SECTION 23 34 00

HVAC FANS

**BASED ON DFD MASTER SPECIFICATION DATED 04/05/2017**

This section has been written to cover most (but not all) situations that you will encounter. Depending on the requirements of your specific project, you may have to add material, delete items, or modify what is currently written. The Division of Facilities Development expects changes and comments from you.

# P A R T 1 - G E N E R A L

## SCOPE

This section includes specifications for fans that are not an integral part of a manufactured device. Included are the following topics:

PART 1 - GENERAL

Scope

Related Work

Reference

Reference Standards

Quality Assurance

Shop Drawings

Operation and Maintenance Data

Design Criteria

PART 2 - PRODUCTS

General

Fan Inlet Air Flow Stations

Centrifugal Fans

Utility Sets

Mixed Flow In-line Fans

In-line Centrifugal Fans

Vane axial Fans

Cabinet Fans

Power Roof Exhaust Fans

Sidewall Centrifugal Fans

Sidewall Propeller Fans

Ceiling Exhaust Fans

Ceiling Destratification Fans

PART 3 - EXECUTION

Installation

Construction verification Items

Functional performance Testing

Agency Training

## RELATED WORK

Section 01 91 01 or 01 91 02 – Commissioning Process

Section 23 05 29 - Hangers and Supports for HVAC Piping and Equipment

Section 23 05 13 - Common Motor Requirements for HVAC Equipment

Section 23 05 48 - Vibration and Seismic Controls for HVAC Piping and Equipment

Section 23 08 00 – Commissioning of HVAC

## REFERENCE

Applicable provisions of Division 1 govern work under this Section.

## REFERENCE STANDARDS

AMCA 203 AMCA Fan Application Manual - Troubleshooting

AMCA 210 Laboratory Method of Testing Fans for Rating

AMCA 300 Reverberant Room Method for Sound Testing of Fans

NFPA 90A Standard for the Installation of Air Conditioning and Ventilating Systems

NFPA 96 Standard for Ventilation Control and Fire Protection of Commercial Cooking Operations

UL 762 Power Roof Ventilators For Restaurant Exhaust Appliances

## QUALITY ASSURANCE

Refer to division 1, General Conditions, Equals and Substitutions.

## SHOP DRAWINGS

Refer to division 1, General Conditions, Submittals.

Include dimensions, capacities, fan curves, materials of construction, ratings, weights, motors and drives, sound power levels, appropriate identification and vibration isolation for all equipment. Sound power levels to be based on tests performed in accordance with AMCA Standard 300.

Submit color selection charts for equipment where applicable.

Fan curves shall indicate the relationship of CFM to static or total pressure for various fan speeds. Brake horsepower, recommended selection range, and limits of operation are to also be indicated on the curves. Indicate operating point on the fan curves at design air quantity and indicate the manufacturer's recommended drive loss factor for the specific application. Tabular fan performance data is not acceptable.

For variable air volume application, include data which indicates the effect of capacity control devices on performance.

## OPERATION AND MAINTENANCE DATA

All operations and maintenance data shall comply with the submission and content requirements specified under section GENERAL REQUIREMENTS.

Delete the following if there are no additional requirements.

In addition to the general content specified under GENERAL REQUIREMENTS supply the following additional documentation:

1. [A/E and commissioning provider to define detailed operation and maintenance data requirements for equipment specifications added to this section.]

## DESIGN CRITERIA

Tested and certify all fans in accordance with the applicable AMCA test code.

Each fan and motor combination shall be capable of delivering 110% of air quantity scheduled at scheduled static pressure. The motor furnished with the fan shall not operate into the motor service factor when operating under these conditions.

Consider drive efficiency in motor selection according to manufacturer's published recommendation or according to AMCA Publication 203, Appendix L.

Where inlet and outlet ductwork at any fan is changed from that shown on the drawings, provide any motor, drive and/or wiring changes required due to increased static pressure or baffling necessary to prevent uneven airflow or improve mixing.

All internal insulation and other components exposed to the airstream are to meet the flame spread and smoke ratings contained in NFPA 90A.

All roof mounted equipment to be provided with curbs or equipment stands in accordance with specification in Section 23 05 29.

# P A R T 2 - P R O D U C T S

Most of the fan specifications are set up to obtain an airfoil fan unless specifically scheduled otherwise. This has been done as a default only. It is not the intent to eliminate forward curved, backward curved, backward inclined, radial bladed, or other wheel types that would suit the application in a more efficient manner. In general, select a fan wheel based on the highest efficiency and lowest brake horsepower practical for the application and schedule the wheel accordingly.

## GENERAL

Use fan size, class, type, arrangement, and capacity as scheduled.

Furnish complete with motors, wheels, drive assemblies, bearings, vibration isolation devices, and accessories required for specified performance and proper operation. All single phase motors to have inherent thermal overload protection.

Provide variable pitch sheaves for drives 3 hp and smaller, fixed pitch sheaves for drives 5 hp and larger. Design all drives for 150% of motor rating.

Use OSHA approved belt guards that totally enclose the entire drive. Construct guards of expanded metal to allow for ventilation; provide tachometer openings at shaft locations.

Statically and dynamically balance all fans so they operate without objectionable noise or vibration.

Select options below based on project requirements.

Use AMCA Type A spark resistant construction for all fans handling flammable or explosive vapors.

All fans handling grease laden vapors shall meet the requirements of UL 762 and NFPA 96.

Provide a corrosion resistant coating on all surfaces exposed to fume and other corrosive exhaust air. Coating to be as scheduled.

Select coating only after discussion of program requirements.

## FAN INLET AIR FLOW STATIONS

For fans that are specified or scheduled to have fan inlet air flow station, provide a piezometer ring air flow station mounted on the fan inlet bell housing. Pressure tubes from the piezometer ring shall be extended to a termination plate labeled with the high and low pressure connections. Provide an initial flow rate coefficient that will be adjusted by the balancing contractor for measured flow reading. Piezometer ring air flow station shall measure static pressure drop through the fan inlet cone to provide an overall air flow measurement to within +/- 5% accuracy. In lieu of a piezometer ring air flow station, a fan inlet probe air flow stations as specified under Section 23 09 14 may be furnished and factory mounted in the fan inlet. Differential pressure transducers for measuring the velocity pressure for air flow measurement shall be supplied under Section 23 09 14 and be mounted in the temperature control panel.

## CENTRIFUGAL FANS

Manufacturers: PennBarry, Peerless, Buffalo, Carrier, Champion, Chicago Blower, Greenheck, New York Blower, Trane, Twin City, Cook, or approved equal.

Construct housing of welded steel with angle iron frame. Use spun or die formed inlet cones to provide a streamlined flow into the wheel. Use airfoil blades welded to spun wheel cones unless otherwise indicated. Shafts shall be AISI C 1045 hot rolled steel turned, ground and polished. Shaft shall be sized for at least 125% of the fans maximum cataloged RPM.

Bearings to be self-aligning grease packed pillow block type with grease seal and external grease fittings with a minimum L50 life of 200,000 hours at the maximum cataloged operating speed. Provide each fan housing with a capped drain connection and bolted and gasketed access door for inspection of fan wheel. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation; apply a second coat of paint to all exterior surfaces.

Note that welded construction is specified, not lockseam construction.

Fans shall bear the AMCA Certified Ratings Seal for Sound and Air Performance.

Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.

For both the centrifugal fans above, note that welded steel construction is specified. The list of acceptable manufacturers will have to be checked on each project for this item because some manufacturers use lockseam construction for the smaller units.

## UTILITY SETS

Manufacturers: ACME, PennBarry, Champion, Chicago Blower, Cook, Greenheck, New York Blower, Pace, Peerless, S&P, Trane, Twin City, or approved equal.

Construct housing of welded or lockseam fabricated steel with reinforcing to prevent housing distortion. Design motor supports to hold motor in place and provide drive adjustment. Bearings to be grease lubricated, self-aligning ball bearing type with grease seal. Provide each fan housing with a capped drain connection and bolted and gasketed access door for inspection of fan wheel. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.

Select options below based on project requirements.

Provide weather covers and weather-resistant enamel finish for fans installed outdoors.

Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.

## MIXED FLOW IN-LINE FANS

Manufacturers: Cook, Greenheck, Trane, Twin City or approved equal

Construct housing of welded steel with reinforcing to prevent distortion. Furnish with streamlined inlet cones and straightening vanes following the fan wheel to minimize noise and reduce turbulence. Provide each housing with a bolted and gasketed access door for inspection and maintenance of fan wheel. Use non-overloading mixed flow type wheel with welded steel or cast aluminum blades. Isolate belt drives from airstream with a belt tube. Externally mount motors on an adjustable base. Bearings to be grease lubricated, self-aligning ball or roller type selected for a minimum L50 life of 200,000 hours at the maximum cataloged fan operating speed. Provide extended lubrication lines with grease fittings outside of the fan housing. Shafts shall be AISI C 1045 hot rolled steel turned ground and polished. Shaft shall be sized for at least 125% of the fans maximum cataloged RPM. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all surfaces. Aluminum parts may be left unpainted.

Fans shall bear the AMCA Certified Ratings Seal for Sound and Air Performance.

Design all vertically mounted fans and bearings to withstand the vertical thrust loads.

Provide OSHA compliant belt guard and/or motor cover to cover the motor pulley and belts.

## IN-LINE CENTRIFUGAL FANS

Manufacturers: Acme, PennBarry, Cook, Greenheck, New York Blower, Peerless, Penn, S&P, Twin City, or approved equal.

Do not use these fans on fume exhaust or similar applications. For most applications, the mixed flow in-line type fan will provide better performance and should be used instead of an in-line centrifugal type.

Construct housing of welded steel with reinforcing to prevent distortion. Furnish with streamlined inlet cones and multiple straightening vanes following the fan wheel to minimize noise and reduce turbulence. Provide each housing with a bolted and gasketed access door for inspection of drive and fan wheel. Use non-overloading airfoil blade fans welded to the wheel cones. Isolate belt drives from airstream with a belt tube. Externally mount motors on an adjustable base. Bearings to be grease lubricated, self-aligning ball bearing type with grease seal and external grease fitting. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.

Design all vertically mounted fans to withstand the vertical thrust loads.

Select options below based on project requirements.

Provide one inch galvanized mesh inlet screens for fans without inlet ductwork.

## VANE AXIAL FANS - MANUALLY ADJUSTABLE PITCH

Manufacturers: PennBarry, Buffalo, Chicago Blower, Greenheck, Joy, New York Blower, Woods, or approved equal.

Do not use these fans on fume exhaust or similar applications.

Construct housing of welded steel with reinforcing to prevent housing distortion. Use cast aluminum airfoil wheel blades and hub. Provide straightening vanes downstream of fan wheel to redirect air flow, minimize noise, and reduce turbulence. Provide each housing with a bolted and gasketed access door for inspection of drive assembly and fan wheel. Bearings to be grease lubricated, self-aligning pillow block ball bearing type with grease seal and grease fitting extended to the exterior of the fan casing. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation. Apply a second coat of paint to all exterior surfaces.

Manually adjustable blades to be secured to hub by means of bolts. Design connection to allow for field adjustment of the blade positions and a means to verify that all blades are in the same position.

For belt drive units, provide a belt tube to isolate drives from the airstream. Externally mount motors on an adjustable base.

For direct drive units, use totally enclosed air-over motors with not less than Class B insulation. Extend any bearing lubrication points to the outside of the fan casing.

Design all vertically mounted fans to withstand static and vertical thrust loads for the application as indicated on the plans.

Edit the list below as appropriate for the specific application.

Provide the following accessories:

* Inlet cone
* Outlet cone
* Inlet box
* Inlet vortex breaker
* Inlet bell
* Support legs
* Suspension clips
* OSHA approve belt guard
* Weatherproof motor and drive cover
* Shaft seal
* Inlet screen
* Outlet screen
* AMCA type [A][B][C] spark resistant construction
* Threaded drain connection

## CABINET FANS

Manufacturers: Buffalo, Carrier, McQuay, Trane, York, or approved equal.

Use double width, double inlet airfoil centrifugal fans unless scheduled otherwise. Construct air tight casing and frame of galvanized or rust inhibited prime coated steel with removable panels to allow access to internal parts. Thermally insulate casing with not less than one inch of glass fiber or other closed cell insulation secured to the casing with waterproof adhesive and/or stic clips; coat the exposed surface to minimize erosion. Bearings to be self-aligning grease packed pillow block type with grease seal; they may be mounted internally or externally but internally mounted bearings must be provided with extended grease lines to a point outside the unit.

Select options below based on project requirements.

Provide filter section or a filter rack within fan cabinet suitable for installation of panel filters as scheduled or specified.

## POWER ROOF EXHAUST FANS

Manufacturers: Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME, S&P or approved equal.

Provide upblast or downblast units, as scheduled, with aluminum housing, non-overloading type centrifugal wheel, inlet cone, factory mounted and wired motor and disconnect switch, and bird screen.

Electrical Contractor will provide disconnect switches and thermal overload protection for units with three phase motors.

This must be coordinated with the electrical specifications and the electrical design consultant.

Upblast units to have motor, bearings, and drives completely enclosed and isolated from the exhaust air stream with ventilation provided by outside air. Units handling grease laden vapors to be U.L. listed for conveying such vapors, operating continuously at 300 degrees F.

Also specify an electric or pneumatic damper with blade and edge seals as a shutoff damper at the fan. This may be provided by the temperature control contractor.

## SIDEWALL CENTRIFUGAL FANS

Manufacturers: Carnes, Greenheck, Cook, Jenn-Air, ACME, Penn, S&P or approved equal.

Dome type with spun aluminum housing, non-overloading centrifugal wheel, factory mounted and wired motor and disconnect switch housed in a separate ventilated compartment, belt or direct drive as scheduled, [24 volt electrically] [pneumatically] operated control damper with blade edge and jamb seals, damper operator, and birdscreen.

The shutoff damper may be provided by the temperature control contractor.

## SIDEWALL PROPELLER FANS

Manufacturers: Greenheck, Penn, ACME, Cook, S&P or approved equal.

Constructed of steel with angle iron reinforcing and motor support frame, die formed propeller blades with a welded reinforcing gusset on the backside for added rigidity, belt or direct drive as scheduled, [24 volt electrically] [pneumatically] operated control damper with blade edge and jamb seals, damper operator, birdscreen, and screened inlet/fan guard. Unless a special coating is scheduled, paint fans with a prime coat after metal cleaning and surface preparation; apply a second coat of paint to all exterior surfaces.

The shutoff damper may be provided by the temperature control contractor.

Select options below based on project requirements.

Provide factory fabricated wall sleeves.

## CEILING EXHAUST FANS

Carnes, Greenheck, Penn, Jenn-Air, Cook, ACME, S&P or approved equal.

Centrifugal blower wheel, steel housing with acoustical lining, integral exhaust grille, adjustable mounting brackets to allow for any ceiling thickness, permanently lubricated motor, integral junction box with permanently lubricated and thermally protected motor factory wired, [24 volt electrically] [pneumatically] operated control damper with blade edge and jamb seals, and damper operator.

The shutoff damper may be provided by the temperature control contractor.

Select options below based on project requirements.

Provide wall, eave, or roof discharge assembly, as indicated on the drawings.

## DESTRATIFICATION FANS

Emerson-Chromalox, Envirofan, Hunter, or approved equal.

U.L. listed, all metal construction, baked enamel finish with factory standard color selected by Architect. Motors to be totally enclosed, impedance protected, single speed, of split capacitor design with permanently lubricated ball bearings.

Provide solid state variable speed controls as scheduled.

Motors to be reversible for summer/winter operation.

Also specify/detail an appropriate guard if the fan is used in gyms or similar applications.

# P A R T 3 - E X E C U T I O N

## INSTALLATION

Install as shown on the drawings, as detailed, and according to manufacturer's installation instructions. On units provided with a drain connection, reduce drain connection down to ½” fitting and leave open.

Install thrust restraints in accordance with the requirements of Section 23 05 48.

Contractor shall balance blade assembly of destratification fans after installation to assure stable operation.

## CONSTRUCTION VERIFICATION ITEMS

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 01 91 01 or 01 91 02 in accordance with the procedures defined for construction verification checklists.

## CONSTRUCTION VERIFICATION

Contractor is responsible for utilizing the construction verification checklists supplied under specification Section 23 08 00 in accordance with the procedures defined for construction verification in Section 01 91 01 or 01 91 02.

## FUNCTIONAL PERFORMANCE TESTING

Contractor is responsible for utilizing the functional performance test forms supplied under specification Section 23 08 00 in accordance with the procedures defined for functional performance testing in Section 01 91 01 or 01 91 02.

END OF SECTION