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**Twin City Fan & Blower Guide Specification
Inline Centrifugal HVAC Fans: Model TSL, Belt Driven**

**Twin City Fan & Blower Model TSL Series, Inline Centrifugal Fans**, feature the reliable performance of a centrifugal fan with the space saving advantages of an axial type fan. The TSL offers high efficiencies in the commonly selected area. TSL fans offer superior air and sound performance and the AMCA certified rating seal for air and sound.

The TSL has a higher and broader efficiency range compared to competitive tubular fans and square inline fans. Lower operating speed for a given performance provides longer and more reliable operation.

Model TSL is available in belt driven configurations and mounts both vertically and horizontally, allowing for numerous applications with multiple mounting arrangements. Model TSL is UL/CUL 705 listed.

**Application**

Tubular centrifugal fans such as the TSL are used primarily for low to medium pressure return air systems in heating, ventilating, and air conditioning applications. They are generally more compact than comparable scroll type centrifugal fans and often will fit into tight spaces or in overhead ductwork where other fans of the same duty may not. This is particularly true of the TSL inline fans, which were specifically engineered with a wider efficiency range. This allows selection of smaller fans while maintaining high efficiencies and low operating costs.

Sizes (wheel diameters): 12.25 to 89 inches (311 mm to 2,261 mm)

Airflow: Up to 221,700 CFM (376,664 m3/hour)

Static Pressure: Up to 9 inches wg (2,236 Pa)

Twin City Fan & Blower (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 Registered testing lab.

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 belt driven inline centrifugal fans.
			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 205 - Energy Efficiency Classification for Fans

AMCA Standard 210 / ASHRAE 51 - Laboratory Methods of Testing Fans for Certified Aerodynamic Performance Rating

AMCA Publication 211 - Certified Ratings Program - Product Rating Manual for Fan Air Performance

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

AMCA Publication 311 - Certified Ratings Program - Product Rating Manual For Fan Sound Performance

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

UL/cUL 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.

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.

Provide fan units rated according to AMCA Standard 211 (air performance) and AMCA Publication 311 (sound performance).

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, 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.

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 inline centrifugal fans from a single manufacturer.
			2. PERFORMANCE REQUIREMENTS
				1. Fan Performance Ratings: [Project site elevation- based] [Sea level-based].
				2. AMCA Compliance: Provide units that bear the AMCA-Certified Ratings Seal.
				3. Compliance:

Classified under AMCA Standard 205.

Classified under UL 705.

* + - * 1. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.
			1. CENTRIFUGAL FANS
				1. Belt driven fixed pitch airfoil centrifugal fans, configured for horizontal or vertical flow of relatively clean air for Heating, Ventilating, and Air-Conditioning (HVAC) applications.

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

Permanently attach nameplate displaying serial number and unit information.

* + - * 1. Configuration:

Horizontal, Base-Mounted (HBM): Provide support leg bracket at each end of fan, for floor mounting.

Horizontal, Ceiling-Hung (HCH): Provide four welded hanger clips for support from above with hanger rods.

Horizontal, No Mounting Brackets (HOR):

Vertical, Roof-Mounted (VRM). Include discharge cap with gravity-type butterfly dampers that close when fan is not running.

Vertical, Discharge Up, Floor Mount Bracket at Inlet (VUI).

Vertical, Discharge Up, Ceiling Hung Bracket at Outlet (VUO).

Vertical, Discharge Down, Ceiling-Hung Bracket at Inlet (VDI).

Vertical, Discharge Down, Floor Mount Bracket at Outlet (VDO).

Vertical, Discharge Up, No Brackets (VUN).

Vertical, Discharge Down, No Brackets (VDN).

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

* + - * 1. Fan Wheel: Fabricate from fixed pitch, die formed blades of single-surface airfoil shape welded to a spun steel central hub. Ensure precise blade attachment through use of welding jigs and fixtures.

Fan wheel sizes 122 and 150: Fabricate with single thickness plate-type blades.

Fan wheel sizes 182 and larger: Fabricate with die-formed airfoil blades designed for maximum efficiency and quiet operation.

Continuously weld blades to back plate and wheel cone. Partial welding is not acceptable.

Provide wheel specifically designed for inline fans to offer a higher and broader efficiency range.

Design and fabricate wheel back plate to offer low resistance to the air leaving wheel.

Statically and dynamically balance wheel when fabricated, and again after fan unit has been assembled.

* + - * 1. Fan Shaft: AISI 1045 steel, turned, ground, and polished. Select shaft diameter so that First Critical Speed is minimum 1.43 times maximum operating speed. Finish with petroleum based rust protectant.
				2. Bearings: Manufacturer's standard, self-aligning, field-lubricated pillow block ball or roller bearings, based on fan size and mounting orientation, with grease lines extended to outside fan housing.

Minimum L-50 Bearing Life: 200,000 hours at maximum operating speed, in accordance with AFBMA 9 for Ball Bearings, or AFBMA 11 for Roller Bearings.

* + - * 1. Housing: Formed ASTM A-569 low carbon hot rolled steel with continuously welded seams. Include mounting feet or hanger connections to suit installation requirements. Provide punched inlet and outlet flanges.

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 slip-on companion flanges that match fan flanges for making connections to ductwork.

* + - * 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. Straightening Vanes: Steel, aerodynamically designed to recover velocity pressure and convert it to static pressure in downstream ductwork.
				2. Belt Drives:

Specifier: The standard belt drive safety factor is 120 percent, but optional 150 percent is available.

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.

Motor and Drive Assembly: Rigidly mounted and isolated from airstream. Provide aerodynamically shaped belt shield tubes to isolate drive components from airstream. Continuously weld tubes where they penetrate inner cylinder and outer housing.

Specifier: Retain first following subparagraph for indoor fans. Retain second following subparagraph for outdoor fans, if required. Weather cover is available in hinged or bolt-on configurations.

Belt Guard: [Standard] [OSHA compliant], steel, totally enclosed and sealed. [Paint belt guard yellow.]

[Hinged] [Bolt-on] Outdoor Weather Cover: Provide [hinged] [bolt-on] steel weather cover to shield motor and belt-drive from weather. Fabricate with rainproof ventilation slots.

* + - * 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.

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] [277] [460] [575] [\_\_\_\_\_] V; [1] [3] phase; 60 Hz.

Full Load Amps: [\_\_\_\_\_] A.

Specifier: Select motor enclosure type in following subparagraph.

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

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

When required, provide premium efficiency motor, suitable for inverter duty, for motors controlled by Variable Frequency Drive (VFD).

Provide anti-static shaft grounding blocks to protect motor bearings by draining stray currents to ground.

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], selected in accordance with Division 26 section "Enclosed Switches."

Factory mount and wire disconnect switch.

Ship disconnect switch loose for field mounting and wiring.

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

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

Provide [spring] [neoprene-in-shear] vibration isolators, [and seismic restraints] in accordance with fan manufacturer's requirements, and Division 23, Section "Vibration and Seismic Controls for HVAC Piping and Equipment."

Spring Isolators: Select for [1 inch (25.4 mm)] [2 inch (51 mm)] deflection.

Specifier: The following paragraph is not for standard fan units. Retain paragraph below for fans requiring frequent cleaning and service, or where service through a duct access door is not suitable.

* + - * 1. Interior Access:

Clamshell Design: Provide two mating doors that swing open to allow total access to interior of fan. Include heavy-duty hinges, locking latches, and full gasketing to provide complete seal.

Swingout Design: Provide assembly with all moving fan parts mounted on a swingout door. Include heavy-duty hinges, locking latches, and full gasketing to provide complete seal.

* + - * 1. Finishes:

After fabrication, deburr, clean and chemically pretreat metal parts by phosphatization.

Apply two coats of following finish:

Specifier: The first paragraph below is manufacturer's standard finish. Those that follow are optional finishes. Select finish that is required.

If fans specified for the project have different finishes, include the finish for each fan on the Drawings and delete here.

Air-dried enamel.

High-temperature aluminum paint.

Asphaltum.

Vinyl PVC.

Zinc.

Air-dried epoxy.

Synthetic resin, Santile 855.

Air-dried phenolic, Heresite VR 506.

Epoxy, Carboguard 890 series.

Phenolic epoxy, Plasite 7122L

Baked phenolic, Heresite P 413

Coal tar epoxy.

High-Build baked epoxy, Skotchkote 324.

* + - * 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 or Outlet Safety Screen: Welded wire [barbecue-type] [1 inch (25 mm) square] safety screens fabricated for easy installation and removal.

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 A: Provide non-ferrous metal parts in contact with flowing airstream, and aluminum rub ring where shaft penetrates fan housing.

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

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

Inlet Vane Dampers:

Specifier: For inlet vane dampers, nested dampers take up less space and cost less. External dampers are suitable for hostile environments with dirty air streams. Outlet dampers are the least expensive damper option, but do not have the best energy performance.

Inlet Vane Dampers: Provide pre-rotational inlet vane dampers [nested in fan inlet] [external to fan housing].

Specifier: Retain the following paragraph for motorized inlet vane dampers, and select required voltage for actuator power.

Provide inlet damper actuator suitable for [24] [115] [208] [230] [460] [575] Vac, single phase. [Provide transformer for [575] V actuator.]

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

[Bolted] [Quick Open Latched] Access Door.

Shaft seal, including non-asbestos rubbing ring and metal cover plate, to limit airstream infiltration.

Bolt-on companion flanges that match fan flanges for making connections to ductwork.

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

Retain paragraph below for roof mounted units only. When required, retain subparagraph for tie-down brackets.

Curb Cap: Welded steel, one-piece, weather-tight construction, to adapt from square roof curb to round fan inlet. Fabricate from steel and include pre-punched flange to mate with fan unit inlet flange.

Provide integral tie-down brackets for connection of field-supplied cables.

Specifier: The discharge cap specified in the following paragraph is available on vertical units with roof discharge only.

Discharge Cap: Provide steel stack cap with gravity operated butterfly dampers at fan discharge. Include gasket and pre-punched flange holes to enable bolted connection to fan outlet. Finish with manufacturer's standard paint.

Velocity: 1,800 to 3,000 feet/min (9.1 to 15.2 m/s).

Fusible Link: Holds butterfly dampers on discharge cap open when fusible link melts at 165 deg. F (74 deg. C).

Magnetic Damper Latches: Provide where required to keep dampers closed while fan is not running.

Roof Curb: Minimum 12 inches (300 mm) high, unvented, with 1-1/2 inch (38 mm) thick insulation.

Specifier: Where flow measurement is required, retain following subparagraph. This ring sensor 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 sensor with nylon tubing to 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 [Panel Mounted] [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. Program digital display to show fan flow in cubic feet per minute (cfm). Include two independently adjustable SPDT dry-contact outputs. [Mount pressure transducer/transmitter inside NEMA 4 enclosure.]

Thrust Restraint: Provide thrust restraint support member when fan is horizontally mounted and not anchored to building structure.

* + - 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 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.

Submit report of factory run test.

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.

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