

**Twin City Fan & Blower Guide Specification
High Velocity Fume Exhaust Ventilators: Model TFE, Belt Driven**

**Twin City Fan & Blower Model TFE Series Inline Flow Centrifugal Fume Exhaust Fans** are specially modified versions of the TSL fan designated as TFE for laboratory fume hood exhaust and other life safety applications.

The TFE fan consists of a vertically mounted tubular inline centrifugal fan with a reinforced curb cab and discharge cap. The discharge cap includes an outlet venturi nozzle, increasing the outlet velocity to meet stringent roof exhaust requirements and maximize the over-all plume height of the laboratory exhaust.

Model TFE offers a wide range of nozzle sizes for each fan size to effectively accelerate the exhaust stream based on the specific building exhaust needs. Model TFE is available in belt driven configurations. Model TFE is available with UL/cUL 705 listing for electrical.

**Application**

The TFE Centrifugal Exhaust Fan is intended for use in exhausting laboratory fumes and hazardous chemicals in such a manner that diminishes the likelihood of concentrated, contaminant-laden air from being re-entrained into the building's intake or makeup air. This unit is commonly used in exhaust systems for universities, schools, hospitals, research facilities, laboratories, restaurants and waste water treatment plants.

Sizes (wheel diameters): 10.5 to 54.25 inches (270 mm to 1,375 mm)

Airflow: Up to 70,000 CFM (118,900 m3/hour)

Static Pressure: Up to 7 inches wg (1,740 Pa)

Twin City Fans & Blowers (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 23.02 – CENTRIFUGAL ROOF VENTILATORS

1. GENERAL
	* + 1. SUMMARY
				1. Section includes inline centrifugal exhaust fans, belt driven.
			2. 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 - ASHRAE 51 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating

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

* + - * 1. American National Standards Institute (ANSI): [www.ansi.org](http://www.ansi.org)

ANSI Z9.5 - Laboratory Ventilation

* + - * 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

Specifier: When optional UL/cUL 705 compliance is required, retain the following subparagraph.

* + - * 1. Underwriters Laboratories, Inc. (UL): [www.ul.com](http://www.ul.com):

UL 705 - Standard for Power Ventilators

* + - 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.

Fan volumetric flow rate, fan nozzle outlet velocity, and discharge plume height at indicated wind speed.

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.

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 (sound performance) in an AMCA-accredited laboratory.

* + - 1. COORDINATION
				1. Coordinate sizes and locations of supports required for fan units.
				2. Coordinate sizes and locations of equipment supports, roof curbs, 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 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.
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 inline, centrifugal fans from a single manufacturer.
			2. PERFORMANCE REQUIREMENTS
				1. Fan Performance Ratings: [Project site elevation- based] [Sea level-based].

Specifier: When optional UL/cUL 705 compliance is required, retain the following paragraph and subparagraph.

* + - * 1. Compliance:

Classified under UL 705.

* + - * 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.
			1. INLINE CENTRIFUGAL FANS
				1. Belt - Driven, Inline Centrifugal Fume Exhaust Fans: Inline Centrifugal fan units, configured for roof - mounting, for vertical flow of relatively clean air containing laboratory fumes or hazardous vapors for Heating, Ventilating, and Air-Conditioning (HVAC) applications.

Basis of Design Product: **Twin City Fan & Blower, Model TFE, Belt - Driven, Inline Centrifugal Axial Fans**.

Permanently attach nameplate displaying serial number and unit information.

Fan assemblies: Provide unit suitable for maintaining structural integrity and operation in 125 mile per hour (55.9 meter/second) wind without external guy - wires or supplemental supports when mounted on manufacturer-supplied roof curbs.

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

Specifier: The standard wheel on sizes up to 105 is fabricated in aluminum; 122 and larger is fabricated in steel. For spark resistant construction, select aluminum option in the following paragraph.

For fan wheels up to size 165, select backward inclined blade option in the next paragraph. For fans size 182 and larger, select die-formed airfoil blades.

* + - * 1. Fan Wheel Impeller: Centrifugal design with formed [steel] [aluminum] [backward inclined] [die formed airfoil] blades continuously welded to wheel backplate and wheel cone.

Statically and dynamically balance wheel.

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

Include fins on wheel backplate.

* + - * 1. Spark Resistant Construction: Mount bearings outside flow airstream, and provide sealed metal belt shield tubes.

AMCA Type B: Provide non-ferrous fan wheel impeller and aluminum rub ring where shaft penetrates fan housing.

* + - * 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.

* + - * 1. Provide standard shaft seal to reduce leakage and protect the bearings from contaminated airstreams.
				2. Bearings: Manufacturer's standard field-lubricated ball or roller bearings with pillow block mounting, based on fan size, with grease lines extended to outside fan housing.

Minimum L-10 Bearing Life: 200,000 hours at maximum operating speed, in accordance with ABMA 9 for Ball Bearings, or ABMA 11 for Roller Bearings.

Specifier: In following paragraph, standard material is steel. Select aluminum option when spark - resistant or all-aluminum construction is required.

* + - * 1. Housing: Steel with continuously welded seams and streamlined inlet. Reinforce housing to prevent vibration. Provide punched inlet flange.

Specifier: In following subparagraph, a bolted access door is standard. A quick open latched access door is optional.

[Bolted] [Quick Open Latched] Access Door.

Provide 3/4 inch NPT drain connection at lowest point of housing.

Specifier: In following paragraph, bolted weather cover is standard. A hinged weather cover is optional.

* + - * 1. Weather Cover: Provide [bolted] [hinged] steel weather cover to shield motor and belt-drive from weather. Fabricate with rainproof ventilation slots.

Specifier: Select steel option in following paragraph for all cases except spark-resistant construction.

* + - * 1. Inner Cylinder: [Steel] [Aluminum], rigidly constructed to support fan shaft and bearings, with removable discharge cone.

Specifier: To allow for fan shaft, bearing, and sheave service, design duct access door adjacent to discharge end of fan.

Design fan to allow for servicing fan shaft, bearings, [and sheave] by removing discharge cone.

* + - * 1. Sealed Belt Tube: Sealed to protect belts from the airstream.
				2. Discharge Nozzle and Windband: Provide combination discharge nozzle and windband to increase discharge velocities to velocities that comply with ANSI Z9.5, minimum 3,000 feet/minute (15.2 meter/second).

Design and install windband to provide 120 inch (3,048 mm) minimum discharge height above roof surface.

Design discharge nozzle to develop maximum 9,500 feet/minute (48 m/second) discharge air velocity.

Provide discharge damper providing 100 percent shutoff preventing rain intrusion while allowing plume to develop when fan is energized.

* + - * 1. Straightening Vanes: Fabricate from same material as housing. Aerodynamically designed to recover velocity pressure and convert it to static pressure in downstream ductwork.
				2. Curb Cap: One-piece, weather-tight construction, pre-punched mounting holes for correct attachment to roof curb and fan inlet flange. Fabricate from [painted] [galvanized] steel.
				3. Belt Drives:

Drive Components: V-belt drive, rated for minimum 200 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.

* + - * 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: [3,600] [1,800] [1,200] [900] rpm.

Specifier: If factory disconnect is required, select NEMA enclosure rating in following paragraph, and select one subparagraph below to specify factory or field mounting. Retain second subparagraph when NEMA 7/9 (explosion proof) option is selected.

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 the following paragraph.

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.

* + - * 1. Motor Mounting Platform: Heavy-duty motor mounting platform allows adjustment of drive belt tension.
				2. Hardware: Provide corrosion resistant stainless steel hardware and fasteners.
				3. Coatings:

Specifier: Retain subparagraph 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. Fan shall then be coated with gray enamel.

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.

Inlet Safety Screen: Welded wire safety screens fabricated for easy installation and removal.

Stack Section: Tube extension mounted between the outlet of the fan and the nozzle to create an overall fan height of 120 inches (305 mm).

Specifier: Select height and insulation option in following paragraph where required.

Roof Curb: Self-Flashing, [8 inches (203 mm)] [12 inches (305 mm)] [18 inches (457 mm)] high, unvented [, with 1-1/2 inch (38 mm) thick insulation]. Fabricate roof curb of galvanized steel with wood nailer.

Specifier: Straightening vanes in the following paragraph are available only when optional mixing plenum box is selected.

Vortex Breaker: Installed in the mixing plenum box at the fan inlet to minimize air turbulence.

Specifier: Where required, include mixing plenum box in paragraphs below.

Mixing Plenum Box: Designed to secure fans for wind loads up to 125 mile per hour (11,000 meter/second), mixing plenum box features modular construction allowing for multiple configurations and retrofit installation.

Mixing Plenum Box: Mixing plenum box matching fan housing material of construction, to include integral duct flange to mate to fan inlet.

Specifier: In the following paragraph, the standard mixing plenum box configuration is bottom inlet. Side inlet is optional. For special duct adapting plates on bottom of box, contact factory prior to ordering.

Intake: [Bottom] [Side] intake mixing plenum box for attachment of building duct.

Mount mixing box on heavy duty roof curb.

Insulated mixing box with stainless steel liner.

Specifier: When required, retain the following paragraph for isolation and bypass dampers. These are useful to control the building exhaust flow, affluent air dilution, fan isolation as well as allow for system expansion.

Note the selection of damper materials and coatings. Select these to suit project requirements.

Isolation dampers: When multiple fans are mounted on one common plenum box, provide isolation dampers to isolate each fan in the system for mixing plenum box.

Specifier: The standard isolation damper is galvanized steel. Epoxy coated steel, Heresite coated steel, unfinished aluminum, epoxy coated aluminum, Heresite coated aluminum, 304 stainless steel, and 316 stainless steel are optional.

Parallel blade design, constructed of [galvanized steel] [epoxy-coated steel] [Heresite-coated steel] [unfinished aluminum] [epoxy-coated aluminum] [Heresite-coated aluminum] [304 stainless steel] [316 stainless steel].

Provide [24] [115] V-powered, two-position, spring return actuator rated for NEMA [2/IP54] [4] [7/9] environment to coordinate with fan operation.

Bypass Damper: Provide modulating bypass damper to maintain fan discharge velocity as fan delivery changes.

Specifier: The standard bypass damper is galvanized steel. Epoxy coated steel, Heresite coated steel, unfinished aluminum, epoxy coated aluminum, Heresite coated aluminum, 304 stainless steel, and 316 stainless steel are optional.

Opposed blade design, constructed of [galvanized steel] [epoxy-coated steel] [Heresite-coated steel] [unfinished aluminum] [epoxy-coated aluminum] [Heresite-coated aluminum] [304 stainless steel] [316 stainless steel].

Provide [24] [115] V-powered, modulating actuator, rated for NEMA [2/IP54] [7/9] environment, to coordinate with fan operation.

Specifier: When required, retain the following paragraph to get UL/cUL 705 compliance and labeling.

UL/cUL 705 Compliant Assembly: Provide components required for UL/cUL 705 compliance. Affix UL/cUL 705 labeling and nameplate to finished unit.

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

Spark Resistant Construction: Mount bearings outside flow airstream, and provide sealed metal belt shield tubes.

AMCA Type C: Provide construction that will not permit shaft or fan wheel impeller to contact or strike ferrous metal parts.

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.

Piezometer Ring: Provide piezometer ring type differential pressure device with connections for field-installed flow measuring instrumentation.

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.

Jib Crane and Mounting Base: Provide manually operated jib crane suitable for unit maintenance and motor removal.

Jib Crane Mounting Base: Provide mounting base for manually operated jib crane.

* + - 1. SOURCE QUALITY CONTROL
				1. Factory Run Test: Test run assembled fan units prior to shipment at specified operating speed or maximum RPM allowed. 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. 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.

Retain flexible connector option in following paragraph when required.

* + - * 1. Duct Connections: Drawings indicate general arrangement of ducts and duct accessories. Where indicated on Drawings, [install factory-furnished companion flanges] [and flexible connectors] where indicated on Drawings. [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
				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