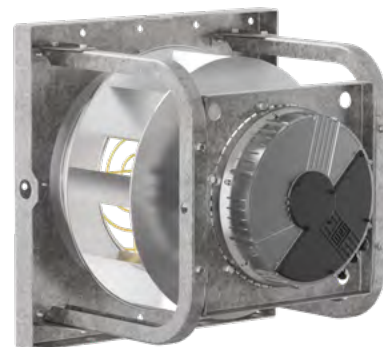
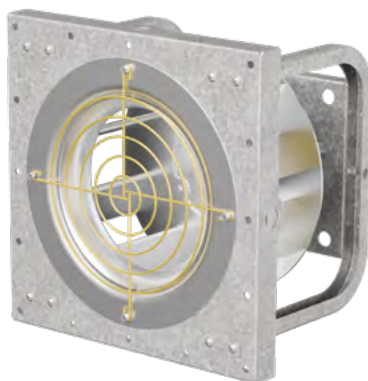




REVIEW AMCA PUBLICATION 410 PRIOR TO INSTALLATION

This manual has been prepared to guide the users of EC Plenum Fans in the proper installation, operation and maintenance procedures to ensure maximum equipment life with trouble-free operation. For safe installation, start-up and operational life of this equipment, it is important that all involved with the equipment be well versed in proper fan safety practices and read this manual. It is the user's responsibility to make sure that all requirements of good safety practices and any applicable safety codes are strictly adhered to. Because of the wide variety of equipment covered in this manual, the instructions given here are general in nature. Additional product and engineering information is available at www.tcf.com.

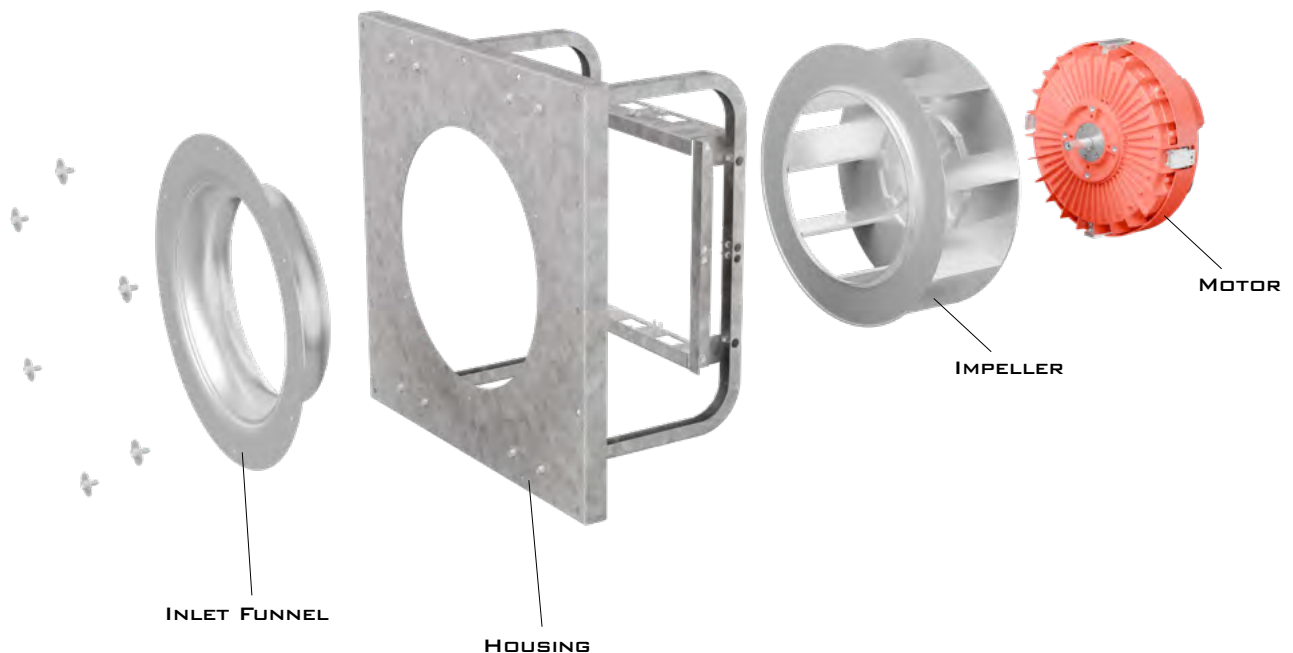
SAFETY NOTICE

Refer to the safety section(s) in this manual prior to installing or servicing the fan. The most current version of this installation and maintenance manual can be found on our website at www.tcf.com/resources/im-manuals.

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EXPLODED VIEW



INTRODUCTION

Purpose of Manual

DO NOT INSTALL, USE OR OPERATE THIS EQUIPMENT UNTIL THIS MANUAL HAS BEEN READ AND UNDERSTOOD. READ AND SAVE THESE INSTRUCTIONS FOR FUTURE USE.

The purpose of this manual is to aid in the proper installation and operation of fans supplied by Twin City Fan Companies, Ltd. These instructions are intended to supplement good general practices and are not intended to cover detailed instruction procedures because of the wide variety and types of fans manufactured by Twin City Fan Companies, Ltd.

It is the responsibility of the purchaser to ensure that the installation and maintenance of this equipment is handled by qualified personnel experienced in such work and equipment.

Instructions given in this manual are general in nature and apply to Model ECPFN wall-mount fans of all sizes and configurations. Most units can be installed, started, operated and maintained using the instructions given. Special applications may require additional information. If application-specific instructions, project submittals, fan drawings, wiring labels, motor labels or other supplied documents differ from this manual, follow the project-specific instructions or contact Twin City Fan & Blower.

Scope

This manual covers wall-mount Model ECPFN fans installed as a single fan or in a fan array. It also includes the basic EC motor power, speed control, communication, alarm and piezometer airflow measurement instructions required for normal installation and commissioning. The manual is intended for installing contractors, OEM and air handling unit builders, commissioning technicians, controls contractors and facility maintenance personnel.

Installation, electrical wiring, controls wiring, start-up, troubleshooting and maintenance are to be performed only by qualified, trained and authorized personnel. Personnel should be familiar with air moving equipment, applicable electrical codes, lockout/tagout procedures, site safety procedures, and the requirements of the final equipment or system.

Additional product and engineering information is available from Twin City Fan & Blower. Fan performance, dimensions, weights, accessories, motor data, control details and wiring information should be verified against fan and motor nameplates, project submittal, wiring labels and drawings.

SAFETY & HAZARD WARNINGS

For general safety practices for air moving equipment, review AMCA Bulletin 410 prior to installation. All personnel involved in installation, operation, and maintenance must fully understand the warning and caution procedures by which hazards are to be avoided.

General Fan Safety

Twin City Fan & Blower offers many safety accessories. These devices may include, but are not limited to, inlet guards, discharge screens, access panels, disconnects and other protective devices. The use and suitability of safety devices is the responsibility of the purchaser and the user. The final installation must account for fan accessibility, service clearances, hazardous environments and the possibility that non-service personnel could contact moving parts or energized equipment.

The following safety precautions should be followed, where applicable:

- Before any work is done on a fan, isolate the fan from electrical supply using a lockout/tagout system in accordance with site procedures and OSHA requirements.
- A stationary, non-rotating fan does not mean the fan is isolated from electrical power. Controls, protective devices, communication commands or stored speed commands may cause a fan to start without notice.
- Do not attempt to slow or stop a rotating impeller by hand, with tools or with foreign objects. Fan impellers have high inertia and injury could result.
- Building pressure, adjacent fans, wind or process airflow can cause windmilling. If necessary, isolate the inlet or discharge to prevent fan rotation before service. Remove all chocks, blocks and tools prior to start-up.
- Wear appropriate personal protective equipment. This may include protective clothing, eye protection, hearing protection, respiratory equipment, hand and foot protection when installing or servicing the fan.
- Always use caution when entering a fan's air path. High velocity airflow can cause you to lose your balance.
- Motor housings, electronics enclosures, fan parts and adjacent surfaces may be hot during or after operation.
- Sharp edges may be present. Wear protective gloves when handling, installing or servicing a fan.
- Fans can operate at high decibel sound levels. Wear proper ear protection to protect from excessive noise levels.

Throughout this manual, there are a number of HAZARD WARNINGS that must be read and adhered to in order to prevent possible personal injury and/or damage to equipment. Two signal words "WARNING" and "CAUTION" are used to indicate the severity of a hazard and are preceded by the safety alert symbol. It is the responsibility of all personnel involved in installation, operation and maintenance to fully understand the warning and caution procedures by which hazards are to be avoided.

 **WARNING:** Used when serious injury or death MAY result from misuse or failure to follow specific instructions.

 **CAUTION:** Used when minor or moderate injury or product / equipment damage MAY result from misuse or failure to follow specific instructions.

NOTICE: Indicates information considered important, but not hazard-related.



WARNING: Lockout/Tagout Required

Verify that proper safety precautions have been followed. Electrical power must be locked off and the fan must be prevented from rotating before service work is performed.



EC Motor and Electrical Safety

Model ECPFN fans use electronically commutated motors with onboard electronics. These motors may contain stored energy after power is removed. Control wiring, analog speed signals, run enable contacts or communication commands do not provide safe electrical isolation.

- Disconnect all power sources before opening electrical enclosures, touching terminals or servicing the fan.
- Verify absence of voltage using appropriate test equipment before touching conductors or terminals.
- Allow motor and device electronics to discharge completely before service. Refer to the motor manufacturer's current documentation to confirm the appropriate discharge time.
- Use an all-pole disconnecting means as required by applicable codes and the project electrical design.
- Do not rely on a 0-10V signal, Modbus command, enable input or Building Management System (BMS) point as an energy isolation device.
- Fans may restart automatically after power restoration, alarm reset, control signal restoration, communication command or removal of a fault condition.
- Route and protect wiring so it cannot contact rotating parts, sharp edges, hot surfaces, grease, oil or chemicals.

The customer is responsible for investigating and installing equipment in compliance with local electrical and safety codes for the equipment location. References that may apply include AMCA Bulletin 410 for air moving equipment safety, AMCA Publications 201 and 203 for field measurement procedures, AMCA Publication 202 for troubleshooting and system effect guidance, ANSI/AMCA 204 for vibration guidance, OSHA 29 CFR 1910.147 for lockout/tagout and the National Electrical Code ANSI/NFPA 70. Applicable UL and CSA marks must be verified on the motor nameplates for the specific unit supplied.

PRODUCT DESCRIPTION AND INTENDED APPLICATION

Product Description

The Model ECPFN is Twin City Fan & Blower's wall-mount plenum fan with integrated electronically commutated motor. The fan is intended for installation into a plenum wall, air handling unit, computer room air handler, computer room air conditioner, data center cooling equipment, retrofit fan array, or other stationary air moving system within the limits shown on the fan nameplate and project submittal.

The wall-mount Model ECPFN platform is designed as a modular fan component that may be used as a single fan or as part of a larger fan array. The product is not intended to serve as a complete fan wall structure unless the surrounding system has been designed, rated and documented for that purpose.

Intended Use

- Use the fan only to move air within the limits of the product nameplate and Twin City Fan & Blower selection.
- Install the fan only in stationary equipment with adequate structural support, service access, electrical protection, and guarding.
- Operate the fan only with required protective devices in place and with all access panels, guards and screens installed where personnel exposure is possible.
- Use the fan only in environments and airstreams for which the unit was selected and ordered.

Improper Use

- Do not operate the fan with missing or ineffective guards where personnel can access moving parts.
- Do not operate in an explosive, corrosive, abrasive, saturated, high-dust or hazardous airstream unless the fan was specifically ordered and labeled for that duty.
- Do not operate outside nameplate voltage, speed, temperature, control or environmental limits.
- Do not modify the fan, impeller, inlet funnel, motor, electronics, guards or support structure without written approval from Twin City Fan & Blower.
- Do not stand, step or place loads on the fan or motor.
- Do not use the fan frame to support ductwork, dampers, silencers, piping, conduit or unrelated equipment.

SHIPPING & RECEIVING

All Twin City Fan & Blower products are carefully constructed and inspected before shipment to ensure the highest standards of quality and performance. Compare all components with the bill of lading and packing list to verify that the proper unit, accessories and documentation have been received.

- Inspect each unit for damage that may have occurred in transit.
- Report any damage immediately to the carrier and file the necessary damage report. Damage should be noted on the bill of lading.
- Verify the fan model, motor type, voltage, control requirements, accessories and guards against the order documents.
- Do not install damaged equipment. If there is doubt about whether the fan or motor has been damaged, contact Twin City Fan & Blower before installation.

NOTICE: Receiving Inspection

Shipping damage can affect balance, alignment, fan clearances, motor bearings and electronics. A fan that appears visually acceptable should still be checked for free impeller rotation, clearances, loose hardware and wiring damage before installation.

HANDLING & LIFTING

Handling of all air moving equipment should be conducted by trained personnel and be consistent with safe handling practices. Verify the lift capacity and operating condition of cranes, forklifts, slings, spreader bars, chains, cables, straps and other handling equipment before lifting. When using hoisting equipment, only qualified and trained personnel should operate the equipment.

Lift and move the fan in a manner that protects the fan, motor, electronics, wiring, inlet funnel and impeller. Components should be handled so that forces are not concentrated in areas where bending, distortion or bearing damage can occur.



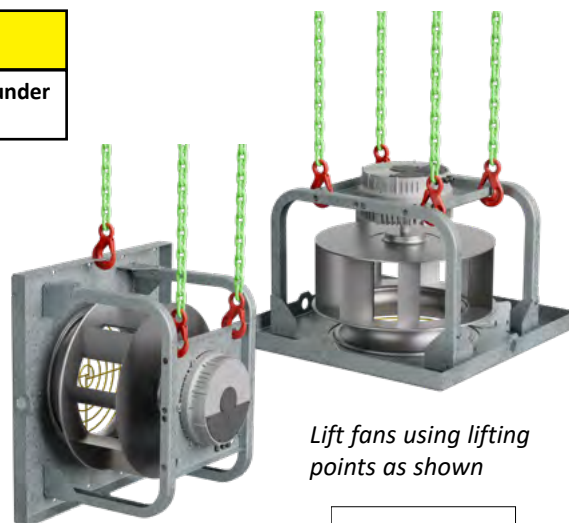
CAUTION: Handling Equipment

Maintain handling equipment to avoid serious personal injury and do not stand under suspended load.

Use only approved lifting points supplied on the fan as indicated by lifting point stickers. If lifting lugs, lifting holes or lifting brackets are supplied, use them only as intended. Use slings and spreader bars as required to prevent side loading or distortion of the frame.

Do Not Lift By

- Do not lift by the inlet funnel.
- Do not lift by the impeller or blades.
- Do not lift by the motor, motor electronics housing, terminal box, conduit, wiring, cable glands, guard or piezometer tubing.
- Do not pass slings, timbers, forks or chains through the fan inlet or impeller.
- Do not allow rigging to contact or load the inlet funnel or impeller.
- Do not drag or roll the fan in a manner that distorts the frame or changes the balance of the impeller.



Lift fans using lifting points as shown

**MUST LIFT
FROM HERE**

011028

Each Model ECPFN fan must be handled using the approved lifting provisions for that module. Do not lift an assembled fan array unless the surrounding structure has been specifically designed and rated for that purpose. In most installations, Model ECPFN fans should be moved, set, aligned, fastened, wired and commissioned individually.

UNIT STORAGE

If fan installation is to be delayed, store the unit in a clean, dry, environmentally stable and protected area. Protect the fan, motor, electronics, wiring, cable ends, connectors, and piezometer taps from moisture, dirt, debris, accidental impact, vibration or shock loading. Cover the fan to prevent foreign material from entering the inlet or discharge.

Extended storage requires periodic inspection. Fans should be stored indoors whenever possible where temperature, dust, moisture, shock and vibration are reasonably controlled. If the unit must be stored outdoors, it should be blocked off the ground and covered with a water-resistant material while still allowing suitable ventilation to reduce condensation.

- Inspect stored equipment monthly for corrosion, damage, moisture, debris, loose hardware and blocked airflow taps.
- Protect cable ends, connectors, glands, and electronics enclosures from moisture and contamination.
- Avoid areas with significant temperature variation that may cause condensation inside motors or electronics.
- If vibration is present in the storage area, isolate the fan from the vibration source to reduce the possibility of bearing damage.
- Rotate the impeller and motor shaft periodically as recommended by the motor supplier.
- Maintain storage records showing inspection dates, corrective actions, shaft rotation and storage conditions.

NOTICE: EC Motor Storage

EC motors use sealed bearings and onboard electronics. Keep the motor and electronics dry and free of dirt, dust, vibration, and impact. Do not energize or service motor electronics unless qualified and authorized to do so.

INSTALLATION PLANNING & SUPPORT STRUCTURE

Pre-Installation Review

Before beginning installation, become familiar with the equipment by reviewing the fan assembly drawing, project submittal, wiring diagram, controls sequence, accessories and any special instructions supplied with the order. Confirm that the fan size, orientation, rotation, motor access, service clearances, wall opening, support structure, wiring access and airflow measurement access are suitable for the installation.

Support Structure Requirements

The fan must be mounted to a structure that is flat, rigid, and capable of supporting the static and dynamic loads of the fan and all accessories. The support structure must maintain the fan in the intended position without distortion. Distortion of the fan frame can affect impeller clearance, inlet overlap, vibration, sound, airflow and service life.

- Provide sufficient structure to support the fan assembly and any accessories.
- Mounting surfaces must be flat and aligned before the fan is bolted into place.
- Do not use mounting bolts to pull a distorted wall, frame or fan into position.
- Support ductwork, dampers, silencers, conduit, piping and other accessories independently.

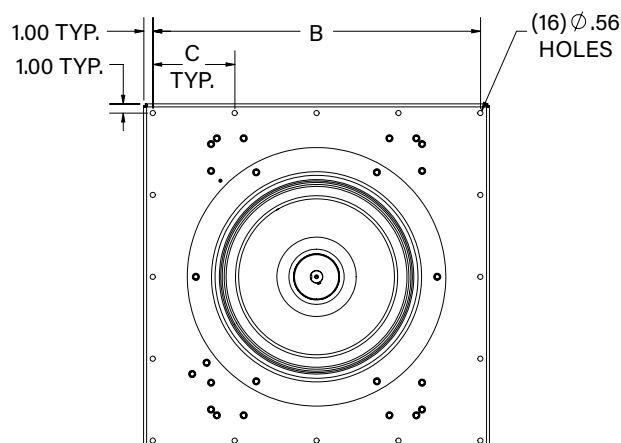
Support structures should be designed to avoid resonance within the operating speed range of the fan. Structural resonance can result in excessive vibration, noise and reduced equipment life. The complete installation, including the fan, support, surrounding structure and accessories, should be checked during commissioning across the intended speed range.

MOUNTING HOLE SPACING

SIZE	B	C
200	22.80	5.70
222	29.50	7.38
245	29.50	7.38
270	35.80	8.95

Note:

1. All dimensions are in inches.



Installation Geometry and Clearances

Installation geometry affects fan performance, sound, vibration, airflow measurement and service access. Obstructions near the inlet or discharge can cause system effect, pre-swirl, inaccurate airflow measurement, unstable operation or excessive noise. As a guide, airflow approaching the fan inlet should converge at an angle not greater than 45° and a minimum inlet clearance of one fan impeller diameter is recommended where practical. The minimum clearance between the back of the fan impeller and the nearest downstream component should be one impeller diameter. Reduced clearance may increase pressure drop by limiting the ability of the airflow to equalize behind the impeller. This applies to both single-fan installations and each fan within an array.

- Maintain the required inlet clearance and avoid obstructions near the inlet funnel.
- Maintain discharge/plenum clearance required for the application.
- Provide access for motor electronics, wiring terminals, controls, alarm relay connections, Modbus addressing and airflow measurement tubing.
- Provide adequate clearance to inspect and clean the impeller, inlet funnel, guards and piezometer taps.
- Do not install devices in the inlet that obstruct airflow or disturb airflow measurement unless specifically accounted for in the selection and approved by Twin City Fan & Blower.

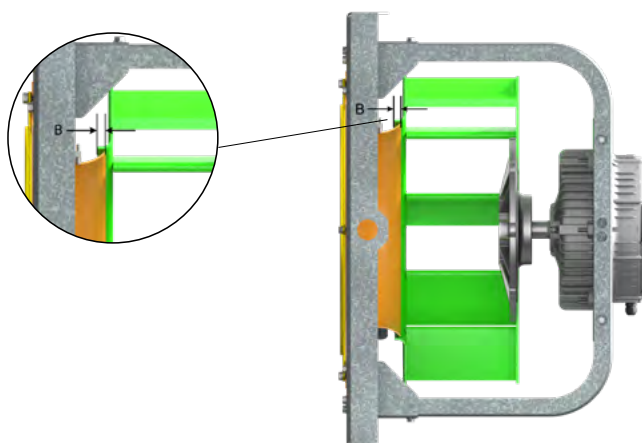
FAN INSTALLATION

1. Move the fan to the final mounting position using approved handling points and safe handling practices.
2. Remove skids, crates and packing materials carefully. Do not damage the fan, wiring, motor, electronics or airflow taps.
3. Inspect the fan, impeller, inlet funnel, motor, wiring, guards, fasteners and piezometer taps for shipping or handling damage.
4. Verify that the wall opening and support structure are flat, rigid, clean and ready to receive the fan.
5. Position the fan in the wall opening without forcing the fan into place.
6. Install mounting fasteners loosely. Do not fully tighten until the fan is aligned and seated properly.
7. Verify that the fan frame has not been distorted by the mounting surface or fastener tightening.
8. After confirming lockout/tagout, rotate the impeller by hand to verify that it turns freely.
9. Confirm that guards, blank-off panels and service panels do not rub or interfere with fan operation.
10. Verify impeller-to-inlet funnel clearance and overlap before applying power.

TIGHTENING TORQUE VALUES FOR HUB SET SCREWS AND BUSHINGS

Hardware Size	Thread Type Size (in.)	Torque (in.-lbs./ft.-lbs.)
9-Blade (SBALN9)	3/8-16 UNC	228/19
9-Blade (SBALN12)	3/8-16 UNC	228/19
7-Blade (SM20)	7/16 BSW	230/19
7-Blade (SM25)	1/2 BSW	362/30
7-Blade (SM30)	5/8 BSW	681/56

Tolerance: +/- 5%



IMPELLER OVERLAP

Size	7-Blade	9-Blade
200	0.20	0.41
222	0.22	0.45
245	0.25	0.50
270	0.28	0.55

Rotation

Verify impeller rotation during commissioning. All Model ECPFN fans are equipped for counterclockwise rotation, as viewed from the drive side of the fan. EC motor rotation is parameter-dependent and must be performed according to the motor-specific wiring and programming instructions.



CAUTION: Rotation Direction

Swapping incoming power leads will not change the rotation on EC motors. Rotation direction is fully defined by drive parameters.



WARNING: Rotation Check

Correct rotation must be verified before the fan is placed into service. If rotation is incorrect, lock out power and correct the condition using the approved motor-specific procedure.

ROTATION VIEW FROM DRIVE SIDE

COUNTER-CLOCKWISE (CCW) EXAMPLE SHOWN



FAN ARRAY INSTALLATION CONSIDERATIONS

Model ECPFN fans are often installed in arrays, but each fan remains an individual air moving device. The surrounding wall, plenum, cabinet, controls and electrical system must be designed to support the entire installation.

Mechanical Installation in Arrays

- Install and align fans one at a time.
- Do not use one fan module to pull another fan or the surrounding structure into alignment.
- Maintain required spacing between modules.
- Verify impeller free rotation on each fan after installation and after any adjustment to the surrounding structure.
- Confirm that guards, blank-off panels and service panels do not rub or interfere with fan operation.

Electrical and Controls in Arrays

- Identify each fan with a unit number, location and controls address before wiring.
- Provide branch circuit protection and disconnecting means in accordance with the project electrical design and applicable code.
- Route power wiring separately from control and communication wiring wherever practical.
- Record Modbus addresses, BMS point names, control zones, alarm relay assignments and transducer assignments in the start-up records.
- If possible, start and test each fan individually before operating the array as a system.

ELECTRICAL INSTALLATION

General Electrical Requirements

The customer is required to investigate and install equipment in compliance with all local electrical and safety codes for the equipment location. All electrical work must be performed by qualified personnel. Verify the fan nameplate, motor nameplate and wiring label before making connections.

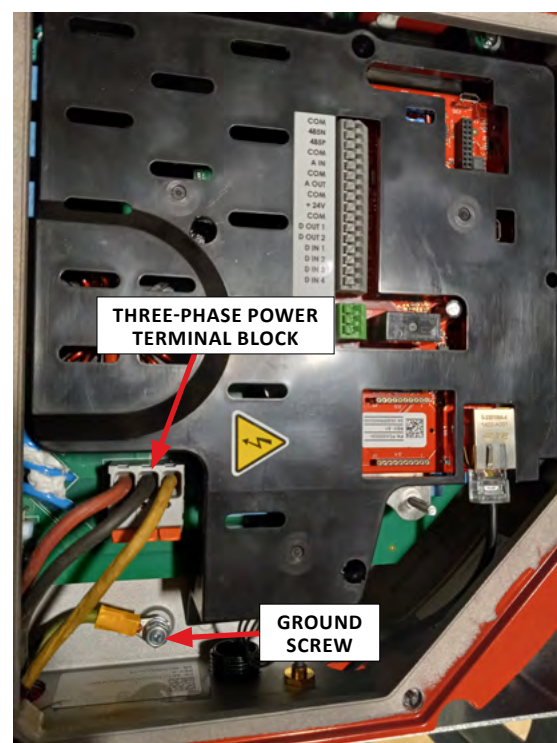
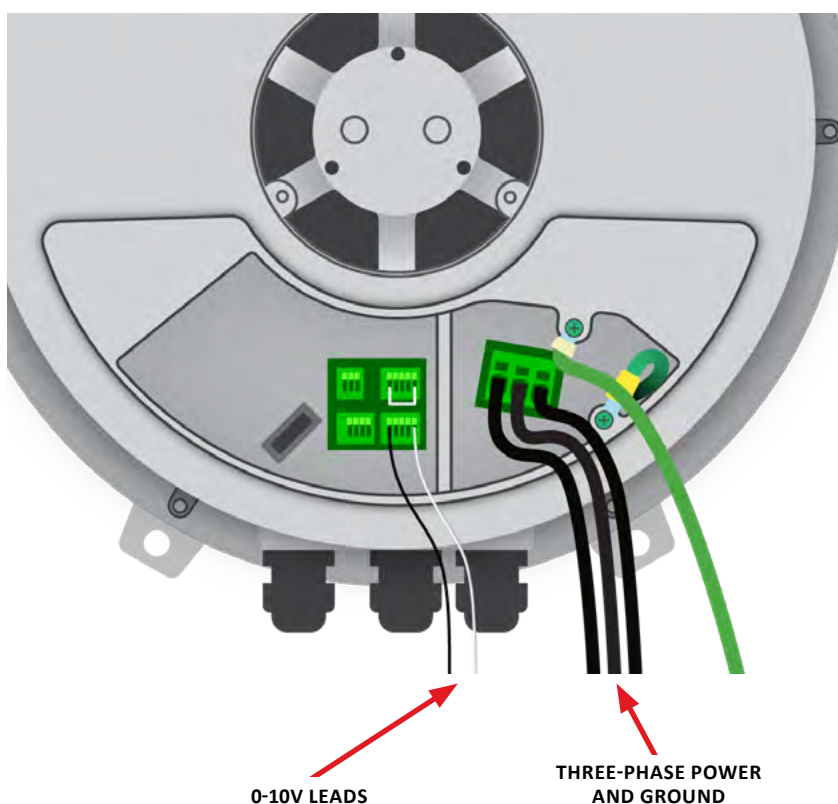
- Connect only to the voltage, phase and frequency shown on the motor nameplate.
- Size power wiring in accordance with the ampacity shown on the nameplate and the National Electrical Code. Increase wire size where long runs require additional capacity to limit voltage drop. A maximum voltage drop of three percent is recommended unless project requirements differ.
- Use copper conductors only unless the project documents and equipment labels specifically permit otherwise.
- Supply voltage should not vary by more than plus or minus 10 percent from the value indicated on the unit nameplate. Phase unbalance should not exceed two percent.
- All units must be electrically grounded in accordance with local codes or, in the absence of local codes, the latest edition of the National Electrical Code, ANSI/NFPA 70.
- Do not use the grounding lug for a neutral conductor.
- Protect wiring from sharp edges. Leave sufficient slack where movement or vibration may occur, but do not allow wiring to contact the impeller, inlet, motor cooling surfaces, hot surfaces, oil, grease or chemicals.
- Provide proper strain relief and seal unused openings.

All fans should be powered through switches that are accessible to service personnel from the fan or in accordance with the site lockout/tagout plan. Each switch should have the ability to be locked in the off position to prevent accidental operation while service is in process. Power leads must be protected at the point of distribution in accordance with the fan nameplate and applicable code.



WARNING: Motor-Specific Verification

Terminal names, functions, default settings and wiring methods vary by motor. Verify all connections against the wiring label supplied on the fan or motor before energizing.



Grounding and Bonding

Ground the fan frame, motor and any electrical enclosures in accordance with the National Electrical Code and local requirements. Verify grounding continuity after installation. Provide bonding jumpers where required by the project design or code. Shield and drain wire terminations for communication cables should follow the controls design and motor-specific instructions.

Residual Current Devices / Ground-Fault Protection

EC motors contain power electronics and electromagnetic compatibility components that may produce leakage current or charging current. If residual current devices, ground-fault protection or similar protective devices are required by the project, they must be selected and coordinated for use with EC motor electronics. Improperly selected protective devices may nuisance trip or may not provide the intended protection. Coordinate requirements with the project electrical engineer, applicable codes and motor-specific documentation.

EMC and Cable Routing

Good wiring practice is required to reduce electrical noise and interference. Route control wiring and communication wiring separately from power wiring wherever practical. Maintain separation between power and signal conductors. Use shielded twisted-pair cable for RS-485 / Modbus communication where required. Use shielded cable for analog signals when required by the project controls design or motor documentation. Keep all wiring clear of rotating parts, sharp edges, hot surfaces, grease, oil and chemical exposure. Provide drip loops where moisture could follow a cable into an enclosure.

CONTROLS, COMMUNICATION AND OPERATING MODES

Basic 0-10V Speed Control

A common operating method for Model ECPFN fans is a 0-10V or 2-10V DC analog speed command from the building management system, unit controller or other customer-supplied control. Motor speed will vary with the input signal according to the programmed minimum and maximum speed limits. Depending on motor setup, 0V may represent off, minimum speed or another programmed state. Verify the programmed behavior before placing the fan into service.

WEG W30 Slim Analog Speed Control Connections

- Connect a jumper cable from either the EXT10V or EXT24V DC terminal to the Run/Stop terminal.
- Connect the ground wire of the 2-10V DC power supply to the EXT-GND terminal.
- Connect the supply wire of the 2-10V DC power supply to the VSP terminal.

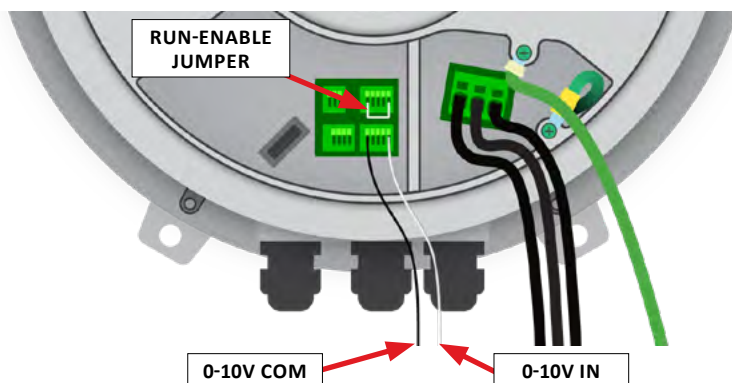
Infinitum Analog Speed Control Connections

- Connect the +24V and D IN 1 terminals with a jumper cable to enable the drive, as shown in the diagram.
- Connect the ground wire of the 0-10V DC power supply to one of the COM terminals on the primary terminal block.
- Connect the supply wire of the 0-10V DC power supply to the A IN terminal.

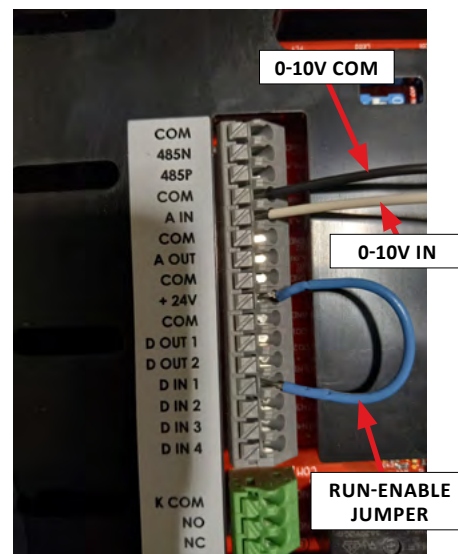
All Motors

- Verify correct polarity of the 0-10V signal before operation.
- Motor speed is adjusted by varying the input voltage of the DC power supply.
- Verify the relationship between commanded voltage and actual speed during commissioning.
- Confirm whether the fan starts at a minimum voltage, runs at minimum speed below a threshold, or remains off until an enable or command is present.
- Confirm BMS scaling so the displayed command matches the actual motor command.

WEG W30 Slim Control Connections



Infinitum Control Connections



Run Enable / Start-Stop Control

Run enable permits operation when power and a speed command are present. It does not isolate power and must not be used as a lockout/tagout method. Where a field enable circuit is used, verify that the enable input is wired according to the motor-specific section and project controls design. The fan may restart automatically when run enable is restored if power and speed command are present.

Modbus RTU / RS-485 Communication

All Model ECPFN motors also support Modbus RTU communication for monitoring, command, setup or diagnostics. Communication wiring should be installed using appropriate shielded twisted-pair cable, routed separately from power wiring and terminated according to the controls design.

WEG W30 Slim Modbus Connections

- To communicate with the motor via Modbus, connect RS-485 wiring from BMS or unit controller to the 485_RX, 485_TX and EXT_GND terminals.

Infinitum Modbus Connections

- Connect RS-485 wiring from BMS or unit controller to the 485_N and 485_P terminals.
- The last unit on a daisy chain configuration should have the RS-485 Termination Dip Switch set to the ON position.
- All other units must have the DIP switch set to the OFF position.

All Motors

- Assign and record a unique address for each fan in an array.
- Verify baud rate, parity, stop bits and register map before commissioning.
- Use a daisy-chain topology unless the motor or controls design requires another method.
- Avoid star wiring unless specifically allowed by the communication design.
- Record communication settings in the start-up documentation.

Communication defaults, register maps, addressing procedures, supported read/write functions, termination and biasing requirements, diagnostic features, and other motor-specific limitations vary by motor manufacturer and motor model. The motor manufacturer's documentation should be used when configuring, wiring, commissioning or troubleshooting the communication interface. If information in this manual differs from the motor manufacturer's documentation, contact Twin City Fan & Blower for clarification before proceeding.

Alarm / Status Relay

Where an alarm or status relay is used, wire the relay to the BMS or unit controller according to the wiring label. Confirm whether the relay indicates a fault, run status, ready status or other programmed function. During commissioning, verify relay operation at the controller and record the normal and fault states.

Speed Range Suppression / Resonance Avoidance

Because EC motors are speed controlled, the fan may be operated across a broad range of speeds. During commissioning, sweep the fan through the intended operating range and observe vibration, sound and structural response. If excessive vibration or resonance occurs in a narrow speed range, the control system or motor parameters may need to avoid that range. Any suppressed range should be recorded in the start-up documentation and approved by the project engineer or responsible party.

PIEZOMETER AIRFLOW MEASUREMENT

Two-Tap Piezometer Installation

Model ECPFN fans are supplied with a standard two-tap piezometer airflow measurement arrangement. The airflow measurement system estimates fan airflow by measuring differential pressure and the inlet funnel is used as the measuring element, avoiding probes placed in the high-velocity airstream.

The standard Model ECPFN arrangement includes a high-pressure tap located on the panel face and a low-pressure tap located on the throat of the inlet funnel near the top. Customer-supplied tubing is connected to the taps and routed to the differential pressure transducer. Route tubing so it does not contact moving parts, hot surfaces, sharp edges, wiring terminals or service areas. Protect tubing from kinks, leaks, traps, water accumulation and damage during maintenance.

Measurement of Airflow

The airflow equations in this manual are intended for flow estimation and are based on the following assumptions. If these assumptions are not met, accuracy may be affected.

- Airflow is from 40 percent to 100 percent of wide-open volume.
- There are no vanes, probes, dampers or other obstructions in or near the inlet that disturb the entering airflow.
- Flow entering the funnel is even, without pre-swirl.
- The fan has standard impeller-to-inlet cone overlap.
- Air density at the inlet is accurately determined when using the non-standard density method.
- The inlet is free, or any correction required by the application has been accounted for.



Non-Standard Density Method

One of the following equations is used to measure the flow:

$$ACFM = C1 * A * \sqrt{(\Delta P / \rho)}$$

where: A = Actual inlet funnel throat area at pressure tap location (square feet) - from Table 2 below

ΔP = The differential in static pressure from the high and low pressure taps (inches w.g.)

ρ = Air density (pounds mass/cubic foot)

C1 = Value from Table 1 below

Standard Density Method

The equations can be simplified by assuming standard density and assuming funnel dimensions match drawing dimensions. The following tables show the factor (F) for each fan size and type. The equation then becomes the following:

For standard air ($\rho = 0.075 \text{ lb/ft}^3$):

$$ACFM = F \sqrt{\Delta P}$$

where: F = factor from Table 2 below

ΔP = The differential in static pressure from the high and low pressure taps (inches w.g.)

Table 1: C1 Values

Size	C1* Free Inlet
200-7-AF	729.61
200-9-AF	680.64
222-7-AF	744.79
222-9-AF	653.97
245-7-AF	730.35
245-9-AF	655.73
270-7-AF	729.01
270-9-AF	548.14

* Values for C1 factors are based on free inlet (not ducted).

Table 2: A and F Values

Size	Free Inlet F	A
200-7-AF	2467.01	0.93
200-9-AF	2130.49	0.87
222-7-AF	3154.11	1.16
222-9-AF	2492.69	1.07
245-7-AF	3967.00	1.49
245-9-AF	3058.12	1.28
270-7-AF	4952.95	1.87
270-9-AF	3698.18	1.85

Transducer Sizing for Piezometer Measurement

Selecting a pressure transducer with the appropriate range is critical in order to get accurate measurements using the piezometer airflow measurement system. Since most transducers list accuracy as a percent of full scale, if the range selected is too high, this can have a significant impact on the accuracy of the flow measurement. If the range is too low, there is risk of damaging the instrument and/or getting inaccurate readings or no reading at all.

The following steps are for sizing the pressure transducer for use with the piezometer airflow measurement system:

1. Determine the maximum flow rate in CFM that the fan is expected to produce. This maximum should be the greater of normal, maximum and/or emergency conditions.
2. Find the formula for calculating the actual flow rate from page 12 of this document for the corresponding size and type of fan being used.
3. Calculate the pressure drop corresponding to the maximum flow rate determined in Step 1.
4. Select the pressure transducer with the smallest range that includes the pressure drop calculated in Step 3.
5. Now take the maximum range from the pressure transducer selected in Step 4 and use that to calculate the maximum flow rate that could be measured with this transducer.
6. Determine an acceptable safety factor for sizing the transducer.
7. Multiply the maximum flow rate from Step 1 by the safety factor. If the maximum flow rate from Step 5 is less than the result, bump up the transducer to the next largest size. Otherwise, the transducer from Step 4 should be used.

START-UP AND COMMISSIONING

Before Applying Power

Before applying power, confirm that the fan and final system are ready for start-up. Follow site-specific safety procedures and verify lockout/tagout before performing any inspection requiring contact with the fan or electrical equipment.

- Fan is installed in the correct orientation and mounting bolts are tightened.
- Fan is not distorted by the wall, frame, cabinet or ductwork.
- Guards, access panels and screens are installed as required.
- Inlet and discharge are clear of tools, packaging, debris and foreign material.
- Impeller rotates freely by hand.
- Impeller-to-inlet funnel overlap and clearance have been checked.
- Piezometer tubing is connected, labeled, secure and clear of moving parts.
- Array fans are individually labeled and matched to the controls drawings.
- Nameplate voltage, phase and frequency match the power supply.
- Power wiring, grounding, branch protection, disconnects, control wiring, alarm wiring and communication wiring have been verified.
- Run enable, 0-10V speed command, Modbus settings or BMS points have been verified where applicable.



WARNING: Start-Up Safety

Verify that proper safety precautions have been followed. Electrical power must be locked off and the fan must be prevented from rotating before service work is performed. Remove all tools, blocks, chocks and foreign objects before applying power.

Initial Energization

1. Apply power to the fan according to site procedures.
2. Verify that no fault or alarm indication is present.
3. Verify that the control signal and run enable are present only when intended.
4. Command the fan to low speed for initial rotation check.
5. Verify rotation agrees with the rotation arrow.
6. Listen for rubbing, scraping, unusual noise, electrical odor or abnormal vibration.
7. Stop the fan immediately if a problem is observed. Lock out power and correct the condition before restarting.
8. Increase speed gradually after correct rotation and smooth operation have been verified.

Speed Range Check

Run the fan through the intended operating speed range. Observe vibration, sound, structural response, control stability and motor status. Identify any resonant speeds or ranges with excessive vibration. If a problem speed range is found, correct the installation or use approved controls/motor settings to avoid that range. Record any suppressed ranges in the start-up documentation.

After One Week of Operation

After one week of operation, check all accessible fasteners and tighten if necessary. Inspect wiring, conduit, cable glands, tubing, supports, seals, guards and accessories. Check for unusual noise, vibration, rubbing, airflow measurement instability, alarms or fault history. Correct any problem before continued operation.



OPERATION

Normal Operation

Operate the fan within the limits shown on the fan nameplate, motor label, project submittal and approved controls sequence. Keep the inlet and discharge clear and maintain a clean airflow path. Avoid operating the fan in an unstable flow region. Use the intended control input, controller or BMS command for normal speed control. Do not repeatedly cycle the motor by removing and restoring line power unless approved by the motor documentation.



WARNING: Automatic Restart

An EC motor may restart after power return, control signal return, run enable restoration, communication command, fault reset or removal of a blockage. Personnel must remain clear of the impeller and air path whenever power is available to the fan.

MAINTENANCE

This section contains general maintenance instructions for Model ECPFN fans. Develop a regular maintenance schedule according to the needs and criticality of the fan. Periodic inspections and observations of sound, vibration, airflow, motor condition, controls, wiring and tubing will help prolong the life of the fan. Always keep records of maintenance performed.

Suggested Maintenance Schedule

Condition	Maintenance Item
Start-Up	Complete start-up checklist, vibration check, airflow measurement check and controls verification.
After One Week	Check fasteners, seals, wiring, tubing, guards, unusual noise, vibration and fault history.
Monthly / Quarterly	Inspect for debris, loose hardware, damaged wiring, tubing condition, blocked taps and guard condition. Interval depends on environment and criticality.
Semi-Annual	Check vibration, fasteners, support structure, motor cleanliness, airflow taps, tubing, transducer zero and BMS scaling.
Annual	Perform full mechanical, electrical, controls, airflow measurement and support inspection. Review maintenance records and alarm/fault history.

Impeller and Inlet Funnel Maintenance

Periodically inspect the impeller and inlet funnel for dirt buildup, corrosion, damage, cracks, rubbing, loose hardware or signs of stress. Clean components as required. Do not bend blades, remove balance weights, or add coatings, weld or other material that could affect balance. If cleaning, repair or damage may have changed balance, check vibration before returning the fan to service.

Structural Maintenance

All structural components and devices used to support or attach the fan to a structure should be checked at regular intervals. Fasteners, supports, walls, frames, isolators, seals, guards, and surrounding structures are subject to loosening, corrosion, fatigue and other failure modes. Improper mounting can lead to poor operating characteristics, fan fatigue, noise, vibration and failure.

Cleaning

Before cleaning, lock out and tag out the fan and prevent rotation. Remove debris from the inlet, discharge, impeller, inlet funnel, motor surfaces, guards and surrounding plenum. Avoid directing water, solvent or compressed air into motor electronics, terminal boxes, cable glands or piezometer taps unless the cleaning method is approved for the supplied components. After cleaning, verify free impeller rotation, clear airflow path and stable vibration before returning to service.

EC Motor Maintenance

The three basic rules for EC motor maintenance are to keep the motor clean, dry and properly ventilated. EC motors use sealed bearings and normally do not require operational lubrication unless the motor nameplate or motor documentation specifically states otherwise. Dirt and dust can act as thermal insulation and may cause overheating or premature failure. Keep motor cooling surfaces and surrounding areas clean so air can circulate as intended.

- Keep motor and electronics dry and clean.
- Remove dust and debris from motor cooling surfaces using methods that do not damage the motor, electronics, wiring or seals.
- Inspect cables, conduit, strain relief, terminal covers, cable glands and seals.
- Do not open or repair motor electronics unless authorized and qualified to do so.
- Do not pressure wash motor electronics or enclosures unless the supplied motor and enclosure rating, site procedure and motor documentation allow it.

TROUBLESHOOTING GUIDELINES

Use current safety practices when investigating fan or system performance problems. General safe practices and performance troubleshooting guidelines can be found in AMCA Publications 410 and 202, respectively. Fan application and field measurement procedures can be found in AMCA Publications 201 and 203.

Most fan problems can be pinpointed to one of these common causes.

Air Capacity Problems

1. System resistance is not at design rating. If resistance is lower than expected, airflow and power may increase. If resistance is higher than anticipated, air volume will decrease.
2. Fan speed is not at design speed or BMS command is not scaled correctly.
3. Run enable, control signal, communication command or motor parameter is limiting speed.
4. Actual air density does not match design conditions. This could be due to temperature or elevation effects.
5. Dampers, filters, coils, screens, or other devices are closed, plugged, dirty or incorrectly installed.
6. Impeller is rotating incorrectly, mounted improperly or rubbing.
7. Parts of the system or fan have been damaged or need cleaning.
8. Piezometer tubing, transducer, airflow factor, density correction or BMS square-root extraction is incorrect.
9. Fan inlet conditions include obstruction, pre-swirl or poor approach.

Noise Problems

1. Fan is not operating at the design point.
2. Fan is operating in an unstable flow region or near stall.
3. Poor inlet or discharge conditions are present.
4. Loose panels, guards, fasteners or surrounding structure are vibrating.
5. Foreign material is attached to or contacting rotating components.
6. Motor/electrical noise is present due to supply, settings or controls.
7. Objects in high-velocity airstream generate sound.

Vibration Problems

1. Mounting structure is loose, distorted or resonant.
2. Fan was distorted during installation.
3. Foreign material is attached to the impeller.
4. Impeller, motor or other rotating component is damaged.
5. Fasteners are loose or missing.

6. Vibration is transmitted from another source.
7. Impeller is rubbing against the funnel.
8. Fan is operating in stall or unstable flow.

Motor/Electrical Problems

1. Incoming power is missing, incorrect, unbalanced or outside nameplate limits.
2. Power wiring or grounding is incorrect.
3. Run enable is not active.
4. 0-10V signal is missing, reversed, scaled incorrectly or outside expected range.
5. Modbus command, address, communication settings or BMS point mapping is incorrect.
6. Alarm or fault is active.
7. Motor electronics are overheated or cooling is blocked.
8. Branch protection or ground-fault device is not compatible with the motor electronics.
9. Parameters, speed limits, rotation settings or control mode are incorrect.

Controls / Communication Problems

1. Wrong fan address or duplicated address in an array.
2. RS-485 polarity reversed.
3. Incorrect baud rate, parity, stop bits, termination or wiring topology.
4. Shield or drain not terminated according to the controls design.
5. BMS command is not reaching the correct fan.
6. Analog and communication commands are conflicting.
7. Controller is using the wrong scaling, range or units.
8. Closed-loop control is unstable or not tuned for the system.

Airflow Measurement Problems

1. High and low tubing reversed.
2. Tubing kinked, blocked, leaking, wet or disconnected.
3. Transducer not zeroed or calibrated.
4. Wrong fan size, wheel option, airflow factor or density assumption.
5. BMS scaling is incorrect.
6. Inlet condition violates measurement assumptions.
7. Transducer range is too high for accuracy or too low for maximum airflow.
8. Fan is operating outside the valid measurement range.

Alarms and Faults

The information in the table below is general in nature. For the most accurate information on alarms, fault codes, potential causes and troubleshooting, refer to the motor manufacturer's current documentation.

Symptom / Fault	Probable Cause	Corrective Action
Fan will not run	No power, no run enable, no command, active fault, incorrect wiring, communication issue	Verify disconnect, branch protection, nameplate voltage, ground, run enable, 0-10V command, alarm status and communication settings
Fan runs at wrong speed	Incorrect 0-10V scaling, speed limits, parameters, BMS point, Modbus command or control mode	Verify command signal at the motor, programmed limits, BMS scaling and communication commands
Alarm relay active	Motor fault, wiring issue, overtemperature, phase issue, communication fault or programmed alarm state	Read motor fault information where available. Verify power, cooling, wiring and reset procedure
Communication lost	Wrong address, RS-485 polarity, wiring topology, shield/ground issue, wrong baud/parity/stop bits, missing termination	Verify wiring, settings, address, termination and controller configuration
Nuisance trip	Ground-fault device, leakage current, EMC filter current, branch protection, wiring damage or moisture	Inspect wiring and moisture condition. Review protective device selection with project electrical engineer and motor documentation



INSTALLATION/START-UP CHECKLIST

Become familiar with the equipment by reviewing the fan assembly drawing for special instructions and accessories. Always observe site-specific and regulatory safety precautions.

MECHANICAL INSTALLATION

- ☐ Fan inspected for damage
- ☐ Fan installed square and level
- ☐ Fan not distorted by wall/support
- ☐ Impeller rotates freely
- ☐ Guards/screens installed
- ☐ Mounting surface flat and supported
- ☐ Fasteners torqued
- ☐ Impeller/funnel overlap verified
- ☐ Access clearance confirmed

ELECTRICAL INSTALLATION

- ☐ Nameplate voltage verified
- ☐ Disconnect installed and accessible
- ☐ Power wiring terminated
- ☐ Wiring routed away from rotating/hot/sharp surfaces
- ☐ Control and power wiring separated
- ☐ Branch protection verified
- ☐ Grounding verified
- ☐ Control wiring terminated
- ☐ Cable glands/strain relief installed

CONTROLS AND COMMUNICATION

- ☐ 0-10V signal verified if used
- ☐ Alarm relay verified
- ☐ Modbus address recorded
- ☐ Speed command response verified
- ☐ Rotation verified
- ☐ Run enable verified
- ☐ Modbus wiring verified if used
- ☐ BMS point mapped
- ☐ Minimum and maximum speed verified

AIRFLOW MEASUREMENT

- ☐ High/low tubing connected correctly
- ☐ Tubing clear of moving parts
- ☐ Transducer zeroed
- ☐ Density assumption verified
- ☐ Tubing labeled
- ☐ Transducer range verified
- ☐ Correct fan factor entered
- ☐ BMS scaling verified



WARNING

Verify that proper safety precautions have been followed.
Electrical power must be locked off.

START-UP

- ☐ Fan started at low speed
- ☐ No rubbing
- ☐ Full speed range checked
- ☐ Resonant speeds documented
- ☐ Rotation correct
- ☐ No unusual noise

AFTER ONE WEEK

- ☐ Fasteners checked
- ☐ Vibration/noise checked
- ☐ Alarms/fault history reviewed
- ☐ Wiring and tubing inspected
- ☐ Airflow reading checked

NOTICE

Always observe site-specific and regulatory safety precautions.

MODEL NUMBER: _____

SERIAL NUMBER: _____

FAN SIZE: _____

MOTOR TYPE: _____

VOLTAGE: _____

FAN LOCATION/
ARRAY POSITION: _____

COMPLETED BY: _____

DATE COMPLETED: _____





FAN MAINTENANCE LOG

Model Number _____

Serial Number _____

Date	Operating Hours	Maintenance Performed	Vibration Reading	Airflow Reading	Faults / Alarms	Performed By	Comments





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