



INSTALLATION, OPERATION, AND MAINTENANCE MANUAL

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Table of Contents

Before You Begin.....	4
Safety.....	5
Safety Checklist.....	5
Shipping and Receiving.....	6
Off Loading and Handling	6
Storage	7
Long Term Storage	7
Foundations & Support Structures	9
Concrete Slab Foundations	9
Structural Steel Support Foundations	10
Equipment Mounted Fans	10
Fan Types	11
Ventilating Fans (AF, BC, BCIL, FC, VA).....	11
Industrial Fans (BISC, HPS & HPO, IE)	12
Fan Arrangements.....	14
Fan Rotations	16
Fan Wheel Types.....	17
Glossary of Fan Terms & Accessories	18
Installation & Start-Up.....	22
Pre Start-Up Checklist.....	24
Start-Up Procedure	25
Assembly & Disassembly Procedures.....	26
Wheel Alignment	27
Bearings.....	27
V-Belt Drives	30
Flexible Couplings	31
Variable Inlet Vane (V.I.V.) Dampers.....	35



Outlet Dampers	36
Heat Slingers	37
Shaft Seals	37
Preventive Maintenance	39
Maintenance Procedures	41
Wheel (Rotor) Balancing	41
Vibration at Fan Operating Frequency	41
Bearing Servicing, Cleaning, and Lubrication	42
Disassembling Ball or Roller Bearings for Service	42
Bearing Lubrication	43
Grease Charts for Bearing Types	44
Lubrication Procedure	45
Lubrication Frequency	45
Motor Bearing Lubrication	45
Trouble Shooting - Fans	46
Trouble Shooting – Motors	48
Recommended Replacement Parts	48
Ordering Replacement Parts	49
Warranty	50
Speed Up Policy	51



Before You Begin

This manual is prepared as a guide to assist in the installation, operation, and maintenance of your centrifugal type fan. Proper maintenance will help to ensure safe operation, minimize problems, and maximize the life of the equipment.

Due to the highly customized nature of our products, this manual is generic in nature. It aims to address most end user concerns. Please contact the factory if additional or more specific information is required.

A drawing and performance curve are furnished as a minimum for most orders. This drawing will have information such as bearing lubrication recommendations and purchased component details. Purchased components include items such as motors, bearings, couplings, isolators, and more. Please consult the specific product manufacturer for more detailed information about their specific products.

It is imperative that an experienced mechanic, familiar with rotating machinery, install and start-up this equipment. Only well-trained personnel should assemble, maintain, or replace these fans.

- NEVER allow an untrained person to work on the fan.
- NEVER remove warning labels and this manual from the fan.
- NEVER run the fan without all safety guards in place.

Third party certified service technicians are available to assist you with installation and start-up supervision. Fan Equipment Co., Inc. does not provide technicians for field service, however, we can assist you in finding a third-party technician upon request. Fan Equipment Co., Inc. supports its equipment with the warranty policy detailed in the “Warranty” section of this manual. Please read the “Warranty” section thoroughly before adjusting or repairing any fan components. Arrangements for service work are made through your sales representative or by contacting our corporate offices in North Las Vegas, Nevada.

Before operating this equipment, familiarize yourself with this IOM manual.

We also recommend reading AMCA Publication 410, Recommended Safety Practices.



Safety

The improper installation or operation of fans can pose a hazard to people and property. Only trained and experienced personnel should install and maintain fans.

Fans are specialized equipment that include high speed rotating elements which can be dangerous if handled improperly. Individuals who are not familiar with the equipment and proper servicing methods may not realize the harm they can do to themselves or the fan; and should NEVER be permitted to work on the fan. Fans are sold with the understanding that customers will recognize the risk of high-speed rotating elements and understand that only people who are aware of the risks associated with the essential operating characteristics of a fan should be permitted to work on them.

Each fan is designed to operate safely up to a stated maximum speed (RPM) and temperature. DO NOT EXCEED THESE LIMITS.

All installations must meet all pertinent state and local safety codes and the requirements of the Occupational Safety and Health Act (OSHA).

Safety Checklist

The following points must be included in your Safety Checklist program:

1. Flexible couplings and V-belt drives must have guards that completely encase the rotating parts. Do not start or operate the equipment without guards.
2. Shaft guards should be provided for Arrangement No. 1, 8, and 9 fans. Guards should extend from one bearing to the other.
3. Screens should be provided for open inlet fans and for outlets not connected to ducting.
4. Accessories with moving parts such as tachometers, turning gears, and heat slingers must have guards.
5. Before starting up the equipment, ensure all parts have been installed correctly, all bolts and nuts are tight, all tools and other materials have been removed, and all personnel are clear from the area.
6. The periodic maintenance and lubrication procedures outlined in this manual must be faithfully followed to keep your equipment running properly.
7. A lock out procedure to ensure that the fans cannot start when maintenance personnel are performing service functions is mandatory. It is customary to lock out the power from the drive and use red tags to alert personnel to the shut-down.



Shipping and Receiving

All shipments are EXW collect our North Las Vegas, NV factory; not freight allowed. Standard shipments include a pallet and/or a skid with protective plastic wrap. Special instructions are subject to additional cost for protective packaging which would include skeleton crating, wooden box crate, and export boxing. The equipment becomes the property and responsibility of the buyer at the point of shipment.

All equipment is inspected and prepared for shipment in accordance with the requirements of the commercial carrier and/or any special considerations required by the nature of the product. Rough handling or the forces encountered during a long truck route may cause damage to the unit(s). The buyer should carefully inspect the shipment before accepting delivery from the carrier. Shipping damage and claims are the responsibility of the buyer for shipments made F.O.B. shipping point.

All damage or shortages discovered at time of delivery must be noted on the carrier's freight bill or bill of lading. Any damage or shortages discovered after delivery must be reported to the carrier immediately. The carrier should inspect the damage with you and ensure that a concealed damage report is filed.

Off Loading and Handling

Most centrifugal fans are shipped completely assembled and mounted on wooden pallets or skids, suitable for forklift off loading and handling. Larger equipment is furnished with lifting lugs for off-loading and handling. If necessary, lift the equipment with ropes or slings placed under structural support members such as motor or bearing bases. The holes cut in the bearing and/or motor stands can also be used for attachment of slings or ropes. The motor eye bolt is for lifting the motor only, not the complete fan.

Arrangement No. 3 fans must be lifted under the bearing supports, not under the shaft.

Large fans that require crane equipment for handling must be lifted with a spreader bar fixture provided by others.

Slings must be used to prevent damage to equipment, particularly for special protective coatings that provide corrosion protection during operation.

All scratches must be touched up after final installation and handling.



Large accessories such as inlet boxes, damper assemblies, and sound attenuators may be shipped separately because of handling and shipping size restrictions.

Sensitive accessories such as damper actuators or other instrumentation devices are shipped separately to avoid damage in transit.

Fan rotors are always factory balanced to ANSI G2.5 (minimum) before shipment. Differences in mounting shafts and foundation support structures may require a field balance after final installation. Acceptable residual rotor unbalance levels are scheduled in other sections of this manual.

- DO NOT lift fan wheels by the blades or the shroud.
- DO NOT roll wheels or place excessive loads on fan shaft.

Storage

It is best for the equipment to be installed and operated upon receipt. If this is not possible, the equipment must be stored in a dry, protected area. Whether stored indoors or outdoors, always protect the equipment with tarps, and protect electrical equipment from corrosion.

The fan shaft should be protected with oil base coatings and the bearings must be kept clean and dry. The fan wheel must also be kept clean, dry, and free from corrosive or erosive elements. The fan wheel should be rotated frequently to circulate lubricants in the fan bearings and to prevent the brinelling of the bearings. Do not store equipment with vibration isolators installed. Never store other materials by stacking or piling items on the fan.

Long Term Storage

If the equipment is to be stored for thirty (30) days or longer, the following procedures must be followed:

1. Add additional grease to bearings as necessary to fill voids and prevent condensation from accumulating.
2. Cover and seal bearings to prevent contamination.
3. Remove drive V-belts and store in a dry, protected area.
Belts should be stored in plastic wrap.
4. Coat the fan shaft with a protective coating.
5. Coat drive sheaves with rust preventative and cover with plastic wrap.
6. Seal the inlet and outlet openings with heavy plywood.



7. Consult the specific motor manufacturer's IOM for their storage recommendations.
8. Cover the entire fan with protective tarps or waterproof paper.

Periodic Attention:

1. Rotate the fan shaft every thirty (30) days to circulate the grease in the bearings.
2. Purge the bearings of grease and condensation every sixty (60) days. Rotate the shaft while purging grease. Do not use high pressure pneumatic greasers.
3. Renew the protective coatings on the shaft, sheaves, and motor every ninety (90) days.
4. If extended factory warranty provisions are part of your purchase order, a complete log of the storage maintenance procedures is required. As a minimum you must record: the day of inspection, name of service personnel, findings and comments for each maintenance item performed.

Preparation for Start-Up:

1. Prior to start-up, purge, clean, and re-lubricate the bearings per the applicable bearing section that follows.
2. Remove any rust from the drive components and inspect the drive belts for condition.
3. Manually rotate the fan impeller and check for proper running clearances.
4. Check that all bearing and drive set screws, hold down bolts, and motor mounting bolts are tight.
5. Prior to installation of drive V-belts, run the motor for ten (10) minutes and confirm proper current draw and mechanical operation.



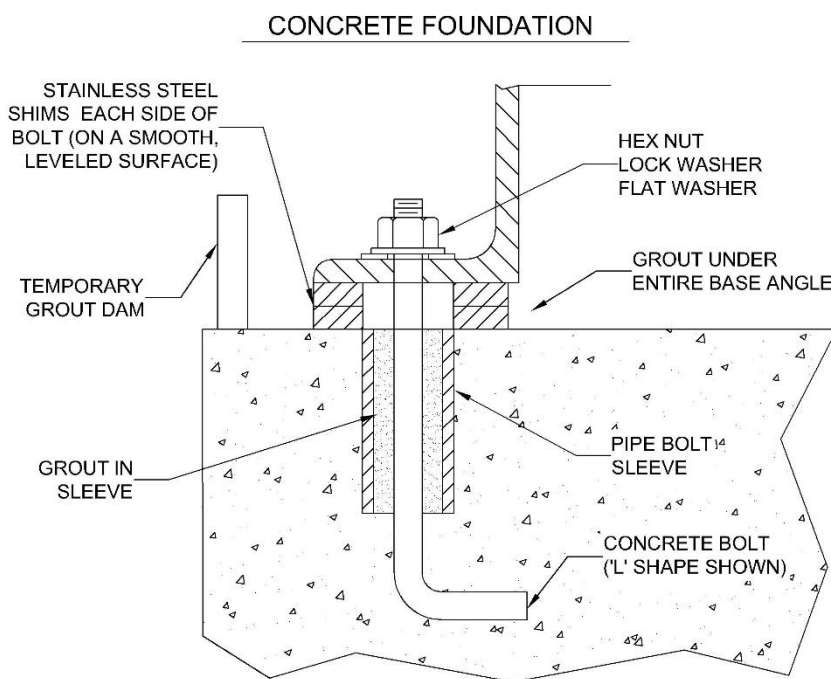
Foundations & Support Structures

The foundation and/or support structure you provide for this equipment is essential for proper fan operation. A well-designed foundation must be flat, level, and sufficiently rigid to assure that the natural vibration frequency of the foundation is stable and adequately separated from the rotational natural vibration frequency of the fan. This consideration must be extensively studied when fans are mounted above grade on structural steel support members. Incorrectly designed foundations or support structures can cause excessive equipment vibration levels and seriously endanger personnel.

The following is offered only as an introduction to the fundamentals of foundation design. The fan manufacturer cannot be responsible for foundation designs. Qualified engineers familiar with local soil conditions and building codes must prepare the foundation design details.

Concrete Slab Foundations

A heavy, poured concrete slab, on grade, is the best foundation design. The concrete should weigh at least 3 to 5 times the combined weight of the fan and drive component accessories. The footing should be large enough to prevent settling. The top of the slab should extend beyond the outside boundaries of the equipment by 6 to 8 inches. The slab should be poured in one piece; then bevel the edges to prevent chipping and for drainage. The best anchor bolts are "L" or "T" shaped and should be set in pipe sleeves approximately two (2) inches larger than the anchor bolt diameter. The sleeves provide some tolerance when aligning the anchor bolts with the fan base angle foundation holes. Anchor bolt length must consider the thickness of leveling shims, the fan base angle thickness, the thickness of washers and nuts, plus allowing extra bare threads for adjustment. The thread area of the bolts must be clean and lubricated.



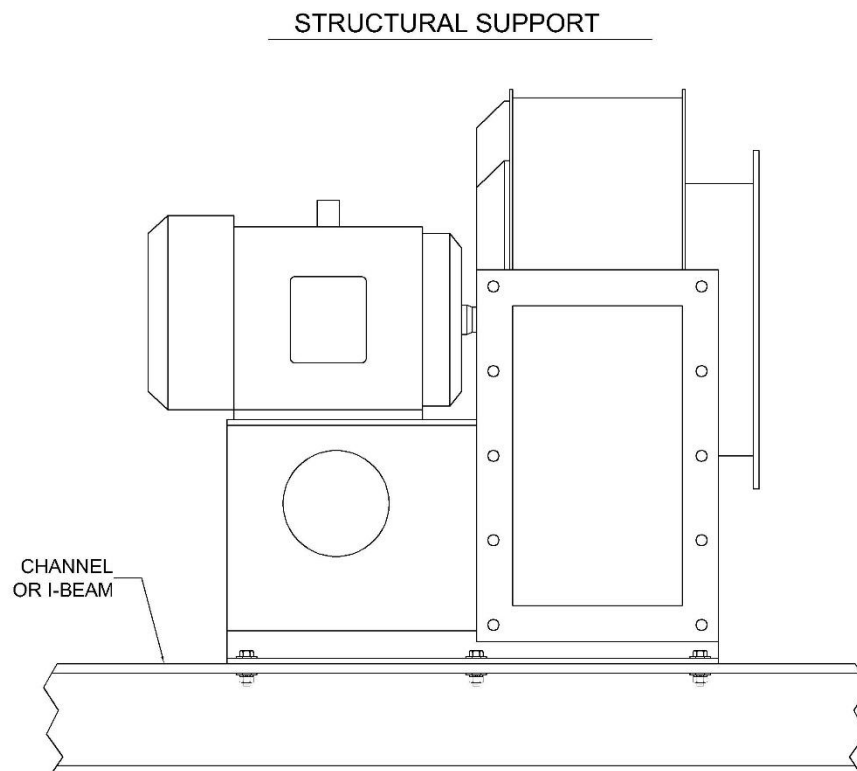


NOTE: The gap between the fan base angle and the foundation slab must be filled with grout after the fan is positioned and leveled. Gaps between the foundation slab and the fan base angle can contribute to excessive vibration.

Structural Steel Support Foundations

Fans that must be mounted above grade, on structural steel support structures, require special attention at design. The structure must be designed to support the equipment weight plus all dynamic loads of operation. Natural frequencies for fabricated structures are sometimes excited by the equipment's rotating frequencies. Support members should be as heavy as possible and include concrete reinforcements.

The use of spring isolators for equipment mounted on structural steel work is strongly discouraged. The use of springs adds another complication to the already difficult task of designing an adequate structural steel support structure.



Equipment Mounted Fans

Fans that are mounted as auxiliary equipment on other machines, or on mobile trailers, must be mounted so that vibration is prevented from being transmitted between the units. In certain instances, vibration isolators may be helpful.



Fan Types

Ventilating Fans (AF, BC, BCIL, FC, VA)

AF - Airfoil Ventilating Fans

Wheel Blade Type: hollow airfoil backward inclined.
15 sizes each (AFS & AFD): 24.5" to 73" wheel dia.
Performance Type: high volume with medium/low static pressure.
Construction: AMCA Classes I, II & III as well as our extreme Class IV.



AF Wheel

BC - Backward Curve Ventilating Fans

Wheel Blade Type: flat single thickness backward inclined
21 sizes each (BCS & BCD): 12" to 89" wheel dia.
Performance Type: high volume with medium static pressure.
Construction: AMCA Classes I, II & III as well as our extreme Class IV.



BC Wheel

BCIL - Backward Curve In-line Ventilating Fans

Wheel Blade Type: flat single thickness backward inclined
19 sizes: 12" to 73" wheel diameters.
Performance Type: high volume with medium static pressure.
Construction: AMCA Classes I, II & III as well as our extreme Class V.



BCIL Fan



FC - Forward Curve Ventilating Fans

Wheel Blade Type: single thickness forward curved
19 sizes each (FCS & FCD): 12" to 73" wheel dia.

Performance Type: high volume with low static
pressure.

Construction: AMCA Classes I, II & III as well as our
extreme Class IV.



FC Wheel

VA - Vane Axial Ventilating Fans

TA - Tube Axial Ventilating Fans

Wheel Blade Type: fixed single thickness curved &
twisted blades.

17 sizes: 15" to 72" wheel diameters.

Performance Type: high volume with low static pressure.

Construction: Standard Duty (SD), Heavy Duty (HD).



VA Axial Fan

Industrial Fans (BISC, HPS & HPO, IE)

BISC - Backward Inclined Single Camber Industrial Fans

Wheel Blade Type: backward inclined single camber
curved blades.

40 sizes: 12" to 80" wheel diameters.

Performance Type: medium volume with high static
pressure.

Construction: Standard Duty (SD), Heavy Duty (HD),
and Extra Heavy Duty (XHD).

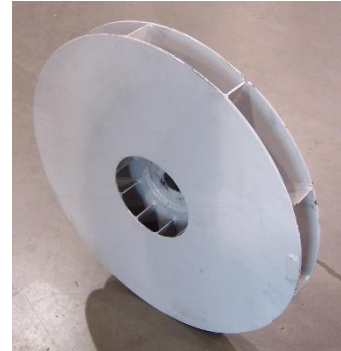


BISC Wheel



HPS & HPO - High Pressure Industrial Fans

Wheel Blade Type: straight radial bladed.
159 sizes: 18" to 85" wheel diameters.
Performance Type: low volume with high static pressure.
Construction: Standard Duty (SD), Heavy Duty (HD).



HPS Wheel

IE - Industrial Exhaust Fans

Wheel Blade Type: straight radial bladed.
45 sizes: 9" to 85" wheel diameters.
Performance Type: medium volume with medium static pressure.
Construction: Standard Duty (SD), Heavy Duty (HD), Extra Heavy Duty (XHD).

IE fan wheels are available in three different straight radial bladed wheel designs with multiple styles to match your application:

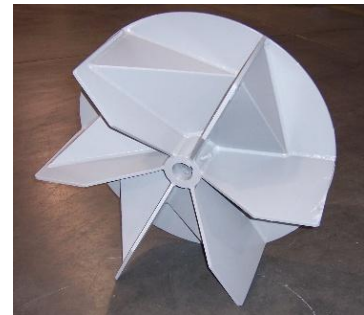
- O-IE (shroud-less spider type)
- M-IE (shrouded spider or shrouded backplate)
- L-IE (shroud-less backplate type).



IE "O" Wheel



IE "M" Wheel

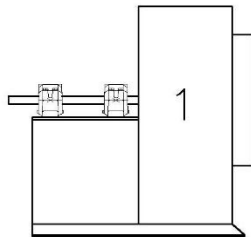


IE "L" Box Gusset Wheel

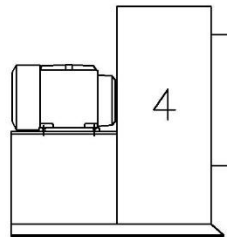


Fan Arrangements

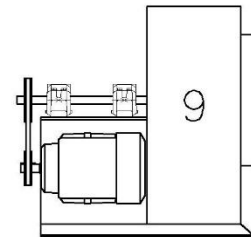
SINGLE WIDTH:



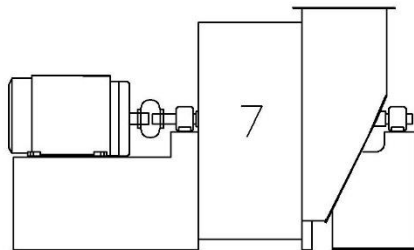
ARRANGEMENT 1:
BELT DRIVEN. IMPELLER IS
OVERHUNG.
TWO BASE MOUNTED
BEARINGS.



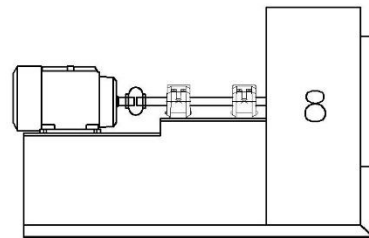
ARRANGEMENT 4:
DIRECT CONNECTION TO BASE
MOUNTED MOTOR. IMPELLER IS
OVERHUNG.



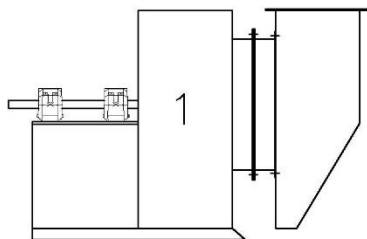
ARRANGEMENT 9:
BELT DRIVEN. MOTOR IS MOUNTED
ON SIDE OF BASE. TWO BASE
MOUNTED BEARINGS.
IMPELLER IS OVERHUNG.



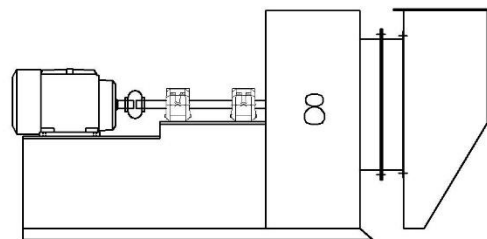
ARRANGEMENT 7: (WITH INLET BOX).
BELT DRIVEN OR DIRECT CONNECTION TO
BASE MOUNTED MOTOR. ONE BEARING
ON EACH SIDE OF IMPELLER.



ARRANGEMENT 8:
DIRECT CONNECTION TO EXTENDED
BASE MOUNTED MOTOR. COUPLED TO
TWO BASE MOUNTED BEARINGS.
IMPELLER IS OVERHUNG.



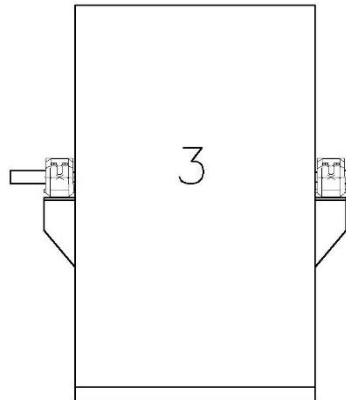
ARRANGEMENT 1: (WITH INLET BOX).



ARRANGEMENT 8: (WITH INLET BOX).

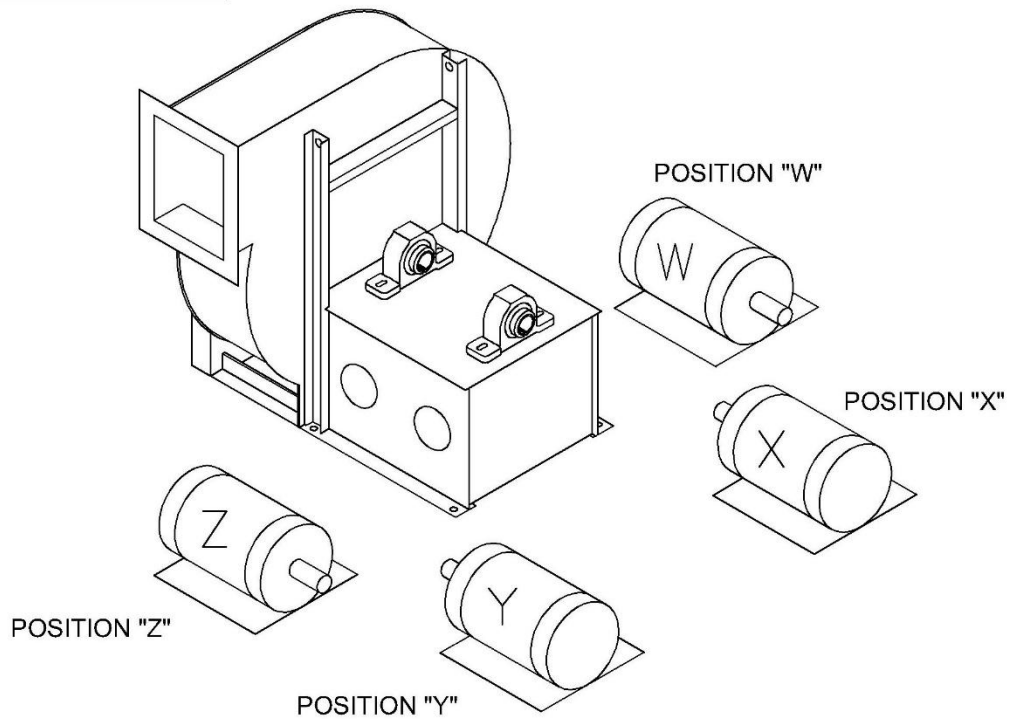


DOUBLE WIDTH:



ARRANGEMENT 3:
BELT DRIVEN OR DIRECT CONNECTION.
ONE BEARING ON EACH SIDE OF IMPELLER.

MOTOR POSITIONS:





Fan Rotations


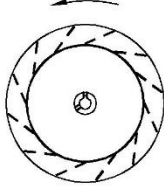
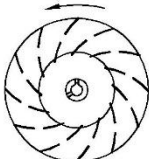
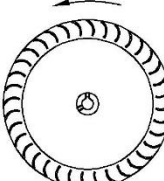
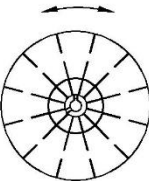
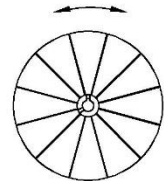
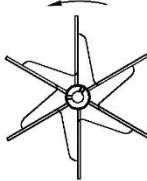
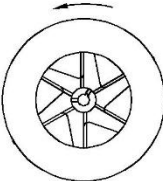
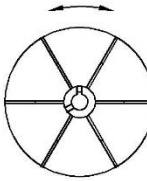
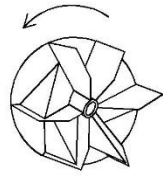
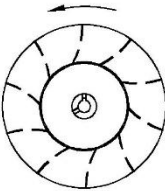
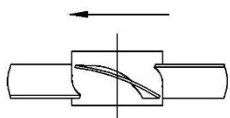
ROTATION AND DISCHARGE POSITIONS ARE ALWAYS DETERMINED BY LOOKING AT THE FAN FROM THE DRIVE (MOTOR) SIDE.					
CLOCKWISE					
	CLOCKWISE UP BLAST	CLOCKWISE TOP ANGULAR UP	CLOCKWISE TOP HORIZONTAL	CLOCKWISE TOP ANGULAR DOWN	
	CLOCKWISE DOWN BLAST	CLOCKWISE BOTTOM ANGULAR DOWN	CLOCKWISE BOTTOM HORIZONTAL	CLOCKWISE BOTTOM ANGULAR UP	
	COUNTER CLOCKWISE				
		COUNTER CLOCKWISE UP-BLAST	COUNTER CLOCKWISE TOP ANGULAR UP	COUNTER CLOCKWISE TOP HORIZONTAL	COUNTER CLOCKWISE TOP ANGULAR DOWN
		COUNTER CLOCKWISE DOWN BLAST	COUNTER CLOCKWISE BOTTOM ANGULAR DOWN	COUNTER CLOCKWISE BOTTOM HORIZONTAL	COUNTER CLOCKWISE BOTTOM ANGULAR UP

NOTES:

1. DIRECTION OF ROTATION IS DETERMINED FROM THE DRIVE SIDE OF THE FAN.
2. ON SINGLE INLET FANS, THE DRIVE SIDE IS CONSIDERED THE SIDE OPPOSITE THE FAN INLET.
3. ON DOUBLE INLET FANS WITH DRIVES ON BOTH SIDES, THE DRIVE SIDE IS THAT WITH THE HIGHER POWERED DRIVE.
4. DIRECTION OF DISCHARGE IS DETERMINED IN ACCORDANCE WITH THE DIAGRAMS. ANGLE OF DISCHARGE IS REFERRED TO THE VERTICAL AXIS OF FAN AND DESIGNATED IN DEGREES FROM THAT AXIS. THE ANGLE OF DISCHARGE MAY BE ANY ANGLE AS REQUIRED.



Fan Wheel Types

INLET SIDE VIEWS			
AF:	 AIRFOIL	BC:	 BACKWARD CURVED
BISC: BISC-Q:	 BACKWARD INCLINED SINGLE CAMBER	FC:	 FORWARD CURVED
HPS:	 HPS HIGH PRESSURE	HPO:	 HPO HIGH PRESSURE
IE:	 'O' TYPE (PADDLE WHEEL)	 'M' TYPE	 'L' TYPE
			 'L' TYPE (BOX GUSSET)
RT:	 RADIAL TIPPED	VA: TA:	(TOP VIEW OF WHEEL)  AIR FLOW AXIAL FLOW



Glossary of Fan Terms & Accessories

Access door - Provides limited fan access for wheel inspection. Common types include:

Bolted: flush panel bolted to the housing scroll.

Quick: panel hinged to the housing scroll at one end and a hand-operated fastener at the other end.

Port: for narrow width units where space does not permit a bolted access door.

Ports consist of a threaded pipefitting with plug.

Actuator - A mechanical accessory item attached to an outlet damper, inlet box damper, or VIV damper to move its blades to either the open or closed position, or to an intermediate position for airflow modulation. Electrically or pneumatically operated.

Air density - The mass per unit volume of air (lb./ft.³)

AMCA - (Air Movement and Control Association International) A non-profit organization that sets standards for the HVAC industry.

Average outlet velocity - The airflow rate per unit area of a fan calculated by dividing the airflow by the area of its discharge (FPM).

Axial fan - A fan in which the airflow through the impeller is predominately parallel to the axis of rotation (parallel to shaft axis). The impeller is contained in a cylindrical housing.

Backdraft damper - A device mounted in a duct or opening that permits airflow in one direction only.

Backplate - A circular plate in a centrifugal fan wheel that connects and supports the fan blades and transmits torque to them.

Barometric pressure - The absolute pressure exerted by the atmosphere at a location of measurement.

Blade (fan) - The flow element of a fan, which transforms rotational energy of the impeller to kinetic energy of the airflow.

Blade (damper) - A movable surface in a damper, which can be rotated to control airflow.

Blade liners - Metal pieces the same size and shape as a fan blade, added for wear resistance.



Centrifugal fan - A fan in which a gas, such as air, is moving a primarily axial direction upon entering the impeller and is changed by the impeller blades to an essentially radial flow direction at the impeller's discharge.

Critical speed – The speed which corresponds to the natural frequency of the rotating fan element (wheel and shaft assembly) when mounted on rigid supports without benefit of damping.

Curb - A roof penetration with raised perimeter to seal against the weather and to facilitate installation of roof mounted ventilation equipment (i.e. axial and inline fans).

Decibel - A dimensionless number expressing the levels of sound power or sound pressure.

Design temperature - The maximum gas temperature at which a fan or damper can be continuously operated.

Duct - Passageway used primarily for conveying air or other gases at low pressures.

Ducted fan - A fan with ductwork connected to either its inlet or outlet, or both.

Evase - A gradual transition of duct at a fan outlet to increase cross-sectional area and static pressure.

Expansion Joint - A flexible member used to attach a fan inlet and/or outlet to connecting ductwork.

Fan - A device, which utilizes a power driven rotating impeller for moving air or gases.

Fan appurtenances - Accessories added to a fan for purposes of control, isolation, safety, static pressure regain, wear, etc. common fan appurtenances include inlet boxes, inlet box dampers, variable inlet vanes, outlet dampers, vibration isolation bases, inlet screens, belt guards, evases, sound attenuators (silencers), and wear protection.

Fan static efficiency - A dimensionless value equal to the total efficiency times fan static pressure divided by fan total pressure.

Fan total efficiency - Ratio equal to fan power output divided by the fan input power.

Fan inlet - The plane perpendicular to an airstream where the flow first meets the inlet cone or the inlet box.

Fan outlet - The plane perpendicular to the airstream at the outlet opening of the fan or the outlet opening at the evase.



Fan shaft - A cylindrical metal piece on which a fan wheel is mounted and rotated.

Fan sound power - The sound power radiated into the standard test duct. Sound power level in dB = ten times the logarithm (base 10) of the ratio of the fan sound power in watts to the reference sound power of 10^{-12} watts.

Fan speed - the rotative speed of an impeller (RPM).

Fan static pressure - The difference between the fan total pressure and the fan velocity pressure. Therefore, fan static pressure is the difference between the static pressure at a fan outlet and the total pressure at a fan inlet (in WG).

Flanges - Consists of a plate or angle with mounting holes, welded to the fan inlet or outlet.

Flow rate - The volumetric flow rate at a specified gas density (CFM). Equal to the mass flow rate divided by the fan gas density.

Heat slinger - is a cast aluminum disk with cooling fins and is sized to suit applications; must be utilized for temperatures 200°F and over. Located between the fan housing and inboard bearing to block the flow of hot air from the shaft opening to the bearing.

Housing - A stationary enclosure for an impeller designed to direct the flow of the gas stream through the fan. May also affect the energy transformations of the gas stream.

Housing side plate liners - Narrow strips of metal fastened to the side plates of the fan housing at the connection of the scroll. Used to protect against erosion.

Hub - The center portion of an impeller connecting it to the shaft and having provision for transmitting torque.

Impeller - The rotating portion of the fan, designed to increase the energy level of the gas stream. Can also be referred to as a wheel, squirrel cage, fan, or rotor.

Inlet box - An elbow at inlet(s) to a centrifugal fan, which directs gas flow at a right angle to the fan shaft. Provided in either 360°, 180°, 270°, or 90° position.

Inlet cone - Used on BISC, BC, and FC inlets. Standard mild carbon steel spinning is used for class I and II only, up to 400°F maximum, with size limitations. Fabricated cones are used for temperatures above 400°F and larger blower sized (i.e. #6-1/2 BCS and above).

Inlet plate - Used on I.E. and HPS blower inlets and bolts directly to the inlet side of the fan housing. Standard is mild carbon steel inlet collar welded to the support plate.



Opposed blade damper - A damper in which adjacent blades rotate in opposite directions.

OSHA guards – A barrier to moving machine parts to protecting workers from injury.

Shaft guard: usually solid metal, covers the shaft.

Belt guard: expanded metal face is standard; solid type and other modifications such as tachometer holes or drains are available per customer request.

Coupling guard: solid metal covering coupling is standard.

Heat slinger guard: expanded metal covering heat slinger is standard.

Packing - Seal material to minimize or eliminate leakage at where shaft enters the housing.

Parallel blade damper - A damper in which the blades rotate in the same direction.

Point of rating - The specified fan operating point on its characteristic curve.

Pressure loss - Difference in pressure between two points in a flow system, usually caused by frictional resistance to fluid flow through an opening, in a duct or other flow system.

Shaft seal - A device to limit air or gas leakage between the shaft and fan housing, or between the axles and frame of a damper.

Shroud - Part of the centrifugal fan wheel opposite the backplate that supports the blades.

Shut off - The point of fan operation where the airflow is zero.

Spark resistant construction – AMCA defined standards to specify the degree to which a fan's construction minimizes the risk of generating sparks.

Type "A": AMCA standards require that all parts of the fan in contact with the air or gas being handled shall be of a non-ferrous material.

Type "B": AMCA standards require that the fan shall have a non-ferrous impeller and non-ferrous ring about the opening through which the shaft passes.

Type "C": AMCA requires the fan shall be constructed such that a shift of the impeller or shaft will not permit two ferrous parts of the fan to strike.

Standard air density - A density of 0.075 lb./ft.³ (1.2 kg/m³) corresponding approximately to air at 20°C (68°F), 29.92 in. Hg (101.325 kPa) and 50% relative humidity.

Static regain - The conversion of velocity into static pressure by reducing the velocity of the airflow. Can be achieved with an evase.

Variable inlet vane (V.I.V.) damper - Round control damper for fan inlet having blades arranged radially and operating in parallel, to control flow. Spins the air in the direction of fan rotation. It has a resistance effect as well as flow modifying effect.



Installation & Start-Up

General Comments

It is Fan Equipment Co., Inc.'s standard procedure to run test and balance signature all complete fan units up to and including 500 HP. Your fan will be correctly aligned, lubricated, and shipped assembled; ready for mounting on a properly designed foundation. The forces encountered during shipment, handling, and rigging can, however, disturb the factory settings. Before operating the fan, be sure the following items and the Start-Up Procedure outlined later in this manual are satisfied.

Anchoring to Foundation

Position the fan such that the mounting holes in the fan base angle are in line with the anchor bolts set in the foundation. If vibration isolators are used, position the isolator's mounting holes over the foundation anchor bolts. Lower the fan onto the anchor bolts. Level the unit and align the duct connections with the fan collars or flanges. The fan flanges are not designed to support duct loading or moment forces. All ducting into and from the fan must be independently supported. Duct connections that are misaligned will impart loads to the fan that can distort and alter critical fan tolerances that can adversely affect performance or mechanical behavior. Grout in the gap underneath the fan base angle and securely tighten all anchor bolts.

Bearings

Bearings on factory assembled units will have been properly lubricated and are ready for operation. Bearings shipped loose, as replacements or spares, will require cleaning and lubrication prior to operation. Refer to the specific manufacturer's literature for more information.

V-Belt Drives

V-belt drives on factory assembled fans have been properly aligned and tensioned. The alignment must, however, be checked and corrected prior to operation. This must be done to correct any movement that occurred during shipping and handling. A sufficiently long straight edge or length of string is the best reference for checking the sheave alignment.

To mount V-belt drives:

1. Clean the motor and the fan drive shafts, removing any protective coatings. Remove any burrs or rough spots; and coat the shafts with a light lubricant.
2. Mount the fan and motor sheaves to their respective shafts. Hand pressure only is required. Do not pound on the sheaves with hammers to install or remove.
3. Clean the sheave grooves of all oil, rust, grease, and metal burrs.
4. Loosen the motor base adjusting screws so the drive belts seat in the grooves without forcing. Do not roll the belts or use a tool to move the belts over the grooves.



5. Align the fan and motor shafts parallel to each other; and at right angles to the belts. Use a straight edge or length of string pulled taut over the faces of the sheaves to sight alignment.
6. Tighten the belts by adjusting the motor base adjusting the screws. Proper belt tension is measured with a belt tension gauge. Excessive tension can damage the fan and/or motor bearings.

For adjustable pitch sheaves, belts are tensioned by moving the motor on its mounts or base; not by changing the pitch diameter of sheave grooves. Refer to the specific manufacturer's literature for more information.

Motor Wiring

The wiring of all electrical accessories must be in accordance with the motor manufacturer's recommendations and wiring diagrams. Electric motors have connection diagrams on the nameplate. Fan motors must be connected to the power supply through a delegated disconnect switch and magnetic starter, with suitable overload and short circuit protection.

All wiring must comply with the National Electrical Code (NEC) and local code requirements.

ALL MOTOR DRIVEN FANS MUST BE CONNECTED TO A DISCONNECT SWITCH SO THAT THE MOTOR CAN BE POSITIVELY ISOLATED FROM THE POWER SOURCE. MAINTENANCE PERSONNEL MUST CONTROL POWER TO THE UNIT TO AVOID ACCIDENTAL STARTING OF EQUIPMENT DURING MAINTENANCE OR REPAIR.

Motor conduit boxes can be rotated in 90° increments to connect to the power source. Be sure the power source voltage and amperage are compatible with the motor requirements and that the insulation class is compatible with the ambient temperature. Electric motors are designed to run at temperatures up to 180° F. The total motor operating temperature is a combination of the ambient temperature and the motor temperature rise caused by resistance of the electrical windings.

Motors are generally provided with their bearings factory lubricated and ready for operation. It is the owner's responsibility, however, to confirm that the motor bearings are lubricated before starting up.



Pre Start-Up Checklist

Before initial start-up or after servicing, perform the following checklist:

1. CONFIRM ALL FASTENERS ARE SECURE. All foundation anchor bolts, bearing hold down bolts, locking collars, wheel retaining set screws, bearing set screws, and sheave mounting bolts must be properly tightened.
2. Belt driven units: check the V-belt drive alignment and belt tension (refer to the “V-Belt Drives” section of this manual).

Direct coupled units: check the coupling / shaft alignment (refer to the “Flexible Couplings” section of this manual).

3. Check bearing alignment and lubrication.
4. Rotate the fan wheel by hand to check that it turns freely and does not strike the housing or inlet cone. DO NOT START THE FAN IF ANY METAL-TO-METAL RUBBING SOUNDS ARE DETECTED.
5. Confirm all electrical connections are as described in the previous section and in compliance with all applicable codes and standards.

6. Make sure all access doors and bolted covers are sealed and tight. Doors, covers, and inlet cones are held by nuts threaded onto weld studs. The maximum torque allowed for these fasteners is shown on the chart to the right.

Torque Values: C/S Studs		
Stud Size	Ft-Lbs	In-Lbs
1/4"	4	48
5/16"	8	96
3/8"	12	144
1/2"	30	360

7. Variable inlet vanes or dampers (if supplied) must move freely.
8. Duct connections must not impose loads on the fan. Expansion joints should be used when movement is expected from thermal growth or if the fan is mounted on vibration isolators. All ducts and connections must be sealed “air-tight”. All connections must be installed so that air flow, into and out of the fan, is not obstructed.

CAUTION:

Never torque bolts in series. Always use a staggered torquing sequence. Start tightening at 12:00, then 6:00, then 3:00, then 9:00, etc.



Start-Up Procedure

After all of the items in the Pre-Startup Checklist have been completed, begin the following Start-Up procedure:

1. "Bump" the motor to determine proper direction of fan wheel rotation. Arrows on the fan or motor show correct rotation. If rotation must be changed, reverse any two (2) motor leads on three (3) phase motors. For single phase motors, refer to the motor wiring diagram.
2. Energize the starter circuit and allow the fan to accelerate to full speed. Generally, motors are sized so that operating fan speed is obtained in fifteen (15) seconds. Large diameter fans and narrow width high pressure blowers may take twenty (20) or more seconds to achieve rated speed. ***IT IS THE OWNER'S RESPONSIBILITY TO FURNISH ELECTRICAL COMPONENTS CONSISTENT WITH THE DRIVE MOTOR'S LOCKED ROTOR STARTING CHARACTERISTICS.***
3. The drive V-belts will "chirp" or "squeal" briefly at start-up. Higher horsepower fan drives may generate a small amount of smoke as the drive V-belts are suddenly activated at start-up.
4. Observe the fan and motor as the fan runs at operating speed. Unusual vibration or overheating of the bearings should be investigated immediately. It is typical for anti-friction bearings to exhibit a running surface temperature in excess of 165° F. This surface will be too hot to touch. This is no cause for alarm. Refer to the engineering data supplied for your fan unit or consult the factory for specific information regarding bearing temperatures.
5. Check the fan after it has been running for approximately eight (8) hours. Stop the fan and recheck all alignments, inspect the bearings, re-tighten all hold down bolts, re-tension drive V-belts, and tighten all set screws.



Assembly & Disassembly Procedures

These procedures apply to all fans.

Specific instructions for special drive arrangements are noted by **bold** type.

Disassembly

ALWAYS MAKE CERTAIN THE ELECTRIC POWER IS TURNED OFF AND WILL REMAIN OFF BEFORE PERFORMING ANY MAINTENANCE PROCEDURE.

1. For units without mounting legs, use floor blocks to prevent rolling.
2. Remove accessories, as necessary.
3. **Arrangement 4:** Carefully slide the wheel off the shaft.
4. Unbolt and remove the motor from the motor support stand.
5. **Arrangements 1 and 9:** Remove belt guard, v-belts, and v-belt sheaves/pulleys.
6. Remove the wheel by first unbolting and removing the inlet side plate or inlet cone.
7. Remove set screws, shaft key, retainer plate and/or lock wires. Loosen bolts for taper-lock bushings and utilize backout holes to remove the bushing from the hub.
8. To remove the motor, remove the bolts holding the motor to the motor base.

Reassembly

To reassemble, reverse the sequence of operations itemized above. Properly prepare the fan bearings for remounting (as described on the following pages), and perform these additional procedures:

1. Arrangement 4 fans: position the motor on the motor stand, tighten hold down bolts finger tight.
2. De-burr fan wheel's hub and apply a light lubricant and slide the wheel onto the shaft.
3. Adjust the wheel position to provide for proper inlet overlap or position inside of housing. Fan wheels fastened with taper-lock bushings require the wheel to be positioned slightly back from the inlet, as the wheel will move forward when the bushing is tightened.
4. Insert key into hub. The key must extend beyond all set screw holes. Locate the key at 6 o'clock and tighten the set screw over the keyway only. The remaining set screw will be tightened after final alignment.



5. Refit the inlet cone or inlet side plate and check for proper wheel to inlet fit. When correct, tighten the second wheel set screw and firm up tightness of the set screw over the keyway.
Arrangement 4 fans: Finish tightening the motor hold down bolts.
6. Apply silicone or other seal/gasket substance compatible with the gas stream to the fan mating surfaces and refit the inlet sections.
7. Secure the fan to a rigid, level foundation as previously discussed.
Arrangement 9 fans: Align V-belt drive components; tighten down motor hold down bolts.
8. Replace all accessory items.
9. Perform the Pre-Start-up check as outlined in the “Pre-Start-up Checklist” section in this manual.

Wheel Alignment

Align the wheel to the housing or inlet cone(s) by following this procedure:

1. Level the fan on its foundation as described previously. Tighten the anchor bolt nuts.
2. If mounted on a concrete foundation pour the grout, let harden, and check for final alignment and leveling.
3. Check that the motor and bearing hold down bolts are tight.
4. Check the V-belt drive alignment.
5. Rotate the wheel by hand; check that the wheel runs freely without rubbing at any point. Ensure that there is an even circumferential gap. There will be an overlap of the fan wheel shroud and inlet plate or cone on almost all fans.

Bearings

Fan wheels and shafts for fans furnished in arrangement numbers 1, 3, 7, 8, 9 & 10 are supported primarily by pillow block anti-friction bearings. Fan Equipment Co. uses a variety of roller, ball or sleeve type bearings depending on the application and service conditions of the fan. Generally, the following procedures should be followed when disassembling and reassembling all pillow block bearings:

1. Determine the size and type of the subject bearing.
2. Note the position of the fixed and expansion bearings. Replacement in the exact location is essential for proper bearing temperature, performance, and service life.



3. Refer to your specific submittal data for any special considerations or procedures applicable to your fan unit.
4. Match-mark all parts to avoid reassembly errors; do not mix and interchange parts from one bearing to another. Inspect and clean all parts with mineral spirits.
5. Clean and de-burr the fan shaft. Polish out all small irregularities with emery cloth. The bearing must not be seated on worn or flat sections of the shaft. Fan shafts that are worn and/or damaged must be replaced.

Slide bearings into position on the fan shaft, and follow the steps below for each type of bearing:

NOTE: *The following information is provided as a general reference.
Please consult the specific bearing manufacturer for current detailed information.*

Pillow Block Heavy Duty Ball Bearings

(For example: Link-Belt P-U300 series and Dodge "SC" types)

Installation is as follows:

1. Slide the bearing with extended inner race into position on the fan shaft.
2. Tighten the bearing hold down bolts finger tight.
3. Align the rotating assembly so the wheel does not strike any part of the housing or inlet fixture.
4. Securely tighten the bearings to the bearing support stand.
5. Tighten the self-locking, cupped point screws or spring locking collar onto the fan shaft.
6. Reattach any extended grease lines and fittings.
7. Fill the grease lines and bearing housings with grease taking great care not to over fill the bearing pillow block with grease.

CAUTION:

A bearing with too much grease in it will overheat and fail prematurely.



Pillow Block Spherical Roller Bearings

(For example: Link-Belt 6800 series and Dodge USAF 500 series)

These bearings are either fixed or floating (expansion), split pillow block, spherical roller-bearing assemblies. General installation is as follows:

1. Set the bottom section of the split housing in place on the bearing support pedestal.
2. Apply anti-seize compound to outside diameter and threads of tapered sleeve and face of lock nut to aid in tightening of the adapter.
3. Position the multi-labyrinth seal ring (if used), adapter sleeve, roller bearing element, lock washer, lock nut and second seal loosely; slide onto the fan shaft.
4. Securely hand tighten the lock nut onto the adapter sleeve.
5. Insert feeler gauges between the outer ring and the unloaded roller bearing on both sides of the bearing, until a snug fit is obtained. Record this gauge measurement.
6. Lower the fan shaft with the bearing and adapter assemblies into the bottom section of the pillow block housing. Take care to align the labyrinth seals with the seal grooves in the housing pillow block.
7. Loosely bolt the bottom pillow block sections to the bearing support pedestal; align the assembly with shims so that the wheel does not strike the housing or inlet fixture. Shims are also placed under the bearings to "center relieve" the hold down tension.
8. Position the floating (expansion) bearing insert centrally in the bottom pillow block housing section.
9. The fixed bearing insert is positioned for placement of a spacer ring that fits on the lock nut side to keep the bearing flush with the opposite side of the pillow block housing.
10. Snug-up the lock nut with a wrench.
11. Place a brass drift against the lock nut and strike the drift repeatedly. Evenly distribute the blows by rotating the fan shaft between strikes. This procedure drives the inner ring farther up on the adapter sleeve and releases pressure on the threads. Use the wrench again to tighten the lock nut. Repeat this procedure until the clearance has been reduced to the desired amount and record this value. Refer to the specific spherical roller bearing manufacturer for their bearing clearance reduction recommendations.
12. Secure the lock nut by bending the lock washer tang into the lock nut slot.
13. Insert the spacer into the fixed bearing housing on the lock nut side.
14. Lubricate the bearing with grease or oil.



15. Check that the bearing races are not cocked in the housing; apply a sealant such as “Permatex” on the housing mating surfaces; and mount the top half of the pillow block housing to the bottom half.
16. If the bearing seals are free to rotate with the shaft and stop easily; tighten the hold down cap bolts.

IMPORTANT: When replacing bearing inserts on assembled fans, it is MANDATORY that measurements and adjustments be made with ONLY the weight of the fan shaft supported by the bearings. ALL loads imposed by the fan rotor and other accessories, such as drive sheaves, must be supported by blocks or other means.

V-Belt Drives

V-belt driven fans that are factory assembled have been aligned and test run before shipping. Because of the forces encountered during shipping and handling, the drive alignment must be checked before operation as follows:

1. Check that sheaves are locked in position with keys firmly installed and seated.
2. The sheave faces must be parallel as checked with a straight edge or string.
3. Start the fan and check for proper rotation.
4. Run the fan at operating speed. A slight bow should appear on the slack side of the belts.
5. Adjust belt tension, if required, with a belt tension gauge by adjusting the position of the motor on its' sliding base.
6. The drive belts will squeal a bit, especially higher horsepower units, upon start up. ***DO NOT OVER-TIGHTEN THE BELTS.***
7. Please refer to the manufacturer’s detailed instructions.

Assembling or Replacing V-belt drives

1. Clean the motor and fan shafts. Be sure they are free from corrosion. Clean the bore of each sheave and coat with white grease or oil. Then remove all oil, grease, rust, and burrs from the sheaves.
2. Place the fan and motor sheaves on their respective shafts. ***DO NOT POUND THE SHEAVES ONTO THE SHAFTS***, as this might damage the bearings. Tighten the sheaves in place. The sheave should be as near as possible to the bearing pedestal without the sheave or belts hitting the support pedestal.



3. Move the motor on its slide base until the belts can be placed in the sheave grooves without forcing. Do not roll belts or use a tool to force the belts over the grooves.
4. Adjust the fan and motor sheaves so they are parallel. Use a straight edge or string pulled taut against the sheave faces to check for squareness. The belts should be at right angles to the shafts.
5. Tighten the belts by adjusting the motor slide rail screws, moving the motor back on its' base. Use a belt tension gauge to determine proper belt tension. Excessive tension can cause premature bearing and/or belt failure.
6. Start the fan and run at full speed.
7. Continue the process of adjusting belt tension until a slight bow appears on the slack side of the belts. Give the belts a few days running time, then readjust the belt tension.

Flexible Couplings

Fans shipped assembled, with the coupling mounted, have the coupling halves aligned. Shipping and handling can cause the alignment to change; however, the coupling alignment should always be checked before start-up. Use the following procedure:

Mounting

1. Place coupling halves or hubs on the shafts with the faces flush with the shaft ends. The hubs should slide onto the shafts with light tapping by a soft lead or rubber hammer.
2. Locate the motor on its base with the coupling faces set at the proper gap. This gap is detailed on the fan dimensional drawing or is given in the coupling manufacturer's literature. Most drive motors furnished by Fan Equipment Co., Inc. have ball bearings that prevent axial movement of the motor shaft.
3. If the drive motor has sleeve bearings, the mechanical center of the motor rotor must be located before the coupling can be properly positioned and aligned. To find the axial movement of the motor shaft:
 - a. Run the motor and notice how far the motor shaft moves.
 - b. Push the shaft in as far as it goes into the motor housing and mark a line on the shaft at the housing.
 - c. Then pull the shaft out as far as it goes and scribe another line.
 - d. Half the distance between the two marks is the mechanical center of the motor.



4. If motor axial movement becomes a problem, use a limited end float type coupling to keep the motor near its mechanical center.
5. Please refer to the manufacturer's detailed instructions.

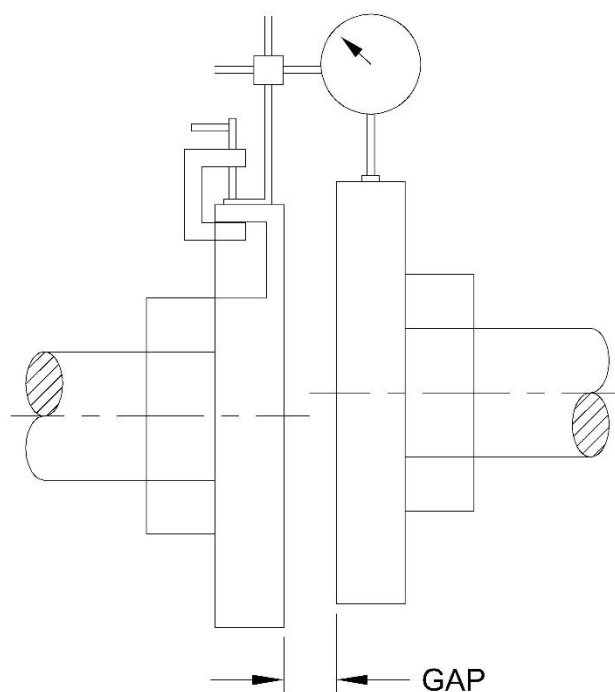
Coupling Alignment

Flexible couplings must be aligned accurately. A laser is preferred since it is more accurate, however, the dial indicator method can also be used. The dial indicator readings will show exactly what shim adjustments must be made. Because the position of the fan shaft is determined when the fan shaft and bearings are aligned, any necessary adjustments are made by moving the driver. When in correct alignment, the coupling faces are parallel and the hubs concentric.

Dial Indicator Method – Parallel Alignment

1. Fasten the indicator bracket on one hub with the dial button contacting the alignment surface of the opposite hub.
2. Rotate the shaft on which the indicator is attached and take readings at four (4) points: top, each side, and bottom.
3. The difference between the two (2) radial side readings indicate the motor must be moved sideways.
4. The difference between the two (2) top and bottom readings indicate the motor must be raised or lowered by adding or removing the same thickness of shims under all four (4) mounting feet.
5. The amount of shim correction in each case is half the difference between the two (2) paired ratings.

PARALLEL ALIGNMENT

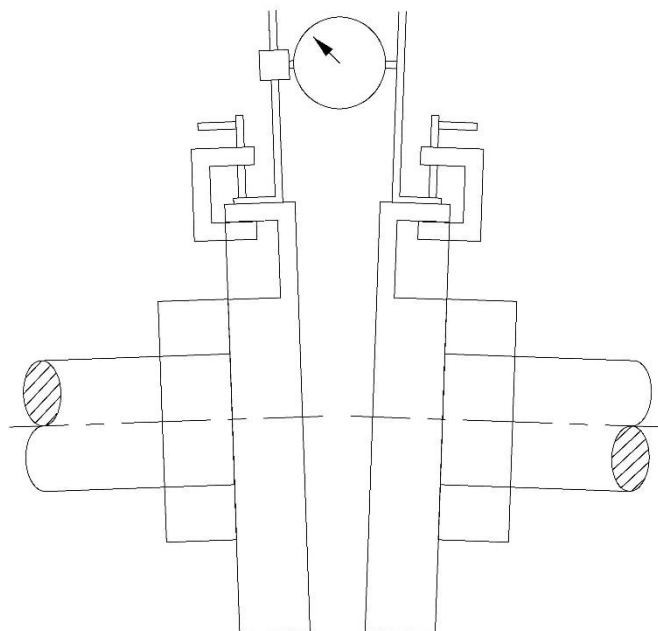




Dial Indicator Method –
Angular Alignment

1. Fasten the indicator brackets on the hubs as shown.
2. Rotate both shafts in unison so the four (4) readings are taken between the same two (2) points on the hubs.
3. Adjust the motor position until the same reading is obtained all around the coupling. This equalizes the clearance or gap between the hub faces.

ANGULAR ALIGNMENT



Straight Edge and Feeler Gage Alignment

1. For parallel alignment, place a straight edge across the coupling hubs.
2. Raise or lower the motor by shimming until the straight edge lies true and flat at the top and the bottom of the hubs.
3. Now use the straight edge on the sides of the hubs to align them horizontally.
4. Shift the motor sideways if adjustment is necessary.
5. To set angular alignment, the clearance between the hub faces must be equal at four (4) points as measured with feeler gauges.



Flexible Coupling Lubrication

All metal type couplings such as Falk Steelflex and Fast gear units require regular lubrication. To re-lubricate, remove the lube plug(s) and add lubricant until the excess purges out the bottom opening; replace the lube plug.

Lubricant recommendations are included with your submittal data package; in general, recommended lubricants are:

Grease - Shell Alvania Grease #2 or Exxon Fibre Grease C.

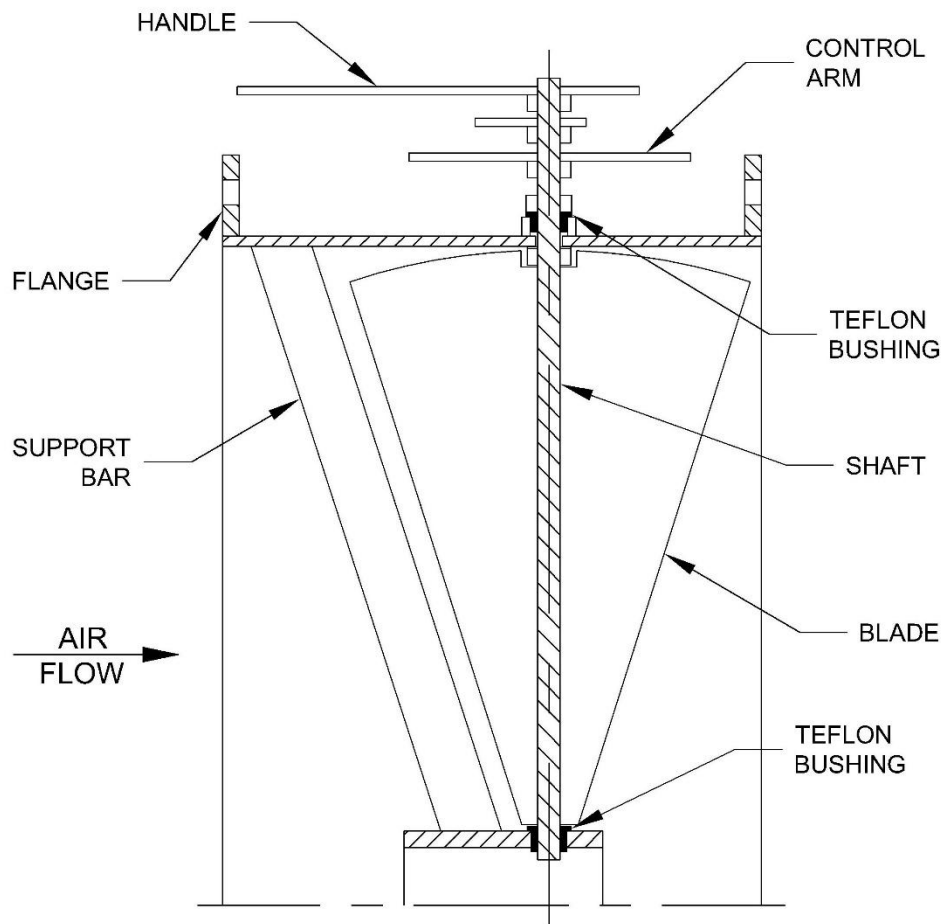
Oils - Mineral base oils having a minimum viscosity of 150 SUS, or SAE 140 gear oil.

Rubber element type couplings such as Dodge Raptor do not require lubrication.



Variable Inlet Vane (V.I.V.) Dampers

Variable inlet vane dampers are used to control the fan's capacity through moveable vanes located at the fan inlet. A linkage assembly connects the vanes so that the vanes move in unison when operating the control shaft. Most V.I.V. assemblies are furnished as separate bolt-on sections. Some fans, however, are furnished with the vanes "nested" inside the fan inlet cone throat. Double width fans are furnished with two (2) separate V.I.V. assemblies, connected to a common linkage so that both vane assemblies move in unison with one (1) control shaft.



The V.I.V. section is assembled and adjusted for proper operation at the factory before shipment. When the fan is received at the job site; check that the vanes spin the air in the same direction as the wheel rotates. Before the inlet duct work is attached, operate the control lever to make certain the vanes move freely from fully open to fully closed.

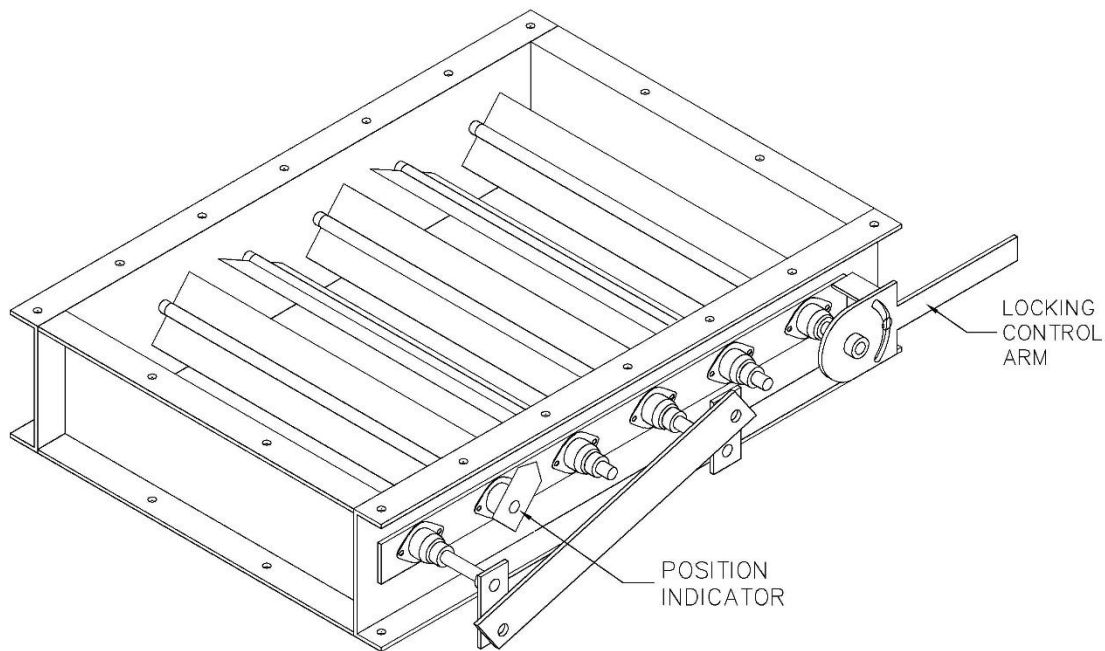


V.I.V.'s provided for manual operation are furnished with a locking quadrant and wing nut to fix the control lever after system adjustments are made.

V.I.V.'s may also be furnished with automatic actuators which follow a system control signal to balance air flow performance. Automatic actuators come in all sizes and shapes. The mounting bracket is the responsibility of those supplying and mounting the actuator. When specified, Fan Equipment Co., Inc. can furnish and factory mount automatic actuator assemblies.

Outlet Dampers

Outlet dampers are usually furnished in a separate channel frame that bolts to the fan's outlet flange. Smaller fans can be furnished with one (1) or two (2) wafer type blades that are integral to an extended fan outlet section.



Most outlet dampers are furnished as "opposed blade", meaning the blades move opposite to each other as they are closed. Dampers can be furnished for manual or automatic operation and are furnished with the same features as the V.I.V.'s above.

Gravity back draft dampers are not furnished with control levers. They swing from fully closed to fully open when the fan is in operation.



Heat Slingers

A heat slinger is a split aluminum rotor bolted to high temperature fan shafts to dissipate heat conducted along the fan shaft; and to induce air flow around bearing housings. Heat slingers are installed by placing the two (2) halves over the fan shaft and bolting together as follows:

1. The open side of the heat slinger should face the fan when the fan has oil lubricated bearings.
2. The open side of the heat slinger should face the bearings when the fan is furnished with grease lubricated bearings.
3. The open side of the heat slinger should face the motor on arrangement No. 4 fans.

Shaft Seals

Simple rubbing shaft seals are provided for most fan applications. These seals are cut from rigid sheets of compressed carbon fiber or Teflon. The seals are held in place by weld studs and a retaining plate. Air leakage along the fan shaft is minimal but present.

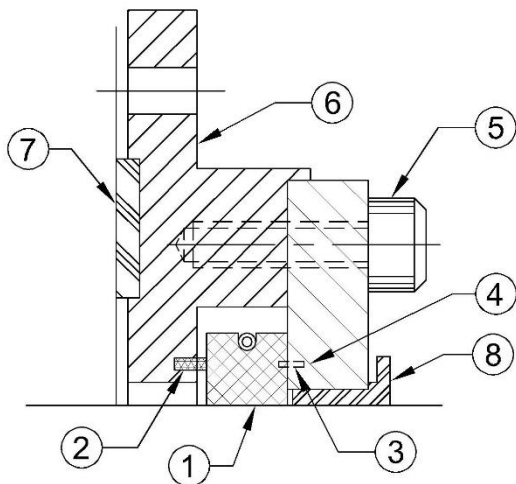
Carbon ring shaft seals are furnished when negligible or no leakage along the fan shaft is desired. These seals can be single or double element type; and can be furnished with purge air connections for charging with an outside gas source for sealing. These seals tolerate the thermal expansion of high temperature fan applications well, eliminating the need for centerline support designs for many fans. Specific instructions for fans furnished with carbon ring shaft seals are furnished with each unit.

John Crane shaft seals are segmental bushing shaft seals that are available for general industrial applications involving the movement of gases and vapors. These are dry running seals and lubrication is NOT recommended. The seals are pre-assembled cartridges which can be installed in minutes. The centering ring assures perpendicularity and centering during installation. The bushing “follows” shaft runout or misalignment to maintain continuous close clearance to the shaft. The bushing I.D. is sized to eliminate the possibility of excessive shaft or bushing wear. These seals operate at temperatures up to 850° F, pressures up to 1100 inches W.G. (40 psig) and speeds up to 5000 RPM.



John Crane SINGLE units are designed for flow restriction. Single segmental bushing seals provide leak protection by restricting the escape of process gas to the atmosphere.

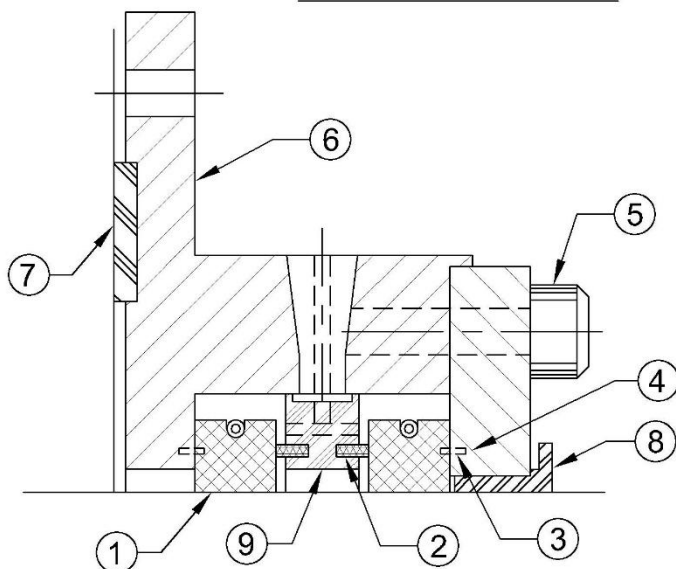
SINGLE ASSEMBLY



#	DESCRIPTION
1	SEGMENTED BUSHING
2	SPRING
3	ANTI-ROTATION PIN
4	FOLLOWER
5	CAP SCREW
6	HOUSING
7	GASKET
8	CENTERING RING

John Crane DOUBLE units are designed for zero process leakage. Double segmental bushing seals provide leak protection by allowing zero leakage of process gas to the atmosphere.

DOUBLE ASSEMBLY



#	DESCRIPTION
1	SEGMENTED BUSHING
2	SPRING
3	ANTI-ROTATION PIN
4	FOLLOWER
5	CAP SCREW
6	HOUSING
7	GASKET
8	CENTERING RING
9	LANTERN RING



Preventive Maintenance

To ensure trouble-free operation and long life, a regular schedule of preventive maintenance and lubrication must be followed. Frequency of inspection and lubrication depend upon the operating conditions and the time period the fan is used. We recommend daily observation after the fan is first put into service, to determine the inspection and lubrication requirements.

Do not make any repairs or alterations to the fan equipment during the warranty period without Fan Equipment Co., Inc.'s prior authorization or the warranty is void.

CAUTION:

- Before performing any inspection, make sure that the fan is locked OFF so that the unit cannot be started.
- Do not shut down fans handling high temperature gas or air until the system cools down.

Periodic inspections should include the following items:

1. **Air Flow** - Check for obstructions such as dirt, rags, etc. in the inlet or outlet duct work.
2. **Screens, V.I.V.'s, and other flow accessories** - Clear periodically, dirt causes resistance to air flow, decreasing the air volume supplied by the fan.
3. **V-belt Drives** - Check for belt wear, alignment of sheaves, and belt tension. Replace belts in matched sets only. New belts will not perform properly when used with used belts because of length differences. Belts must be free from grease and oil.
4. **Wheel** - Inspect the blades for dust or dirt accumulation. Particulate build up can cause unbalance. Cover the bearings with plastic film and clean with steam, water jet, compressed air, or wire brush. If blades are aluminum, be careful not to damage them while cleaning. Make sure the wheel is centered to prevent blades from striking the housing. Check for proper wheel rotation. **If cracks** are found in the wheel, remove the fan from service until proper repairs can be made.
5. **Hardware** - Check that all foundation bolts, wheel hubs, set screws, wheel locking fixtures and bearing hold down bolts are sufficiently tight.



6. **Shaft** - Check that all shafts are properly aligned. The shaft must not be cocked in the bearings because misalignment causes overheating, wear to dust seals, bearing failure, and rotor unbalance.
7. **Bearings** - Check for excessive temperature or chatter in all bearings. High speed bearings are designed to run at temperatures above 1650 F. **Do not replace a bearing simply because it feels hot.** Check the pillow block temperature with an accurate thermocouple contact thermometer or an infrared thermometer or contact Fan Equipment Co., Inc. for assistance.
8. **Surface Coatings** - Check that surface coatings or paints are in good condition. Repainting of exterior and interior surfaces extends the service life of your equipment. Select coatings to withstand the operating temperature and chemical content of the gas stream. For normal temperature and service conditions, good machinery enamel may be used.
9. **Alignment** - Check the alignment of fan bearings, flexible couplings, wheel, and inlet cones regularly. Misalignment causes bearing and/or motor overheating, wear to dust seals, bearing failure, and rotor unbalance.
10. **Damper and V.I.V.'s** - The linkage connections must be checked for tightness. Check all automatic dampers for freedom of movement. Blades should close tightly and evenly. Clean damper blades and linkages and inspect for corrosion and erosion. Observe as operating motors and controls stroke through a complete cycle then adjust or repair, as necessary.
11. **Flexible Couplings** - Lubricate metal and gear type couplings as required by each specific type. Thomas disc and rubber insert style couplings, such as Dodge Para-flex and Rex-Omega couplings do not require lubrication but must be inspected for pin and bushing wear.
12. **Motors** – Keep open motor windings clean by removing dust and dirt because contamination causes excessive insulation temperatures. **Keep motors dry.** When motors are idle for long periods of time, single phase heating or small space heaters may be necessary to prevent water condensation on the windings. **Be sure the motor is not overloaded. Excessive starting of motors may burn out the motor. Check the amperage draw against the motor nameplate rating; and consult the manufacturer for the maximum allowable number of consecutive starts.**



Maintenance Procedures

Wheel (Rotor) Balancing

All Fan Equipment Co., Inc. wheels (rotors) are balanced at the factory before shipment. Most fans shipped assembled have also had a running test performed to confirm mechanical and balance characteristics are correct. A fan handling clean, dry air should not need balancing once it is installed and running properly. Dust or particulate build up on fan rotors causes unbalance. Inspect your fan periodically to determine the amount of blade wear. Blow off any dust or particulate build up on blades and inside the housing before balancing a rotor, check the preceding troubleshooting section.

Portable instruments are available that indicate vibration displacement in mils (1 mil = 0.001 inches), or velocity in inches/second. If you have vibration instrumentation, use the table below to determine when your fan is operating with too much vibration.

Vibration at Fan Operating Frequency

RPM	Initial Operation		Shut Down	
	Mils.	Vel.	Mils.	Vel.
3600	0.53	0.1	2.4	0.45
1800	1.06	0.1	4.77	0.45
1200	1.59	0.1	7.16	0.45
900	2.12	0.1	9.45	0.45
720	2.66	0.1	11.97	0.45
600	3.18	0.1	14.31	0.45

1. When the fan operating frequency falls between the above listed frequencies, the value for the higher frequency should be used.
2. Displacement is a measured value with the probe or seismic type pickup positioned firmly on the fan bearing housing, in the desired plane of measurement. Displacement is a peak-to-peak (full wave) value.
3. Initial operation values are expected values for clean, well maintained, and balanced fans operating at steady state conditions after transient conditions of start-up, i.e., acceleration, temperature changes, etc. have stabilized. The values (for measurement of equipment unbalance) must be taken for the exact fan operating frequency, filtering out extraneous values that can be measured for different frequencies.



4. Operation of any fan above the shut-down levels listed above may cause equipment failure and extensive damage, as well as endangerment to personnel. A corrective measure would be to retain an authorized service representative to inspect the installation, suggest appropriate actions, and balance the rotating assembly, as necessary.
5. Fan Equipment Co., Inc. balances and run tests the equipment on a heavy concrete foundation. Installation variables, such as (but not limited to) foundations and mounting provisions, may result in vibration levels somewhat different from the levels achieved at the factory.
6. When vibration isolation systems, such as spring isolators are used, fan balancing should be performed with the isolator components "locked out" to establish a rigid structure. The isolation components should be readjusted after the final balance is achieved.

Bearing Servicing, Cleaning, and Lubrication

Disassembling Ball or Roller Bearings for Service

1. Remove bearing races from shaft, place in a suitable container with clean petroleum solvent or kerosene and soak. If kerosene is used, all parts must be wiped dry with a clean cloth. Rotate each bearing by hand to dislodge any dirt particles.
2. Remove old grease and oil from the bearing pillow block. The solvent or kerosene can be used to clean the housing. Carefully wipe all parts dry with a clean cloth to prevent dilution of the new lubricant by the solvent.
3. When bearing grease is badly oxidized, soak in light oil (SAE 10 motor oil) at 200° to 240° F before cleaning as discussed above. Spin the clean bearing in light oil to remove solvent.
4. Reassemble and add lubricant to the correct level.
5. To clean bearings without removing them from the pillow blocks, flush 180° to 200° F light oil, kerosene or solvent through the pillow block while rotating the shaft slowly. Remove badly oxidized grease by flushing with hot aqueous emulsions. Drain the solution, flush the pillow block with hot, light oil and re-drain before adding new lubricant.



Bearing Lubrication

This section provides guidelines for the grease lubrication of ball, roller, and sleeve bearings. Most Fan Equipment Co., Inc. fans are furnished with grease lubricated anti-friction bearings. Lubrication schedules are noted on the certified drawing provided for all blowers that require grease lubrication. Fans furnished for special service conditions requiring specific lubrication instructions are furnished with this data as part of the fan data submittals. Please contact Fan Equipment Co., Inc. if you require assistance or additional information about the lubrication requirements of your fan.

Fans that are shipped assembled have been lubricated at the factory; but should be checked before starting up the fan.

Replacement bearings typically are not lubricated. Before installation, clean the bearing thoroughly, wash out the rust preventative with a petroleum solvent, and dry the parts with a clean cloth. Then lubricate the bearing with grease.

Because bearings operate at high temperatures, a quality grade of lubricant is essential. The lubrication data furnished with your fan unit should be followed. The following tables show acceptable lubricants based on the type of bearing.

CAUTION:

1. Not all greases are chemically compatible!
If you intend to change the grade or type of lubricant, first, verify compatibility with the bearing manufacturer. Be sure to completely flush out all of the old lubricant before proceeding.
2. It is not recommended to use EP or long-fibered grease.

NOTE: *The following information is provided as a general reference.
Please consult the specific bearing manufacturer for current, detailed information.*



Grease Charts for Bearing Types

Split Pillow Block, Double Row, Roller Bearings

Manufacturer	Bearing Type	Grease	Base
Dodge	P2B-500-USAF's	Mobilith SHC100	Lithium
Link-Belt	6800 Series	Mobilith SHC100	Lithium
Timken	SAF-22500's	Mobilith SHC100	Lithium

Split Pillow Block, Single Row, Roller Bearings

Manufacturer	Bearing Type	Grease	Base
Dodge	P2B-S2 Series	Exxon Unirex N2	Lithium
Link-Belt	P-B22400 Series	Exxon Ronex MP	Lithium

Pillow Block, Single Row, Ball Bearings

Manufacturer	Bearing Type	Grease	Base
Dodge	P2B-SCM Series	Exxon Unirex N2	Lithium
Dodge	P2B-SCH Series	Exxon Unirex N2	Lithium
Dodge	P2B-GTM Series	Exxon Unirex N2	Lithium
Dodge	P2B-GTH Series	Exxon Unirex N2	Lithium
Link-Belt	P-300 Series	Exxon Ronex MP	Lithium
Sealmaster	MP Series	Goldplex HP	Lithium
Sealmaster	EMP Series	Goldplex HP	Lithium

Flange, Single Row, Ball Bearings

Manufacturer	Bearing Type	Grease	Base
Link-Belt	F-U300 Series	Exxon Ronex MP	Lithium
Link-Belt	FE-U300 Series	Exxon Ronex MP	Lithium
Sealmaster	MSF Series	Goldplex HP	Lithium



Lubrication Procedure

Open the pipe plug or grease relief fitting in the bottom of the pillow block to allow excess grease to escape. Be careful to prevent dirt from entering the bearing. Fill the pillow block approximately 1/3 full. Too much grease can cause the bearing to overheat resulting in premature failure.

Lubrication Frequency

The lubrication schedule for any application is determined by the operating conditions. Bearings handling clean, dry air at room temperatures require less frequent lubrication (every 6 to 10 months) than bearings in dirty, hot environments (every 1 to 4 weeks). Re-lubrication is important as it purges contaminants from the bearing. Determine the correct lubrication schedule for your installation by visually examining the purged lubricant. If the lubricant is clean, lengthen the time between re-lubrications; if it is contaminated, shorten the interval.

Motor Bearing Lubrication

Motors are generally shipped with the bearings already lubricated. For specific instructions, consult the motor manufacturer's maintenance manual.



Trouble Shooting - Fans

If you are experiencing problems or questioning the performance of your fan, please check the table below before calling for service.

To use this table, match the issue you are experiencing to the listings of symptoms in the left hand column. For each symptom, the most likely causes are shown in the middle column and the suggested solutions are shown in the right column.

Symptom	Cause	Solution
Capacity or pressure below rating	Total system resistance is higher than design	Increase fan speed - Contact factory before proceeding
"	Speed too low	Check drive system
"	Dampers or V.I.V.'s not properly adjusted	Reset to correct position
"	Poor fan inlet or outlet conditions	Increase speed; provide turning vanes or baffles in duct work
"	Air leaks in system	Repair duct work
"	Damaged wheel	Repair. Followed by balancing. Contact factory before proceeding
"	Rotation direction incorrect	Reverse electrically
Vibration and Noise	Misalignment of drive belts, sheaves, or coupling	Refer to applicable sections to correct
"	Unstable foundation	Refer to applicable sections to correct
"	Foreign material in fan causing unbalance	Clean per manual section
"	Worn bearings	Replace per applicable sections to correct
"	Damaged wheel or motor	Replace wheel or repair and balance wheel
"	Broken or loose bolts	Tighten or replace
"	Bent shaft	Replace with new shaft
"	Worn coupling	Replace with new coupling
"	Fan wheel or drive unbalanced	Balance in place per applicable section



(continued)		
Symptom	Cause	Solution
Vibration and Noise	120 Cycle magnetic hum due to electrical input	Check input line for high or unbalanced voltage
"	Fan delivering more than rated capacity	Reduce speed, close dampers
"	Loose dampers or V.I.V.'s	Tighten or replace
"	Speed too high or fan rotating in wrong direction	Reduce speed, check electrical connections, reinstall fan wheel
"	Vibration transmitted to fan from other source	Poor installation -refer to applicable manual section
Overheated Bearings	Too much grease in bearings	Clean and re-grease per applicable section
"	Poor alignment	Re-align
"	Bent Shaft	Replace with new piece
"	Dirt in bearings	Clean and re-grease per applicable section
"	Excessive belt tension	Realign and tension per applicable section
Driver Overloaded	Speed too high	Recheck driver selection
"	Volume flow rate over capacity because system resistance is lower than design	Fan improperly specified
"	Rotating wrong direction	Correct per applicable section
"	Wheel wedging or binding	Reinstall wheel
"	Motor wired wrong	Rewire per applicable section



Trouble Shooting – Motors

Symptom	Cause	Solution
Vibration and Noise	Armature unbalanced	Replace with new armature
“	Loose hold down bolts	Tighten bolts
Motor Laboring	Low or High Voltage	Check supply voltage
High Temperature	Overload	Clean dirt from windings
Armature rubs against stator	Worn Bearings	Replace Bearings
Low Insulation Resistance	Moisture	Check resistance with megohm meter

Recommended Replacement Parts

The following spare parts are recommended for all fans:

1. Fan bearings (one set).
2. Drive components (v-belt components, couplings, etc.).
3. Shaft seals.
4. Gaskets.

These additional spare parts are recommended for fans with the following conditions:

- Fans operating in hostile environments where corrosion or erosion is present.
- Fans that are essential to the operation of your system or facility.

1. Fan wheel.
2. Fan shaft.
3. Motor.
4. Housing.
5. Special Equipment (TBD).



Ordering Replacement Parts

Replacement parts can be ordered from your local sales representative or by contacting Fan Equipment Co., Inc. factory.

To order replacement parts, the following information is required:

1. The fan order number or serial number that is stamped on the fan nameplate.
2. The fan size and type.
3. The fan arrangement.
4. Description of part(s).
5. Any special materials of construction, paints, or coatings.

Additional Information:

When ordering wheels, shafts, motors, bearings, or drive components, the following additional information is required:

1. Wheel - Indicate type and class of wheel; direction of rotation; operating speed and temperature; material of construction; whether the hub is internal or external to the back plate; the bore and keyway dimensions.
2. Shaft - Provide length; diameter; material; and keyway dimensions.
3. Bearings - For anti-friction bearings, specify the following: ball or roller type; size; manufacturer; and whether fixed or expansion.
4. Drive components - Identify sheave size and type; bushing size; V-belt number and size; or flexible coupling component required.
5. Motors - The name of the motor manufacturer and the nameplate data.



Warranty

Unless otherwise agreed upon in writing, all shipments are EXW collect our North Las Vegas, NV factory, not freight allowed.

Responsibility for damage or loss of products is transferred to the owner at this time. Unless specific instructions are included in the customer's purchase order, all shipments will be prepared for common carrier truck transportation. Packaging will be suitable to protect the product under normal circumstances, and to the acceptance standards of the carrier. Special shipping instructions must be agreed upon at placement of order.

Fan Equipment Co., Inc. warrants that the design, construction, and materials of our products will be first-class, and free from defects in the materials and workmanship for a period not to exceed eighteen (18) months from shipment or twelve (12) months from date of installation, whichever occurs first. Our sole obligation under this Warranty is limited to the repair or replacement, without charge, at the purchase order F.O.B. point, of any defective parts. Fan Equipment Co., Inc. will not be responsible for damages, contingent liabilities, or consequential damages of any nature, resulting from the above stated Warranty; or from any defect in our products, either in materials, design, or construction, or arising from the use of such products. We do not guarantee against abrasion, corrosion, erosion, or accumulation of material buildup on the fan wheel (rotor).

The above stated Warranty is given expressly in lieu of all other warranties expressed or implied, including warranties of merchantability and fitness for particular purpose, and constitutes the only Warranty made by seller.

Warranties on equipment not of our manufacture are limited to the Warranty terms of our suppliers.

All Warranty claims must be submitted to Fan Equipment Co., Inc. within ten (10) days of discovery of defect within the warranty period or shall be deemed waived. Do not attempt to make any repairs to the fan equipment during the warranty period without the prior written authorization of Fan Equipment Co., Inc., or its' representatives; otherwise, the Warranty is voided.

Fan Equipment Co., Inc. shall not be liable for any injury to persons or property resulting from improper installation, operation, misapplication, neglect, modification, repair, or maintenance (including lubrication) of equipment by customers or third parties.



Speed Up Policy

This document addresses Fan Equipment Co., Inc's policy for requests to increase the speed of our equipment.

Almost all our equipment is provided with a drawing that typically lists the maximum speed. This maximum value is intended to be valid during the warranty period.

Once the warranty period has expired, the maximum speed of all equipment is the original operating RPM.

Fan Equipment Co., Inc. will not authorize a speed increase (of ANY amount) unless specifically reviewed and sanctioned by Fan Equipment Co., Inc.'s Engineering Department.

This policy is based on, but not limited to, the following:

It is our experience that we are not always informed as to the true mechanical operating condition of the fan. Some factors that can affect fan performance include fan inlet temperature & density, voltage, the actual point of operation, metal erosion, corrosion, and physical damage. One or a combination of these factors might eventually lead to failure. Increasing the fan speed could speed up that timetable and lead to the false impression that we were responsible for the failure.

The condition of fan bearings must also be considered. There have been cases where the fan bearings were tampered with (albeit with good intentions) without our knowledge. Improper bearing lubrication and maintenance is another factor. The bearings might operate marginally until a speed increase is experienced. An increase in speed and load could cause not only bearing failure but also fan wheel and shaft damage. The impression to the customer would be that our sanctioned speed increase was the culprit.

Please contact me if you have any questions.

Regards,

Mike Harris, President

Mike Walker, Senior Engineering Consultant

