HowdenBuffalo

Service Manual

Installation and Maintenance of Axial Flow Fans

Warning

Failure to comply with these instructions could cause serious bodily harm or property damage and will void the warranty.

NP 484 9/99

Table of contents

Section		Page
I.	General information	1
II.	Receiving/Handling/Storage	2
III.	Application recommendations	3
IV.	Foundation/Supporting structures	4
V.	Installation	5
VI.	Blade angle settings	5
VII.	Pre-startup checklist	7
VIII.	Initial startup procedure and balance	7
IX.	Dismantling fixed pitch and single blade controllable pitch fans	8
X.	Reassembling fixed pitch and single blade controllable pitch fans	9
XI.	Dismantling and reassembling controllable pitch fans	9
XII.	Bearings	9
XIII.	Maintenance	13
XIV.	Lubrication	15
XV.	Safety	17
Appendix A - Procedure to verify/set blade tip angle and torque		18
Appendix B - Exploded views of fans		22
Appendix C - Troubleshooting		32
Appendix D - Installation guidelines		34

I. General information

Introduction

This manual provides the information necessary to install, operate and maintain axial flow fans. Maintenance guidelines and procedures are set so that your equipment will operate efficiently, with minimum repair or replacement. Read Section XV “Safety” before operating equipment. It is strongly advised that an experienced erector supervise installation and start-up of the equipment. Service personnel are available by arrangement through New Philadelphia Division Field Service Department.

Fan description

The New Philadelphia Division Series 1000/2000/3000 Axivane® and Adjustax S fans are constructed with cast aluminum blades and hubs. The blades and hubs are cast in permanent molds for true blade alignment and accurate aerodynamic blade cross sections of all rotor assemblies. These vaneaxial fans are equipped with adjustable pitch blades that allow blade position to be custom set for maximum operating efficiency.

Type B vaneaxial and tubeaxial fans are equipped with permanently set blade angles. The rotors are constructed of either formed blades welded to a steel hub or a one-piece cast-aluminum design. Adjustax MPT tubeaxial-style fans incorporate rotors with die-cast airfoil aluminum blades which are clamped in split hubs.

The vaneaxial design incorporates stationary guide vanes located directly behind the fan rotor that straighten the air flow as it leaves the fan (Fig. 1). The tubeaxial design gives a rotating action to the air flow leaving the fan. At low pressure, the air flow straightens out a short distance from the fan.

Fan casings are of fabricated steel construction with either welded or rolled flanges. The casings are given one coat of orange paint prior to shipment. Special finishes and coatings are available at additional charge. All rotor assemblies are balanced before being mounted in the fans. Before shipment, fans are operated and balanced within factory recommended specifications. Final balance vibration levels are recorded for future reference.

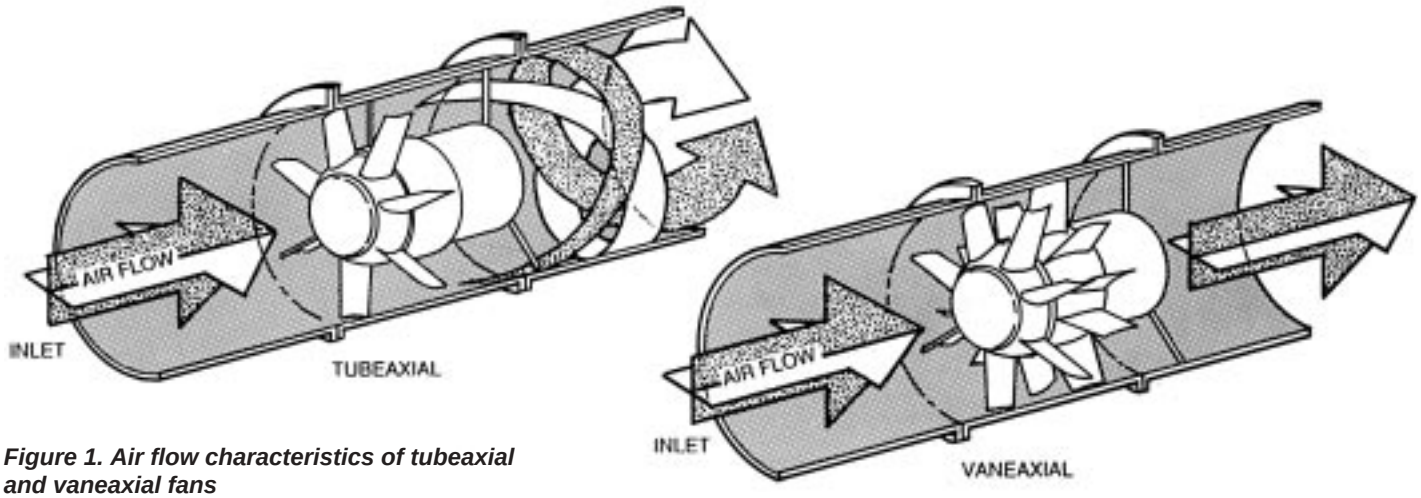


Figure 1. Air flow characteristics of tubeaxial and vaneaxial fans

Fan accessories

All fans are equipped with intake and discharge flanges to provide for duct connection. Inlet bells, available as an accessory, are recommended for improving inlet air flow from a plenum. Inlet bell screens and fan supports are available as standard accessories at extra cost.

Inlet bells are fabricated of steel, aluminum or fiberglass. Screen guards are made of crimped aluminum wire, and fan supports are made of formed steel plate. Fan supports, when purchased with the fan, are always bolted to the fan prior to shipment.

Fan parts

All required parts shown in this manual are described in Appendix B - Exploded views of fans. When ordering repair fan parts, give fan model number and serial number (obtained from name plate on fan casing) along with the complete description of required part.

Fan motors

Standard motors on direct-connected fans are totally enclosed, foot-mounted or flange-mounted. Motors are furnished with standard voltages of 230/460 volts or 200 volts for operation on three-phase, sixty-cycle, AC power. Special voltages or cycles can be furnished on request. Underwriters Approved, Class I, Group D enclosures are available, as well as Class H insulation for high temperature (air temperature above 110- and below 150-degrees Fahrenheit).

Fan service

The New Philadelphia Division maintains a staff of field service personnel for inspecting, adjusting, supervising or installing replacement parts on existing units. Their expert knowledge may be of great assistance in getting your fan unit back in service with a minimum of delay.

Warning - Warranty notice

Failure to follow these instructions may void the warranty. Read and follow these instructions when transporting, handling, storing, installing and maintaining this fan.

II. Receiving/Handling/Storage

Receiving and Unloading

Upon unloading this equipment, inspect it for damage. If damage has occurred, file a claim immediately against the carrier. Shortages should be reported to the Customer Services Department in New Philadelphia, Ohio, within fifteen (15) days from receipt of shipment at destination.

Handling

We recommend the use of a sling around the fan casing for lifting the fan unit. When handled with a single hoist, use a spreader bar to keep the sling from sliding on the housing. If chain or wire slings are used, they should be well padded where they contact the fan, especially where special coatings and paints are involved, as they are easily damaged. Always touch up scratches before installation. Large units may have lifting lugs or holes which should be used instead of a sling. Severe impacts could distort the casing or damage the bearings.

Storage

If not installed in place immediately, this fan should be protected to remain dry at all times. Coat all external machined surfaces with a material to prevent corrosion. Cover and seal bearings to prevent entrance of contaminants. Do not allow any material of any kind to be stored on or in the fan.

1. The fan should be stored indoors, in an area which is clean, dry and where control over temperature, rapid or extreme changes in humidity, shock and vibration are reasonably maintained as below.

2. For extended storage and negotiated extended warranty, the following instructions must be followed:

a) The storage area is to be free from any shock or vibration of 2 mils maximum at 60 Hertz, to prevent motor bearings from brinelling. Exceeding these limits will require vibration dampening material under units.

b) Storage area temperatures should not be below 50˚F or over 120˚F, and relative humidity should be a maximum of 60%. All units equipped with space heaters are to have the heaters connected if storage conditions exceed these environmental limits.

c) When the fan is in storage longer than three (3) months, fan rotors are to be rotated manually several revolutions at least once every three (3) months. Rotors are to be marked so that a different blade is in the vertical position after each rotation. If the fan is a controllable pitch unit, the controllable pitch mechanism should be actuated full stroke at the same time. A small amount of grease (**approximately one (1) cubic inch**) is to be added, at the grease fittings every six (6) months. This is to ensure the bearings are always coated with lubricant. For grease type, see Section XIV. Lubrication.

d) All moisture drains are to be fully operable while in storage, and/or the drain plugs removed from the motor. (Fig. 2) The fan must be stored so that the drain is at the lowest point. All breathers and automatic "T" drains must be operable to allow breathing.

Figure 2. Location of moisture drains

e) Motor windings are to be meggered at the time of storage and also at the time of storage removal with the values recorded. Any drop in resistance value greater than 50% will necessitate electrical or mechanical drying of motor. Further, motor bearings should be checked for moisture. If moisture is present, replace bearings and re-lubricate units.

NOTE: Industry standards dictate that a motor should megger at least one (1) megohm plus KV rating of motor as new. Therefore, megger reading after storage should not be less than one (1) megohm.

3. Upon removal from storage, fan-motor bearings are to be re-greased.

III. Fan application recommendations

WARNING

Contact with rotating fan blades can cause severe injury or death. Never insert items into the fan to determine movement or direction of rotation. Install fan guards or screen-on arrangements with exposed fans. Always use lockout and tagout procedures before performing fan adjustments, maintenance, service or inspection.

Fan mounted with duct ahead of the fan

No inlet bell is required. Fan supports bearing the weight of the complete fan can be mounted horizontally on the floor or hung from the ceiling. Special supports for vertical mounting are required for the larger fan sizes.
NOTICE: When connecting fan to duct work, care should be taken to avoid twisting or deforming the housing as this may cause the blades to strike the fan casing and/or cause vibration and noise problems.
When duct work is mounted ahead of the fan, 90˚ elbows directly ahead should be avoided. If an elbow must be used, turning vanes should be installed to minimize turbulence to the air entering the fan.

Fan installed to draw air from a plenum

An inlet bell is recommended for maximum efficiency and lower noise levels. Specially-designed inlet bells and screens are available to fit each fan model. There should be a distance of at least two fan diameters from the face of the inlet bell to an obstruction such as a wall or building. The minimum free distance from the inlet bell to either side and roof should be one fan diameter. Should it be impossible to conform to these recommendations, contact New Philadelphia Division Customer Service Department for assistance in resolving your installation problems.

Vibration and sound isolation

Fan vibration and sound will be reduced when the fan is isolated from the supporting structure and duct-system by properly sized, commercially available rubber or spring isolators. Heavy inertia pads are generally not required for Axivane fans. Metal to metal connections at the fan should be avoided wherever possible. Use of flex connectors is highly recommended. See Appendix D, Installation Guidelines.

NOTE: A bad inlet condition will reduce fan efficiency, cause an increase in fan noise level, and possibly lead to premature rotor failure.

IV. Foundation and supporting structures

A proper foundation is absolutely essential. It must be rigid and level, ensuring permanent alignment of the fan drive and preventing excessive vibration. Because of local conditions such as varying sub-foundations and soil conditions and the possibility of resonant vibration, the fan manufacturer cannot be responsible for foundation design.

The foundation should be designed by competent engineers to assure sufficient stability and to separate the natural vibration frequency of the foundation from the rotational frequency of the fan. An unstable foundation or improper installation can be a major contributor to excessive maintenance costs.

Poured concrete foundation

The best fan foundation is poured concrete beneath the fan and all drive components. A general rule of thumb: the weight of concrete foundation should be three- to five-times the total weight of the fan and drive equipment. This weight acts as an inertia-block to stabilize the foundation. The foundation should be flared or the footing increased in size to resist settling. The top of the foundation should extend at least 6 inches outside the outline of the fan base and should be beveled on the edges to prevent chipping. All foundations should be poured as a single unit. Figure 3 shows a typical floor-mounted installation.

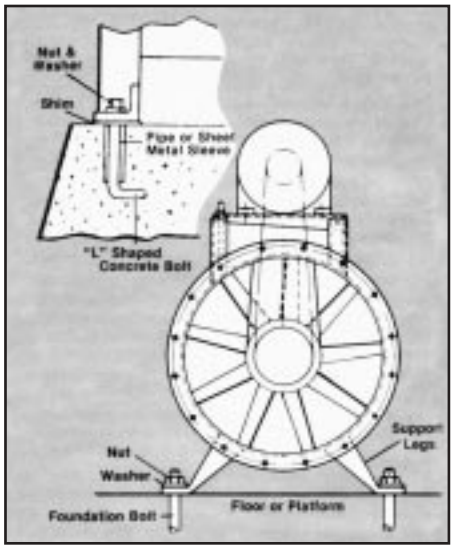


Figure 3. Typical floor-mounted installation

Anchor bolts can be either L- or T-shaped. They should be placed in pipe or sheet-metal sleeves, approximately two inches larger in diameter than the anchor bolts, to allow for adjustment in bolt location after concrete has set. In estimating the length of bolts, allow for the thickness of nuts and washers, thickness of fan base and extra threads for draw downs and shims. Seating area for washers and nuts must be clean and thread area must be clean and lubricated.

Steel foundation

A structural steel foundation must be sufficiently rigid to assure permanent fan alignment. The foundation must be designed to carry the equipment weight plus the centrifugal loads imposed by operation with minimum deflection. The entire structure must be constructed in a permanent manner such as welding or riveting. If bolting is used, a proper torque must be applied along with a locking nut or tack weld to prevent bolts from loosening.

When installed above ground level the fan must be located near or above a rigid wall or heavy column. Overhead platforms or supports must be rigidly constructed, level, and sturdily braced in all directions.

Equipment mounted

If fan is mounted on equipment with parts that vibrate, fan support must be designed to prevent this vibration from being carried to the fan. The natural frequency of the support should differ from the fan running speed by at least 20%. Use of vibration isolators under the fan is recommended.

Suspended installation

For a ceiling suspended installation, proper vibration hangers must be used, as shown in Figure 4, including thrust isolator to limit axial movement. For installation in ductwork, see Figure 5. Suspension hangers must provide sufficient load bearing capacity to support fan, drive and duct.

Figure 4. Ceiling suspended installation

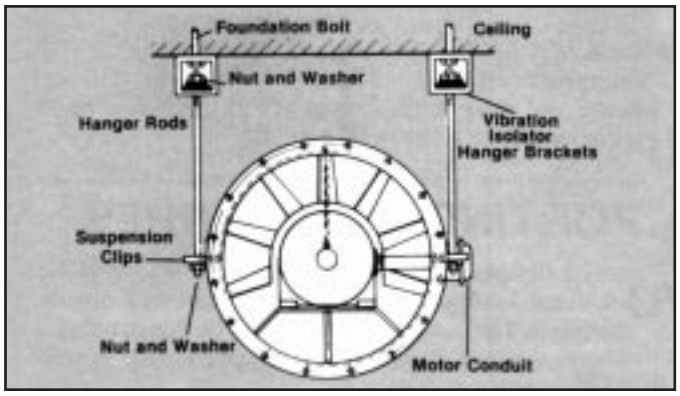
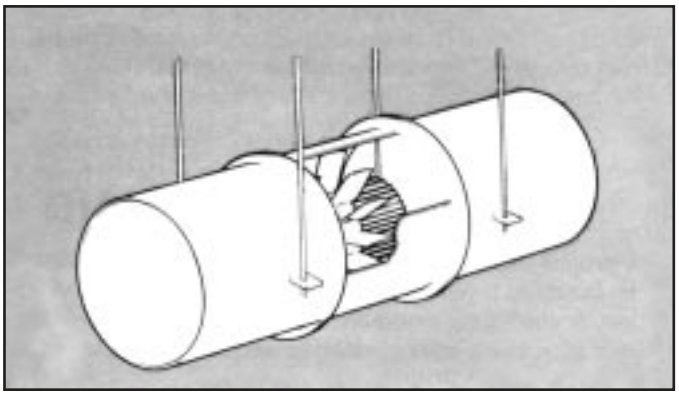


Figure 5. Ductwork supported installation



V. Installation

All supporting points must be uniformly located so there is no twisting or distortion through the fan unit. Also, the intake should be carefully arranged to direct a smooth and uniform air flow into fan rotor. When installing the fan, be sure to allow space for service functions such as:

- Removing motors and fan rotors
- Lubrication
- Inspection and service
- Adjusting blade pitch settings
- V-belt replacement and alignment and motor base adjustment

If the fan is to be ductwork connected, provide access doors for internal inspection. Install all wiring and fusing in accordance with the National Electrical Code and local requirements. Be sure wiring and power supply (voltage, frequency and current) are suitable for motor requirements listed on motor nameplate.

Installation suggestions for V-Belts

CAUTION: Over-tightening belts will cause damage to belts and bearings.

1. Be sure that shafts are parallel and sheaves are in proper alignment. Belts should be at right angles to shafts. Use a straight edge or taut cord placed across faces of sheaves to aid in alignment.

2. Do not drive sheaves on or off shafts. Be sure shaft and keyway are smooth and that bore and key are of correct size. Remove burrs if necessary by dressing with finishing file. Wipe shaft key and bore with oil. Tighten all screws carefully. Recheck and re-tighten after eight hours of operation.

3. Belts should never be forced over sheaves (more belts are broken from this improper method of installation than actually fail under normal operating conditions).

4. Belt tension should be reasonable. When in operation, the tight side of belt should be in a straight line from sheave to sheave and with a slight bow on the slack side. Check belt tension after eight hours of operation. All drives should be inspected periodically to be sure belts are under proper tension and are not slipping.

5. Do not install new sets of belts in drives where sheaves have worn grooves. To eliminate premature belt failure, replace worn sheaves with new sheaves.

6. Do not use belt dressing, but keep belts clean at all times.

7. When replacing belts on a drive, be sure to replace the entire set with a new set of matched belts.

8. Store V-belts in cool, dark, dry place.

If Browning Belt Tension Checker is used, consult Browning deflection tables for proper deflection force for specific type and size of belt, sheave pitch diameter, and belt span.

Tension new drives at the maximum deflection force recommended. Check tension at least two times during first day's operation, as there normally will be a rapid decrease in belt tension until belts have run in. Check tension periodically after the first days operation and keep tension in recommended area. The correct operating tension for a V-belt drive is the lowest tension at which the belts will not slip under peak load condition.

VI. Blade angle settings

Notice

De-energize the fan before performing adjustments, service, inspections or lubrication. Use lockout and tagout procedures prior to conducting adjustments, maintenance, service or lubrication.

On all fans, except Controllable Pitch fans, the blade angles have been set at the factory for the duty required. Rough handling during shipment can affect these settings. Check settings of all blades before start-up.

Adjustax S blade angle setting

The adjustment for Adjustax S fans is simple because blades can be moved by hand when fan is at rest. During operation, centrifugal force on the patented O-ring construction prevents blades from moving. Check by comparing the setting on the Vernier scale (Fig.6) with the rating specified on the order. To change settings, lock power OFF and adjust by hand from fan inlet. For ducted fan inlets, blades are adjustable from blade access door using a tool that grips blade tip (Fig.7) and a drive/ratchet. Door handle is used as blade adjusting tool. Do not open access door when fan is running.

CAUTION

Never set blades at a value higher than the "Maximum Blade Setting."

NOTE: After adjustment, it is not necessary to re-torque the blade attaching bolts. For Adjustax fans that do not use O-ring construction, loosen the two socket cap screws to adjust blade setting. Be sure the cap screws are dirt-free before re-tightening.

Figure 6. Adjustax S blade setting vernier

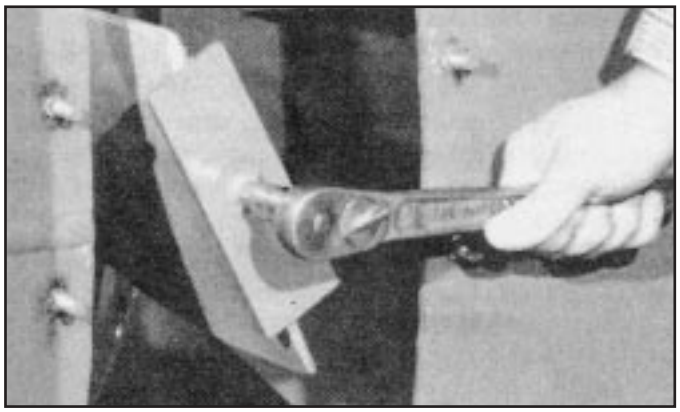
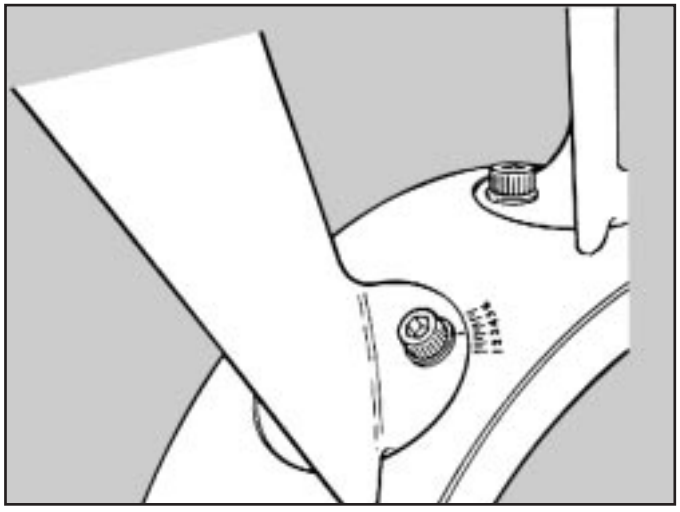


Figure 7. Adjustment of ducted inlet fans



Series 1000/2000/3000 blade angle setting

For Series 2000/3000 fans, the blade index range is numbered from 0-6; Series 1000 fans' blade index range is 0-16. The number 0 is the highest angle of attack in both fan series and requires the greatest horsepower. As index setting number is moved toward 6 or 16, the flow, pressure, and horsepower are reduced. If it is necessary to readjust blades, be sure each blade is set at the same index number and always check the motor amperage to prevent motor overload. Also, after each adjustment, turn rotor by hand to make sure blades are not striking the casing or motor support.

To adjust blades, the following procedure should be used:

a. Remove spun-aluminum nose piece.

b. Loosen blade locknut.

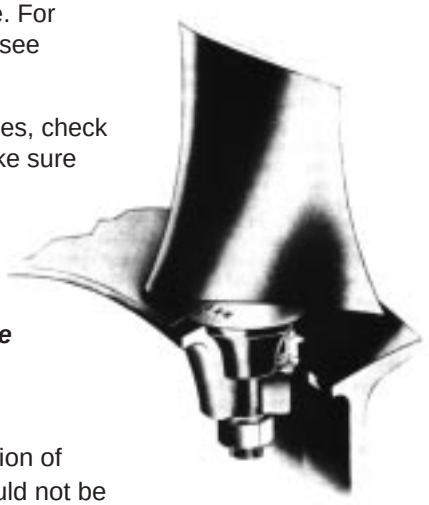
c. Set blade at the new position by use of the markings at the blade root.

d. Tighten the locknut while holding blade to make sure the position does not change. For blade nut torque values, see Appendix A.

e. After changing all blades, check all blade positions to make sure they are all identical.

f. Replace nose piece securely.

Figure 8. Axivane blade setting scale



When securing the position of blades, the lock nut should not be tightened more than necessary to hold blades at the proper angle. Maximum blade position allowed and torque value for locknut is specified on a caution emblem attached to rotor hub.

Due to the fact that only one half hour to one hour of labor is required to change blade angle setting of any adjustable pitch fan, it is the responsibility of the customer to adjust or change blade angles on an adjustable pitch fan. The motor-nameplate current is not to be exceeded when the ventilated system is operated at its highest possible pressure.

Procedure to verify/set blade tip angle and torque – see Appendix A.

Controllable-pitch fan blade adjustment

Externally actuated controllable-pitch fans have blade positioning actuators on the outside of fan casing. Actuators may be pneumatic, electronic, hydraulic or manual. Others may be a combination of electro-pneumatic or electro-hydraulic. The actuator is connected to a lever or other push-pull device which is connected by way of a linkage system to each blade.

The maximum blade angle is set at the factory and should not be increased unless approved by the New Philadelphia Division. The actual blade angle can be measured at any point within the pitch range, using the blade-angle measurement procedure in Appendix A.

VII. Pre-startup checklist

Before initial startup or after servicing, perform this checklist:

1. Carefully review all prior work. All foundation bolts and bearing locking collars must be tight. Remove all loose material from duct or area in front of fan intake.

2. Align V-belt drive. All V-belt fans that are shipped assembled have been factory aligned. However, because of rough handling during shipping, alignment must be checked as follows:

a) Be sure sheaves are locked and in position.

b) Check that the key is firmly seated in keyway.

c) Check alignment by placing straight edge or taut cord across faces of the driving and driven sheaves. The motor and fan shafts must be parallel, with V-belts at right angles to shafts.

3. Check bearing alignment and lubrication.

4. Turn fan rotor over by hand to check that it runs free and does not bind or strike housing. If rotor strikes the housing:

a) For direct-drive C-face mounted motor arrangement – check all connection joints for proper alignment to ensure that there is no twisting or distortion of fan housing.

b) For direct-drive foot-mounted motor arrangement – remove rotor and re-shim motor to align shaft on fan housing centerline; uniform clearance should be obtained between tips of blades and inside diameter of housing.

c) For V-belt mounted motor arrangement – remove rotor and re-shim bearing pillow blocks; uniform clearance should be obtained between tips of blades and inside diameter of housing.

5. Check electrical wiring to motor on motor name plate.

6. Make sure access doors and weather covers are tight and sealed. The maximum torque that can safely be applied to weld studs is shown in Table 1.

7. On adjustable pitch fans, check all blades for proper settings.

8. Duct connections, if required, from fan to ductwork must not be distorted. Ducts should never be supported by the fan. Expansion joints between duct connections should be used where expansion is likely to occur or when fan is mounted on vibration isolators. All duct points should be sealed to prevent air leaks. Remove all debris from ductwork and fan.

9. Flex connections should be installed in a manner that will not obstruct air flow during operation.

Table 1. Maximum torque* on access doors

Stud size	1/4	5/16	3/8	1/2	5/8
Torque (ft.lbs.)	4	8	12	30	60

*** Based on well-lubricated steel bolts**

VIII. Initial startup procedure and balance

After performing the pre-startup checklist, read all fan nameplates for special instructions and follow this procedure:

1. “Bump” the motor to check for proper rotor rotation. Start motor in accordance with manufacturer’s recommendations. Arrows on fan nameplate indicate proper direction of rotation and air flow.

2. Bring fan up to speed. If fan does not come to speed promptly, trip from line and investigate cause. As soon as fan is up to speed, check motor amperage on each phase for balance and correct motor load. The full load amps are stamped on fan nameplate and must not be exceeded. Watch for unusual vibration and overheating of bearings and motors. Multi-speed motors should be started at lowest speed and then run at high speed operation. Check fan speed on V-belt driven units and adjust motor sheave to give desired RPM.

3. At first indication of trouble or unusual vibration, shut down the fan and check for the problem using Appendix C “Troubleshooting,” as a guide.

4. If any symptoms of “air starvation/stall” occur, a separate make-up system should be installed. Air starvation/stall causes an unusual, low, rumbling vibration sound.

5. After a running period, usually about eight hours, recheck all alignments and inspect the bearings. Check

that all bolts and set screws are tight. For V-belt fans, readjust the V-belt as necessary.

6. Balance – This unit was operated and dynamically balanced within factory recommended specifications. If you place your hand or finger upon the outside of unit, its operation should feel smooth and free of vibrations. This balance must always be maintained to assure long, faithful service. If operation is not smooth, contact our Customer Service Department at New Philadelphia, Ohio, advising fan serial number (stamped on nameplate) and fan model number.

WARNING: Axial fans should not be operated in the stall/surge region. The stall/surge region is defined as any region in which the system resistance line does not pass through the normal operating area as shown in the fan performance curve. Any attempt to operate this equipment in this stall region can be extremely dangerous and may result in damage to equipment as well as to nearby personnel. Operate this fan only in accordance with the installation, operation and maintenance manual. Fan performance curve is available from factory or sales representative.

IX. Dismantling fixed-pitch and single-blade adjustable-pitch fans

(See Appendix B, "Exploded Views of Fans.")

Remove fan from duct work and/or fan supports. Then perform the following steps:

1. Remove accessories, if used:

Inlet cone; inlet screen; for V-belt drive only, weather cover and belt guard.

2. To remove rotor:

WARNING

When removing rotor, always properly support rotor with slings to prevent personal injury and damage to equipment.

a) Remove spinner or coverplate nosepiece, if supplied, by removing screws. To maintain fan balance of units with spinners, match mark spinner to housing before removing. Remove cotter pin or lockwire, where applicable.

b) Remove rotor held by a castle nut or hex slotted nut by removing cotter pin and nut; carefully remove rotor from shaft, taking extra care not to lose the key or backup washer.

c) Remove rotor from QD hubs by removing the three hex-head draw-up bolts which hold rotor to hub; oil these bolts if dry, and insert into tapped holes in the rotor hub; alternately and evenly tighten bolts one-half turn until taper fit is broken; if difficult to break taper fit, carefully tap hub lightly with mallet and remove rotor from hub.

d) Remove rotor held by retaining plate and locking bolt by removing locking bolt and hex bolt from motor shaft; remove retaining plate; carefully remove rotor from shaft, taking extra care not to lose loose parts.

e) Remove rotor held by lock nut and lock washer by bending tab of lock washer back, to clear slot in lock nut; remove nut and lock washer; carefully remove rotor from shaft, taking extra care not to lose loose parts.

f) If binding occurs, penetrating oil may free it.

g) When hub is supplied with drilled and tapped holes, a rotor puller facing against the motor shaft can be used to aid in removing the rotor.

h) If blades are worn or broken, the entire rotor assembly should be replaced to ensure a properly balanced fan.

i) Inspect all parts and replace any which are excessively worn.

3. To remove bearings (V-belt drives):

a) Remove drive sheaves and belts.

b) Remove inner cylinder cover plates.

c) Remove fan sheave.

d) Remove grease fittings and grease lines.

e) Remove bearings, following the procedure in the V-belt bearing section for the particular bearing furnished for your unit.

WARNING

If removal of motor is necessary, proper rigging and safety practices must be used to avoid personal injury and damage to equipment. If assistance is desired, contact the New Philadelphia Division to arrange for a field service representative to supervise removal of motor.

X. Reassembling fixed-pitch and single-blade adjustable-pitch fans

(See Appendix B, "Exploded Views of Fans.")

To reassemble fans, reverse the order of the dismantling steps, and perform the additional procedures that follow:

1. When remounting direct-drive motor or V-belt fan shaft, be sure shaft is properly positioned on fan-casing center line, providing equal clearance between tips of blades and inside of housing. It may be necessary to shim motor or fan shaft bearings to obtain equal clearance.

2. Clean motor shaft, QD-hub (where applicable), bore of rotor, cap screws and holes for cap screws.

3. Remount rotor on shaft:

a) If rotor is attached with castle nut or slotted nut: install backup washer; insert key; apply anti-seize compound on shaft; install face washer, castle nut or hex slotted nut and cotter pin.

b) If rotor is attached with QD-hub: apply a thick, even layer of Loctite anti-seize compound to outside of QD-hub and to inside of rotor bore; assemble rotor on taper seat of QD-hub; clean and lightly oil hex head draw-up bolts; insert bolts in QD-hub using lock washers and flat-washer; alternately and evenly tighten to the torque shown in Table 2.

Table 2. Tightening torque for QD-hub bolts

Hub size	A	B	C	D	E
Torque (ft.lbs.)	3.5	6	12	22	32

c) If rotor is held by retaining plate and locking bolt: insert key; apply anti-seize compound on shaft; slide rotor gently on shaft; install retaining plate and locking bolt and hex bolt to motor shaft.

d) If rotor is held by locknut and washer: insert key; apply anti-seize compound on shaft; slide rotor gently on shaft; install locknut and lock washer; tighten locknut until rotor is properly seated on shaft; bend lock washer tab into slot on locknut to prevent locknut from loosening.

4. Remount fan. Perform pre-startup checklist before operating the unit.

WARNING

Over- or under-tightening causes mechanical damage to the fan.

XI. Dismantling and Reassembling controllable pitch fans

Consult factory for assistance. Service personnel are available by arrangement through the New Philadelphia Customer Services Department.

(See Appendix B, "Exploded Views of Fans.")

XII. Bearings

The V-belt driven fan shafts for V-belt drive units are supported by either flange mounted (Fig. 9) or pillow block (Fig. 10) anti-friction bearings.

The particular type of bearing - ball or roller - is carefully matched to the application. The following subsections give assembly/disassembly procedures for each bearing type. If more detailed information is required, contact the bearing manufacture.

The procedure below should be followed whenever assembling or disassembling any type of bearing:

1. Inspect and thoroughly clean bearings if necessary. If a bearing is disassembled, mark its parts in relation to each other to avoid reassembly errors. Do not mix parts of one bearing with another.

2. Determine the type of pillow block and location of fixed bearing.

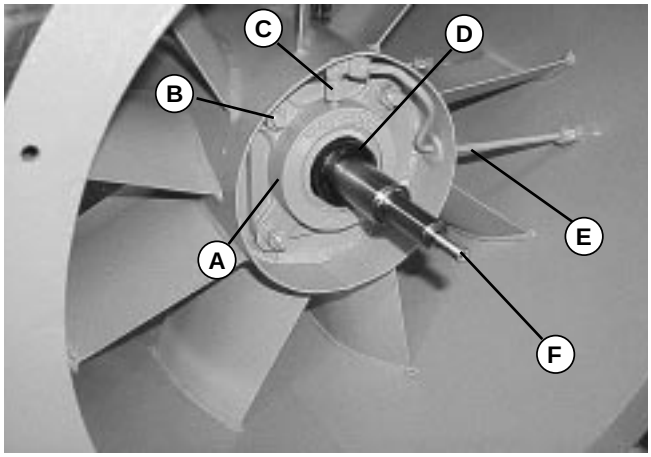
3. Check all nameplates on fan for any special instructions.

4. Mount bearings in position on the shaft, following the procedures below for your type of bearing.

5. Clean the shaft and remove burrs or other irregularities. Be sure bearing is not seated on worn or flat sections.

Figure 9. Flange mounted fan shaft

Type B Arrangement #9 Fans
Through size 48"

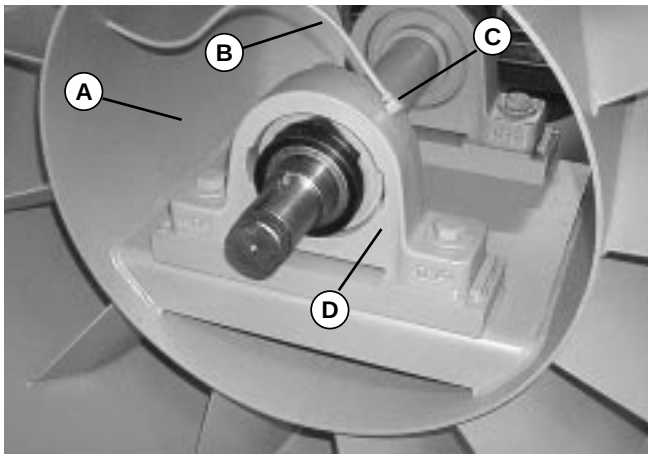


A. Flange pillow block
B. Hex nut & lock washer
C. Lubrication adapter
D. Locking collar
E. Grease tube
F. Fan shaft

Figure 10. Pillow block mounted fan shaft

Type B Arrangement #9 Fans
Size 54" and Larger

Adjustax Type S Arrangement #9 Fans
Sizes 22" through 72"



A. Inner cylinder
B. Grease or oil tube
C. Oil or grease tube housing fitting
D. Cover bearing

Flange Cartridge Ball Bearings

These flange cartridge type ball bearing pillow blocks are always shipped assembled, pre-lubricated and ready for installation as follows:

1. Slip each bearing pillow block and extended inner race into position on the fan shaft.

2. Bolt the pillow blocks in position on their mounting surfaces after aligning. The pillow blocks must be mounted so the fan rotor does not strike any part of the housing.

3. Tighten the self-locking cupped point setscrews securely onto the shaft. Positive race-to-shaft lock is attained when the hardened cup point setscrews are tightened securely through the extended ends of the inner race.

4. Fill the grease tube with grease. Attach grease tube fitting to bearing housing. Run grease tube to outside of fan housing. Attach grease fitting to grease tube. Follow this procedure for both bearings. Be sure the grease tube is filled with grease.

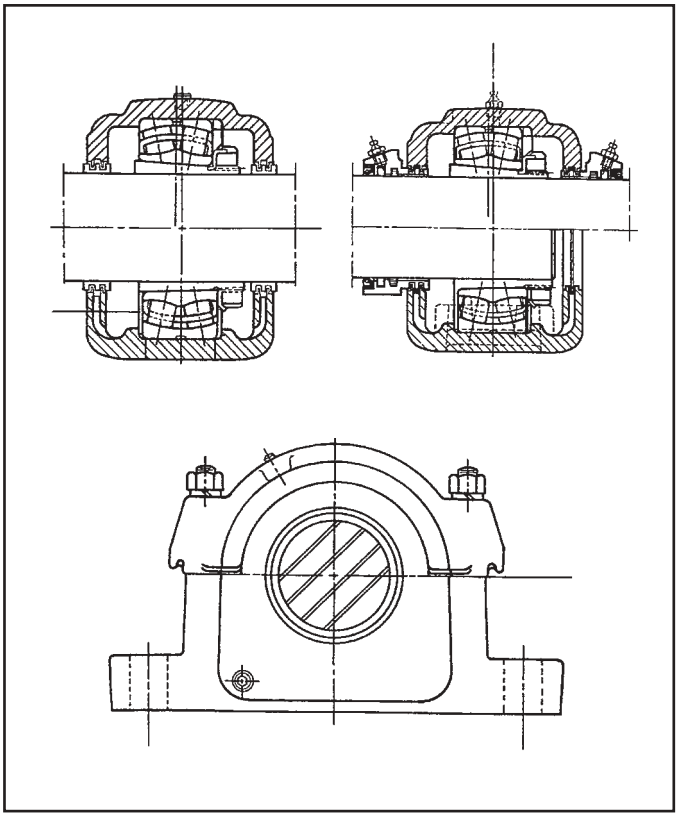
5. To disassemble, reverse this procedure. Be sure setscrews are loose.

6. FAFNIR bearings have a separate locking collar. Install the locking collar by following the procedure in "Fixed Cartridge Ball Bearings," page 11.

Spherical Roller Pillow Blocks

These fixed or floating type spherical roller pillow blocks (Fig. 11) are not pre-lubricated and require assembly. They do not have to be cleaned before installation, as the bearing preservative coating is compatible with lubricants. To install, follow these steps:

Figure 11. Spherical bearings



1. Set lower section of split housing in position on its mounting surface. If an oil sight gauge is used, install it in the pillow housing in place of one of the lower plugs.

2. Apply anti-seize compound on the outside diameter and threads of tapered sleeve and face on locknut to help in tightening adapter.

3. Assemble multi-labyrinth seal ring (if used), adapter sleeve, roller bearing, lock washer, locknut and second seal loosely and slip onto shaft.

4. Hand tighten locknut onto adapter sleeve as tightly as possible.

5. Insert feeler gauges between outer ring and the unloaded roller on both sides of bearing until snug. Record this figure.

6. Lower shaft with bearing and adapter assemblies into lower half of pillow block housings. Be sure multi-labyrinth seals are aligned with seal grooves. Bolt lower housing to bearing mounting surface after shimming and aligning. Pillow blocks should be mounted so fan rotor and shaft do not strike fan housing.

7. Position floating bearing centrally in lower housing. For a fixed bearing, position bearing for insertion of “C” spacer that is inserted on locknut side to keep the bearing flush with the opposite side of housing.

8. Tighten locknut with a spanner wrench until snug. Place brass bar against locknut and strike bar several times with a hammer. Rotate shaft to distribute blows on locknut. These blows drive inner ring farther up on adapter sleeve and release pressure on threads. Use spanner wrench to further tighten locknut. Repeat this procedure until desired clearance is obtained.

9. Secure locknut by bending lock washer tang onto locknut slot.

10. Insert “C” spacer in fixed bearing base on locknut side.

11. Lubricate bearings with grease or oil per Section XIV, Lubrication.

12. Replace top half of pillow block (cap). Use a sealant such as Permatex on the split surfaces. Make sure races are not cocked in housing before tightening cap bolts and that the bearing seals are aligned with shaft.

13. To disassemble, reverse the above.

Fixed Cartridge Ball Bearings

These fixed cartridge type ball bearing pillow blocks (Figure 12) are always shipped pre-lubricated, assembled and ready for installation.

Figure 12. Fixed cartridge ball bearings

1. Slip each bearing pillow block locking collar into position on the fan shaft. The locking collars will face each other.

2. Align, shim and bolt pillow blocks in position on their mounting surfaces. Mount so fan rotor does not strike any part of fan housing.

3. To install the locking collar (Fig. 13):

a) Mate cam of collar with cam of bearing inner ring.

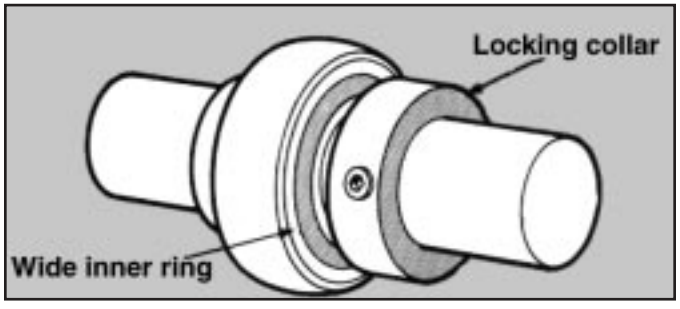
b) Pressing collar lightly against inner ring, turn collar in direction of shaft rotation until it grips shaft and inner ring.

c) With drift pin in collar hole, tighten collar in direction of shaft rotation to lock.

d) Tighten setscrew in collar until allen wrench twists.

4. To disassemble, reverse this procedure. Be sure to remove burrs on shaft caused by setscrews before removing pillow block from shaft. A honing stone will remove burr.

Figure 13. Locking collar installation



Ball Bearing Pillow Block

These fixed and floating type ball bearing pillow blocks are shipped with bearings mounted in the housings but with locking collars separate. The bearings are not pre-lubricated. Refer to Figure 14:

1. Remove end cover (2), gasket (10), plates (11) with packing (7). Be careful not to damage gasket and packings.

2. Slide pillow block housing (1), bearing (3) and plate (11) onto shaft. Position bearing on shaft, making sure that the cam end of inner ring (5) points out.

3. To position the floating bearing in its housing, measure collar projection “A” on the fixed unit and duplicate it on the floating unit. Since “A” is the same on both pillow blocks, the floating bearing will automatically be positioned in the center of the floating space.

4. Bolt pillow blocks securely in position on their mounting surfaces after shimming and aligning. The outside diameter of shaft and housing should clear equally all around. Pillow blocks must be mounted so fan rotor and shaft do not strike any part of fan housing.

5. Slide locking collar (4) into position against bearing inner ring (5). Turn collar in direction of shaft rotation until it grips shaft and inner ring. Tighten collar with a drift pin. Tighten setscrew in collar until allen wrench twists.

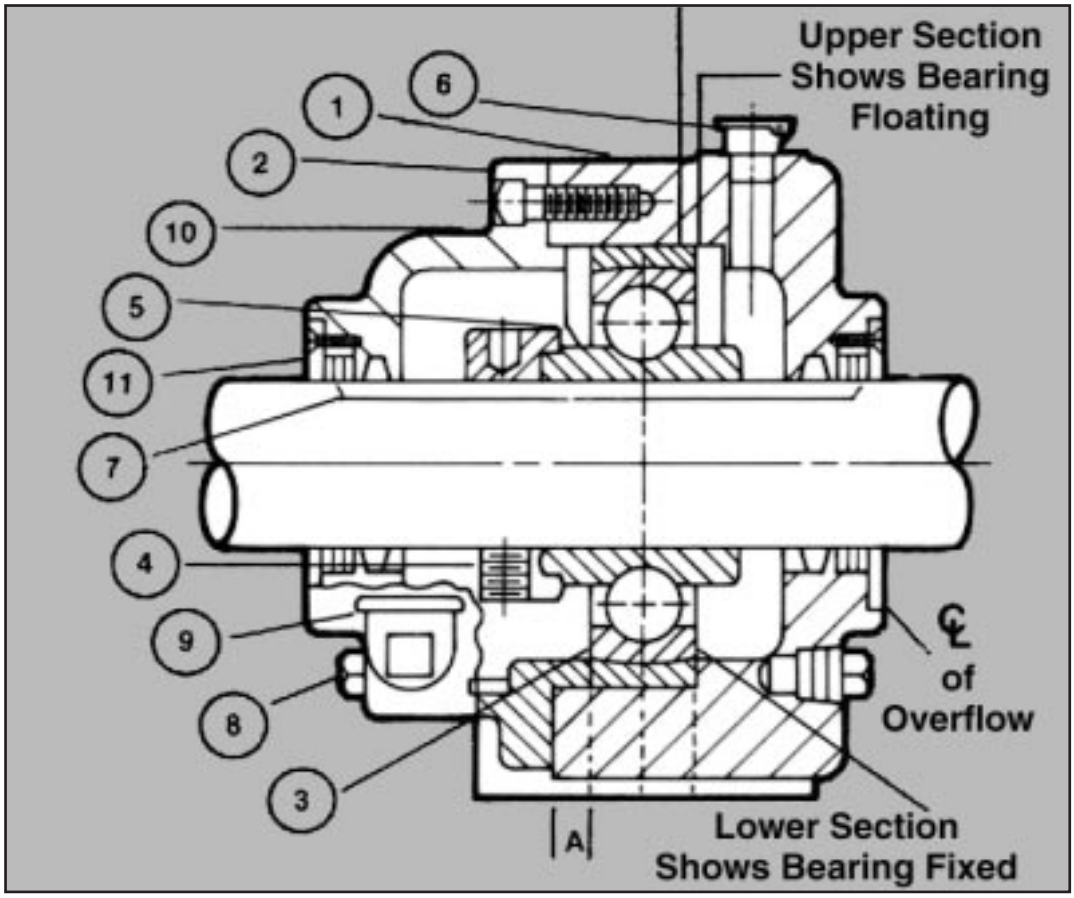
6. Replace gasket (10), and cover (2), packing (7) and plate (11) on end cover.

7. Draw up screw holding plates just enough to hold packing rings securely in place.

8. Fill with grease in top cup (6) until overflow cup (9) is full. Fill only when fan is not running.

9. To disassemble, reverse this procedure. Be sure to remove burr on shaft caused by the setscrew with a honing stone before removing the pillow block from the shaft.

Figure 14. Pillow block ball bearing



Procedure for reinstallation of new pillow blocks in belt driven Series 1000/2000/3000 fans (using two fixed bearings)

Fans with 14”, 17-l/2’’, 21” and 26-1/2” Hubs

1. Tighten bolts which hold the front pillow block to its mounting angle or mounting plate (shim as necessary to center fan in casing for equal tip clearance at the tip of all blades).

2. Position the front pillow block on the fan shaft so that the front edge of the bearing is 1-3/8” from the back edge of the steel insert (or shaft shoulder) of the fan rotor. This should give approximately 1/8’’ to 3/16” clearance between the inner fairing edge and the trailing edge of the fan rotor.

Figure 15. Fixed bearing series 300 pillow block

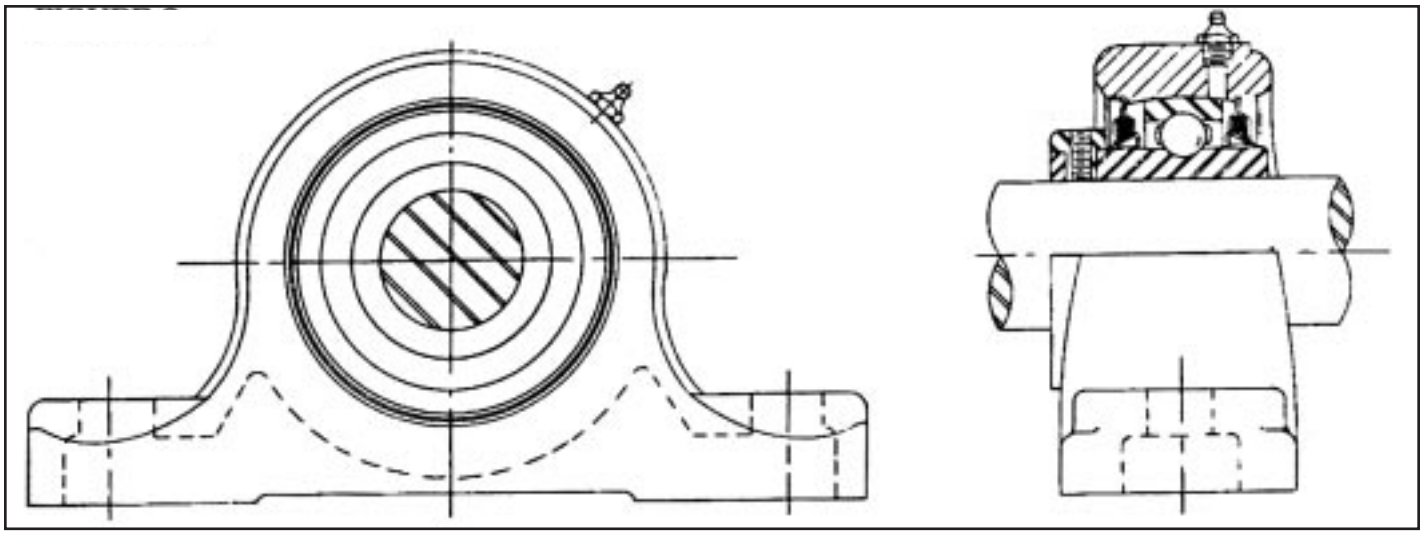
Then tighten the set screws of the bearing locking collar into the slots in the shaft. Tighten until the Allen wrench supplied with the bearing distorts.

3. Tighten bolts which anchor the rear pillow block to its mounting angle or plate.

4. Rotate the shaft a few times by hand, push the rotor shaft forward (opposite air flow). Then position the bearing locking collar in the center of the float (the axial movement of the rear bearing). Tighten the bearing collar set screws in to the shaft slot using the Allen wrench supplied until the wrench distorts.

5. The purpose of the above procedure is to place the fan thrust load on the front bearing and the radial load or belt pull on the rear bearing.

6. Grease leads must be connected and new bearings lubricated.



XIII. 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 depends upon your operating conditions and how much the fan is used. Weekly inspections are recommended when the fan is first installed to determine how frequently inspections should be made. Do not make any repairs during the warranty period without prior approval or the warranty is void.

Notice

De-energize the fan before performing adjustments, service, inspections or lubrication. Use lockout and tagout procedures prior to conducting adjustments, maintenance, service or lubrication.

Preventive maintenance

Periodic inspections should include the following:

1. Air flow– Check for obstructions (dirt, rags, etc.) in inlet or outlet ductwork.

2. Screens, VIVs and other air flow accessories– Remove dirt, which causes resistance to air flow and decreases volume of air supplied.

3. V-Belt drives– Check belt wear, alignment of sheaves and tension. Replace belts with a complete set of matched belts; new belts will not work properly with used belts because of length differences. Belts must be free of grease.

4. Rotor– Inspect rotor blades for dust or dirt accumulation

which can unbalance fan. Wrap bearings tightly with plastic film and clean with steam, water jet, compressed air or wire brush. Be careful not to damage aluminum blades while cleaning. Make sure rotor is centered to prevent blades from striking housing, and rotating in proper direction.

5. Hardware– Check all foundation bolts, rotor hubs, set-screws, rotor locking bolts and bearing locking collars.

6. Surface coatings– Check condition of surface coatings and paints. Repainting interior and exterior parts of fan and ductwork extends service life. Select paint able to withstand operating temperatures and conditions.

7. Shaft– Check shaft for proper alignment; shaft must not be cocked on bearings. Misalignment can cause overheating, worn dust seals, bearing failure and unbalanced condition.

8. Vibration– Excessive vibration must not be permitted. See Appendix C, "Troubleshooting" for possible causes. Table 3 (Allowable vibration at fan operating frequency) lists safe vibration levels.

9. Bearings– Check all bearings for excessive temperature or chatter. High-speed fan bearings are designed to run hot (165 degrees). Do not replace a bearing simply because it feels hot. Check pillow block temperature with a pyrometer or contact thermometer.

10. Motor–

a) Blow out open motor windings with low pressure air to remove dust or dirt which cause excessive insulation temperatures. Air pressures above 50 psi can cause motor damage.

b) Keep motor dry. When motor is idle for a long time, single-phase heating or a small space heater may be necessary to prevent water condensation in the windings.

c) Lubricate motor bearings per Table 6 (Typical bearing lubrication schedule).

d) Be sure motor is not overloaded. Check the amperage drawn against the motor nameplate rating.

Fan Balancing

The fan rotors on axial fans are balanced by the factory. Most fans shipped completely assembled have had a running test to check balance. If the rotors have not been severely handled or damaged, no additional balancing should be required. A fan handling clean air should not need balancing once it is balanced. Dust build-up on fan blades or blade wear unbalances a fan. Inspect the fan periodically to determine the amount of dust build-up or wear. Before balancing a rotor for any reason, check the Troubleshooting section.

Portable instruments are available that indicate vibration displacement in mils (1 mil = 0.001 inches). If you have vibration instrumentation, use Table 3 to determine when a fan is operating with too much vibration.

Table 3. Allowable vibration at fan operating frequency

	Initial Operation		Corrective Action Alarm		Shut Down or Stop	
RPM (Freq.)	Disp. (mills)	Vel. (ips)	Disp. (mills)	Vel. (ips)	Disp. (mills)	Vel. (ips)
3600	.5	.09	1.3	.25	3.0	.56
1800	1.0	.09	2.6	.25	5.0	.47
1200	1.5	.09	4.0	.25	7.0	.44
900	2.0	.09	5.3	.25	8.0	.38

CAUTION

Do not attempt to balance a mechanical problem or a dirty fan

Notes:

1. When the fan operating frequency falls between the above listed frequencies, the values for the higher frequency should be used.
Example - Fan speed of 2500 rpm; use values of 3600.

2. Displacement is a measured value with the probe or pickup (seismic type) positioned firmly on the fan housing flange (for a radial indication) in the desired plane of measurement. Displacement is a peak- to-peak (full wave) value.

3. Initial operation values are the expected values for clean, well-maintained and balanced fans operating at steady state conditions after the transient conditions of startup, e.g. acceleration, temperature changes, etc., have passed. 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 frequency. At times, these values may not be obtained on new, initial installations due to field conditions beyond the control of the company.

4. Operation of any fan above corrective action/alarm levels for a prolonged period of time or operation above shut down for any period of time may cause equipment failure and extensive damage as well as endangerment to personnel. A corrective measure would be to retain an authorized service representative (at service rates in effect at time of visit) to inspect the installation, suggest corrective measures as necessary and balance the fan if required. Effort should be made to maintain vibration levels as close to the initial operation vibration levels as possible. This will help to assure optimum equipment life expectancy.

5. Equipment is run tested and balanced to standard internal specifications. Since installation variables such as (but not limited to) foundations and mounting provisions, vibration levels may vary somewhat from factory values.

6. When a Vibration Isolation System is employed, fan balancing should be performed with the isolator components "locked-out" to establish a rigid structure. The isolation components should be readjusted after balance.

Bearing Servicing and Cleaning

When roller or ball bearings are disassembled for service:

1. Remove bearing races from shaft, place in a suitable container with a clean petroleum solvent or kerosene and soak. If kerosene is used, all parts must be wiped dry with a clean cloth. Chlorothane Nur® or mineral spirits can be used, but some people object to the drying action on the hands. Other solvents similar to Inhibisol (r), made by Peneton Company of Tenafly, NJ can be used. Revolve each bearing by hand to help dislodge any dirt particles.

2. Remove all old grease and oil from 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 solvent.

3. When bearing grease is badly oxidized, soak in light oil (SAE 10 or less motor oil) at 200-240°F before cleaning as discussed in the prior steps. Spin the clean bearing in light oil to remove any solvent.

4. Reassemble and add lubricant to the proper level.

5. To clean bearings without removing them from the pillow blocks, flush 180-200°F light oil, kerosene or solvent through 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.

XIV. Lubrication

Good preventive maintenance requires proper lubrication practices. Use only the recommended lubricants specified and follow the lubrication schedules listed.

All bearing cavities and grease leads have been properly loaded prior to shipment. Fans which are to be installed promptly upon delivery require no additional lubrication.

NOTE: If a lubrication instruction plate is mounted on the outside of the fan (near one of the grease fittings) follow the instructions on that plate, in lieu of those printed below.

Refer to the lubrication schedule to determine the proper time for lubrication. Grease all fittings with lubricant as specified within the following paragraphs. Use a hand operated grease gun only. **DO NOT OVERGREASE AS THIS CAN BE AS HARMFUL AS TOO LITTLE GREASE.** Lubrication of anti-friction bearings should be done as a part of a planned maintenance schedule. The Recommended Lubrication Interval should be used as a guide to establish this schedule.

Cleanliness is important in lubrication. Any grease used to lubricate anti-friction bearings should be fresh and free from contamination. Similarly, care should be taken to properly clean the grease-inlet area of the motor to prevent grease contamination.

Motor bearings

Motor bearings must be lubricated to the manufacturer's recommendations. Do not over-lubricate. Motors are shipped with tags attached that provide the manufacturer's recommendations. If these tags are missing, follow the typical motor lubrication schedule below.

The fan motor anti-friction bearings may be lubricated with the motor running or stationary. Stationary with the motor warm is preferred.

Table 4. Recommended motor lubrication by volume

Using a hand operated grease gun only, pump in the following recommended grease volume:

FRAME SIZE	VOLUME IN CUBIC INCHES	
	1800 RPM and slower	3600 RPM
182 thru 215	0.5	0.5
254 thru 286	1.0	1.0
324 thru 365	1.5	1.5
404 thru 449	2.5	1.0
5000	2.5	1.5

Table 5. Motor lubrication frequency

HORSEPOWER	*STANDARD CONDITIONS	**SEVERE CONDITIONS
1 thru 7-1/2 1800 RPM and slower	3 years	1 year
10 thru 75 1800 RPM and slower	2 years	6 to 12 months
100 and greater 1800 RPM and slower	1 year	6 months
All over 1800 RPM	6 months	3 months

***STANDARD CONDITIONS: Eight hours per day, normal or light loading, clean, @ 40°C (100°F) maximum ambient.

** SEVERE CONDITIONS: Twenty-four hours per day operation or shock loading, vibration, or in dirt or dust @ 40°-50° C (100° - 120°F) ambient.

CAUTION

It is important to use the same type of lubricant as initially loaded at the factory. If you must change the grade, make or type of lubricant, flush out all the old lubricant before changing.

Anti-friction fan bearings

The key to long life of bearings is the application of the proper lubricant at a frequency that is determined by your unit's operating conditions-exposure to moisture and dirt and bearing temperature.

Lubricant Selection. A good grade lubricant, free from chemically active material is vital. Use Chevron oil SRI No. 2 Polyurea base or equal in all bearings. For best results, use the same product when re-lubrication. If you must change to a different grade, make or type of lubricant, flush out all the old lubricant thoroughly before changing. If a lubricant is used at temperatures above its design limit, the oil and base oxidize and thermally decompose into a gummy sludge.

Frequency of re-lubrication. The most common cause of bearing failure is not lack of lubricant but rather abrasion or oxidation resulting from contaminated grease. Re-lubrication purges the bearing of solid or liquid contaminants. How often to re-lubricate can be determined only from operating conditions. Bearings for fans handling clean air at normal room temperature needs less frequent lubrication than do those moving dirty air at elevated temperatures. Determine the proper re-lubrication interval for your unit by setting up a trial schedule and visually examining the purged lubricant. If the lubricant is clean, lengthen the period between lubrications; if it is contaminated, shorten the interval. To aid in setting up the initial period, use either table 6 or table 7 to obtain greasing intervals for various operating conditions. These are only typical. You must establish the proper interval for your unit.

Table 6. Typical bearing lubrication schedule

Operation Condition		Bearing Operating Temperature	Greasing Intervals
Dirt	**Moisture**		
Fairly clean	None	32°F to 120°F 120°F to 160°F 160°F to 200°F	6 to 12 months 1 to 12 months 1 to 4 weeks
Moderate to extremely dirty	None	32°F to 160°F 160°F to 200°F	1 to 4 weeks 1 week
Fairly clean	Heavy moisture & direct water splash	32°F to 200°F	1 week

Table 7. Schedule for Series 1000/2000/3000 belt-driven pillow block type bearings

SIZE OF FAN HUB	FRAME SIZE OF DRIVING MOTOR	CONDITIONS	LUBRICATION CYCLE (MONTHS) OPERATING SPEED-RPM							GREASE VOLUME CU. IN.
			500	1000	1500	2000	2500	3000	3500	
14	ALL	Standard	6	6	6	4	4	2	2	1.0
		Severe	3	3	3	2	2	1	1	1.0
17-1/2	ALL	Standard	6	6	4	4	2	1	1	2.0
		Severe	3	3	2	2	1	1/2	1/2	2.0
21	143-284	Standard	6	6	4	4	2	1	1	2.0
		Severe	3	3	2	2	1	1/2	1/2	2.0
	326-365	Standard	6	4	2	2	1	1	1/2	2.7
		Severe	3	2	1	1	1/2	1/2	1/4	2.7
26-1/2	143-284	Standard	6	6	4	4	2			2.0
		Severe	3	3	2	2	1			2.0
	286-365	Standard	6	4	2	2	1			2.7
		Severe	3	2	1	1	1/2			2.7
	404-445	Standard	6	4	2	1				4.1
		Severe	3	2	1	1/2				4.1

NOTICE:
The New Philadelphia Division does not recommend mixing lubricants due to possible incompatibility. Motors with Class H, Type RN or Class H, Type RH insulation systems, nuclear applications, MUST be lubricated with Chevron SRI No. 2 with no substitutions permitted. DO NOT substitute other manufacturing brands without first consulting our factory. If it is desired to change lubricant, follow instructions for lubrication and repeat lubrication a second time after 100 hours of service. Care must be taken to look for signs of lubricant incompatibility, such as extreme soupiness visible from the grease relief area.

Lubrication of Controllable Pitch Mechanisms

CONTROLLABLE PITCH FANS require periodic lubrication for fan pitch control mechanisms and blade bearings (depending upon hub size or style) in addition to the fan motor bearings. An external grease fitting is located on the actuating bar of the lever assembly or on the casing near the actuating bar or on the mechanism end bell. PUMP BY MEANS OF HAND GREASE GUN AS INDICATED BELOW.

CAUTION:
Grease slowly to prevent damage to the bearing seals. Rotate rotor slowly while lubricating.

RECOMMENDED LUBRICANT FOR CONTROLLABLE PITCH MECHANISMS: CHEVRON SRI NO.2

Table 8. Recommended lubrication amounts and intervals for controllable pitch mechanisms

BALL BEARING CONTROL MECHANISMS MECHANISM PART NUMBERS	LUBRICATION AMOUNT *STANDARD CONDITIONS	LUBRICATION AMOUNT **SEVERE CONDITIONS	LUBRICATION INTERVAL *STANDARD CONDITIONS	LUBRICATION INTERVAL **SEVERE CONDITIONS
P/N 500988-213 through 500988-220 (for 17-1/2" Dia. Hubs)	2 cu. in.	2 cu. in.	6 months	3 months
P/N 500988-202 through 500988-209 (for 21" Dia. Hubs)	2 cu. in.	2 cu. in.	6 months	3 months
P/N 500988-221through 500988-232, 500988-257 & 500988-264 (for 26-1/2" Dia. Hubs)	2 cu. in	2 cu. in.	6 months	3 months
P/N 500988-211,500988-212, 500988-262 & 500988-263 (for 30" Dia. Hubs)	2 cu. in.	2 cu. in.	6 months	3 months

* STANDARD CONDITIONS: Eight hours per day, normal or light loading, clean, @ 40°C (100°F) maximum ambient.
**SEVERE CONDITIONS: Twenty-four hours per day operation or shock loading, vibration, or in dirt or dust @ 40-50° C (100 - 120°F) ambient.

Lubrication of Blade Bearing

BLADE BEARINGS– All controllable pitch fan blades have some type of thrust bearing and bushing to maintain blade radial position. The type of blade bearing depends upon the age and hub size of the fan. All current Axivane® Fans are equipped with Teflon-type thrust and radial bearings, which require no lubrication. Axivane® Fans manufactured prior to 1979 may have roller thrust bearings and needle radial bearings that may be replaced with the Teflon-type bearings using a bearing retrofit kit. These kits are available through our Customer Services Dept. at New Philadelphia, Ohio. Please advise fan serial number (stamped on the nameplate) and the fan model number when ordering replacement parts.

XV. Safety

Air handling equipment must be properly installed and operated by trained and experienced personnel. To do otherwise is dangerous and may cause injury. The installation must meet all pertinent state and local safety codes and requirements of OSHA.

Seller shall not be liable for any injury to persons or property resulting from improper installation, operation, repair or maintenance of equipment by customers or third parties.

Equipment operating on corrosive, abrasive and/or toxic systems require extreme precautions with access doors, drains and shaft seals. Only trained operating and maintenance personnel should work on such special equipment, and only after testing for the presence of toxic gasses or explosive chemical deposits. Coupling guards, shaft guards, v-belt drive guards and inlet and outlet safety screens are recommended for all equipment.

Appendix A

Procedure to verify/set blade tip angle using a template

All New Philadelphia Division adjustable pitch fan blades are set at the factory to the blade setting (tip angle) required to produce the specified flow and pressure. The installer or owner may wish to verify that the blade angle is correct, or may wish to change this angle if the operating point must be changed. The following procedure details steps to verify or change blade tip angles utilizing a blade angle template.

The line connecting the leading and trailing edges of the blade is the chord line. The tip angle is the angle between the chord line and the direction of rotation. See Table 11, "Blade Tip Angle Settings."

1. Create a blade template: on a piece of flexible material, draw a straight line and label it "Rotation."

2. Gain access to fan inlet. This may require removal of inlet screens or access doors.

Note:

For two-stage fans, access to the second stage will require removal of the second vane section.

3. Clean an area of the fan housing slightly larger than the blade template. With a pencil or marker, draw a line in the rotation direction on the fan housing.

4. To verify tip angle:

a) Position the rotation line of the blade template over the rotation line marked on the fan housing.

b) Position blade tip over rotation line and mark a point on the template at the leading and at the trailing edge of the blade tip. Draw a line between these points and label as the chord line.

c) Measure the angle between the chord line and the rotation. This is the tip angle of the blade.

d) Using this template, compare tip angles of all blades to ensure angles are identical.

5. To set tip angle:

a) Make a blade angle template with the chord line at the desired tip angle.

b) Position the rotation line of the blade template over the rotation line marked on the fan housing.

c) Align the leading edge of the blade with the chord line. If the blade is at the proper angle, the trailing edge should also align with the chord line.

d) If the trailing edge does not align with the chord line, loosen the blade in accordance with the blade adjustment instructions. Turn the blade until properly aligned with the chord angle, and re-tighten the blade.

e) Repeat steps c. and d. for all blades.

Procedure to verify/set blade torques

Blade nut torque for Series 1000/2000/3000 fans and blade attaching bolt for Adjustax S fans should be checked (or set) using the values in the following tables. Torque values must always be verified in the tightening direction. CAUTION: Do not exceed maximum setting given on caution emblem which is affixed to the rotor hub.

Table 9. Series 1000/2000/3000 fans blade nut torque and caution Emblem for Aluminum and Steel Rotors

Rotor Type	Blade Nut Torque[1]	Caution Emblem[2]
14" Aluminum 14" Steel	130 Ft. Lbs. 250 Ft. Lbs.	* 1393199 1390457
17-1/2" Aluminum 17-1/2" Steel	130 Ft. Lbs. 250 Ft. Lbs.	* 1393199 1390457
21" Aluminum	220 Ft. Lbs.	** 1393200
26-1/2" Aluminum 26-1/2" Steel	220 Ft. Lbs. 400 Ft. Lbs.	* 1393200 1390458
30" Aluminum 30" Steel 30" Reversible	450 Ft. Lbs. 450 Ft. Lbs. 450 Ft. Lbs.	1391991 1385149 1393405

[1]For assembly use this value to set torque wrench. For verification of torque value, acceptable values are ±10%.

[2]Stock caution emblems with appropriate setting number may be used until stock is depleted. Future emblems will have setting numbers written by shop.

See NCS30 for previous E.O.S.

* 1385149-0 through 1385149-29 with appropriate setting number may be used until stock is depleted.

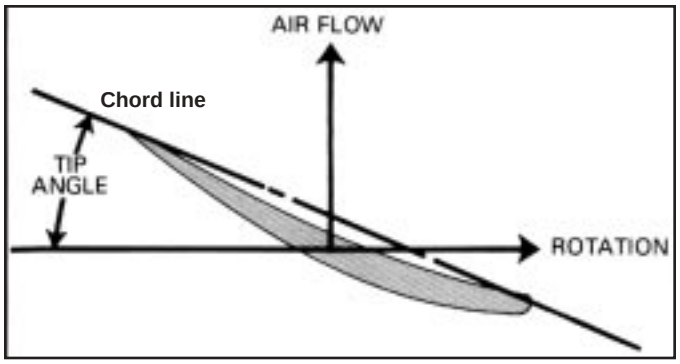
** 1385149-30 through 1385149-53 with appropriate setting number may be used until stock is depleted.

Table 10. Adjustax S Unbrako cap screw torque setting

Hub Series	Torque ft./lb.
A	15.5
B	31.0
C	31.0
D	61.0
E	132.0

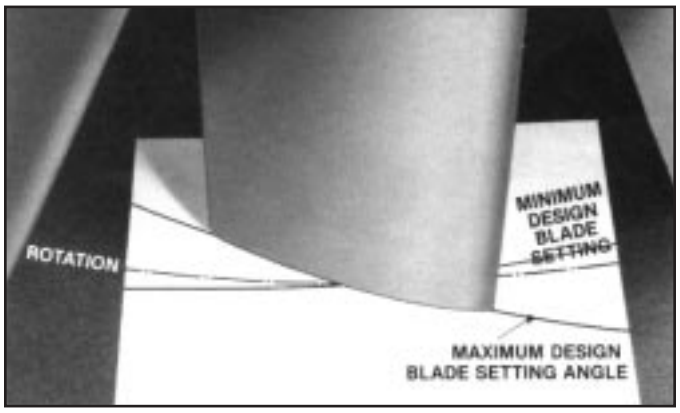
Table 11. Axivane blade angle settings

BASE ROTOR DIA.	NO. ROTATING BLADES	NO. STATIONARY VANES
14	10	8
17 1/2	12	9
21	14	9
26 1/2	16	13
30	16	13



Hub Series		Blade P/N		Min. Hub Angle	
	14" 1000	AP	3074116	AP	18°, #20
		CP		CP	

Curve Setting	Hub Angle Degrees	Tip Angle – Degrees								
		18	21¼	23¼	25¼	27¼	29¼	32	34	36
0	56	44	37	35	32	31	28	27	26	24
2	51	40	33	31	28	27	24	23	22	20
4	47	36	29	27	24	23	20	19	18	16
6	44	33	25	23	20	19	16	15	14	13
8	40	29	22	20	17	16	13	12	11	9
10	36	25	18	16	13	12	9	8	7	5
12	32	21	14	12	9	8	6	5	3	1
14	29	18	10	9	5	5	2	1	0	-2
16	25	14	7	5	2	1	-2	-3	-4	-6
18	21	10	3	1	-2	-3	-6	-7	-8	-10
20	18	6	0	-3	-6	-7	-10	-11	-12	-14



Hub Series		Blade P/N		Min Hub Angle	
	21" 2000	AP	3391947-2	AP	18°, #9
		CP	3391947-3	CP	18°, #9

Setting	Hub Angle Degrees	Tip Angle — Degrees									
		25	27	29	32	34	36	38	42¼	45	48
0	63	53	50	47	45	43	41	40	37	35	33
1	58	48	45	42	40	38	36	35	32	30	28
2	53	43	40	37	35	33	31	30	27	25	23
3	48	38	35	32	30	28	26	25	22	20	18
4	43	33	30	27	25	23	21	20	17	15	13
5	38	28	25	22	20	18	16	15	12	10	8
6	33	23	20	17	15	13	11	10	7	5	3
7	28	18	15	12	10	8	6	5	2	0	-2
8	23	13	10	7	5	3	1	0	-3	-5	-7
9	18	8	5	2	0	-2	-4	-5	-8	-10	-12

Hub Series		Blade P/N		Min Hub Angle	
	30" 2000	AP	3391756-2	AP	18°, #9
		CP	3391756-5	CP	18°, #9

Setting	Hub Angle Degrees	Tip Angle — Degrees									
		38	42¼	45	48	54	60	66	72	78	84
0	63	50	45	41	39	35	31	28	26	24	23
1	58	45	40	36	34	30	26	23	21	19	18
2	53	40	35	31	29	25	21	18	16	14	13
3	48	35	30	26	24	20	16	13	11	9	8
4	43	30	25	21	19	15	11	8	6	4	3
5	38	25	20	16	14	10	6	3	1	-1	-2
6	33	20	15	11	9	5	1	-2	-4	-6	-7
7	28	15	10	6	4	0	-4	-7	-9	-11	-12
8	23	10	5	1	-1	-5	-9	-12	-14	-16	-17
9	18	5	0	-4	-6	-10	-14	-17	-19	-21	-22

Hub Series		Blade P/N		Min Hub Angle	
	17" 1000	AP	3073151	AP	9.5°, #21
		CP	3388973	CP	9.5°, #21

Hub Setting	Hub Angle Degrees	Tip Angle — Degrees									
		21¼	23¼	25¼	27¼	29¼	32	34	36	38	42¼	45
0	48	41	37	34	31	29	27	26	25	24	23	22
2	44	37	34	30	28	26	24	23	22	21	19	18
4	40	33	30	26	24	22	20	19	18	17	15	14
6	37	29	26	23	20	18	16	15	14	13	11	10
8	33	26	22	19	16	14	12	11	10	9	8	7
10	29	22	19	15	13	11	9	8	7	6	4	3
12	25	18	15	12	9	7	5	4	3	2	1	0
14	22	14	11	8	5	3	2	1	0	-2	-3	-4
16	18	11	7	4	1	0	-2	-3	-4	-5	-7	-8
18	14	7	3	0	-3	-4	-6	-7	-8	-9	-11	-12
20	10	3	0	-4	-7	-8	-10	-11	-12	-13	-15	-16

Hub Series		Blade P/N		Min Hub Angle	
	26" 2000	AP	3387210-1	AP	13°, #10
		CP	3387210-2	CP	13°, #10

Setting	Hub Angle Degrees	Tip Angle — Degrees									
		34	36	38	42¼	45	48	54	60	66	72
0	63	50	47	44	40	38	36	32	29	26	25
1	58	45	42	39	35	33	31	27	24	21	20
2	53	40	37	34	30	28	26	22	19	16	15
3	48	35	32	29	25	23	21	17	14	11	10
4	43	30	27	24	20	18	16	12	9	6	5
5	38	25	22	19	15	13	11	7	4	1	0
6	33	20	17	14	10	8	6	2	-1	-4	-5
7	28	15	12	9	5	3	1	-3	-6	-9	-10
8	23	10	7	4	0	-7	-4	-8	-11	-14	-15
9	18	5	2	-1	-5	-7	-9	-13	-16	-19	-20
10	13	0	-3	-6	-10	-12	-14	-18	-21	-24	-25

Hub Series	26" 1000	Blade P/N	Min. Hub Angle
		AP 3387895-1	AP 18° #24
		CP 3387895-2	CP 18° #24

Setting	Hub Angle Degrees	Tip Angle – Degrees							
		34	36	38	42½	45	48	54	60
0	55	44	41	40	36	35	33	30	29
2	51	40	37	36	32	31	29	26	25
4	47	36	33	32	28	27	25	22	21
6	43	32	30	28	25	24	22	19	18
8	40	29	26	25	21	20	18	15	14
10	36	25	22	21	17	16	14	11	10
12	32	21	19	17	13	12	10	7	6
14	28	17	15	13	10	9	7	4	3
16	25	14	11	10	6	5	3	0	-1
18	21	10	7	6	2	1	-1	-4	-5
20	18	6	4	3	-1	-2	-4	-7	-9
22	14	2	0	-1	-5	-6	-8	-11	-12
24	10	-2	-4	-5	-9	-10	-12	-15	-16

Hub Series	26" 1000	Blade P/N	Min Hub Angle
		AP 3387721-1	AP 14°, #22
		CP 3387721-2	CP 14°, #22

Setting	Hub Angle Degrees	Tip Angle — Degrees							
		45	48	54	60	66	72	78	84
0	55	30	29	26	24	22	20	19	18
2	51	26	25	22	20	18	16	15	14
4	47	22	21	18	16	14	12	11	10
6	43	19	18	15	13	11	9	8	7
8	40	15	14	11	9	7	5	4	3
10	36	11	10	7	5	3	1	0	-1
12	32	8	7	4	2	0	-2	-3	-4
14	28	4	3	0	-2	-4	-6	-7	-8
16	25	0	-1	-4	-6	-8	-10	-11	-12
18	21	-4	-5	-8	-10	-12	-14	-15	-16
20	18	-8	-9	-12	-14	-16	-18	-19	-20
22	14	-12	-13	-16	-18	-20	-22	-23	-24

Hub Series	26½" 3000	Blade P/N	Min. Hub Angle
		AP 3398829-2	AP 30° #7
		CP 3398829-4	CP 30° #7

Setting	Hub Angle Degrees	Tip Angle – Degrees				
		34	36	38	42	45
0	65	49	46	44	40	38
1	60	44	41	39	35	33
2	55	39	36	34	30	28
3	50	34	31	29	25	23
4	45	29	26	24	20	18
5	40	24	21	19	15	13
6	35	19	16	14	10	8
7	30	14	11	9	5	3

Table 12. Blade angle settings in degrees for Adjustax S vaneaxial fans

REFERENCE SETTING	HUB	"A-ROTOR" DIAM. BLADE ANGLE IN DEGREES									
	14.4	18	22	23 1/2	25	27	29	33	35	38	
-20	16.8	8.8	2.05	0	-1.6	-3.3	-4.8	-7.35	-8.35	-9.7	
-10	21.8	13.8	7.05	5.0	+3.4	+1.7	+0.2	-2.35	-3.35	-4.7	
0	26.8	18.8	12.05	10.0	8.4	6.7	5.2	+2.65	+1.65	+0.3	
+10	31.8	23.8	17.05	15.0	13.4	11.7	10.2	7.65	6.65	5.3	
20	36.8	28.8	22.05	20.0	18.4	16.7	15.2	12.65	11.65	10.3	
23.2	38.4	30.4	23.65	21.6	20	18.3	16.8	14.25	13.25	11.9	
30	41.8	33.8	27.05	25.0	23.4	21.7	20.2	17.65	16.65	15.3	
35	44.3	36.3	29.55	27.5	25.9	24.2	22.7	20.15	19.15	17.8	
40	46.8	38.8	32.05	30.0	28.4	26.7	25.2	22.65	21.65	20.3	
50	51.8	43.8	37.05	35.0	33.4	31.7	30.2	27.65	26.65	25.3	
60	56.8	48.8	42.05	40.0	38.4	36.7	35.2	32.65	31.65	30.3	

REFERENCE SETTING	HUB	"B-ROTOR" DIAM. BLADE ANGLE IN DEGREES											
	18.14	22	23 1/2	25	27	29	33	35	38	40	43	45	48
-20	16.8	10.1	7.7	5.55	3.0	+0.75	-2.6	-3.8	-5.95	-6.55	-7.85	-8.65	-9.7
-10	21.8	15.1	12.7	10.55	8.0	5.75	+2.4	+1.2	-0.95	-1.55	-2.85	-3.65	-4.7
0	26.8	20.1	17.7	15.55	13.0	10.75	+7.4	6.2	+4.05	+3.45	+2.15	+1.35	+0.3
+10	31.8	25.1	22.7	20.55	18.0	15.75	+12.4	11.2	+9.05	8.45	7.15	6.35	+5.3
+20	36.8	30.1	27.7	25.55	23.0	20.75	+17.4	16.2	+14.05	13.45	12.15	11.35	+10.3
+23.2	38.4	31.7	29.3	27.15	24.6	22.35	19.0	17.8	15.65	15.05	13.75	12.95	11.9
30	41.8	35.1	32.7	30.55	28.0	25.75	22.4	21.2	19.05	18.45	17.15	16.35	15.3
35	44.3	38.5	35.2	33.05	30.5	28.25	24.9	23.7	22.55	20.95	19.65	18.85	17.8
40	46.8	40.1	37.7	35.55	33.0	30.75	27.4	26.2	24.05	23.45	22.15	21.35	20.3
50	51.8	45.1	42.7	40.55	38	35.75	32.4	31.2	29.05	28.45	27.15	26.35	25.3
60	56.8	50.1	47.7	45.55	43	40.75	37.4	36.2	34.05	33.45	32.15	31.35	30.3

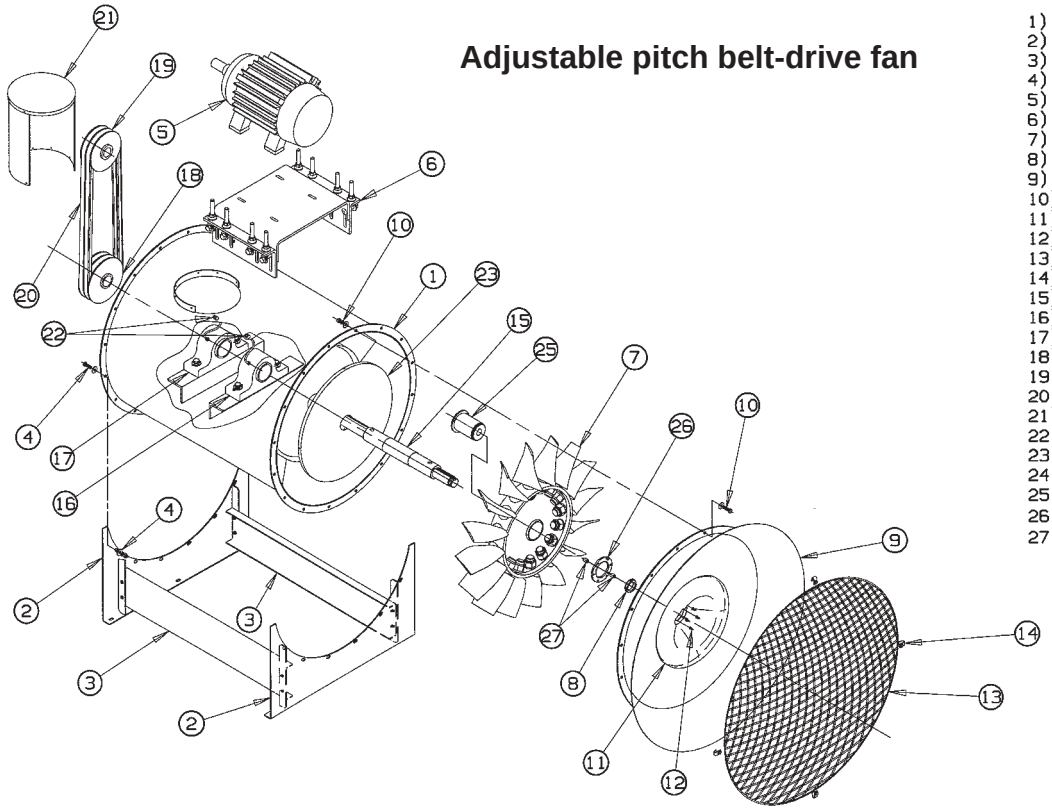
REFERENCE SETTING	HUB	"C-ROTOR" DIAM. BLADE ANGLE IN DEGREES									
	21.54	27	29	33	35	38	40	43	45	48	54
-20	16.8	8.7	6.2	+1.95	+0.2	-1.95	-3.05	-4.6	-5.6	-6.8	-8.9
-10	21.8	13.7	11.2	6.95	+5.2	+3.05	+1.95	+0.4	-0.6	-1.8	-3.0
0	26.8	18.7	16.2	11.95	10.2	+8.05	6.95	5.4	+4.4	+3.2	+1.1
+10	31.8	23.7	21.2	16.95	15.2	13.05	11.95	10.4	9.4	+8.2	+6.1
20	36.8	28.7	26.2	21.95	20.2	18.05	16.95	15.4	14.4	+13.2	11.1
23.2	38.4	30.3	27.8	23.55	21.8	19.65	18.55	17.0	16.0	14.8	12.7
30	41.8	33.7	31.2	26.95	25.2	23.05	23.05	20.4	19.4	+18.2	16.1
35	44.3	36.2	33.7	29.45	27.2	25.55	24.45	22.9	21.9	20.7	18.6
40	46.8	38.7	36.2	31.95	30.2	28.05	26.95	25.4	24.4	+23.2	21.1
50	51.8	43.7	41.2	36.95	35.2	33.05	31.95	30.4	29.4	+28.2	26.11
60	56.8	48.7	46.2	41.95	40.2	38.05	36.95	35.4	34.4	33.2	31.1

REFERENCE SETTING	HUB	"D-ROTOR" DIAM. BLADE ANGLE IN DEGREES										
	27.2	33	35	38	40	43	45	48	54	60	66	72
-20	16.8	10.0	7.8	5.0	3.3	1.05	-0.4	-1.95	-4.4	-6.6	-8.3	-9.7
-10	21.8	15.0	12.8	10.0	8.3	6.05	+4.6	+3.05	-0.6	-1.6	-3.3	-4.7
0	26.8	20.0	17.8	15.0	13.3	11.05	9.6	8.05	+5.6	+3.4	+1.7	+0.3
+10	31.8	25.0	22.8	20.0	18.3	16.05	14.6	13.05	10.6	8.4	6.7	5.3
+20	36.8	30.0	27.8	25.0	23.3	21.05	19.6	18.05	15.6	13.4	11.7	10.3
23.2	38.4	31.6	29.4	26.6	24.9	22.65	21.2	19.65	17.2	15.0	13.3	11.9
30	41.8	35.0	32.8	30.0	28.3	26.05	24.6	23.05	20.6	18.4	16.7	15.3
35	44.3	37.5	35.3	32.5	30.8	28.55	27.1	25.55	23.1	20.9	19.2	17.8
40	46.8	40.0	37.8	35.0	33.3	31.05	29.6	28.05	25.6	23.4	21.7	20.3
50	51.8	45.0	42.8	40.0	38.3	36.05	34.6	33.05	30.6	28.4	26.7	25.3
60	56.8	50.0	47.8	45.0	43.3	41.05	39.6	38.05	35.6	33.4	31.7	30.3

REFERENCE SETTING	HUB	"E-ROTOR" DIAM. BLADE ANGLE IN DEGREES									
	31.8	40	43	45	48	54	60	66	72	78	84
-20	16.8	8.6	6.0	4.5	2.4	-1.1	-3.4	-5.45	-7.1	-8.5	-9.7
-10	21.8	13.6	11.0	9.5	7.4	+3.9	+1.6	-0.45	-2.1	-3.5	-4.7
0	26.8	18.6	16.0	14.5	12.4	8.9	6.6	+4.55	+2.9	+1.5	+0.3
+10	31.8	23.6	21.0	19.5	17.4	13.9	11.6	9.55	7.9	6.5	5.3
20	36.8	28.6	26.0	24.5	22.4	18.9	16.6	14.55	12.9	11.5	10.3
23.2	38.4	30.2	27.6	26.1	24.0	20.5	18.2	16.15	14.5	13.1	11.9
30	41.8	33.6	31.0	29.5	27.4	23.9	21.6	19.55	17.9	16.5	15.3
35	44.3	36.1	33.5	32.0	29.9	26.4	24.1	22.05	20.4	19.0	17.8
40	46.8	38.6	36.0	34.5	32.4	28.9	26.6	24.55	22.9	21.5	20.3
50	51.8	43.6	41.0	39.5	37.4	33.9	31.6	29.55	27.9	26.5	25.3
60	56.8	48.6	46.0	44.5	42.4	38.9	36.6	34.55	32.9	31.5	30.3

Appendix B - Exploded views of fans

Adjustable pitch belt-drive fan



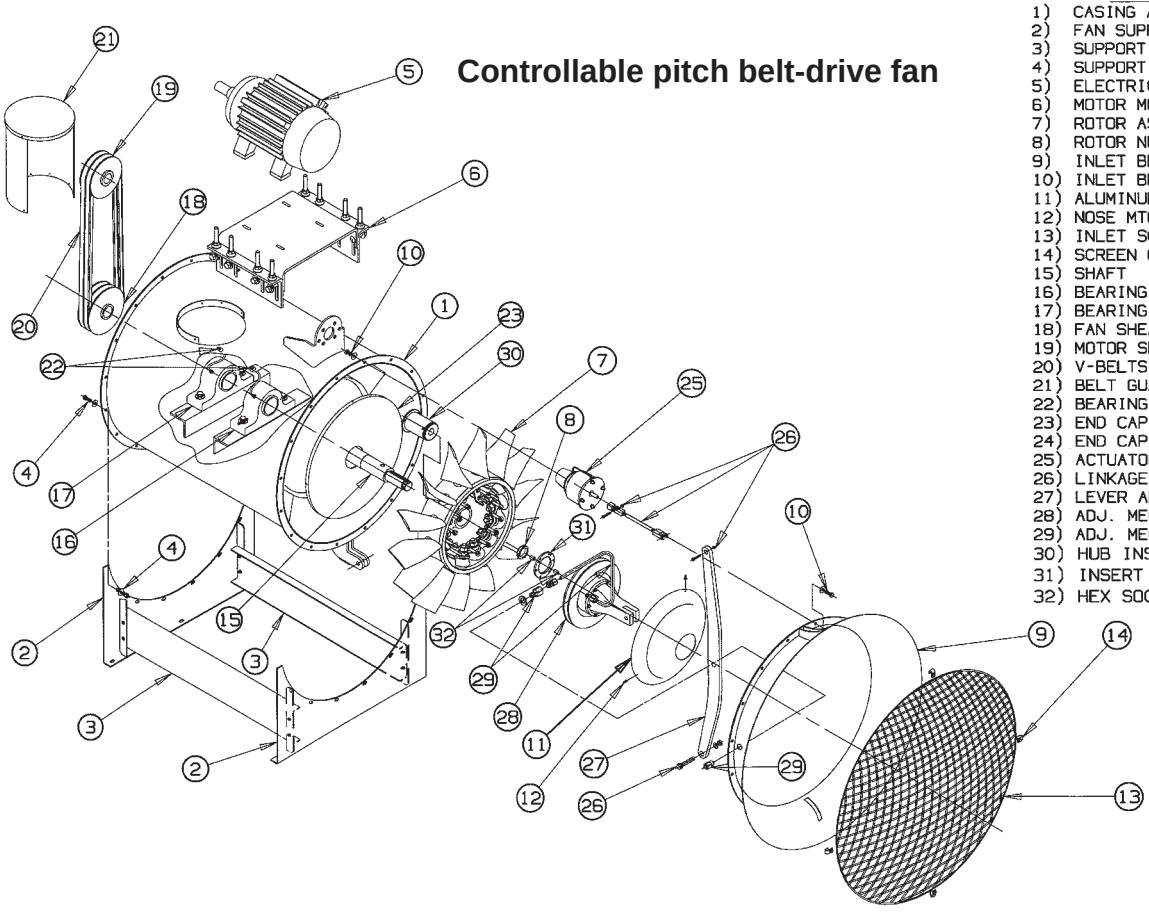
ITEM NUMBERS

1) CASING ASSEMBLY
2) FAN SUPPORT
3) SUPPORT BRACE
4) SUPPORT MTG. HARDWARE
5) ELECTRIC MOTOR
6) MOTOR MOUNTING PLATE
7) ROTOR ASSEMBLY
8) ROTOR NUT AND LOCKWASHER
9) INLET BELL
10) INLET BELL MTG. HARDWARE
11) ALUMINUM NOSE
12) NOSE MOUNTING HARDWARE
13) INLET SCREEN GUARD
14) SCREEN GUARD CLIP
15) SHAFT
16) BEARING
17) BEARING
18) FAN SHEAVE
19) MOTOR SHEAVE
20) V-BELTS
21) BELT GUARD
22) GREASE LEADS
23) END CAP - FRONT
24) END CAP - REAR (NOT SHOWN)
25) HUB INSERT
26) INSERT LOCK RING
27) HEX SOCKET HEADLESS SET SCREW

Ordering Repair Parts

- **Give Fan Model**
- **Give Fan Serial Number**

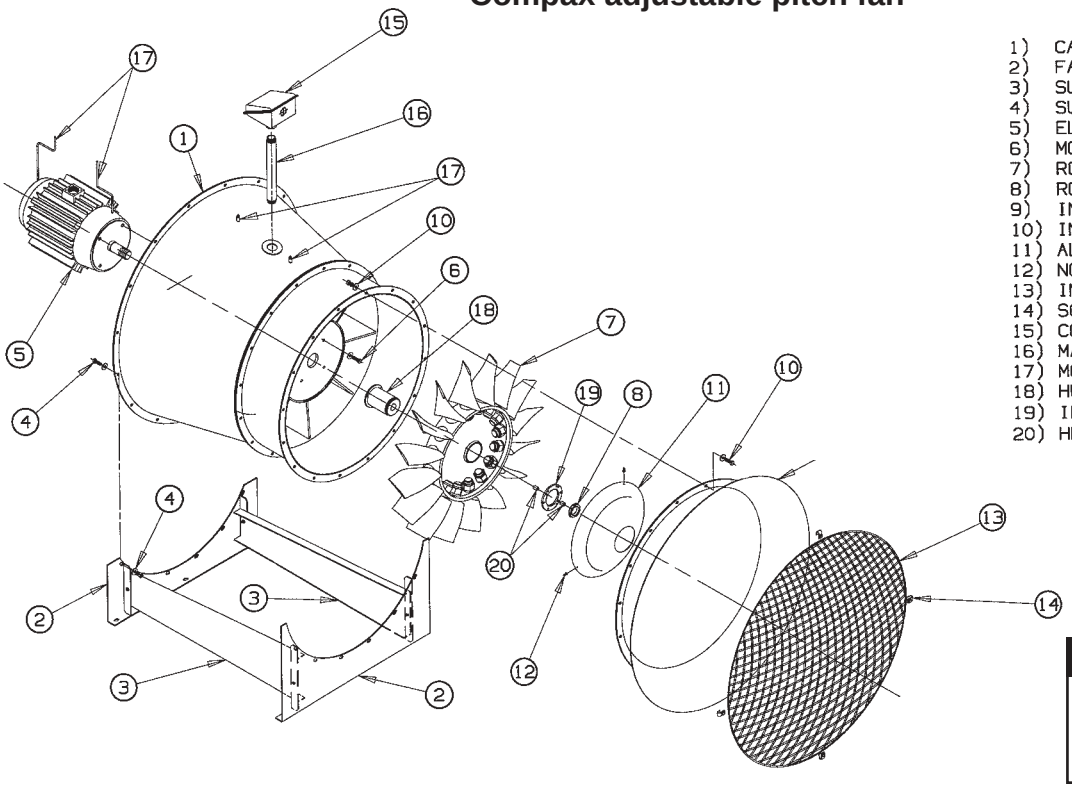
Controllable pitch belt-drive fan



ITEM NUMBERS

1) CASING ASSEMBLY
2) FAN SUPPORT
3) SUPPORT BRACE
4) SUPPORT MTG. HARDWARE
5) ELECTRIC MOTOR
6) MOTOR MOUNTING PLATE
7) ROTOR ASSEMBLY
8) ROTOR NUT AND LOCKWASHER
9) INLET BELL
10) INLET BELL MTG. HARDWARE
11) ALUMINUM NOSE
12) NOSE MTG. HARDWARE
13) INLET SCREEN GUARD
14) SCREEN GUARD CLIP
15) SHAFT
16) BEARING
17) BEARING
18) FAN SHEAVE
19) MOTOR SHEAVE
20) V-BELTS
21) BELT GUARD
22) BEARING GREASE LEADS
23) END CAP - FRONT
24) END CAP - REAR (NOT SHOWN)
25) ACTUATOR
26) LINKAGE (ACTUATOR/LEVER BAR)
27) LEVER ARM
28) ADJ. MECHANISM
29) ADJ. MECHANISM GREASE LEADS
30) HUB INSERT
31) INSERT LOCK RING
32) HEX SOCKET HEADLESS SET SCREW

Compax adjustable pitch fan



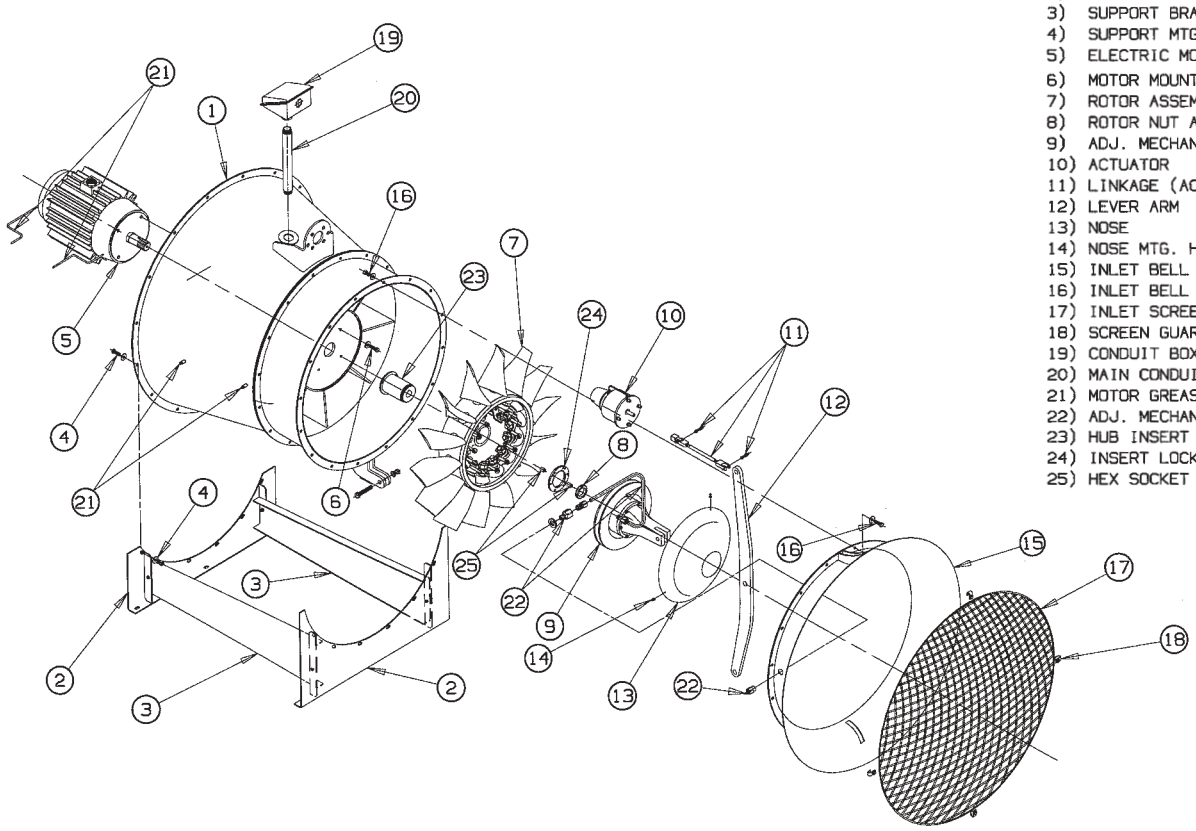
ITEM NUMBERS

1) CASING ASSEMBLY
2) FAN SUPPORT
3) SUPPORT BRACE
4) SUPPORT MTG. HARDWARE
5) ELECTRIC MOTOR
6) MOTOR MOUNTING HARDWARE
7) ROTOR ASSEMBLY
8) ROTOR NUT AND LOCKWASHER
9) INLET BELL
10) INLET BELL MTG. HARDWARE
11) ALUMINUM NOSE
12) NOSE MOUNTING HARDWARE
13) INLET SCREEN GUARD
14) SCREEN GUARD CLIP
15) CONDUIT BOX KIT PARTS
16) MAIN CONDUIT PIPE
17) MOTOR GREASE LEADS
18) HUB INSERT
19) INSERT LOCK RING
20) HEX SOCKET HEADLESS SET SCREW

Ordering Repair Parts

- **Give Fan Model**
- **Give Fan Serial Number**

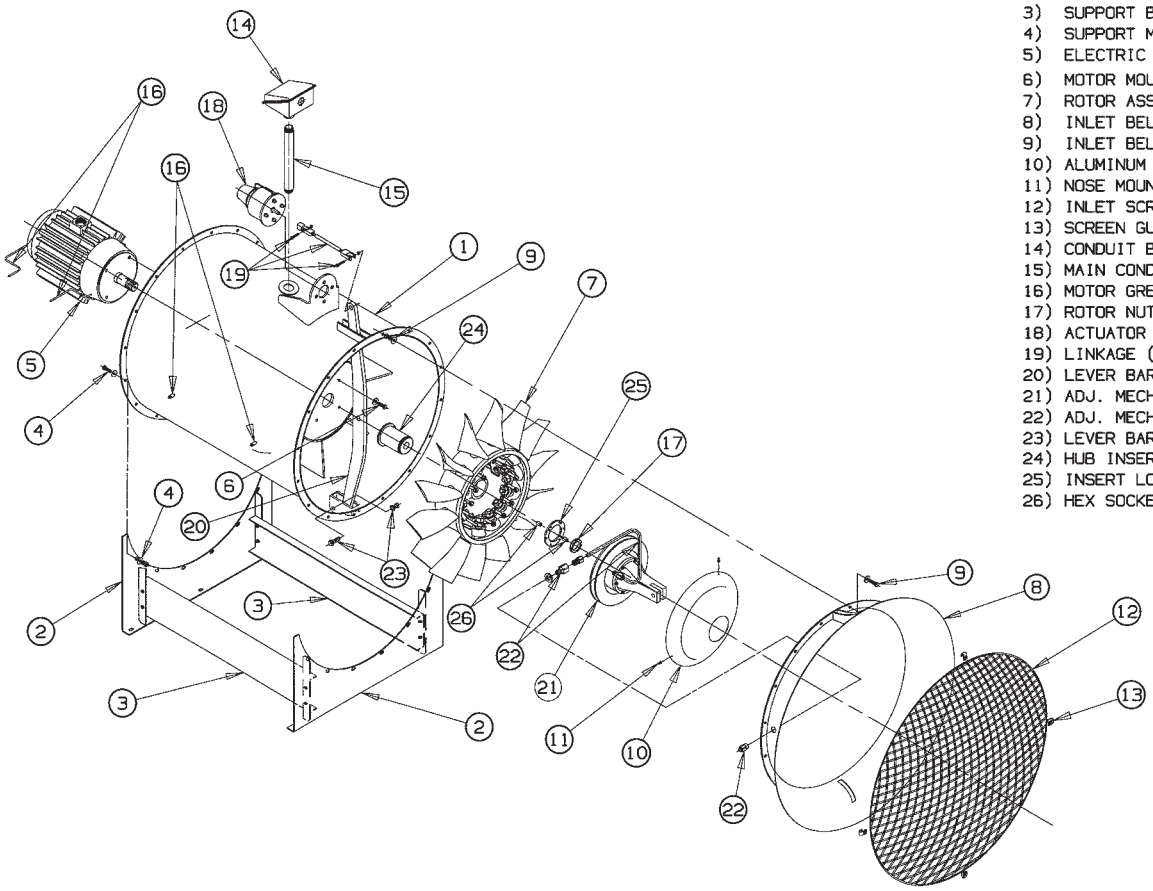
Compax controllable pitch fan with external actuator



ITEM NUMBERS

1) CASING ASSEMBLY
2) FAN SUPPORT
3) SUPPORT BRACE
4) SUPPORT MTG. HARDWARE
5) ELECTRIC MOTOR
6) MOTOR MOUNTING HARDWARE
7) ROTOR ASSEMBLY
8) ROTOR NUT AND LOCKWASHER
9) ADJ. MECHANISM
10) ACTUATOR
11) LINKAGE (ACTUATOR/LEVER BAR)
12) LEVER ARM
13) NOSE
14) NOSE MTG. HARDWARE
15) INLET BELL
16) INLET BELL MTG. HARDWARE
17) INLET SCREEN
18) SCREEN GUARD CLIP
19) CONDUIT BOX KIT PARTS
20) MAIN CONDUIT PIPE
21) MOTOR GREASE LEADS
22) ADJ. MECHANISM GREASE LEADS
23) HUB INSERT
24) INSERT LOCK RING
25) HEX SOCKET HEADLESS SET SCREW

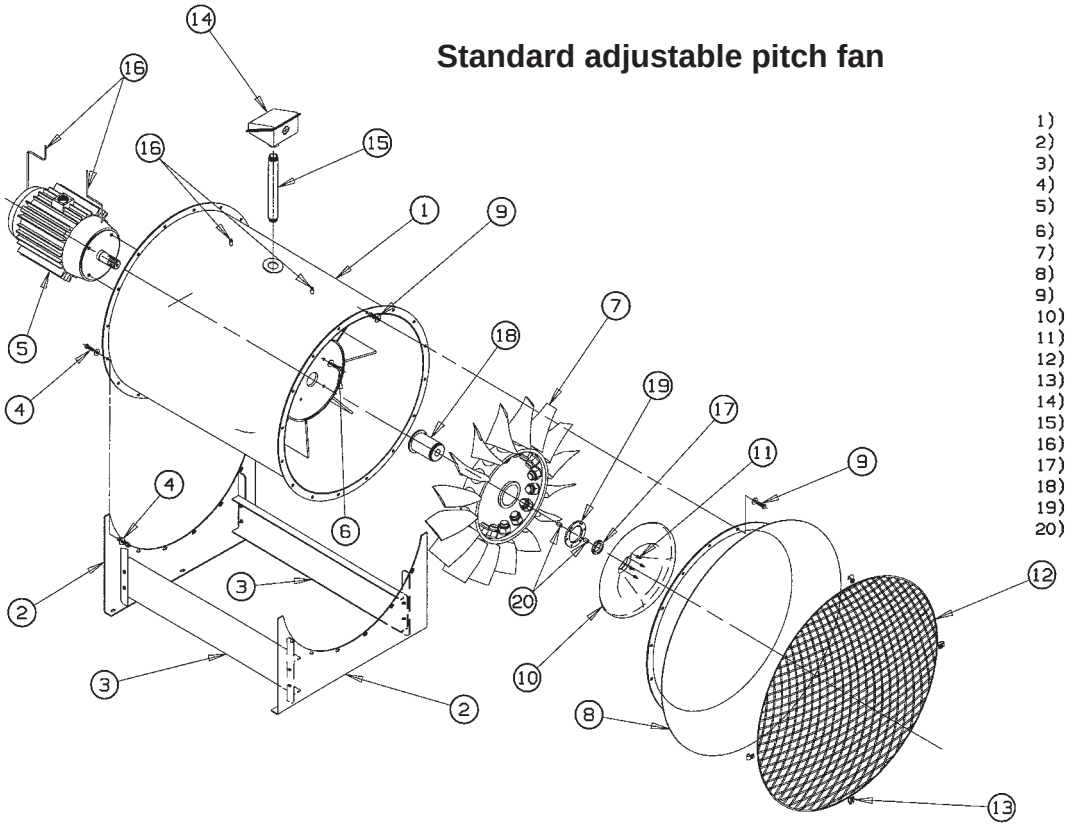
Controllable pitch fan with lever arm in casing



ITEM NUMBERS

1) CASING ASSEMBLY
2) FAN SUPPORT
3) SUPPORT BRACE
4) SUPPORT MTG. HARDWARE
5) ELECTRIC MOTOR
6) MOTOR MOUNTING HARDWARE
7) ROTOR ASSEMBLY
8) INLET BELL
9) INLET BELL MTG. HARDWARE
10) ALUMINUM NOSE
11) NOSE MOUNTING HARDWARE
12) INLET SCREEN GUARD
13) SCREEN GUARD CLIP
14) CONDUIT BOX KIT PARTS
15) MAIN CONDUIT PIPE
16) MOTOR GREASE LEADS
17) ROTOR NUT AND LOCKWASHER
18) ACTUATOR
19) LINKAGE (ACTUATOR/LEVER BAR)
20) LEVER BAR
21) ADJ. MECHANISM
22) ADJ. MECHANISM GREASE LEADS
23) LEVER BAR MOUNTING HARDWARE
24) HUB INSERT
25) INSERT LOCK RING
26) HEX SOCKET HEADLESS SET SCREW

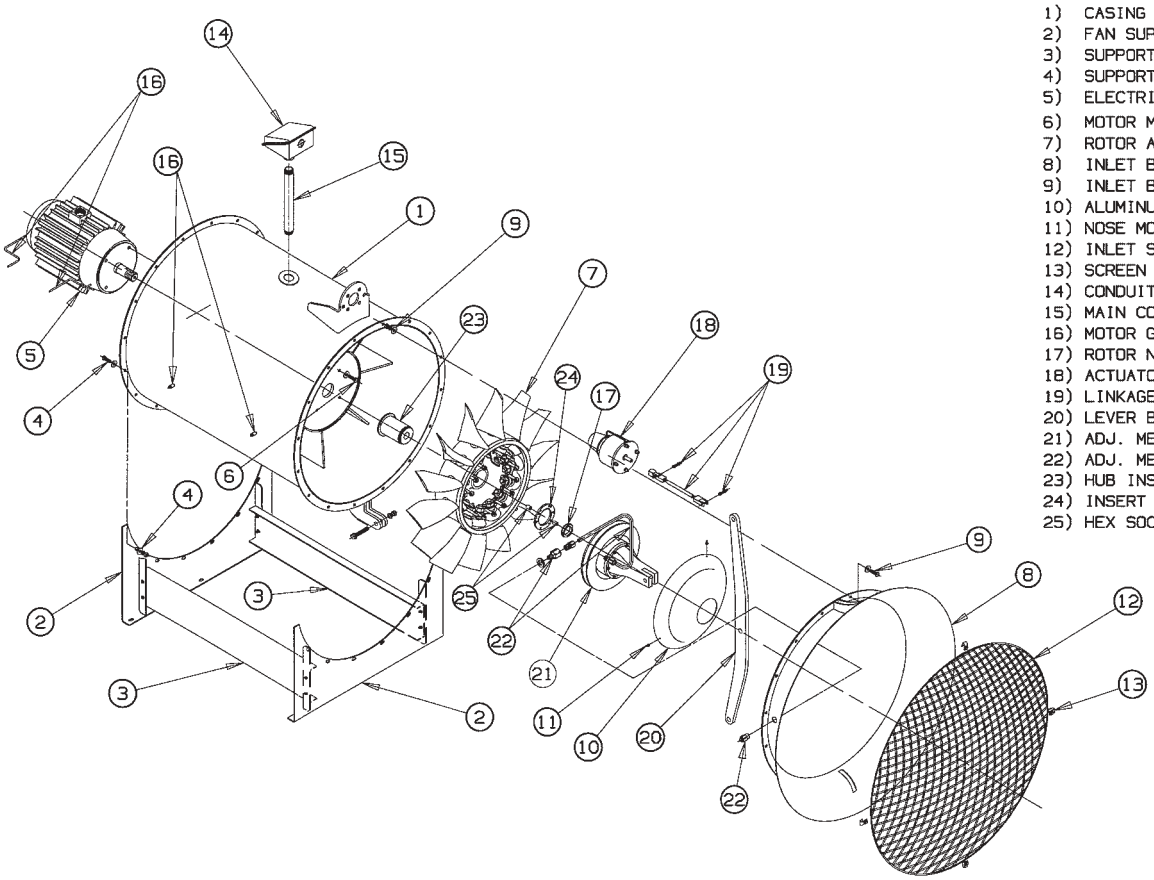
Standard adjustable pitch fan



ITEM NUMBERS

1) CASING ASSEMBLY
2) FAN SUPPORT
3) SUPPORT BRACE
4) SUPPORT MTG. HARDWARE
5) ELECTRIC MOTOR
6) MOTOR MOUNTING HARDWARE
7) ROTOR ASSEMBLY
8) INLET BELL
9) INLET BELL MTG. HARDWARE
10) ALUMINUM NOSE
11) NOSE MOUNTING HARDWARE
12) INLET SCREEN GUARD
13) SCREEN GUARD CLIP
14) CONDUIT BOX KIT PARTS
15) MAIN CONDUIT PIPE
16) MOTOR GREASE LEADS
17) ROTOR NUT AND LOCKWASHER
18) HUB INSERT
19) INSERT LOCK RING
20) HEX SOCKET HEADLESS SET SCREW

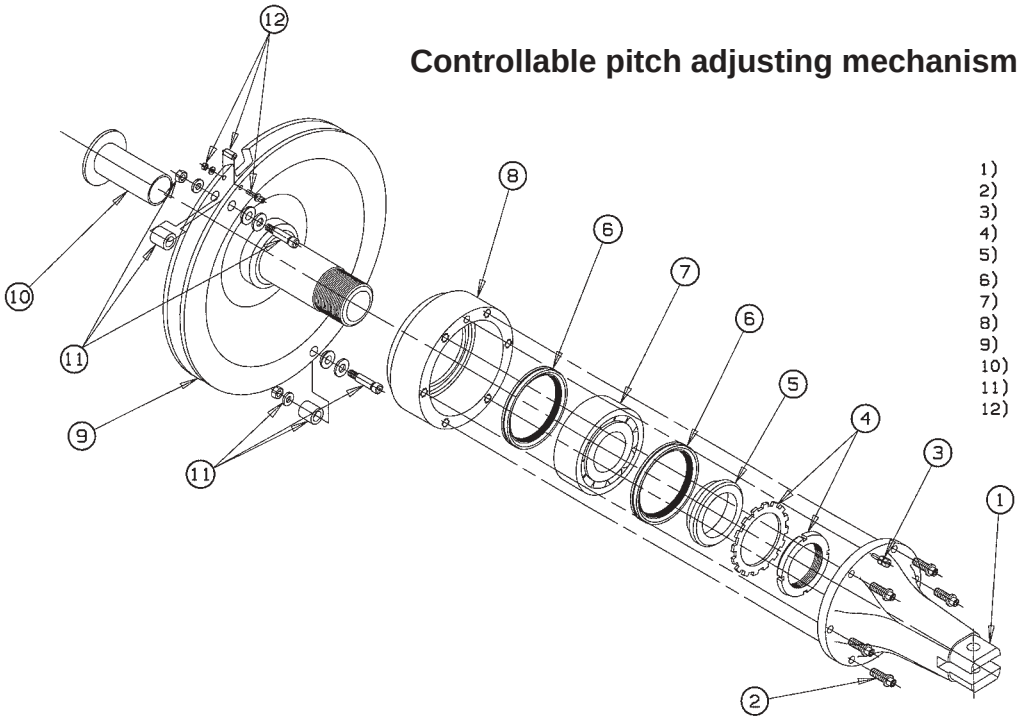
Standard controllable pitch fan



ITEM NUMBERS

1) CASING ASSEMBLY
2) FAN SUPPORT
3) SUPPORT BRACE
4) SUPPORT MTG. HARDWARE
5) ELECTRIC MOTOR
6) MOTOR MOUNTING HARDWARE
7) ROTOR ASSEMBLY
8) INLET BELL
9) INLET BELL MTG. HARDWARE
10) ALUMINUM NOSE
11) NOSE MOUNTING HARDWARE
12) INLET SCREEN GUARD
13) SCREEN GUARD CLIP
14) CONDUIT BOX KIT PARTS
15) MAIN CONDUIT PIPE
16) MOTOR GREASE LEADS
17) ROTOR NUT AND LOCKWASHER
18) ACTUATOR
19) LINKAGE (ACTUATOR/LEVER BAR)
20) LEVER BAR
21) ADJ. MECHANISM
22) ADJ. MECHANISM GREASE LEADS
23) HUB INSERT
24) INSERT LOCK RING
25) HEX SOCKET HEADLESS SET SCREW

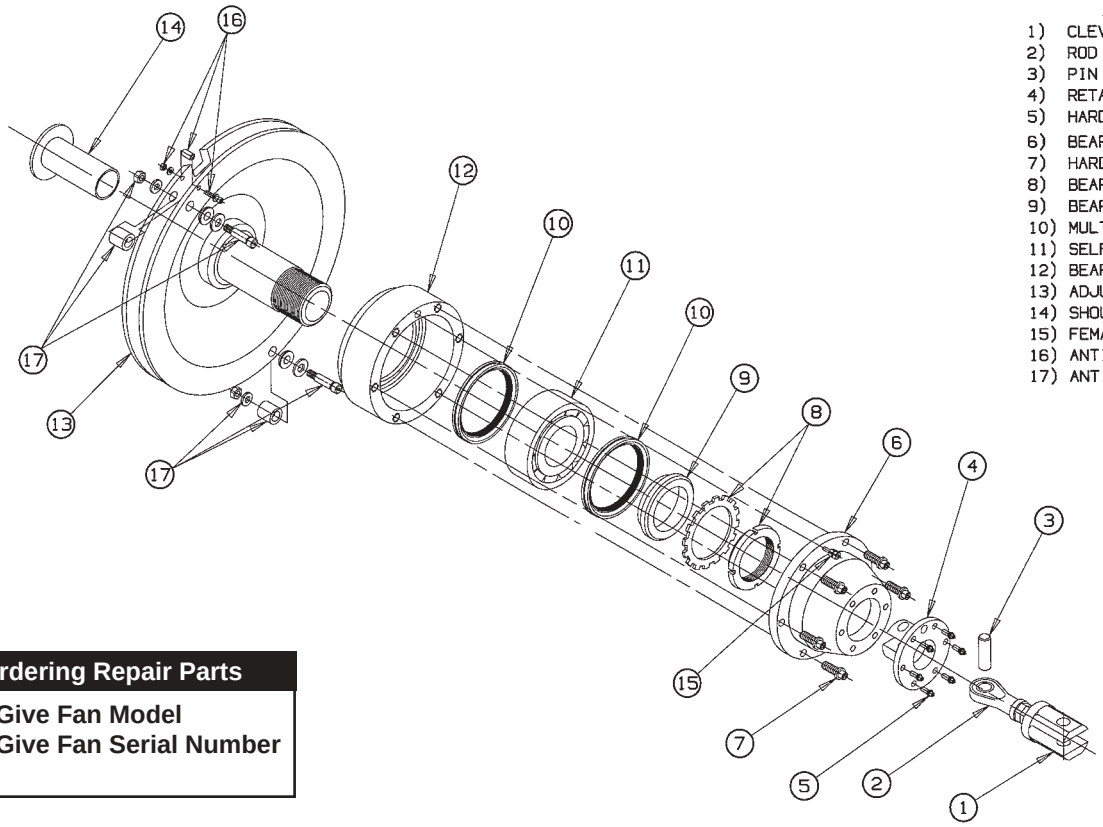
Controllable pitch adjusting mechanism (500988-)



ITEM NUMBERS

1) BEARING RETAINER
2) MOUNTING HARDWARE (BEARING RETAINER)
3) FEMALE CONNECTOR
4) BEARING LOCKNUT AND LOCKWASHER
5) BEARING SPACER
6) MULTI-DISC SEAL
7) SELF ALIGNING BALL BEARING
8) BEARING HOUSING
9) ADJUSTING DISC
10) SHOULDERED INSERT
11) ANTI-ROTATION ROLLER ASSEMBLY
12) ANTI-ROTATION PIN ASSEMBLY

Controllable pitch adjusting mechanism (500988-257)



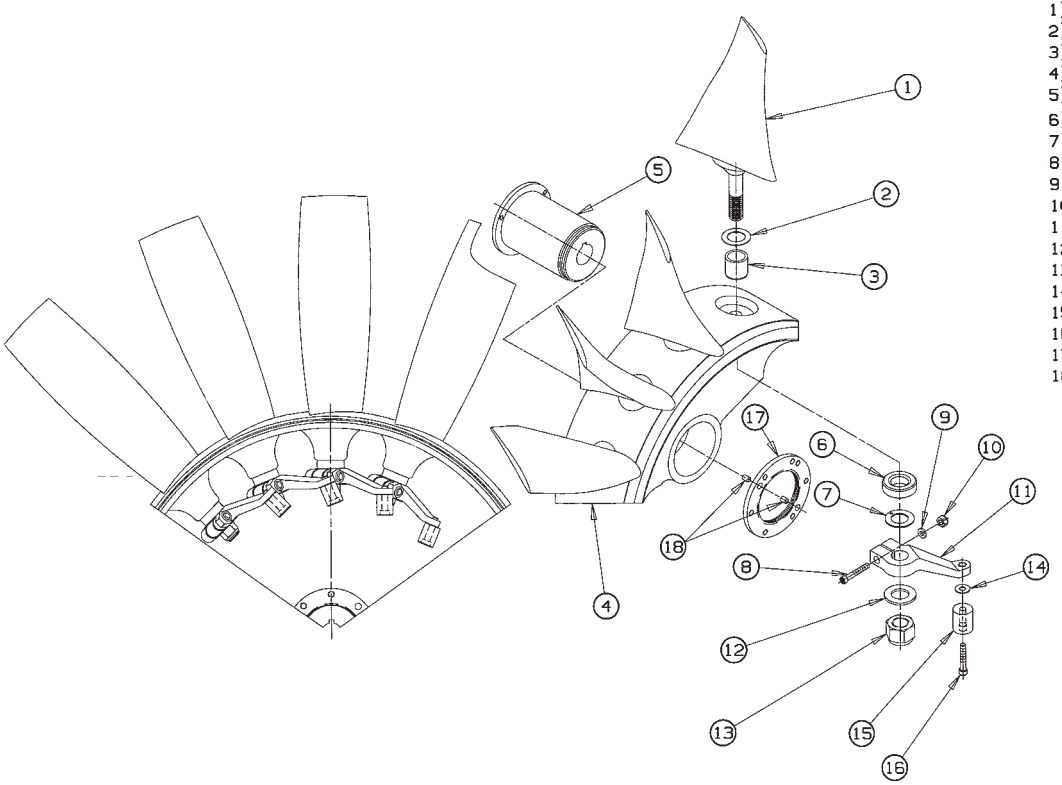
ITEM NUMBERS

1) CLEVIS
2) ROD END BEARING
3) PIN
4) RETAINER
5) HARDWARE (RETAINER)
6) BEARING RETAINER
7) HARDWARE (BEARING RETAINER)
8) BEARING LOCKNUT AND LOCKWASHER
9) BEARING SPACER
10) MULTI-DISC SEAL
11) SELF ALIGNING BALL BEARING
12) BEARING HOUSING
13) ADJUSTING DISC
14) SHOULDERED INSERT
15) FEMALE CONNECTOR
16) ANTI-ROTATION PIN ASSEMBLY
17) ANTI-ROTATION ROLLER ASSEMBLY

Ordering Repair Parts

- **Give Fan Model**
- **Give Fan Serial Number**

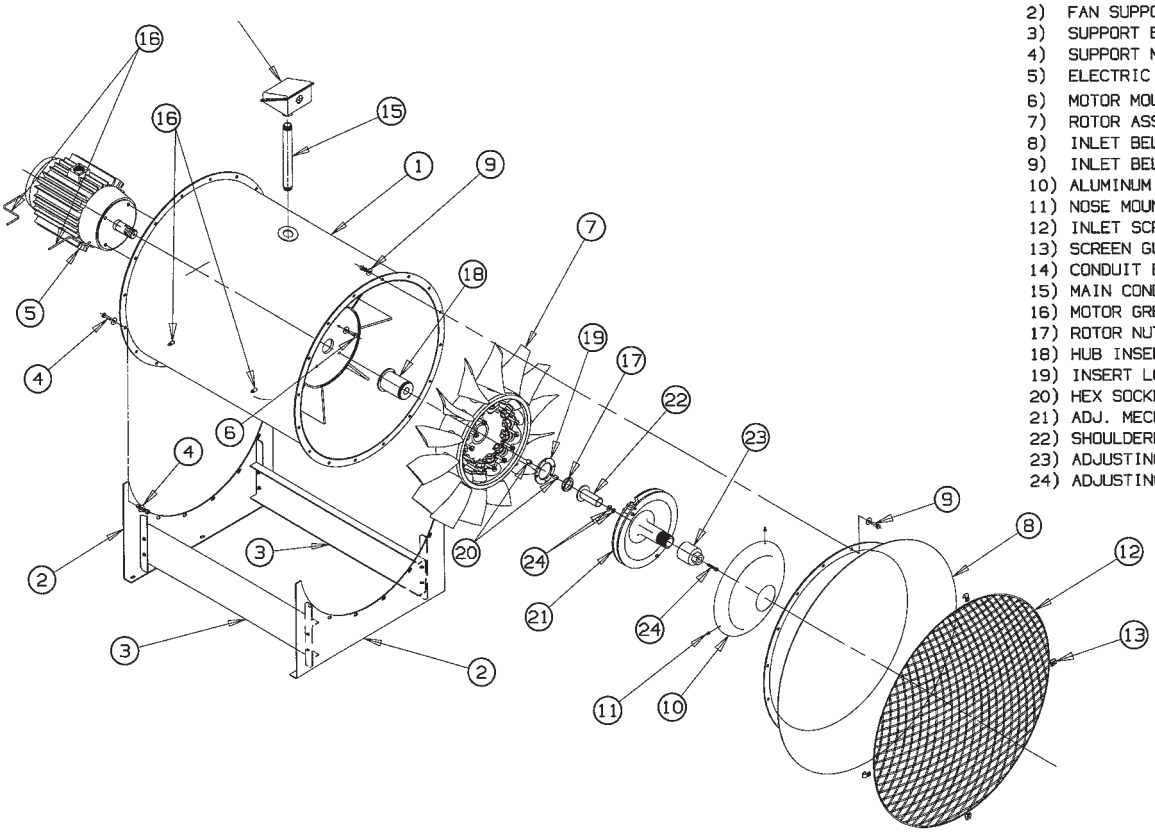
17-1/2”, 21”, and 26-1/2” controllable pitch rotor assembly



ITEM NUMBERS

1) C.P. BLADE
2) TEFLON WASHER
3) BUSHING
4) 26-1/2" HUB
5) HUB INSERT
6) SPACER
7) THRUST WASHER
8) BUTTON HEAD CAP SCREW
9) FLAT WASHER
10) LOCK NUT
11) CLAMP
12) WASHER
13) NUT
14) SUPPORT WASHER
15) ROLLER
16) SOCKET HEAD SHOULDER SCREW
17) INSERT LOCK RING
18) HEX SOCKET HEADLESS SET SCREW

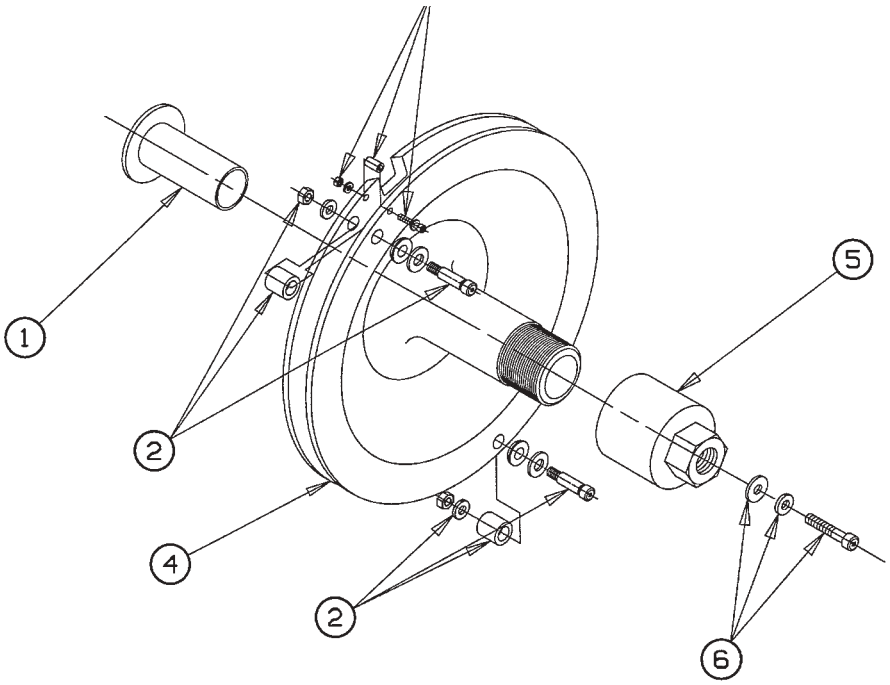
Simultaneously adjustable pitch fan



ITEM NUMBERS

1) CASING ASSEMBLY
2) FAN SUPPORT
3) SUPPORT BRACE
4) SUPPORT MTG. HARDWARE
5) ELECTRIC MOTOR
6) MOTOR MOUNTING HARDWARE
7) ROTOR ASSEMBLY
8) INLET BELL
9) INLET BELL MTG. HARDWARE
10) ALUMINUM NOSE
11) NOSE MOUNTING HARDWARE
12) INLET SCREEN GUARD
13) SCREEN GUARD CLIP
14) CONDUIT BOX KIT PARTS
15) MAIN CONDUIT PIPE
16) MOTOR GREASE LEADS
17) ROTOR NUT AND LOCKWASHER
18) HUB INSERT
19) INSERT LOCK RING
20) HEX SOCKET HEADLESS SET SCREW
21) ADJ. MECHANISM
22) SHOULDERED INSERT
23) ADJUSTING NUT
24) ADJUSTING NUT MOUNTING HARDWARE

Simultaneously adjustable pitch adjusting mechanism (#500988-)



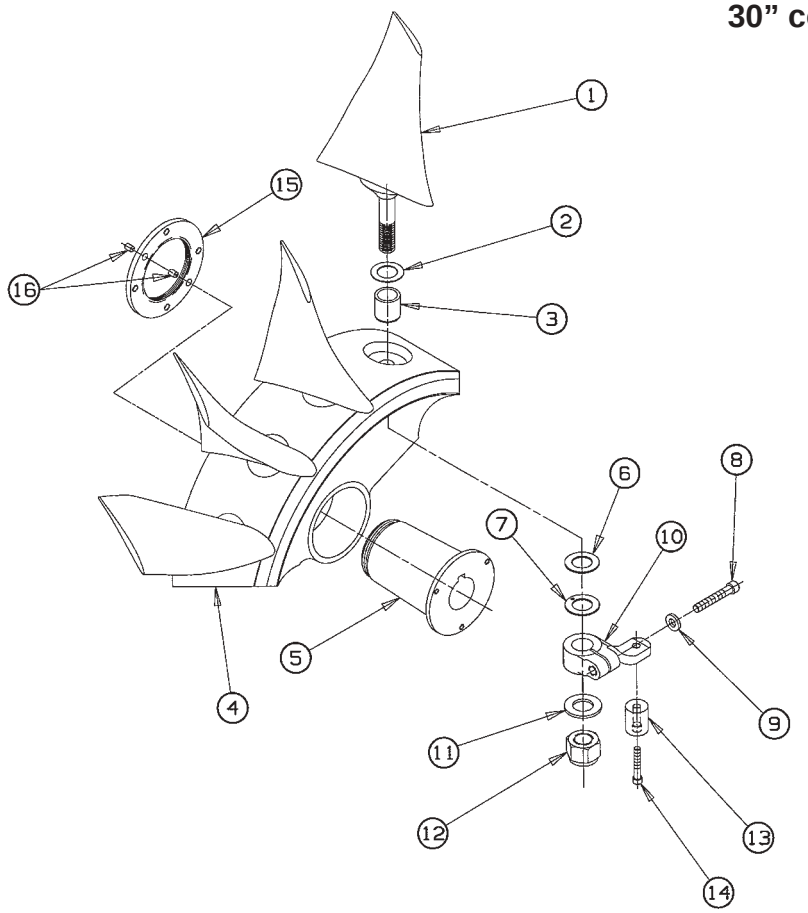
Ordering Repair Parts

- **Give Fan Model**
- **Give Fan Serial Number**
- **Give Fan Item Number**

ITEM NUMBERS

1) SHOULDERED INSERT
2) ANTI-ROTATION ROLLER ASSEMBLY
3) ANTI-ROTATION PIN ASSEMBLY
4) ADJUSTING DISC
5) ADJUSTING NUT
6) ADJUSTING NUT MOUNTING HARDWARE

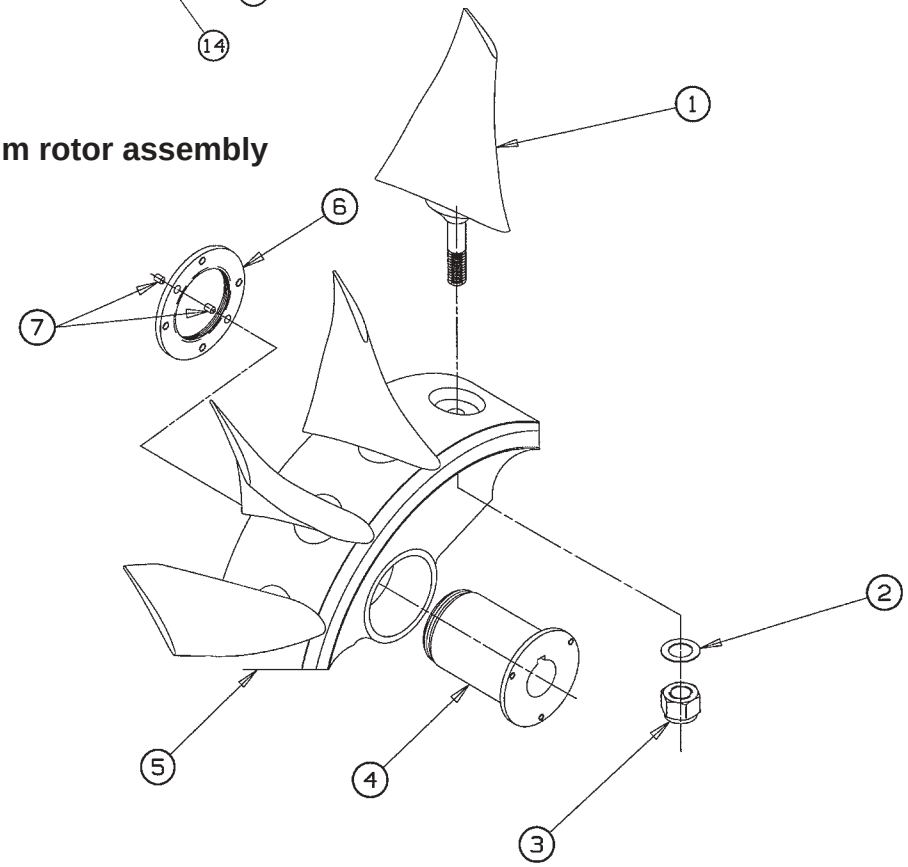
30” controllable pitch rotor assembly



ITEM NUMBERS

1) C.P. BLADE
2) TEFLON WASHER
3) BUSHING
4) 30" HUB
5) TAPERED HUB INSERT
6) WEAR WASHER
7) THRUST WASHER
8) KNURLED SOCKET HEAD CAP SCREW
9) FLAT WASHER
10) TORQUE CLAMP WITH HELI-COIL
11) WASHER
12) LOCKNUT
13) ROLLER
14) SOCKET HEAD SHOULDER SCREW
15) INSERT LOCK RING
16) HEX SOCKET HEADLESS SET SCREW

Standard adjustable pitch aluminum rotor assembly



ITEM NUMBERS

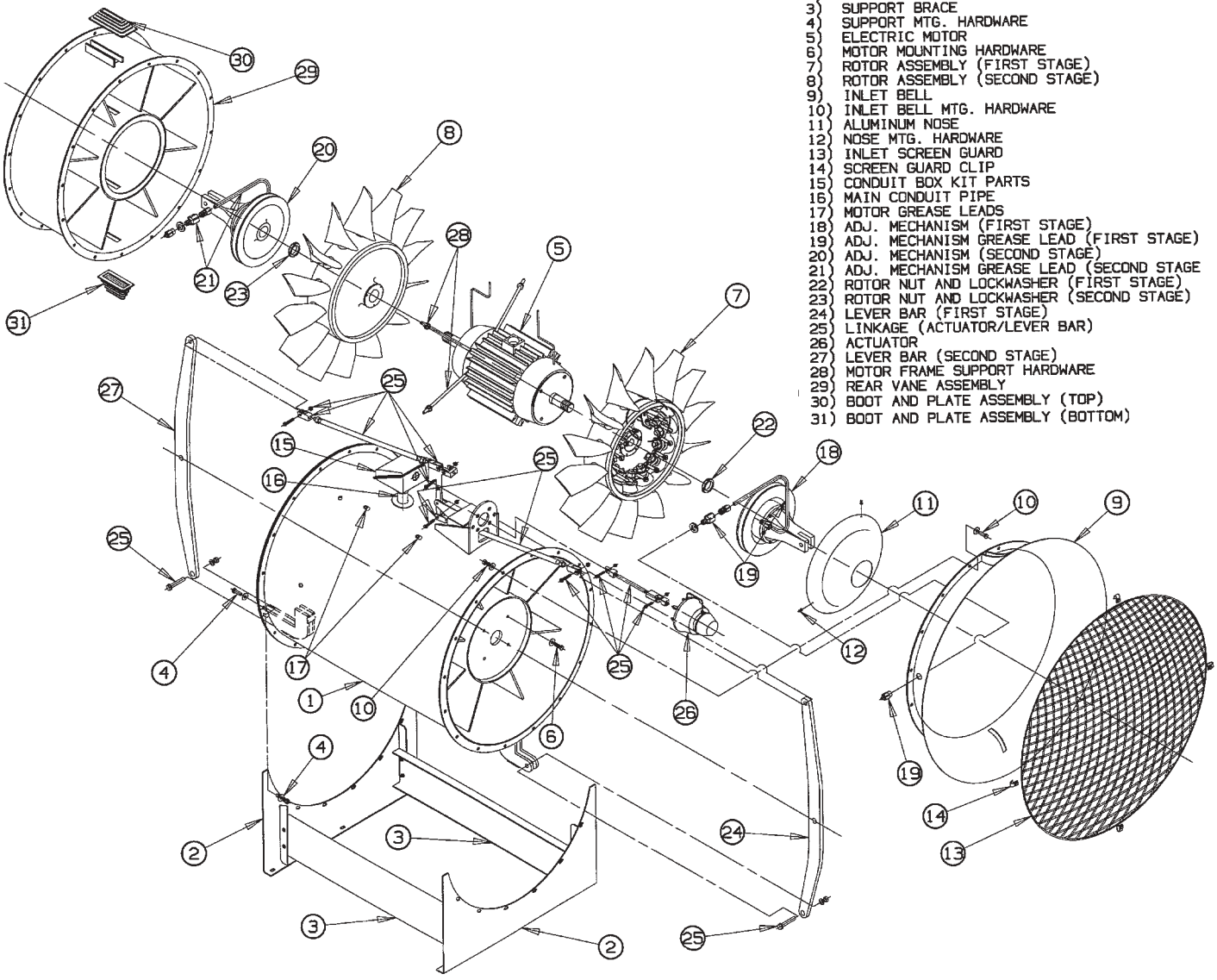
1) A.P. BLADE
2) WASHER
3) BLADE NUT
4) HUB INSERT
5) HUB
6) INSERT LOCK RING
7) HEX SOCKET HEADLESS SET SCREW

NOTE:

HUB SIZES 14", $17\frac{1}{2}$", 21" AND 30" ITEMS 4, 6 AND 7 INSTALLED AS SHOWN

HUB SIZES $26\frac{1}{2}$" ITEMS 4, 6 AND 7 INSTALLED OPPOSITE AS SHOWN

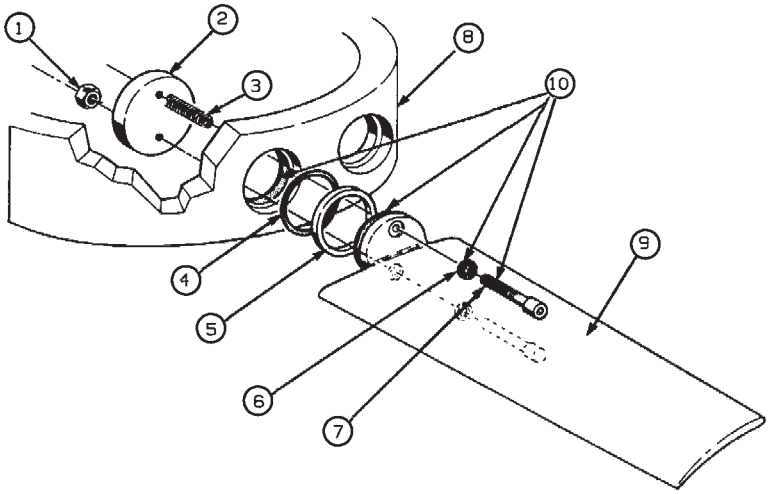
2-Stage controllable pitch fan



ITEM NUMBERS

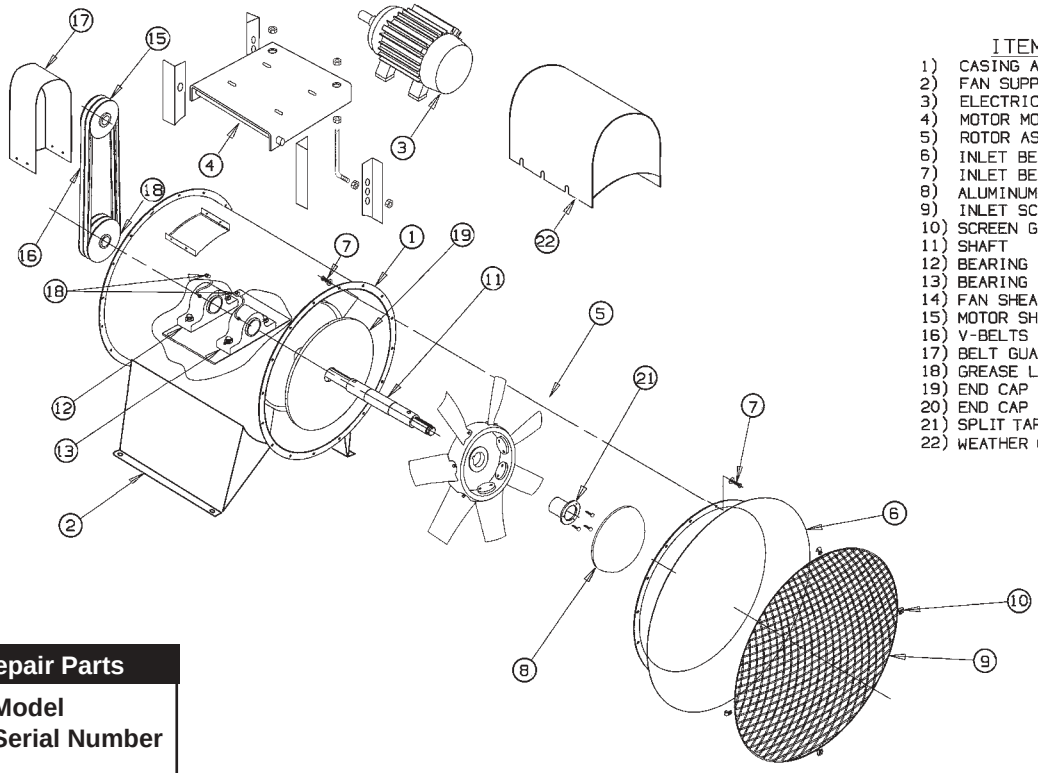
1) CASING ASSEMBLY
2) FAN SUPPORT
3) SUPPORT BRACE
4) SUPPORT MTG. HARDWARE
5) ELECTRIC MOTOR
6) MOTOR MOUNTING HARDWARE
7) ROTOR ASSEMBLY (FIRST STAGE)
8) ROTOR ASSEMBLY (SECOND STAGE)
9) INLET BELL
10) INLET BELL MTG. HARDWARE
11) ALUMINUM NOSE
12) NOSE MTG. HARDWARE
13) INLET SCREEN GUARD
14) SCREEN GUARD CLIP
15) CONDUIT BOX KIT PARTS
16) MAIN CONDUIT PIPE
17) MOTOR GREASE LEADS
18) ADJ. MECHANISM (FIRST STAGE)
19) ADJ. MECHANISM GREASE LEAD (FIRST STAGE)
20) ADJ. MECHANISM (SECOND STAGE)
21) ADJ. MECHANISM GREASE LEAD (SECOND STAGE
22) ROTOR NUT AND LOCKWASHER (FIRST STAGE)
23) ROTOR NUT AND LOCKWASHER (SECOND STAGE)
24) LEVER BAR (FIRST STAGE)
25) LINKAGE (ACTUATOR/LEVER BAR)
26) ACTUATOR
27) LEVER BAR (SECOND STAGE)
28) MOTOR FRAME SUPPORT HARDWARE
29) REAR VANE ASSEMBLY
30) BOOT AND PLATE ASSEMBLY (TOP)
31) BOOT AND PLATE ASSEMBLY (BOTTOM)

Type S blade assembly – O-Ring type



1) ANCO NUT
2) RETAINING PLATE
3) HELICAL COIL
4) O-RING
5) RETAINING RING
6) WASHER
7) UNBRAKO CAPSCREW
8) HUB
9) BLADE
10) APPLY ANTI-SEIZE COMPOUND

Adjustax Type S belt-drive

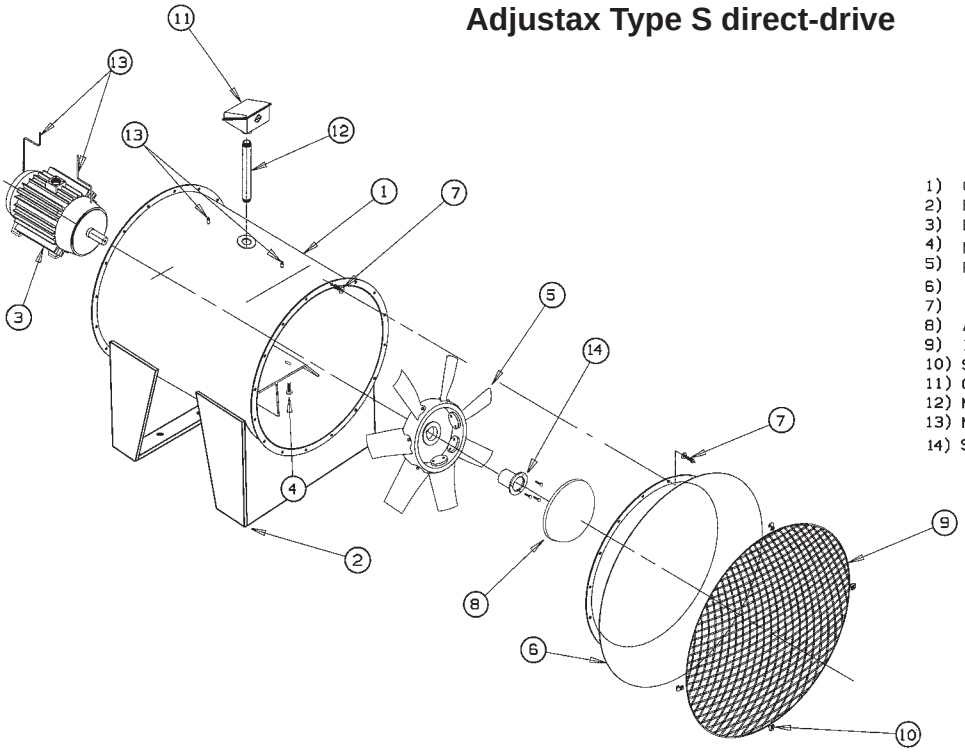


ITEM NUMBERS
1) CASING ASSEMBLY
2) FAN SUPPORT
3) ELECTRIC MOTOR
4) MOTOR MOUNTING PLATE
5) ROTOR ASSEMBLY
6) INLET BELL
7) INLET BELL MTG. HARDWARE
8) ALUMINUM NOSE
9) INLET SCREEN GUARD
10) SCREEN GUARD CLIP
11) SHAFT
12) BEARING
13) BEARING
14) FAN SHEAVE
15) MOTOR SHEAVE
16) V-BELTS
17) BELT GUARD
18) GREASE LEADS
19) END CAP - FRONT
20) END CAP - REAR (NOT SHOWN)
21) SPLIT TAPER LOCK BUSHING
22) WEATHER COVER

Ordering Repair Parts

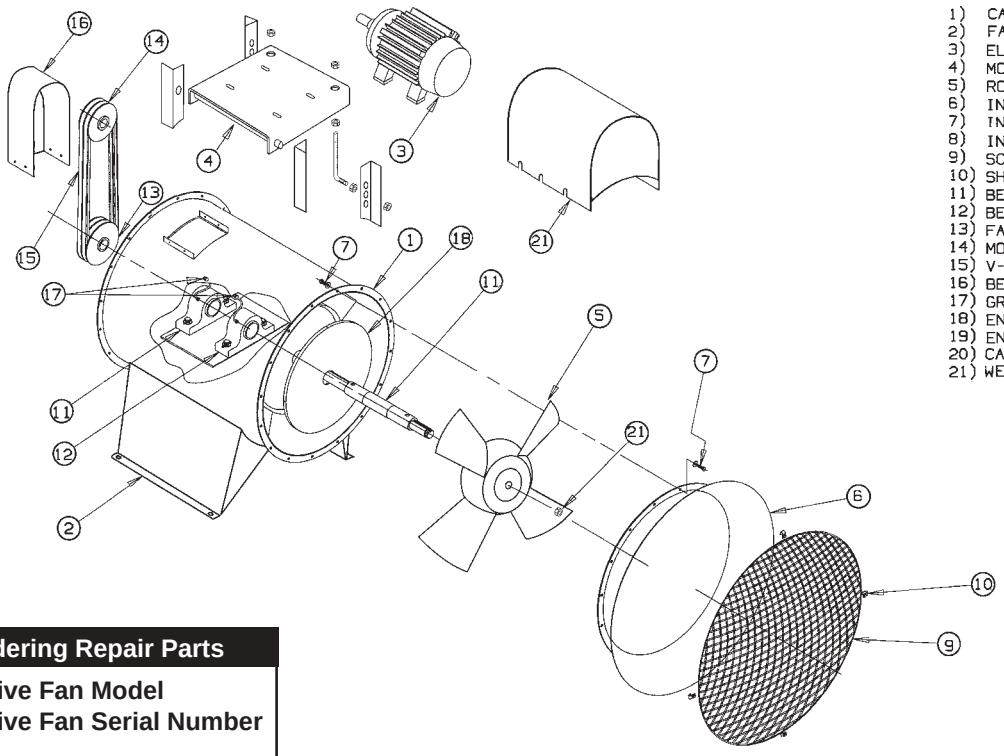
- **Give Fan Model**
- **Give Fan Serial Number**

Adjustax Type S direct-drive



ITEM NUMBERS
1) CASING ASSEMBLY
2) FAN SUPPORT
3) ELECTRIC MOTOR
4) MOTOR MOUNTING HARDWARE
5) ROTOR ASSEMBLY
6) INLET BELL
7) INLET BELL MTG. HARDWARE
8) ALUMINUM NOSE
9) INLET SCREEN GUARD
10) SCREEN GUARD CLIP
11) CONDUIT BOX KIT PARTS
12) MAIN CONDUIT PIPE
13) MOTOR GREASE LEADS
14) SPLIT TAPER LOCK BUSHING

Vaneaxial Type B belt-drive

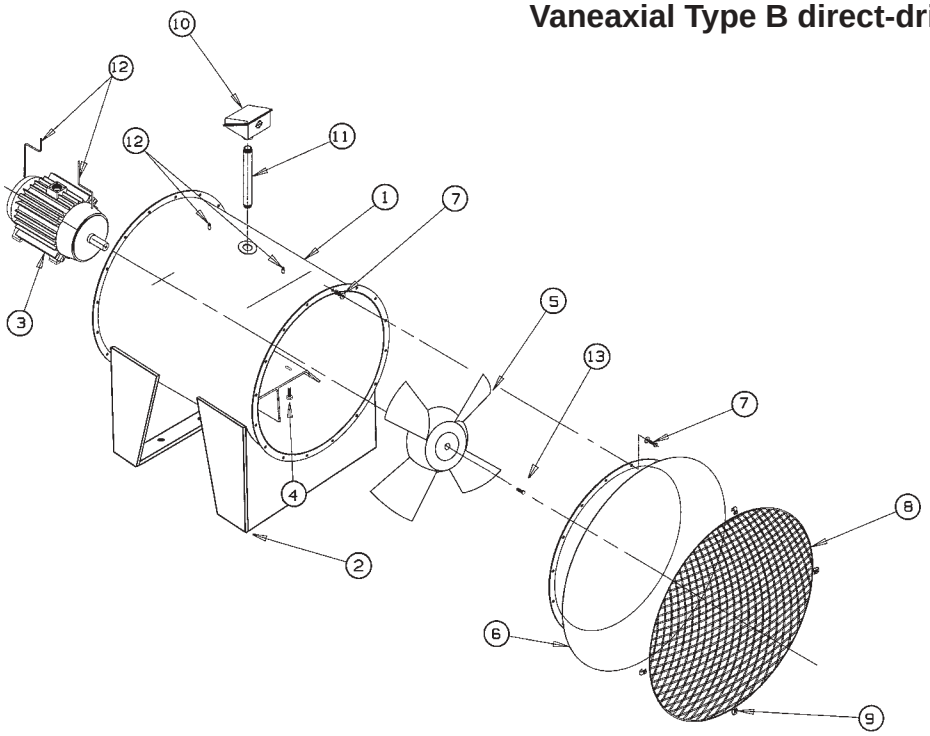


ITEM NUMBERS
1) CASING ASSEMBLY
2) FAN SUPPORT
3) ELECTRIC MOTOR
4) MOTOR MOUNTING PLATE
5) ROTOR ASSEMBLY
6) INLET BELL
7) INLET BELL MTG. HARDWARE
8) INLET SCREEN GUARD
9) SCREEN GUARD CLIP
10) SHAFT
11) BEARING
12) BEARING
13) FAN SHEAVE
14) MOTOR SHEAVE
15) V-BELTS
16) BELT GUARD
17) GREASE LEADS
18) END CAP - FRONT
19) END CAP - REAR (NOT SHOWN)
20) CASTLE NUT
21) WEATHER COVER

Ordering Repair Parts

- **Give Fan Model**
- **Give Fan Serial Number**

Vaneaxial Type B direct-drive



ITEM NUMBERS
1) CASING ASSEMBLY
2) FAN SUPPORT
3) ELECTRIC MOTOR
4) MOTOR MOUNTING HARDWARE
5) ROTOR ASSEMBLY
6) INLET BELL
7) INLET BELL MTG. HARDWARE
8) INLET SCREEN GUARD
9) SCREEN GUARD CLIP
10) CONDUIT BOX KIT PARTS
11) MAIN CONDUIT PIPE
12) MOTOR GREASE LEADS
13) CAPSCREW, HEX HD

Appendix C

Table 13. Troubleshooting

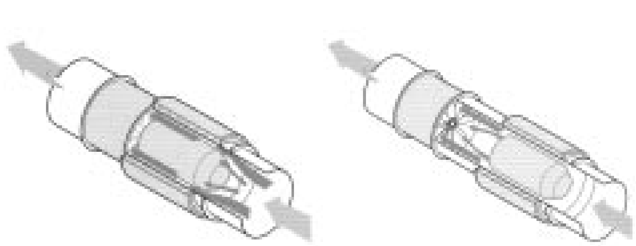
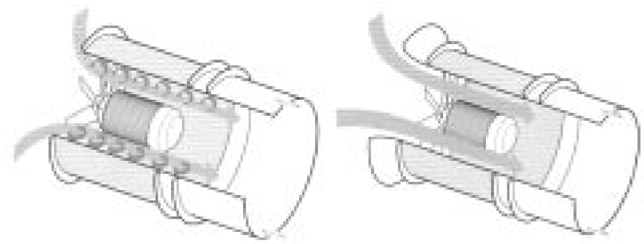
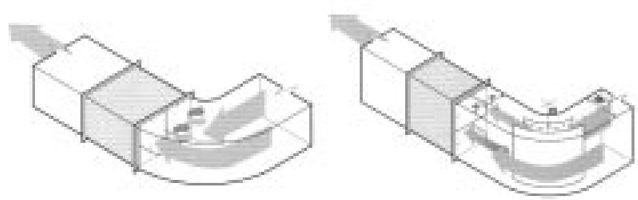
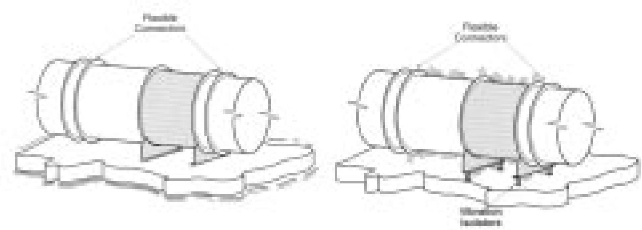
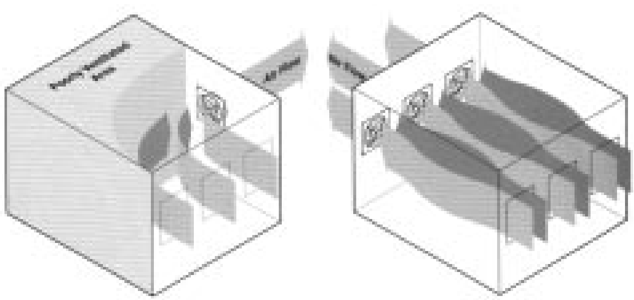
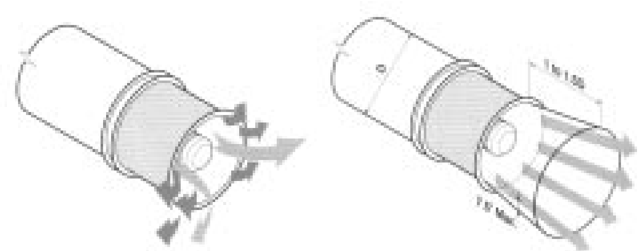
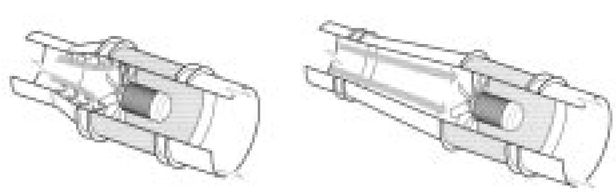
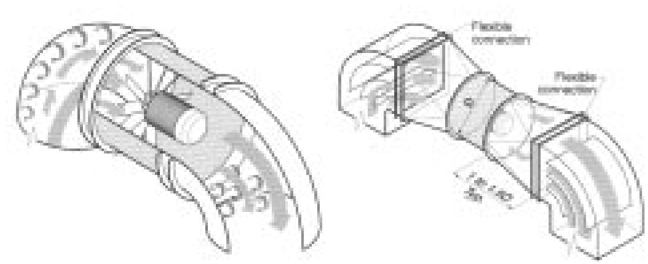
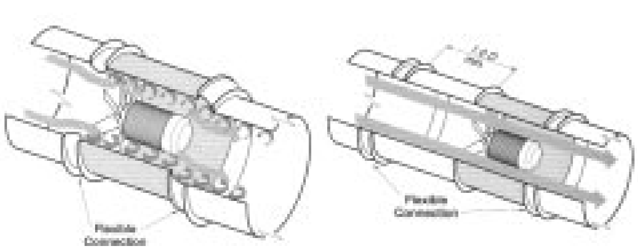
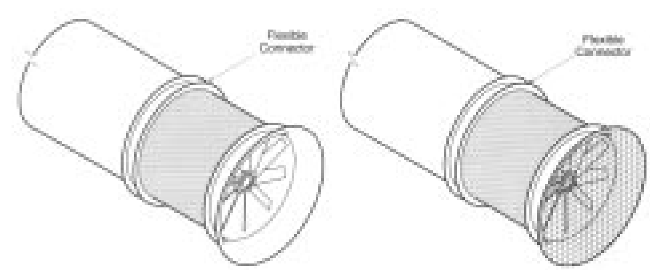
Symptom	Cause	Solution
Capacity or pressure below rating	Total resistance of system higher than design	For adjustable pitch fans, change the blade setting, staying within the limits shown on the nameplate. For belt drive fans the speed can be changed. We recommend contacting the factory before making either change
	Speed too low	Check drive system
	Dampers or variable inlet vanes not properly adjusted	Reset
	Poor fan inlet or outlet conditions	Increase speed, provide turning vanes or baffles in ductwork.
	Air leaks in system	Repair.
	Damaged rotor	Contact factory
	Rotation direction incorrect	Reverse electrically
	Rotor mounted backwards on shaft	Correct
Vibration and noise	Misalignment of V-belts, couplings or sheaves	See Section V - Installation
	Unstable foundation	See Section IV - Foundation and Support Structures
	Foreign material in fan causing unbalance	Clean rotating components
	Worn bearings	Replace
	Damaged rotor or motor	Contact factory
	Broken or loose bolts or setscrews	Tighten or replace
	Bent shaft	Replace
	Worn coupling	Replace
	Fan rotor or drive unbalanced	Contact factory
	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, or reset blade position
	Loose dampers or VIV's	Tighten or replace
	Speed too high or fan rotating in wrong direction	Reduce speed, check for electrical reversal or reinstall rotor
	Vibration transmitted to fan from some other source	Poor insulation; see Section IV - Foundation
Overheated bearing	Too much grease in ball or roller bearings	Clean and regrease
	Poor alignment	Realign
	Bent shaft	Replace shaft
	Dirt in bearings	Clean and lubricate
	Excessive belt tension	Realign. See Section V - Installation
Driver overloaded	Speed too high	Recheck driver
	Volume flow rate under capacity because system resistance higher than design	Fan improperly specified application
	Specific gravity or density of gas greater than design rating	Fan improperly specified, contact factory
	Rotating direction wrong	Reverse electrically
	Rotor wedging or binding	Reinstall rotor
	Motor wired wrong	Rewire; consult electrical contractor

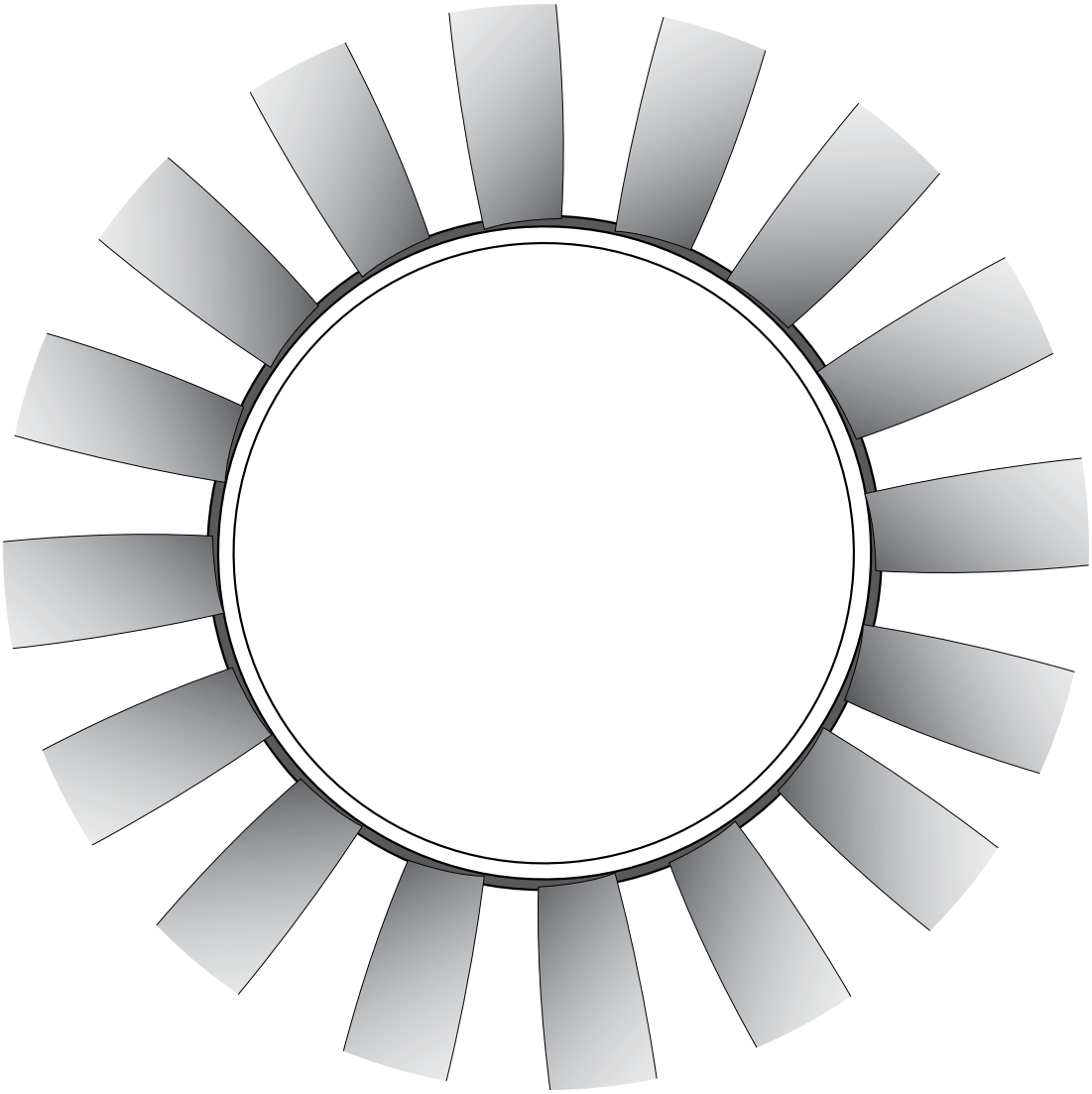
Table 13. Troubleshooting (Motor)

Symptom	Cause	Solution
Vibration and noise	Armature unbalance Loose hold-down bolts	Replace armature Tighten
Motor laboring	Low or high voltage	Check supply voltage
High temperature	Overload	Clean dirt from windings per XIII Preventive Maintenance
Armature rubs against stator	Worn bearings	Replace bearings
Power to motor but motor doesn't run	Commutator brushes on d-c motor worn or not seated under proper tension	Clean or replace bushes
	Too much or not enough lubrication in bearings	Clean and regrease
Low insulation resistance	Moisture	Check resistance with megohm meter

Appendix D

Axial Fan Installation Guidelines

Not Recommended / Recommended	Not Recommended / Recommended
	
	
	
	
	



HowdenBuffalo

2029 W. DeKalb Street • Camden, SC 29020
Sales: 1-800-327-8885
Emergency Service: 1-800-458-FANS
www.howdenbuffalo.com