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**Twin City Fan & Blower Guide Specification
High Efficiency Plug Fans: Model BFPL Series, Direct or Belt Driven**

**Twin City Fan & Blower (TCF) Model BFPL** plug fans are housed in the customer’s enclosure for applications where the system plenum acts as the fan housing. The BFPL features a backward curved, non-overloading, single thickness airfoil type wheel. The BFPL’s welded construction can withstand most industrial applications. The motor and drive are mounted to the plug panel which protects them from the gas stream. The insulated plug allows for extreme temperature applications. The plug assembly may be bolted or welded in place with the shaft in either the vertical or horizontal position for maximum flexibility.

**Application**

BFPL are compact and versatile allowing them to be used for air circulation in a variety of commercial and industrial applications including air curtains, air heaters, ceiling, wall, and floor panel plenums, degreasers, dryers, dust collectors, evaporators, freezers, kilns, ovens, packaged air handlers, parts washers, penthouses, smoke houses, space heaters, spray booths, and other high temperature applications.

Sizes (wheel diameter): 12.4 to 49.21 inches (315 mm to 1,250 mm)

Airflow to 76,000 CFM (129,100 m3/hour)

Static pressure to 12 inches wg (3,000 Pa)

TCF is an industry leading designer and manufacturer of high quality commercial and industrial fans and is a division of Twin City Fan Companies, Ltd. Our extensive product line includes centrifugal fans and blowers, axial fans, and power roof ventilators. For the commercial market, TCF supplies ventilation fans for retail and office buildings, restaurants, schools, hospitals, and government buildings. TCF’s industrial fans are used in a wide variety of process applications for numerous industries including Petrochemical, Nuclear, Cement, Steel, and Air Pollution Control. Special materials, construction, coatings, and accessories are available to fit any application requirements.

TCF has completed thousands of successful installations across the globe and has a proven track record for tackling the most technically complex applications within the fan industry. TCF is also known for its technical design capabilities, comprehensive testing services, and responsive sales team. Due to the company’s extensive expertise and long-standing reputation for proven quality, TCF products continue to be specified around the globe.

TCF occupies over 1,000,000 sq. ft. of manufacturing space across ten facilities in the U.S, with expanded manufacturing and service operations located in South America, Europe, India, China, and Singapore. 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 Twin City Fan & Blower Sales Representative, who can be contacted through: Twin City Fan & Blower, Minneapolis MN; (763) 551-7600; email: tcf\_sales@tcf.com; [www.tcf.com](http://www.tcf.com).

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SECTION 23 34 16.05 – PLUG FANS

1. GENERAL
	* + 1. SUMMARY

Specifier: Select fan drive style in following paragraph.

* + - * 1. Section includes backward curved plug fan fans, [direct-] [belt-] driven.
			1. REFERENCE STANDARDS
				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 210 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating

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

* + - * 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 (air performance) and AMCA Standard 300 (sound performance) in an AMCA-accredited laboratory.

* + - 1. COORDINATION

Coordinate sizes and locations of supports required for fan units.

Coordinate sizes and locations of equipment supports, building penetrations.

* + - 1. FIELD CONDITIONS

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.

* + - 1. WARRANTY

Specifier: Consult TCF 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 Twin City Fan & Blower, Minneapolis MN; (763) 551-7600; email: tcf\_sales@tcf.com; website: [www.tcf.com](http://www.tcf.com).
				2. Source Limitations: Obtain plug fans from a single manufacturer.
			2. PERFORMANCE REQUIREMENTS

Fan Performance Ratings: [Project site elevation- based] [Sea level-based].

Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.

* + - 1. BACKWARD CURVED CENTRIFUGAL PLUG FANS
				1. Description: [Direct ] [Belt ]- Driven Centrifugal Plug fans.

Basis of Design Product: **Twin City Fan & Blower, Model BFPL**.

Specifier: Coordinate fan orientation with notations on drawings.

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

Specifier: Select fan blade option in the following paragraph.

* + - * 1. Fan Wheel: Provide fabricated backward curved, single thickness blades continuously welded to rim and backplate. Hub to be keyed to shaft. Partial welds are not acceptable.

Materials of Construction: Manufacturer’s standard, based on wheel size, pressure class, and application.

Statically and dynamically balance wheel.

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

* + - * 1. Mounting Panel:

Construct of minimum 7 Ga (0.1793 inch) (4.6 mm) steel with formed flanges.

Prepunch panel for bolt mounting, or weld panel assembly in place.

Specifier: Standard plug allows for horizontal or vertical upflow conditions. Vertical downflow is optional.

Provide cross frame bearing support that allows bearing service without disassembly of panel or frame.

Specifier: Standard fan allows for horizontal or vertical installation. Select discharge direction(s) based upon Project requirements.

Construct for [horizontal flow] [vertical [upflow] [downflow]].

Specifier: Delete the following paragraphs for shafts and bearings for Arrangement 4 fans only.

* + - * 1. Fan Shaft:

AISI C1045 hot-rolled steel.

Turn, grind, and polish shaft.

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

Apply petroleum based rust preventative coating.

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.

* + - * 1. Motor Base: Fabricate from heavy gauge steel, and pre-punch holes for motor mounting bolts.

Provide four-point leveling and positive belt tensioning adjustments.

* + - * 1. Direct Drive:

Specifier: Retain paragraph below for direct drive, Arrangement 4 fans only.

Mount fan wheel directly on motor shaft.

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

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

Include OSHA compliant coupling guard.

* + - * 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, static-free V-belts.

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]. [Paint belt guard yellow.]

* + - * 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 TCF 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.

Motor Mounting Platform: Heavy-duty motor mounting platform that allows adjustment of drive belt tension. Motor location per drawing schedule.

* + - * 1. Coatings:

Specifier: Retain paragraph 1, 2, or 3 based on application requirements. Delete remaining paragraph.

Standard Coating: All carbon steel components shall be cleaned and chemically treated by a phosphatizing process. Fan shall then be coated with blue enamel.

No coating of Airstream

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

* + - * 1. Accessories:

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

Specifier: Optional plug assembly may be required to match customer’s wall thickness or elevated temperatures to protect the motor and drive assemblies. Select thickness based on maximum operating temperature or Project requirements. Standard fans without plug assemblies are suitable for temperatures up to 300 deg. F

Plug Assembly:

Assemble plug to mounting panel at factory.

Provide 2 inch (51 mm) insulated plug for maximum temperatures up to 300 deg. F (149 deg. C).

Provide 3 inch (76 mm) insulated plug for maximum temperatures up to 300 deg. F (149 deg. C).

Provide 4 inch (102 mm) insulated plug for maximum temperatures up to 800 deg. F (427 deg. C).

Provide 5 inch (127 mm) insulated plug for maximum temperatures up to 800 deg. F (427 deg. C).

Provide 6 inch (152 mm) insulated plug for maximum temperatures up to 1000 deg. F (538 deg. C).

Specifier: Standard temperature limit for Arrangement 4 is 150 deg. F. Standard temperature for all other arrangements is 300 deg. F. Maximum temperature limit for wheel diameters 15.75 inches (400 mm) and smaller is 800 deg. F. Select other temperature limits in the following paragraph, when required.

High Temperature Construction for maximum operating temperature: [500 deg. F (260 deg. C)] [600 deg. F (316 deg. C)] [800 deg. F (427 deg. C)].

301 to 500 deg. F (149 to 260 deg. C): Provide high temperature grease, expansion and non-expansion bearings, shaft seal and shaft cooler. TCF standard paint suitable up to 500 deg. F (260 deg. C). Includes recess cone when 4-, 5-, and 6-inch insulated plug is specified.

Specifier: A minimum of 4-inch insulation is required on fans operating from 501 to 800 deg. F.

501 to 800 deg. F (261 to 427 deg. C): Provide high temperature grease, expansion and non-expansion bearings, shaft seal, shaft cooler, high temperature aluminum paint, and recess cone for 4-, 5-, and 6-inch insulated plug.

Specifier: TCF offers fans for high temperature service between 801 and 1,000 deg. F (427 to 538 deg. C). Consult the factory for details of construction and maximum RPM limits. Enter additional requirements in the following paragraph as required. A minimum of 6-inch insulation is required on fans operating from 801 to 1,000 deg. F.

801 to 1,000 deg. F (427 to 538 deg. C): Provide 316 stainless steel wheel and shaft, high temperature grease, expansion and non-expansion bearings, shaft seal, shaft cooler, high temperature aluminum paint, and recess cone for 6-inch insulated plug. [\_\_\_\_\_].

Variable Inlet Vanes:

Specifier: In the following paragraph, select internal type inlet vanes are available on sizes 181 through 491.

Inlet Vane Dampers: Provide pre-rotational inlet vane dampers nested in fan inlet at [70 - 300 deg. F (21 - 148 deg. C)] [301 - 600 deg. F (149 - 316 deg. C)].

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 TCF for recommended options based upon Project requirements.

Electric actuator.

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

Specifier: Select applicable subparagraph and delete remaining subparagraphs

Two-position.

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: Retain following paragraph if safety screens are required. Select options in paragraph to designate screen locations.

Safety Screens: Provide screens at fan [inlet] [outlet].

Specifier: Retain following paragraph when spark-resistant construction is required. Select applicable subparagraph.

Spark Resistant Construction: Mount bearings outside flow airstream.

Specifier: AMCA Type C spark resistant construction has a maximum operating temperature of 800 deg, F (427 deg. C). Select maximum operating temperature as required by project conditions.

AMCA Type C: Provide construction that will not permit shaft or fan wheel impeller to contact or strike ferrous metal parts. Maximum operating temperature: [500 deg. F (260 deg. C)] [800 deg. F (427 deg. C)].

Safety Screens: Provide screen at fan inlet.

Specifier: Shaft Cooler Assemblies are included with high temperature construction. Project requirements may require shaft coolers even though operating temperature may be below high temperature limits. Not available on Arrangement 4 fans.

Shaft Cooler: Bolt-on cast assembly with cooling fins and metal guard.

Specifier: Retain paragraph below when shaft seal is required. Standard shaft seal is provided on fans with high-temperature packages. Consult TCF for recommended options based upon Project requirements.

Shaft Seal: Provide housing seal consisting of woven fibrous material sandwiched between the fan mounting plate and aluminum cover plate.

Specifier: Delete the following paragraph for extended lube lines for Arrangement 4 fans.

Extended Lube Lines: Provide lubrication lines with grease fittings from the fan bearings terminating on the drive side of the fan for ease of lubrication.

Specifier: When a fan housing is required, retain the following paragraph and subparagraphs. Select options to specify rotation and discharge directions, as these are critical to housing fabrication.

Housing: Continuously welded steel. Include aerodynamically spun inlet cone, wheel opening on each side, and weld studs on the inlet side for cone mounting.

[Clockwise] [Counter-clockwise] rotation and [\_\_\_\_\_\_] discharge, as viewed from drive side.

Integral Inlet Cone Assembly: Fabricated mounting brackets welded to mounting panel and inlet panel for pre-aligned inlet funnel within the wheel. Entire assembly removed through the drive side of customer’s enclosure without the need for separate mounting of inlet funnel on customer’s equipment.

Specifier: Fork Lift Lifting Tubes are only available on horizontally mounted fans.

Fork Lift Lifting Tubes: Provide two (2) fabricated tubes welded to fan mounting panel for inserting fork lift tines to assist in installation and removal of horizontal fans.

Specifier: Where flow measurement is required, retain following subparagraph. This flow measurement device can be used with instrumentation provided by Twin City Fans, or instrumentation provided as the work of a separate contract.

Select maximum operating temperature as required by project conditions.

Piezometer Ring: Provide piezometer ring type differential pressure device with connections for field-installed flow measuring instrumentation. Maximum operating temperature: [180 deg. F (82 deg. C)] [600 deg. F (316 deg. C)] .

Pressure Transducer without Display: Provide piezometer ring and transducer to convert differential pressure readings to 4 - 20 mA DC signal proportional to flow.

Specifier: When required, retain enclosure option in following paragraph.

Pressure Transducer/Transmitter with Display [NEMA 4X Enclosure]: Provide piezometer ring and transducer with local digital display to convert differential pressure readings to 4 - 20 mA DC signal proportional to flow. Include two independently adjustable SPDT dry-contact outputs.

* + - 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, [install factory-furnished companion flanges and] 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."

* + - * 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 option 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