****

**Aerovent Guide Specification
Backward Curved Centrifugal Fans: Model BCF, Direct or Belt Driven**

**Aerovent Model BCF** is a backward curved industrial fan, constructed of high quality composite materials, designed for handling particulate free, corrosive or caustic air in high pressure applications where conventional steel and stainless steel fans are not suitable. BCF fans are designed so all parts exposed to the airstream are constructed of premium-quality corrosion resistant materials avoiding material breakdown from most chemicals.

The BCF features a wide wheel and housing, producing a high volume of air at a lower velocity, therefore the need for an expansion evasé is eliminated. Model BCF fans offer superior air and sound performance and the AMCA certified rating seal for air and sound

**Application**

Model BCF fans are suitable for indoor and outdoor locations in the fertilizer, metal and mineral processing, marine, pulp and paper, petrochemical, pharmaceutical, and water and wastewater treatment industries. Typical applications for model BCF fan include fume-control / fume-exhausting, odor control, oil mist emissions, pollution / emissions control, process control, high-moisture environments, and scrubbers.

Sizes (wheel diameters): 16.5 to 60 inches (420 to 1,525 mm)

Airflow: Up to 151,000 CFM (256,500 m3/hour)

Static Pressure: Up to 34 inches wg (8,470 Pa)

Aerovent is a leading designer and manufacturer of high quality industrial air moving equipment. Aerovent has extensive industry experience and years of active research, offering customers flexibility in fan design and construction along with superior service and state-of-the-art technology. With an unmatched variety of axial impellers and centrifugal fan wheels, every fan is built to the customer’s specific needs. This comprehensive selection of products and materials makes Aerovent the ideal choice for a diverse range of industry applications, including: Pulp & Paper, Automotive, Metal & Minerals, Mining, Power Generation, Agricultural, Marine and Water Treatment.

Aerovent occupies over 1,000,000 sq. ft. of manufacturing space in the U.S. Headquarters are located in Minneapolis, Minnesota, which houses the management, sales and marketing, accounting, human resources, material management, engineering personnel, as well as a state-of-the-art AMCA accredited testing lab.

We recommend you consult with your Aerovent Sales Representative, who can be contacted through: Aerovent, Minneapolis MN; (763) 551-7500; email: aerovent\_sales@aerovent.com; [www.aerovent.com](http://www.tcf.com).

This document Copyright© 2017 Aerovent.

SECTION 23 34 16.02 – BACKWARD CURVED CENTRIFUGAL FANS

1. GENERAL
	* + 1. SUMMARY

Specifier: Select fan drive type in the following paragraph.

* + - * 1. Section includes composite material centrifugal fans with backward curved blade design, and [direct] [belt] drive.
			1. REFERENCE STANDARDS

Specifier: Retail the ABMA reference standards only when Arrangement 8 direct drive or belt drive fans are specified.

* + - * 1. American Bearing Manufacturers Association (ABMA): [www.americanbearings.org](http://www.americanbearings.org/):

ABMA 9 – Load Ratings and Fatigue Life for Ball Bearings

ABMA 11 – Load Ratings and Fatigue Life for Roller Bearings

* + - * 1. Air Movement and Control Association International, Inc. (AMCA): [www.amca.org](http://www.amca.org):

AMCA Standard 204 - Balance Quality and Vibration Levels for Fans

AMCA Standard 205 - Energy Efficiency Classification for Fans

AMCA Standard 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating

AMCA Standard 300 - Reverberant Room Method for Sound Testing of Fans

* + - * 1. ASTM International (ASTM): [www.astm.org](http://www.astm.org)

ASTM D4167 - Standard Specification for Fiber-Reinforced Plastic Fans and Blowers

ASTM E84 - Standard Test Method for Surface Burning Characteristics of Building Materials

* + - * 1. National Electrical Manufacturers Association (NEMA): [www.nema.org](http://www.nema.org)

NEMA MG 1 – Motors and Generators

* + - * 1. National Fire Protection Association (NFPA): [www.nfpa.org](http://www.nfpa.org):

NFPA 70 - National Electric Code

* + - 1. ACTION SUBMITTALS
				1. Product Data: Include the following:

Rated capacities and operating characteristics.

Fan Performance Data: Fan performance curves with flow, static pressure and horsepower.

Sound Performance Data: Fan sound power levels in eight octave bands and, A-weighted overall sound power level or sone values.

Motor ratings and electrical characteristics.

Furnished specialty components.

Specified accessories.

Dimensioned standard drawings indicating dimensions, weights, and attachments to other work.

Specifier: If Contractor will be required to provide engineering drawings and calculations for vibration, seismic, or high wind design, insert requirements here.

* + - 1. INFORMATIONAL SUBMITTALS
				1. Source quality-control reports.
				2. Field quality-control reports.
				3. ISO-9001 certificate.
			2. CLOSEOUT SUBMITTALS
				1. Operation and Maintenance Data: Include routine maintenance, adjustment requirements, safety information, and troubleshooting guide.
			3. QUALITY ASSURANCE
				1. Manufacturer Qualifications: Approved ISO 9001-compliant manufacturer listed in this Section with minimum 10 years' experience in manufacture of similar products in successful use in similar applications, and with an ASME NQA-1 compliant Program.

Specifier: Retain paragraph below if Owner allows substitutions but requires strict control over qualifying of substitutions.

Approval of Comparable Products: Submit the following in accordance with project substitution requirements, within time allowed for substitution review:

Product data, including certified independent test data indicating compliance with requirements.

Project references: Minimum of 5 installations not less than 5 years old, with Owner contact information.

Sample warranty.

Substitutions following award of contract are not allowed except as stipulated in Division 01 General Requirements.

Approved manufacturers must meet separate requirements of Submittals Article.

* + - * 1. AMCA Compliance:

Provide fan types tested in accordance with AMCA Standard 210 - ASHRAE 51 (air performance) and AMCA Standard 300 (sound performance) in an AMCA-accredited laboratory.

Provide units that bear the AMCA-Certified Ratings Seal.

Provide fan units rated according to AMCA Standard 205 (fan efficiency grade).

* + - 1. COORDINATION
				1. Coordinate sizes and locations of supports required for fan units.
				2. Coordinate sizes and locations of equipment supports, and roof penetrations.
			2. FIELD CONDITIONS
				1. Handling and Storage: Handle and store fan units in accordance with manufacturer's published instructions. Examine units upon delivery for damage. Store units protected from weather.
			3. WARRANTY

Specifier: Consult Aerovent for available special Project-specific warranties.

* + - * 1. Manufacturer's Warranty: Manufacturer's standard form in which manufacturer agrees to furnish replacement components for fan units that demonstrate defects in workmanship or materials under normal use within warranty period specified.

Warranty Period: 12 months from startup or 18 months from shipment by manufacturer, whichever first occurs.

1. PRODUCTS
	* + 1. MANUFACTURER
				1. Basis-of-Design Manufacturer: Provide fan units manufactured by **Aerovent**, Minneapolis MN; (763) 551-7500; email: aerovent\_sales@aerovent.com; website: [www.aerovent.com](http://www.tcf.com).
				2. Source Limitations: Obtain backward curved centrifugal fans from a single manufacturer.
			2. PERFORMANCE REQUIREMENTS
				1. Fan Performance Ratings: [Project site elevation- based] [Sea level elevation-based].
				2. AMCA Compliance:

Provide units that bear the AMCA-Certified Ratings Seal.

* + - * 1. Compliance:

Classified under AMCA Standard 205.

* + - * 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.
			1. BACKWARD CURVED CENTRIFUGAL FANS
				1. Description: [Direct] [Belt] – driven, centrifugal, composite fans with backward curved blades.

Basis of Design Product: **Aerovent, Model BCF**.

Permanently attach nameplate displaying serial number and unit information.

* + - * 1. Fan Capacities, Characteristics, and Configuration: Refer to Drawing schedule.

Specifier: Select wide/narrow option in the following paragraph based on performance requirements.

* + - * 1. Fan Wheel Impeller: Provide high-efficiency, composite material wheel with backward curved blade design attached to conical rim and backplate, Hub to be keyed to shaft.

Specifier: Select BCF fans are available with two (2) different materials of construction. Fiberglass is the standard material. Carbon Fiber is an upgraded material for most operating points. Carbon fiber construction may be necessary based upon the operating type and/or environmental concerns. Consult Aerovent for selection and application assistance.

Materials of Construction: Manufacturer's composite wheel consisting of premium quality, fire-retardant, corrosion resistant vinyl ester resin, and [fiberglass] [carbon fiber], based on wheel size and pressure class.

Specifier: Select one of the subparagraphs below, based on pressure requirements and tip speed of the fan wheel.

Wheel Types:

Provide medium pressure wheel for tip speeds up to 24,500 feet/minute (124.5 m/s).

Provide high pressure wheel for tip speeds up to 26,000 feet/minute (132.1 m/s).

Blade Construction: Fabricate backward curved blades of single thickness affixed to the rim and backplate through a three-way fastening method. Blades to be continuously bonded to rim and backplate.

Hub to be fastened to backplate with stainless steel fasteners, then entire hub assembly encapsulated for corrosion resistance.

Statically and dynamically balance wheel.

Minimum Balance Quality Grade: G6.3, in accordance with AMCA Standard 204.

Specifier: Standard fan shaft is constructed of hot rolled steel encapsulated in an FRP sleeve bonded to the wheel. 316 stainless steel and Hastelloy C-276 sleeves are available. The sleeve extends out through the housing for corrosion protection. 316 stainless steel shaft without shaft sleeve is available. Substitutions to fan shaft and sleeve shall be based on application requirements. Consult Aerovent for selection and application assistance.

* + - * 1. Fan Shaft:

[AISI C1045 hot-rolled steel] [316 Stainless Steel].

Turn, grind, and polish shaft.

Size shaft for first critical speed minimum 1.43 times maximum speed for each fan class.

[Shaft sleeve constructed of [FRP] [316] [Hastelloy C-276]]

Apply petroleum based rust preventative coating on shaft outside of the fan housing.

Key shaft to wheel hub.

Include OSHA compliant [shaft] [shaft and bearing] guard.

* + - * 1. Bearings: Heavy-duty, grease lubricated, spherical roller or anti-friction ball, self-aligning, pillow block type, based on fan size and mounting orientation located outside the airstream[, with grease lines extended to outside fan housing].

Minimum Average Bearing Life: ABMA L-50 = 200,000 hours at the maximum fan RPM.

Specifier: For fan sizes 165 through 365, retain the option in the next paragraph for field rotatable housing.

Several options are available for fan construction materials. See Accessories for upgrades to the standard product. Consult Aerovent for selection and application assistance.

* + - * 1. Housing: Fabricate [field rotatable] corrosion resistant housing of composite materials consisting of resin and fiberglass, laminated onto a mold, forming a smooth airflow path.

Construct fan housing with premium quality vinyl ester resin

Fire-resistant polyester resin with an ASTM E84 Class I rating with maximum flame spread no greater than 25, when tested in accordance with ASTM E84.

Resin to utilize ultraviolet (UV) protection to minimize degradation due to exposure to ultraviolet light.

Provide aerodynamically designed inlet cone.

Reinforce housing with rigid bracing to increase structural integrity.

Specifier: The standard shaft seal is not gas-tight. For higher performance shaft seals, see Accessories section. Consult Aerovent for selection and application assistance.

Provide standard shaft seal utilizing a close-fitting, fluropolymer shaft closure with stainless steel plate, reducing the transference of gases through the shaft hole opening in the housing.

Utilize hardware exposed to airstream side of housing encapsulated with resin lamination.

Provide integral lifting lugs.

Specifier: In the following paragraph, select option for direction of rotation. If fans with different rotational directions are required, then delete the following subparagraph and add this requirement to the drawing fan schedule.

Provide fan suitable for [clockwise] [counterclockwise] wheel rotation.

Specifier: Select hole drilling and inlet connection options in the following paragraph when required.

Provide [duct connection collar] [[pre-drilled,] flanged inlet] connection.

Provide [pre-drilled,] flanged outlet connection.

* + - * 1. Supports: Steel angle and plate, intermittently welded with sealant filled between welds.

Specifier: Retain the following belt drive paragraphs only when belt driven fans are required.

* + - * 1. Direct Drive:

Specifier: Retain paragraph below for direct drive, Arrangement 8 fans only.

Provide coupling with service factor of 1.5 x motor HP between motor and fan shaft.

Include OSHA compliant coupling guard.

Specifier: Retain the following paragraph and subparagraphs for belt driven fans.

* + - * 1. Belt Drive:

Drive Components: V-belt drive, rated for minimum 150 percent of motor nameplate horsepower, with machined, cast-iron pulleys, and heat resistant, oil resistant, V-belts. Locate belts and drives outside fan housing.

Motor 10 HP and Smaller: Adjustable pitch.

Motor 15 HP and Larger: Fixed pitch.

Specifier: Retain options in the following paragraph when required.

Belt Guard: Steel, ventilated, OSHA compliant [quick access designed with hinged front and rubber latches].

* + - * 1. Motors: Comply with NEMA MG-1 for designation, temperature rating, service factor, enclosure type, and efficiency requirements for motors specified in Division 23 section "Common Motor Requirements for HVAC Equipment."

Motor Sizes: Minimum size as indicated. If not indicated, large enough so driven load will not require motor to operate in service factor range above 1.0.

Motor Speed: Based upon performance requirements and application.

Specifier: If factory disconnect is required, select NEMA enclosure rating in following paragraph, and select one subparagraph below to specify factory or field mounting.

Provide unfused disconnect switch, NEMA [1] [3R] [4] [4X] [7/9 explosion proof], selected in accordance with Division 26 section "Enclosed Switches."

Factory mount and wire disconnect switch.

Ship disconnect switch loose for field mounting and wiring.

Specifier: Select motor electrical data in following subparagraphs, or show this data on the drawing fan schedule. Do not show the data in both places.

Electrical Data:

Voltage: [115] [208] [230] [460] [575] [\_\_\_\_\_] V; [1] [3] phase; 60 Hz.

Voltage: [190] [380] [\_\_\_\_\_] V; [1] [3] phase; 50 Hz.

Specifier: Select motor enclosure type in first following subparagraph.

Enclosure Type: [Open, Drip Proof (ODP)] [Totally Enclosed Fan Cooled (TEFC)]

Specifier: For motors located in hazardous locations, select one or the other of the following. If motor is not located in hazardous location, delete subparagraph. Consult Aerovent for hazardous location classification availability.

[Explosion Proof] [ATEX].

Provide motors that comply with the Energy Independence and Security Act of 2007 (EISA).

Specifier: For motors controlled by VFDs, retain the following subparagraph.

When controlled with a Variable Frequency Drive (VFD), provide premium efficiency motors suitable for inverter duty use.

Specifier: Retain paragraph below for belt-driven units only.

* + - * 1. Motor Mounting Platform: Heavy-duty motor mounting platform that allows adjustment of drive belt tension.

Specifier: Retain paragraph and subparagraph below when isolation is required, and coordinate options with project design.

* + - * 1. Vibration Isolation:

Specifier: Retain paragraph and subparagraph below, and coordinate options with project design.

Provide isolation of fan from connected piping, duct work and foundation in accordance with fan manufacturer's requirements, and Division 23, Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

Specifier: Retain the following paragraphs if fan is to be mounted on a separate base.

Isolation Type Base:

Specifier: Delete paragraph 1 for fans in Arrangement 8. Select options as required.

Spring isolation base: Provide spring isolators [and seismic restraints] with [1 inch (25.4 mm)] [2 inch (51 mm)] deflection.

Inertia type base: Provide spring isolators [and seismic restraints] with [1 inch (25.4 mm)] [2 inch (51 mm)] deflection.

 Specifier: Retain the following paragraphs for smaller sized Arrangement 10 fans only (Sizes 919 and smaller).

Spring Isolator Rail

Equipment isolation rails with integral spring assemblies.

* + - * 1. Interior Access:

Design fan to allow for wheel removal through fan inlet opening.

* + - * 1. Coatings:

Specifier: Retain Paragraph 1. or 2. based on application requirements. Delete remaining paragraph.

Standard Coating: All carbon steel components shall be cleaned and chemically treated by a phosphatizing process. Carbon steel components shall then be coated with gray epoxy.

Special Coating: [\_\_\_\_\_]

* + - * 1. Accessories:

Specifier: Accessories listed in subparagraphs below are optional Aerovent features for this unit. Consult Aerovent representative for recommended options based upon Project requirements.

Access Door: Provide fiberglass, raised, bolted access door for wheel inspection and maintenance.

Drain with Plug: Provide 1 inch NPT threaded pipe coupling constructed in FRP, bonded to lowest point on housing scroll. [Provide 1 inch NPT PVC plug.]

Specifier: High performance may be required due to the application requirements and gases being handled. Double-lip type shaft seals require 316 stainless steel or Hastelloy shaft sleeves or 316 stainless steel shaft. Consult Aerovent for selection and application assistance.

Shaft Seal: Provide double-lip type shaft seal utilizing [fluroelastomer (ex. Viton®] [fluropolymer (ex. Teflon®)] significantly reducing the transference of gases through the shaft hole opening in the housing.

Specifier: When required, edit the following paragraph and subparagraphs to require an inlet box and inlet box options. Inlet box requires a flanged

Inlet Box: Match housing construction, with bolt-on configuration with fan housing.

Access Door: Provide fiberglass, raised, bolted access door for inspection and maintenance.

Drain with Plug: Provide 1 inch NPT threaded pipe coupling constructed in FRP, bonded to lowest point of the inlet box. [Provide 1 inch NPT PVC plug.]

Specifier: Retain paragraph below for units with control dampers only.

Volume Control Devices

Specifier: Outlet dampers require a punched outlet flange with Aerovent standard flange pattern. Standard material of construction is epoxy coated mild steel. FRP and other materials are available upon special request. Consult Aerovent for application recommendations.

Outlet Dampers: [Parallel-blade] [Opposed-blade] dampers constructed of [epoxy coated mild steel] [FRP] [\_\_\_\_\_] suitable for modulating fan delivery at discharge static pressure at 200 deg. F (93 deg. C).

Specifier: Retain paragraph below for units with control dampers only.

Actuators

Specifier: Select applicable paragraph and subparagraphs when actuator is required for volume control device(s).

Actuators listed in subparagraphs below offer various construction features and options. Consult Aerovent for recommended options based upon Project requirements.

Electric actuator.

Double acting pneumatic actuator (air-to-air).

Specifier: Select applicable subparagraph and delete remaining subparagraphs

Modulating service with pneumatic positioner.

Modulating service with electro-pneumatic positioner.

Pneumatic actuator with spring return (air-to-spring).

Specifier: Select applicable subparagraph and delete remaining subparagraphs

Two-position.

Modulating service with pneumatic positioner.

Modulating service with electro-pneumatic positioner.

Specifier: Spark resistant construction for fiberglass fans is recommended when the fan is handling explosive fumes. Retain following paragraph when spark-resistant construction is required.

Spark Resistant Construction:

Provide construction utilizing graphite impregnated resin and strategic grounding lugs that provide a path for any generated static electricity to ground outside the fan housing.

Specifier: Vinyl ester resin construction throughout the fan in contact with the gas stream may be required due to the corrosive agents in the gas stream.

Retain following paragraph if vinyl ester resin is required by the drawing fan schedule or when the gas stream requires. Select options in subparagraph as needed for the application. Surface veil may be required by application. Consult Aerovent for application recommendations.

Full Vinyl Ester Resin Construction

Provide [inlet box] [outlet damper] constructed with premium quality vinyl ester resin to provide additional corrosion resistance to higher concentrated or corrosive compounds in the gas stream.

Specifier: Surface veil may be required due to the corrosive agents in the gas stream. A synthetic surface veil provides added protection against certain corrosives.

Retain following paragraph if surface veil is required by the drawing fan schedule or when the gas stream requires. Select options in subparagraph as needed for the application. Consult Aerovent for application recommendations.

Surface Veil

Provide synthetic surface veil on airstream components of [fan housing] [inlet box] for additional corrosion resistance.

Specifier: ASTM D4167 provides manufacturers a construction standard Fiber-Reinforced Plastic Fans and Blowers. ASTM D4167 is a guide for construction methods, balance requirements, allowable construction defects, aerodynamic ratings and testing, and safe operating speeds.

Retain following paragraph when ASTM D4167 construction is required by the drawing fan schedule. Consult Aerovent for application recommendations.

ASTM D4167 Construction Package

Fans constructed to meet ASTM D4167 include static grounding, surface veil for airstream of the fan and rotor balance quality grade G6.3.

Specifier: Retain following paragraph only for Arrangement 10 outdoor fans, when required.

Weather Cover: Provide steel weather cover to shield motor and belt-drive from weather. Fabricate with rainproof ventilation slots.

* + - 1. SOURCE QUALITY CONTROL
				1. Factory Run Test: Statically and dynamically balance each wheel in accordance with AMCA Standard 204 "Balance Quality and Vibration Levels for Fans" to Fan Application Category BV-3, Balance Quality Grade G6.3. Test run assembled fan units prior to shipment at specified operating speed or maximum RPM allowed. Obtain balance readings by electronic equipment in the axial, vertical, and horizontal directions on each set of bearings.
1. EXECUTION
	* + 1. EXAMINATION
				1. Examine areas to receive fans. Notify Engineer regarding conditions that may adversely affect installation, operation, or maintenance of fans. Proceed with installation once conditions are in accordance with manufacturer's published instructions.
			2. PROTECTION
				1. Protect adjacent construction and finished surfaces during installation and testing.
				2. Except for operational testing, do not operate fan during construction.
			3. INSTALLATION
				1. Install fans in accordance with Contract documents and manufacturer's published instructions.

Specifier: Insert applicable installation requirements for vibration, seismic, and high wind design if applicable to installation.

* + - * 1. Install fan units with adequate clearances for service and maintenance.

Specifier: Coordinate duct installation and specialty arrangements with schematics on Drawings and with requirements specified in duct systems. If Drawings are explicit enough, these requirements may be reduced or omitted.

* + - * 1. Duct Connections: Drawings indicate general arrangement of ducts and duct accessories. Where indicated on Drawings, make final duct connections with flexible connectors. Flexible connectors are specified in Division 23 section "Air Duct Accessories."

Install connecting ducts with adequate clearances for service and maintenance.

* + - * 1. Electrical Connections: Connect wiring in accordance with NFPA 70 and Division 26 section "Low-Voltage Electrical Power Conductors and Cables."

Ground and bond equipment according to Division 26 section "Grounding and Bonding for Electrical Systems."

Ground and bond metal parts exposed to flow airstream.

* + - * 1. Equipment Identification: Label units according to Division 23 section "Identification for HVAC Piping and Equipment."
			1. FIELD QUALITY CONTROL

Specifier: Select option in paragraph below to define the party responsible for final tests and inspections to be performed.

* + - * 1. [Owner will retain] [Contractor shall retain] qualified testing agency to perform field tests and inspections.

Specifier: Retain first paragraph below to describe tests and inspections to be performed.

* + - * 1. Tests and Inspections:

Verify that unit is secured to supports, and that duct and electrical connections are complete. Verify that proper thermal-overload protection is installed in motors, starters, and disconnect switches.

Verify that cleaning and adjusting are complete.

Specifier: Retain options in following paragraph for belt driven units. Otherwise, delete option.

[Disconnect fan belt 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.]

Verify that manual and automatic volume control, and fire and smoke dampers in connected ductwork systems are in fully open position.

Disable automatic temperature-control actuators, energize motor, adjust fan to indicated rpm, and measure and record motor voltage and amperage.

Shut unit down and reconnect automatic temperature-control actuators.

Remove and replace malfunctioning units and retest as specified above.

* + - * 1. Test and adjust controls and safeties. Replace damaged and malfunctioning controls and equipment.
				2. Submit test and inspection reports.
			1. ADJUSTING AND CLEANING
				1. Adjust, clean, and maintain installed fan units in accordance with manufacturer's published instructions.

END OF SECTION