanced prior to fan assembly.
16. The entire rotating assembly shall be designed so the first critical speed is a minimum of 25% greater than the fan design speed.

E. Fan Shaft Bearings

1. Fan bearings shall be foot-mounted type, bolted on a rigid welded steel framework integral with the housing.
2. Bearings shall be sized for a minimum L-10 life of 200,000 hours at maximum fan class operating conditions including belt pull. Bearings shall be selected in accordance with standards set forth by the Anti-Friction Bearing Mfrs. Assn.
3. The bearings shall be double-row spherical, self-aligning, grease lubricated, roller bearings housed in a horizontally split pillow block housing.

4. Bearings shall be SKF-SAF Series 22500 or Linkbelt P-B22400H.
5. Extruded copper grease leads shall be provided to an easily accessible location.

F. Fan Drive

1. Fans shall be belt driven unless otherwise specified. The drive shall be a multiple V-belt type sized for 1.65 times the fan motor horsepower. Sheaves shall be fixed or adjustable based on fan motor horsepower as specified hereinbefore. The fan sheave shall have a tapered lock, split and keyed hub.
2. Motors shall meet requirements specified in Special Conditions Section.
3. Motors shall be 1800 rpm for all belt driven fans and 1200 RPM or 900 rpm for all direct driven fans.
4. An OSHA approved type fan drive guard shall be provided with provision for RPM measurement, without removing the guard. The guard shall be made of 1/2" 16 gauge flattened expanded steel, wrapped around a 16 gauge channel frame suitably braced to prevent vibration. Paint guard with coating similar to fan.
5. Fan belts shall be oil resistant 24,000-hour non-static belts.

G. Fan Material Construction Schedule

1. The following schedule indicates minimum allowable steel gauge thicknesses for construction:

Housing				Wheel			
Wheel Size	AMCA Pressure Class	Side Sheet	Scroll	Blades	Wheel Cone	Back-Plate	Center-Plate (DWDI)
12 thru 22	1	12	14	16	10	8	8
	2	10	12	16	10	8	8
	3	10	10	16	10	8	8
24 thru 33	1	12	14	16	10	8	8
	2	12	14	16	10	8	8
	3	8	10	16	10	8	1/4
36	1	12	14	16	10	8	8
	2	12	14	16	10	8	8
	3	8	10	16	10	8	1/4
40¼ thru 44½	1	12	12	14	10	8	8
	2	12	12	14	10	1/4	1/4
	3	8	10	14	10	1/4	1/4
49	1	12	12	12	10	8	8
	2	12	12	12	10	1/4	1/4
	3	8	10	12	10	1/4	1/4
54¼	1	12	12	12	8	8	1/4
	2	12	12	12	8	1/4	5/16
	3	8	10	12	8	1/4	3/8



Housing				Wheel			
Wheel Size	AMCA Pressure Class	Side Sheet	Scroll	Blades	Wheel Cone	Back-Plate	Center-Plate (DWDI)
60	1	12	12	12	8	3/16	1/4
	2	12	12	12	8	3/8	3/8
	3	8	10	12	8	3/8	3/8
66	1	8	8	10	1/4	3/16	5/16
	2	8	8	10	1/4	3/8	3/8
	3	8	8	10	1/4	3/8	3/8
73	1	8	8	8	1/4	1/4	5/16
	2	8	8	8	1/4	3/8	3/8
	3	8	8	8	1/4	3/8	3/8

- Manufacturers shall use their standard gauges if heavier than those indicated above. Information on standard construction shall be made known if requested by the Architect/Engineer.

## 2.3 PLENUM FAN ASSEMBLIES

### A. General

- All fans shall meet the airflow performance specified and shall not exceed the break horsepower or sound power levels specified on the mechanical equipment schedule.
- Fan performance shall be based on testing and be in accordance with AMCA Standards 210 and 300. All fans shall have a steep pressure/volume curve.
- Fans shall be AMCA certified for air and sound performance.
- Fan(s) shall be plenum type, designed for horizontal airflow
- Fans shall be AMCA arrangement 3 with airfoil backward-inclined blades, AISI C-1045 hot rolled steel turned/ground and polished shaft. Wheel and frame shall be of welded construction
- Completed isolated assemblies shall be dynamically balanced in all 3 planes to category BV-2 for fan 5 hp or less and category BV-3 for fans greater than 5 hp as required by ANSI/AMCA Standard 204 in the horizontal, vertical and axial planes meeting "Factory Filter In" and "Startup Filter Out" requirements.
- Fans shall be single width airfoil centrifugal plenum type, designed for rugged industrial duty and suitable for continuous operation. All fans larger than 18" diameter shall have a minimum of 12 blades. Fans shall be selected to operate at a point no higher than 90% of the peak static pressure rating as defined by the fan performance curve at the selected operating speed.
- Fan shafts shall be solid AISI 1040 or 1045 steel. Shafts shall be turned, ground and polished to a minimum 16-micro-inch finish. Shafts shall be sized to run at a minimum of 20% greater than the maximum AMCA class speed.
- Inlet cones shall be precision spun or die formed. Inlet cones shall be aerodynamically matched to the wheel side plate to provide streamlined airflow in the wheel and ensure full loading of the blades.

10. All fan section access doors shall have one (1) latch, which requires a tool to open.
11. Fans shall be isolated from bulkhead walls by means a neoprene coated flexible fabric connector.

B. Motor

1. Motor shall be TEFC see Motor specification section.
2. Motors shall have a 1.15 service factor. [Motors shall be suitable for use with variable frequency drives].

C. Drive

1. Provide belt or direct drive as indicated.
2. Belt drive
  - a. Belt drive shall have fixed pitch sheaves. Drive belts shall have a 1.50 service factor.
  - b. Drive assembly shall be furnished with a totally enclosed beltguard.
  - c. Sheaves and Belts: All sheaves shall be selected with a 1.5 service factor. Sheaves shall be machined from a close grain cast iron and statically balanced by the manufacturer. Drive belts shall be a V type. One variable pitched sheave shall be provided on motors from 1 to 15 horsepower. Fixed pitch sheaves shall be provided on motors larger than 15 horsepower. Where fixed sheaves are provided one sheave exchange shall be provided as required FOB the factory. Belts shall be oil and heat resistant.
3. Direct drive
  - a. Motor shall be 1200 rpm or less.

D. Bearings

1. Fan bearings shall be heavy-duty, pillow block, self-aligning ball or roller type, and grease lubricated. Using AFBMA ratings, bearings shall be selected for a minimum L-10 life of 100,000 hours. Both bearings shall have the same bore, type and manufacturer. At least one bearing shall be fixed. Both bearings being the floating type is not acceptable. Extended flexible lube lines shall be provided and extended to the drive side of the fan.

E. Base

1. Fans shall be supplied with following features: 2" nominal deflection isolators, fan manufacturer's standard paint finish, inlet
2. Fan assemblies shall be designed for heavy-duty industrial applications with no structural resonance occurring within the fan operating speed range when isolated. Fan framing assemblies shall be fabricated from structural steel. Formed members are not acceptable.

This structural steel shall be welded together to form a rigid integral base. Fan assemblies shall be independently isolated with spring-type vibration isolators.

F. Fan unloading devices

1. Each variable air volume supply and return fan shall be provided with separate variable frequency drives.

2.4 BELTED VENT SETS

A. May not be used in place of centrifugal fan.

B. Similar to centrifugal fans above except:

1. When scheduled on the drawings, fume hood exhaust fans shall, in lieu of topcoat of enamel, modify paint scheme to provide a more corrosive resistant finished product using epoxies or vinyls. Minimum thickness shall be 5 mils.
2. All fans are single-width single-inlet.
3. Statically and dynamically balance fans and delete vibration run test.
4. When fans are mounted exposed-to-weather, in lieu of OSHA guard specified above, provide a weatherproof cover over entire drive assembly to ensure protection from weather.
5. Fans without inlet vanes unless otherwise specified on drawing schedule.
6. Motors shall be total enclosed fan cooled (TEFC) meeting requirements of the Motor Section of the Special Conditions.

2.5 ROOF MOUNTED CENTRIFUGAL FANS

- A. Provide belt driven centrifugal type roof mounted fans with capacities as indicated in the equipment schedules on the mechanical drawings. Fans complete with curb cap suitable for curb mounting. Roof curbs shall be provided by the HVAC Contractor.
- B. Fans housing shall be heavy gauge spun aluminum with gauges as listed in the following schedule, mounted to a rigid support network constructed of galvanized or epoxy coated steel. Fan housing shall have a rigid wire bird screen mounted to the unit discharge.
- C. Drive frame, bearing support, and motor support shall be heavy gauge galvanized steel.
- D. Fan inlet cone shall have a die spun hyperbolic shape, matched to the wheel cone to ensure full loading of fan blades to maximize efficiency.
- E. Fan wheel shall have single thickness backward inclined blades or true hollow airfoil shaped blades. Wheel characteristics shall be non-overloading.
- F. Fan inlet cone, wheel cone, blades and backplate shall be constructed of heavy gauge aluminum.

- G. Blades shall be welded, riveted or bolted to wheel cone and backplate.
- H. Wheel shall be statically and dynamically balanced.
- I. Drive shaft shall be ground and polished high grade steel supported by permanently lubricated sealed ball bearings housed in a cast iron flanged mounted housing.
- J. Bearings shall be sized for a minimum L-10 life of 100,000 hours at maximum fan operating conditions including belt pull. Bearings shall be selected in accordance with standards set forth by the Anti-Friction Bearing Mfrs. Assn.
- K. Drives shall be sized for a minimum of 1.65 times the fan motor horsepower. Sheaves shall be adjustable and have a tapered split and keyed hub. Belts shall be oil resistant 24,000-hour non-static type.
- L. Motor and drive assembly shall be mounted on neoprene vibration isolators.
- M. Motor, drive, and bearings shall be out of the exhaust airstream and housed to facilitate ease of maintenance. Motor cooling shall be through the fan drive and motor housings.
- N. Motor shall be wired to a factory installed disconnect switch. All wiring and electrical components shall comply with the National Electric Code and be UL listed.
- O. Motors shall be TEFC in accordance with the Motor Section of the Special Conditions.
- P. Provide automatic damper. Damper to open when fan is energized and close when fan is de-energized. See Sheet Metal Section for damper specification.
- Q. Damper to be field installed in duct at fan inlet.
- R. All fasteners shall be stainless steel.
- S. Refer to Roof Curbs Section.

## 2.6 UP-BLAST ROOF MOUNTED CENTRIFUGAL FANS

- A. Fans shall be identical construction to roof mounted centrifugal fans above, except for the following:
  1. Fan discharge arranged to discharge the air vertically, away from the roof, using a wind band housing constructed of heavy gauge aluminum.
  2. Motor drive compartment shall be ventilated using outside air. A direct connected breather tube shall be used ensuring contaminated air is not induced.
  3. A grease trough shall provide single-point drainage of grease or residue for kitchen exhaust applications. Refer to Roof Curb Section herein.

## 2.7 IN-LINE TUBULAR CENTRIFUGAL FANS

- A. Provide belt driven centrifugal type in-line fans with capacities as indicated in the equipment schedules on the mechanical drawings.
- B. AMCA pressure Class I or Class II as indicated in the equipment schedule.
- C. Fan housing shall be heavy gauge galvanized steel welded to a rigid galvanized structural steel framework or steel coated with an epoxy finish. Minimum thickness of epoxy finish shall be 5 mils. Fan housing shall be provided with mounting brackets at both inlet and discharge suitable for hanger rods or bolting directly to structure.
- D. Fan housing shall have inlet and outlet connections flanged.
- E. Fan inlet cone shall have a die spun hyperbolic shape and be matched to the wheel cone to ensure full loading of fan blades and to maximize efficiency.
- F. Fan wheel shall have single thickness backward inclined blades or true hollow airfoil shaped blades. Wheel characteristics shall be non-overloading.
- G. Fan inlet cone, wheel cone, blades and backplate shall be constructed of heavy gauge aluminum or steel. Steel construction shall be coated with an epoxy coating having a minimum thickness of 5 mils.
- H. Blades shall be welded to wheel cone and backplate.
- I. Wheel shall be statically and dynamically balanced.
- J. Drive shaft shall be ground and polished high grade steel supported by permanently lubricated sealed ball bearings housed in a cast iron pillow block housing.
- K. Bearings shall be sized for a minimum of L-10 life of 200,000 hours at maximum fan operating conditions including belt pull. Bearings shall be selected in accordance with standards set forth by the Anti-Friction Bearing Mfrs. Assn.
- L. Drives shall be sized for a minimum of 1.65 times the fan motor horsepower. Sheaves shall be adjustable and have a tapered lock, split and keyed hub. Belts shall be oil resistant, 24,000-hour non-static type.
- M. Fan shall be suitable for horizontal or vertical mounting.
- N. Motor, drive, and bearings shall be out of the exhaust airstream and housed to facilitate ease of maintenance. Motor cooling shall be through the fan drive and motor housing. Housing for motor drive and bearings shall be of the same construction as the fan housing.
- O. Motors shall be in accordance with Motors Section of the Special Conditions.
- P. Fans shall be constructed in accordance with AMCA 99-0401 Type A, B or C.

- Q. Provide with 1/2" by 1/2" galvanized wire mesh attached to a galvanized structural steel frame. Frame shall be bolted to the flanged housing construction.
- R. Provide thrust arrestors as required to limit movement of the fan upon start-up.

## 2.8 WALL MOUNTED PROPELLER FANS

- A. Entire fan shall be of heavy-duty industrial type construction.
- B. Fan panel shall be constructed of heavy gauge plate steel with a die formed or spun venturi shaped inlet cone built into the panel.
- C. Fan panel edges shall be formed back. Corners shall be welded and ground.
- D. Fan wheel, motor, drive and bearings shall be supported from fan panel using structural channel or heavy plate steel. Bearing housings and motor base shall be mounted on a heavy steel plate spanning the (2) vertical support members. All construction shall be welded or bolted.
- E. Wheel shall have a minimum of (4) propeller blades, die formed constructed of heavy gauge steel or aluminum. A reinforcing gusset shall be welded or riveted to the blades and to a machined hub.
- F. Drive shaft shall be ground and polished high-grade steel supported by grease-lubricated ball bearings housed in a cast iron pillow block foot mounted housing.
- G. Bearings shall be sized for a minimum L-10 life of 100,000 hours at maximum fan operating conditions including belt pull. Bearings shall be selected in accordance with standards set forth by the Anti-Friction Bearing Mfrs. Assn.
- H. Drives shall be sized for a minimum of 1.65 times the fan motor horsepower. Sheaves shall be fixed or adjustable depending on fan motor horsepower and shall have a tapered lock, split and keyed hub. Belts shall be oil resistant, 24,000-hour non-static type.
- I. Motor shall be in accordance with the Motor Section of the Special Conditions. Motor shall be mounted on an adjustable slide base.
- J. Fans shall be provided with motor side and fan side guards where open or unprotected. Guards shall be 1/2" by 1/2" rod or wire made of galvanized steel. Guard shall completely enclose motor drive and support assembly for motor side guard.
- K. Provide fans with heavy duty Class I low leakage, gasketed, multi-blade automatic damper. See Sheet Metal Section and ATC Section for damper specification.
- L. Fans shall be constructed in accordance with AMCA 99-0401 Type A, B or C.

- M. Where indicated in equipment schedule on mechanical drawings, fans shall be provided with explosion proof motors.

2.9 VANE AXIAL FAN

- A. Fans shall be the size, operating characteristics and capacity as scheduled on the drawings.
- B. In-line vaneaxial fans shall be direct driven, manually adjustable pitch axial flow type, with fan blade angle being capable of manual adjustment while fan is stopped.
- C. Fans shall be constructed as follows:
  1. Fans shall be Arrangement 4 having the fan rotor mounted directly on the motor shaft with the assembly enclosed entirely within the fan casing, suitable for in-line duct mounting.
  2. Fan casings shall be welded of hot rolled steel plate, 3/16" thick, 18" to 38" diameter, with 3/16" thick, flanges continuously welded at inlet and outlet. Sizes greater than 38" diameter shall be 1/4" thick steel with 1/4" thick flanges.
  3. Fan casings shall be fitted with mounting legs or hanging clips as shown on the drawings and as required for the mounting arrangement indicated. Fan mounting legs shall be fabricated from minimum 3/16" steel plate suitably braced to ensure stability and rigidity. Clips for horizontal suspension shall be of minimum 3/8" steel plate mounted at fan centerline. Clips for vertical suspension shall be mounted at center of moment of inertia of fan assembly.
  4. Fan shall have inlet bell and outlet static regain cone as scheduled. Where fan inlet or outlet is not to be connected to ductwork, the manufacturer shall provide OSHA approved protective guard at open inlet and outlet. Provide discharge cone silencers, optimized to fan discharge geometry with minimum dynamic insertion loss of 15/18 dB at 250/500 Hz at 2,000 feet per minute duct velocity.
  5. Fan blades and hubs shall be aluminum castings, alloy 356 T6 aluminum alloy. Fan blades shall be designed for maximum efficiency and be airfoil shaped, varying in twist and width from base to tip. Blade tip clearance shall be within tolerance to meet certified performance of fan. Fan hub shall be a 1-piece aluminum casting. The fan hub shall have the capacity to add or delete impellers in the field for final balance.
  6. Fan blade pitch angle shall be individually, manually adjustable using common wrenches. Special tools shall not be required to adjust blade angle.
  7. The fan rotor assembly shall be statically and dynamically balanced. Direct drive rotors shall be installed on their motor shafts to tolerances as listed below in mils double amplitude.

Fan RPM	Adj. Pitch Direct Drive
	Max Total Amplitude (Mils)
900	2.0
1200	1.5
1800	1.0
3600	0.5

8. After assembly, the fan shall be dynamically balanced while on anti-vibration mountings giving over 90% isolation. The balance standard shall be in accordance with ISO 2372:1974 Quality Grade C for Class II machines.
  9. The aerodynamic design of the fan is such that the maximum power absorbed by the impeller occurs within the normal working range, i.e., it has a non-overloading characteristic.
  10. The impeller shall be secured to the motor shaft by a key and keyway. Axial location shall be provided by a collar or shoulder on the drive shaft with a retaining washer and screw fitted into a tapped hole in the end of the shaft. The screw shall be locked in position.
  11. Fan motors shall be totally enclosed "premium" efficiency air over type, continuous duty, ball bearing with Class B insulation with leads extended through an airtight conduit to a suitably sized conduit box in accordance with NEC 1990 and NFPA 70, mounted on the exterior of the fan casing. External grease fittings with extended grease leads shall be provided for motor lubrication. Motors 256-frame size and smaller shall have permanently sealed bearings. Motor shall be removable from either end of the fan. Foot mount or "C" face flange mount motors will be acceptable. Where specified motors to be 2-speed/2-winding, coordinate with starters. Refer to Motor Section of Special Conditions.
  12. After fabrication, fans shall be sandblasted, primed coated, and finish painted. Zinc chromate epoxy primer shall be applied after surfaces are cleaned and degreased. Finish coat shall be air-dry acrylic enamel.
  13. Axial fans for smoke exhaust applications shall be rated at 150°C or 302°F for (2) hours continuous operation.
- D. All fans shall be provided with supports for horizontal, angular or vertical mounting where indicated on drawings. Horizontal fan floor supports shall be provided by the fan manufacturer and shall be bolted to inlet and discharge flanges of fan. Supports for fans 48" to 84" shall be cross-braced to prevent misalignment and add structural rigidity. Supports shall be constructed of the fan equivalent or heavier gauges of carbon steel. Horizontal ceiling supports shall consist of clips welded to the fan housing. Inlet bell, inlet screen, acoustical diffuser, outlet cone, companion flanges, etc. shall be provided by the fan manufacturer when required.
- E. Performance curves shall be published by the fan manufacturer and based on tests in accordance with AMCA 210. The curves shall be drawn with the fan flow rate plotted against fan total pressure and fan brake horsepower as per Section 10.2.1 of AMCA 210. The total pressure plotted is to be the difference between the total pressure at the fan outlet as defined as Plane 2, and the total pressure at the fan inlet as defined as Plane 1 in AMCA 210. Manufacturers submitting performance data not in full accordance with the requirements of this paragraph will be required to perform a witnessed AMCA performance test for each fan/motor size specified prior to approval. The full cost of such tests, including the time and expense of the observers, shall be borne by the fan manufacturer. Where fans are controlled by variable frequency drives, submit a "family" of performance curves showing fan performance at 100 RPM increments from maximum RPM to 50% speed.



## PART 3 - FAN INSTALLATION REQUIREMENTS

### 3.1 INSTALLATION

- A. Fans shall be installed in accordance with manufacturer recommendations, Contract Drawings and reviewed submittals.
- B. Fans shall be installed so as to ensure easy accessibility for service or removal or replacement of all components such as, but not limited to, fans, motors, belts, drives, bearings, dampers, actuators, isolators, and field connections.
- C. The HVAC Contractor shall install all motors and drives shipped loose. Fans shall be installed and tested, and shall be made fully operational by the HVAC Contractor.
- D. Provide fixed sheaves as necessary for final air balancing. The Contractor shall install the fixed sheave after balancing with the Contractor to adjust the fans.
- E. Manufacturer shall include the adjustment of pitch for adjustable pitch fans as required by balancing.
- F. Set roof mounted fans on sound absorbing insulated curbs. Coordinate installation with Roofing Contractor. Curbs shall be provided by the HVAC Contractor. The HVAC Contractor shall provide all counter flashing.
- G. Mount vent sets and vane axial fans located on roof to inertia bases as required under Vibration Isolation & Seismic Restraint Section 15241.
- H. Make all penetrations through roof or vertical walls watertight. Submit methods of sealing to Architect/Engineer for review and approval.
- I. All fans shall have flexible inlet and outlet couplings to prevent vibration transmission to ductwork.
- J. The Contractor shall assemble all loose parts including motors and drive assemblies on site and shall vibration balance the fans in the field. Field adjustment including belt alignment, wheel balancing, belt tension, greasing of bearings, installation of belt guards, and other loose parts shall be provided by the HVAC Contractor.

### 3.2 COORDINATION

- A. The Contractor shall coordinate the fan arrangement with the coordinated ductwork layout prior to ordering the fan. The Contractor shall provide all labor and materials necessary to change fan arrangement in the field when fan arrangement does not match ductwork.

- B. The inlet and discharge ductwork shall have a minimum straight run of (2) fan diameters upstream and downstream of the fan. The Contractor shall notify the Engineer in writing if these conditions cannot be achieved. Installation of improper inlet/discharge conditions without the review of the Engineer shall be corrected in the field at no cost to the Owner.
- C. The discharge duct arrangement shall comply with AMCA recommended layouts for elbows after fans.
- D. The Contractor shall provide all supplemental steel, supports, rods and hangers necessary to hang or mount fans. Supports shall include thrust restraint as required by the fan manufacturer.
- E. The fan manufacturer and Contractor shall coordinate the fan orientation for tubular centrifugal fans and shall verify that the fan support and bearings are supplied for the coordinated fan orientation (horizontal or vertical). The Contractor shall revise the fan in the field if job conditions require changing of orientation, at no cost to the Owner.
- F. The Contractor shall receive and inspect all fans and motors to make sure that all fans are received without defect. All defective or damaged fans shall be returned to the manufacturer by the Contractor for replacement.
- G. The Contractor shall properly protect all equipment to prevent damage from water, dirt, etc. Protection shall include temporary plastic wrap to keep equipment in original factory condition. Fans used for temporary ventilation during construction shall be totally cleaned and refurbished prior to turnover to the Owner.
- H. The HVAC Contractor shall mount and vibration balance all fans. The Electrical Contractor shall furnish and install power wiring to the fan motor and verify proper fan rotation. The HVAC and Electrical Contractors shall coordinate the starter requirements to ensure that the proper starter is installed for non-standard motors. The ATC Contractor shall wire all interlocking wiring to the fan including smoke detector wiring for fan shutdown.
- I. The HVAC Contractor shall mount all automatic control dampers on the fan either shipped loose or provided by the ATC Contractor.
- J. The HVAC Contractor shall mount all field mounted flow measuring devices on the inlet or discharge of the fan prior to fan installation.

END OF SECTION