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**Twin City Fan & Blower Guide Specification
Airfoil Centrifugal Fans: Model HAF Series, Direct or Belt Driven**

**Twin City Fan & Blower Model HAF** is a single-width, single-inlet, centrifugal fan. The HAF fan is designed with a high efficiency non-overloading airfoil wheel, making the HAF an efficient choice for clean air applications.

**Application**

Model HAF is suitable for indoor or outdoor locations, with free or ducted inlets and outlets. Typical applications include forced draft on fluid boilers, dryers, solvent recovery systems, moisture blow-off, product cooling, and recirculation systems.

Sizes (wheel diameter): 25 to 82 inches (635 mm to 2,085 mm)

Airflow to 160,000 CFM (271,850 m3/hour)

Class 30: Tip speed (Max): 23,000 feet/min (117 m/sec)

Static pressure to Up to 30 inches wg (7,452 Pa)

Class 40: Tip speed (Max): 27,800 feet/min (141 m/sec)

Static pressure to Up to 40 inches wg (9,936 Pa)

Class 50: Tip speed (Max): 29,700 feet/min (151 m/sec)

Static pressure to Up to 50 inches wg (12,420 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 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 16.01 – AIRFOIL CENTRIFUGAL FANS

1. GENERAL
	* + 1. SUMMARY

Specifier: Select direct or belt driven unit in following paragraph.

* + - * 1. Section includes single-width, single-inlet (SWSI) airfoil centrifugal 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):

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
				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 centrifugal airfoil fans from a single manufacturer.
			2. PERFORMANCE REQUIREMENTS
				1. Fan Performance Ratings: [Project site elevation- based] [Sea level-based].
				2. Electrical Components, Devices, and Accessories: Listed and labeled as defined in NFPA 70.
			3. CENTRIFUGAL AIRFOIL FANS
				1. Description: [Direct] [Belt]- Driven Centrifugal Airfoil Fans: Single-width, single-inlet, base-mounted fan for discharge in horizontal direction.

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

Permanently attach nameplate displaying serial number and unit information.

Specifier: Coordinate fan orientation with notations on drawings.

* + - * 1. Fan Capacities, Characteristics, and Configuration: Refer to Drawing schedule.
				2. Fan Wheels: Provide fabricated high efficiency wheel with die-formed airfoil profile alloy steel blades, continuously welded to backplate and wheel inlet cone. Hub to be keyed to shaft. Partial welds are not acceptable.

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

Statically and dynamically balance wheel.

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

Specifier: Delete the following paragraph for Arrangement 4 fans.

* + - * 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.

Specifier: Delete the following paragraph for Arrangement 4 fans.

Retain the option in the following paragraph when extended grease lines are required

* + - * 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. Housing: Continuously welded [steel] [aluminum] [304 stainless steel] [316 stainless steel], reinforced with rigid bracing. Includes aerodynamically spun inlet cone.

Partially welded seams are not acceptable.

Include pre-punched flanges for making connections to ductwork.

Shaft Seal: Manufacturer's standard seal, constructed of non-asbestos woven fibrous ceramic felt materials compressed between aluminum cover plate and fan housing.

Specifier: Paragraph below represents standard construction features for all Arrangement 3SI and 7SI fans and fans with wheel diameters 41 inches (1040 mm) and larger. Delete for smaller sizes.

Pie Split Housing: Provide two mating sections that lift apart to allow removal of fan wheel. Include bolts, hardware, and full gasketing.

Specifier: When insulated housing required for sound or temperature, retain following paragraph. Select option for insulation type.

Provide [factory fabricated steel wall insulated housing] [aluminum clad insulated housing]; minimum thickness [2 inches (51 mm)] [\_\_\_\_\_]. Anchor housing insulation with weld pins.

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

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

* + - * 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 3SI, 7SI, and 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 paragraph and subparagraphs below for belt-driven units only. Fixed pitch drives for all fans are standard equipment. Adjustable pitch drives are optional.

* + - * 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 paragraphs when required.

Belt Guard: Steel, [OSHA compliant] [quick access].

* + - * 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.

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

Specifier: Retain paragraph and subparagraphs 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 without vibration isolation.

Unitary Base: Provide structural steel base to furnish common support for fan, motor, and drive, including guard assemblies.

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

Isolation Type Base: Provide heavy structural base for fan, motor, and drive, when fan assembly is mounted on spring type vibration isolators.

Specifier: Delete subparagraph 1 for Arrangement 3SI, 7SI and 8 fans. 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 paragraph for fans operating with gas streams above ambient temperature. Delete for Arrangement 4 fans.

* + - * 1. Maximum Operating Temperature: [300 deg. F (149 deg. C)] [500 deg. F (260 deg. C)] [600 deg. F (316 deg. C)] [800 deg. F (427 deg. C)].

For operating temperature to 500 deg. F (260 deg C), provide high temperature grease and bearings, shaft seal, and shaft cooler.

For operating temperature to 600 deg. F (316 deg C), provide high temperature grease, expansion and non-expansion bearings, shaft seal, and shaft cooler. Coat steel surfaces with high temperature aluminum paint.

For operating temperature to 800 deg. F (427 deg. C), high temperature grease, expansion and non-expansion bearings, shaft seal, and shaft cooler. Coat steel surfaces with high temperature aluminum paint. Provide insulation blanket between fan housing and pedestal. Modify pedestal as required.

* + - * 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. Fan shall then be coated with blue 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.

Specifier: When required, edit the following paragraph and subparagraphs to require an inlet box and inlet box options. Inlet box damper, if required, is specified above with other dampers. Arrangement 3SI and 7SI included integral inlet box as standard.

Inlet Box: Match housing construction, with [bolt-on] [free-standing] [integral] configuration with fan housing.

Access Door: [Bolted flush with interior] [Raised Bolted [[4 inch (102 mm)] [6 inch (152 mm)] [8 inch (203 mm)]] [Quick Open Latched].

Drain: 3/4 inch NPT [with plug].

Provide [factory fabricated insulated housing] [aluminum clad insulated housing; minimum thickness [2 inches (51 mm)] [\_\_\_\_\_]. Anchor housing insulation with weld pins].

Rectangular evasé with same construction as fan housing, to transition fan outlet to field ductwork.

Specifier: When required, provide optional split housing to allow easier access to wheel and inside of scroll.

Provide Split Housing: [Horizontal] [Pie-shaped] [3-way].

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

Access Door: [Bolted flush with interior] [Raised Bolted [[4 inches (102 mm)] [6 inches (152 mm)] [8 inches (203 mm)]].

Drain: 3/4 inch NPT [with plug].

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

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

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

Volume Control Devices

Specifier: For inlet vane dampers, nested dampers take up less space. External dampers are suitable for hostile environments with dirty air streams. Consult TCF for application recommendations.

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

Outlet Dampers: [Parallel-blade] [Opposed-blade] dampers suitable for modulating fan delivery at discharge static pressure at [70 - 300 deg. F (21 - 148 deg. C)] [301 - 600 deg. F (149 - 316 deg. C)] [601 - 800 deg. F (316 - 427 deg. C)].

Inlet Box Damper: Welded construction, suitable for modulating fan delivery at [70 - 300 deg. F (21 - 148 deg. C)] [301 - 600 deg. F (149 - 316 deg. C)] [601 - 800 deg. F (316 - 427 deg. C)].

Evasé Outlet Dampers: [Parallel-blade] [Opposed-blade] dampers suitable for modulating fan delivery at discharge static pressure at [70 - 300 deg. F (21 - 148 deg. C)] [301 - 600 deg. F (149 - 316 deg. C)] [601 - 800 deg. F (316 - 427 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

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 when spark-resistant construction is required. Type A and B spark resistance is not available for model HAF.

Spark Resistant Construction: Mount bearings outside flow airstream.

AMCA Type C: Provide construction that will not permit shaft or fan wheel impeller to contact or strike ferrous metal parts. Maximum operating temperature: 600 deg. F (316 deg. C).

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.

Temperature Detectors: Provide [thermocouple] [resistance temperature detector (RTD)] at each bearing. Provide terminal block connections for field wiring.

Vibration Detectors: Provide [\_\_\_\_\_] type vibration switch at each bearing. Provide terminal block connections for field wiring.

* + - 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.

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