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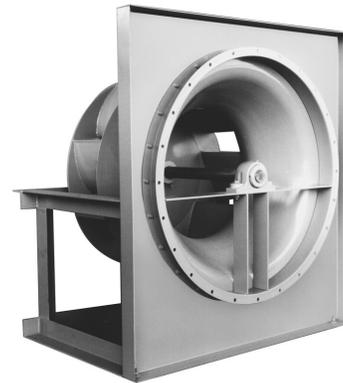
Form 690001

CENTRIFUGAL FANS Series 8100 and 8800 GENERAL PURPOSE AND INDUSTRIAL

INSTALLATION | OPERATION | MAINTENANCE



Typical Series 8100



Typical Series 8800

I. INTRODUCTION

Your Centrifugal Fan is a carefully engineered and constructed piece of machinery which will give long, satisfactory service provided correct installation and proper maintenance practices are observed. This bulletin, along with others for belt drives, motors and/or other accessories which may be furnished as part of your fan, are supplied for your information and guidance. **DO NOT DESTROY AFTER INSTALLATION — RETAIN WITH THE UNIT FOR MAINTENANCE.** Preventative maintenance including periodic inspection, testing, cleaning, lubrication and replacement of worn parts will forestall equipment breakdowns and minimize equipment shut-downs.

In addition to this manual, all fans are shipped with the Air Movement and Control Association (AMCA) Publication 410-90, "Recommended Safety Practices for Users and Installers of Industrial and Commercial Fans". If you did not receive this booklet, immediately contact the factory to obtain a copy or contact AMCA directly. The AMCA Safety Publication 410-90 should be read before installing and operating the equipment to insure safety of personnel and equipment.

II. RECEIVING AND HANDLING

Fans are prepared for shipment according to the Uniform Freight Classification Rules of the carriers. The equipment is carefully inspected before shipment and it is the responsibility of the carrier that it be in perfect condition upon arrival.

When the carrier accepts a shipment and signs our Bill of Lading, the carrier is responsible for any subsequent shortages or damage, evident or concealed, and claim must be against the carrier.

Immediately upon receipt of a shipment, carefully inspect for damage and shortage. If any damage and/or shortage is detected

or suspected, the carrier must be asked to conduct an inspection. The consignee's representative should not accept shipment without a notation on the delivery receipt indicating items not delivered or apparent extent of damage.

When a shipment is opened and damage is found which was not evident externally (concealed damage), it is mandatory that the consignee request an immediate inspection by the carrier. Report damage to the carrier within 15 days. Failure to report damage within the above time limit will cause rejection of a claim.

Promptly file a claim against the final carrier. A claim will not be considered by a transportation company unless presented within nine (9) months from date of receipt of equipment.

WARNING! Fans should never be lifted by the shaft, motor or accessories. These are not designed to support total fan weight and may break causing personal injury or unit damage.

Small, completely assembled units should be handled carefully to avoid dropping or jarring. The units should be lifted only by the base; not by the shaft, wheel, drive, coupling, motor or housing.

Medium sized fans have either four holes in the casing side sheet support angles or separate tabs welded to the casing for lifting and handling.

Large units may be shipped knocked-down (disassembled). Special care is required in handling the individual parts, such as the fan wheels and shafts, to prevent distortion of the components.

Fan wheels and housings which are furnished with special coverings, such as rubber, phenolic enamels, or other protective coatings, should be handled with extreme care as many of these coatings are easily damaged and even a small chipped spot will break the continuity of the coating and destroy its value as a protective covering for the metal.

Fan wheels are carefully balanced to provide smooth operation. If the fan wheel is damaged during handling, it may result in an out-of-balance condition and require re-balancing. If a shaft is dropped or unduly strained, it may be bent which will also result in out-of-balance operation of the fan.

A fan wheel should never be lifted by or allowed to rest its entire weight on the side plates or blades. The fan wheel and shaft assembly can be lifted by slings around the shaft on each side of the wheel so the wheel is supported by its hub. If a chain is used there must be sufficient padding on the shaft and wheel to prevent the scoring of the shaft or injury to the wheel. The chain or cable should be spread with timbers, or braced by some other method to prevent damage to the wheel side plates. If the fan wheel is received separate from the shaft, a support should be placed through the hub for lifting, making sure not to injure the finished bore of the wheel.

All housings which are shipped knocked-down have been completely assembled during manufacture to make certain of proper fit. The various pieces are match-marked to facilitate field assembly.

III. STORING OR LONG TERM SHUTDOWN

Depending upon size, fan equipment may be shipped from the factory either assembled as a unit or as sub-assemblies. The fan manufacturer provides sufficient protection for shipping the equipment to the jobsite. However, if the equipment is not installed and operated within several days, additional precautions are necessary.

Specifications should identify any conditions associated with non-use or storage of the equipment. Precautions may include specifying added protection by the fan manufacturer such as special crating, rust preventative on bare metal parts, special wrapping using tarps, silica gel bags to limit moisture and special covers over the inlets/outlets.

Once the equipment has arrived at the jobsite, but is not installed and placed in operation, the rotor (impeller and shaft) should be rotated by hand periodically to re-coat all lubricated parts with grease and to minimize brinnelling in anti-friction bearings. For assembled fans located in a dirty/moist/cold location, the equipment should be covered and bearings filled with grease to minimize contamination from outside elements. Before start-up, make sure all excess grease is purged out. Stored motors should follow the specific instructions of the motor manufacturer.

The factory does not recommend use of any plastic to cover equipment. This type covering can cause excessive moisture, condensation, rusting and equipment damage.

In addition the factory recommends that wheels must be blocked to prevent their being rotated by the wind.

IV. INSTALLATION

A. VARIABLE FREQUENCY DRIVES AND MOTORS

There are occasions when a Variable Frequency Drive (VFD) will cause poor motor performance and possible damage. To avoid these problems, the Company recommends the following:

1. Select compatible motor and VFD converter; if possible, the motor and the converter should be from the same manufacturer or at least the converter selected should be recommended by the motor manufacturer.
2. A motor shaft grounding system should be used to prevent motor bearing damage from eddy currents.

NOTE: The Company will not honor motor warranty claims if the customer fails to follow these recommendations.

B. Foundations

WARNING! Open all disconnect switches, secure in that position and allow all rotating or revolving equipment to stop before removing belt guard, installing or servicing unit. Failure

to do so may result in personal injury or death from electrical shock or rotating parts.

WARNING! The drive motor and V-belt drive components, when supplied with the centrifugal fan, have been carefully selected for this unit's operating conditions as specified. Changing the drive motor or V-belt drive components could result in unsafe operating conditions which could cause personal injury and/or any of the following:

1. Shaft failure
2. Fan failure
3. Bearing failure
4. Excessive belt wear
5. Motor overload

Fans and motors or other drivers should be mounted on substantial foundations. Concrete is normally the best foundation, although substantial steel frame supports may be used.

The possibility of noise and vibration being present and transmitted through the building is reduced with a substantial foundation. The equipment should be leveled on the foundation and securely held in place by suitable anchors or bolts.

Sleeves in concrete foundations are desirable to permit adjustment of hold-down bolts. If shims are used, they should straddle the mounting bolts and be very firmly held.

When flexible mountings are used it is very important to support the equipment so that its operation is not impaired. This is too frequently ignored and yet without rigid mechanical support the purpose and intent of the isolation is defeated. This is particularly true of belt driven fans, where it is essential that the fan and its motor be mounted on a common rigid base which can then be isolated from the building structure, as a single unit. Since the fan and its motor each operate at its own separate and distinct frequency, they must be bolted to a heavy connecting member to prevent drive distortion and assure smooth operation.

C. Housing Assembly

Self-contained units need only to be securely mounted in a level position on a good substantial foundation with V-belts, sheaves or couplings aligned. However, it is advisable to check the condition of the bearings, fan wheel, vane control mechanism, if any, and coupling.

Larger apparatus may be shipped knocked-down for ease of handling. Housing parts are match-marked to facilitate assembly. Assembly procedure will vary with different sizes of fans, but in general the housing should be assembled first, followed by installation of the wheel with shaft, housing inlet, bearing bases and bearings. In some cases the fan wheel either with or without the shaft installed may be set in the partially assembled housing easier than it can be installed later in the completed housing. Most housings are designed with the inlet removable to permit installation of the wheel and shaft through this opening.

D. Convertible

Some fans designated as having "convertible" housings are designed so the direction of discharge can be changed easily in the field.

To change the discharge of convertible fans:

1. Support the housing with a sling or by blocking. Remove the bolts fastening one or both supports to the housing.
2. Rotate the housing to the desired position.
3. Replace bolts.

E. Fan Wheels and Fan Wheel Types

All fan wheels are balanced before shipment. They should fit the shaft snugly. The key should fit both the fan hub and shaft

snugly, and the set screws should be tightened to the appropriate torque.

Rotation of the fan equipment and its corresponding fan wheel is designated as clockwise or counter-clockwise viewing it from the drive side. Single inlet fans are always considered as having the backplate side (or side opposite the inlet) the drive side (even though they may be arranged to drive from the inlet side).

For correct performance, it is essential that a fan wheel of corresponding rotation be assembled in a given housing, and also that the fan wheel be rotated in the proper direction. This can be determined from the fact that correct rotation of a centrifugal fan wheel is always in the direction leading from the "cut-off" (shortest radius of the housing) around the housing scroll towards the outlet. Rotation of a fan wheel where the blades are carried on a spider is easily determined from the fact that the supporting spider or arms are on the back of the blades. The correct rotation being in a direction away from the supporting arms or spider.



Series 8100/8800 Backwardly Inclined Airfoil Bladed

F. Erection of Heavy Duty Fans

For large heavy duty equipment and fans shipped knocked-down, it is recommended that the installation be supervised by an experienced fan erection mechanic.

G. Bearings

Depending upon bearing speed required, anti-friction bearings are either grease lubricated at the factory or supplied with oil cups for oil lubrication. Appropriate bearing manufacturer's instruction for mounting and maintenance of the bearings are supplied in the instruction envelope for the bearings used.

If the bearings are received separate from the fan or if they are removed from the fan for any reason, be sure to keep them clean and free from dirt and other contaminants.

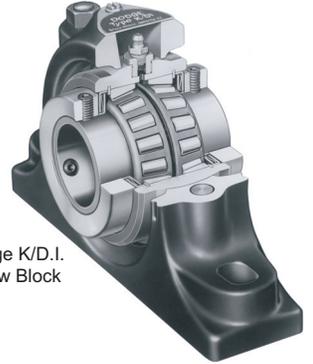


LB22400 Series

LB6800 Series



Fafnir RAS



Dodge K/D.I. Pillow Block



Dodge SC/SCM

H. Alignment

Bearing alignment is critical even on many ball and roller bearings designated as "self-aligning". On all bearings, if the dust and dirt seals are built into the bearing housing and not part of the race or journal assembly, alignment should center the shaft within one-half the normal radial clearance at the edge of the housing, to prevent excessive dust seal wear and possible shaft scoring.

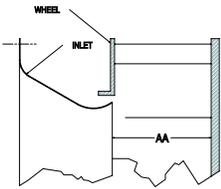
I. Locking Devices (Bearing Collars)

Most bearings have locking devices to insure against the shaft turning inside the inner bearing race and to limit end play. Eccentric type collars should be turned in the direction of shaft rotation until tight prior to tightening the set screws. Locking devices should be tightened only after the bearings have been properly aligned. The locking collars may be on the inside or outside of the bearings, depending on the design of the equipment. In all cases the collars must be both inside or both outside, to prevent movement of the shaft. Any replacements should be on the same side as with the original equipment.

J. Wheel/Inlet Installation

The wheel/inlet relationship on commercial and industrial fans is important if optimum performance is to be obtained. The inlet should be centered within the wheel radially. On backwardly inclined and airfoil fans the inlet fit distance (AA) is measured from the inner edge of the inlet bell to the backplate of the wheel. Radial bladed fans may not have a backplate. For ease of installation, the inlet fit distance is measured from the outside plane of the inlet to either the edge of the hub (H) or to the backplate (B) depending upon wheel type.

K. Detail of Wheel/Inlet Installation



Series 8100 and 8800

Series 8100 and 8800 (AA)					
Size	in	mm	Size	in	mm
18	6.34	161.0	40	13.82	351.0
20	6.97	177.0	45	15.25	387.4
22	7.68	195.1	49	17.06	433.3
24	8.54	216.9	54	18.45	468.6
27	9.42	239.3	60	20.56	522.2
30	10.46	265.7	66	22.64	575.1
33	11.50	292.1	73	25.12	638.0
37	12.54	318.5	81	27.75	704.9

NOTE: Inlet clearances apply to SW and DW fans except for Series 8800.

L. Drives

Sheaves should be firmly locked in position and the key should fit tightly. Alignment is correct when the fan and motor shafts are parallel and belts are perpendicular to the shaft. A straight edge or taut cord may be used to line up the sheaves. Belts should be under light tension and should feel "live" when thumped. Belts should deflect slightly under light pressure. Excessive tension should never be applied since it will damage the cords and shorten the life of the belts. Never pry the belts over the rim of the sheave, but slack off on the take-up bolts until the belts can be slipped over the rim of the sheaves. Prying the belts over the rim of the sheave may break the cords and shorten the life of the belts and may possibly damage the fan.

M. Couplings

Couplings on units shipped assembled are carefully aligned at the time of assembly. To prevent possible strains and damage in shipment, the coupling bolts, pins or flexible members are disconnected, or may be removed and shipped separately.

When assembling, carefully check the alignment of the coupling and make corrections if necessary. Sometimes, handling during transportation will throw the coupling out of line.

Accurate alignment can usually be obtained by holding a straight edge across the adjoining flanges (or by means of a dial indicator) at four equal positions around the circumference and adjusting the coupling halves until they are parallel and concentric. The clearance between the faces of the couplings can be equalized at four equidistant points by checking with a tapered thickness gauge. For best results angular alignment should be within one degree on most commercial type couplings. Shafts should be centered within .003" (.076 mm).

Flexible couplings should be adjusted so that end thrust caused by the fan is not transmitted to motor bearings. Also, where the drive is by steam turbine or large motor, final alignment of the coupling should be made when the driving motor or turbine is hot, to take apparatus expansion into account.

N. Fan Pre-Operating Checklist

Without exception, Acme recommends that all fans include applicable guards and safety devices. Equipment ordered without the applicable safety devices is clearly the responsibility of the purchaser. Further, the purchaser warrants that he has determined and acquired any and all safety devices required for equipment sold by Acme.

Before putting the fan into operation, remove any shipping wire or blocking holding the wheel and turn it by hand to be sure it is

free and not rubbing against the casing or inlet. Check for tightness of the wheel on the shaft. Be sure bearings are lubricated and in alignment. Check tightness of bearing collars as they may loosen during shipment. Check coupling, belts or applicable drive for alignment. Apply power momentarily to assure correct rotation.

Factory mounted motors on fans may shift during shipment requiring check of V-belt alignment and tension. Re-position the motor for proper alignment and belt tension if necessary. For centrifugal fans re-position the motor on its base to take care of belt tension.

Check wheel rotation when starting the unit to be sure it conforms to the direction of the rotation arrow on the casing.

Check bearing hold-down bolts, bearing set screws and sleeve adaptors for tightness. Be sure to check the bearing for lubrication. See the included bearing instruction book for details.

SET SCREW TIGHTENING SCHEDULE

1. Before initial operation of the fan, tighten set screws according to the procedure outlined below.
2. After 500 operating hours or three months, whichever comes first, tighten set screws to the full recommended torque.
3. At least once a year, tighten set screws to the full recommended torque.

PROCEDURE FOR TIGHTENING SET SCREWS IN BEARINGS AND HUBS

One Set Screw Application

Using a torque wrench, tighten the set screw to the torque recommended in Table 1.

Two Set Screw Application

1. Using a torque wrench, tighten one set screw to half of the torque recommended in Table 1.
2. Tighten the second set screw to the full recommended torque.
3. Tighten the first set screw to the full recommended torque.

The operation of the vane control should be checked before the fan is started to make sure that all links are free, that the operation is smooth, and that there is no distortion of the casing to cause any binding. See the vane control installation manual for details.

Table 1. Recommended Tightening Torque for Set Screws

Set Screw Diameter	Torque (in-lbs)
#10	35
1/4	80
5/16	126
3/8	240
7/16	384
1/2	744
9/16	1080
5/8	1500
3/4	2580
7/8	3600
1	5400

V. INSTALLATION CHECKLIST

- A. Read AMCA 410-90 which is shipped with the fan.
- B. Comply with all Federal, State and local codes and regulations.
- C. Always utilize trained and experienced personnel.
- D. Always use safe and inspected tools and equipment.

- E. All drive and inlet/outlet guards are installed properly.
- F. Fan accessories and motor are properly wired and fan is isolated from causing a shock.
- G. Location for fan is completed and ready to accept fan upon arrival.
- H. Cranes, tools and equipment needed for installation are available.
- I. Properly trained personnel are available and prepared to handle fan.
- J. Locate identifying paperwork such as Packing List and Bill of Lading.
- K. Compare paperwork with items being received for proper items and quantity.
- L. Inspect fan for damage such as dents, scrapes, bent shafts, broken parts, etc. Inspect carefully if signs of abuse during transit are obvious.
- M. Notify carrier in writing of any problems immediately.
- N. Notify Acme of any discrepancies or damage and what has been done to correct it.
- O. Read nameplate and identify fan and jobsite location. Compare with jobsite paperwork.
- P. Verify all parts are present, properly assembled and in working order.
- Q. Verify proper discharge and rotation.
- R. If fan is assembled, verify that the wheel and shaft turn freely without noise and appear to be balanced.
- S. Verify that bearings have been lubricated. Verify that coupling, if supplied, is lubricated.
- T. Verify nameplate data once again. Be sure the correct fan is on the correct application.
- U. Housing Interfaces
 - 1. Verify all tie-down bolts are tight. Verify motor is tied down and adjusted.
 - 2. Verify access doors, drains and other accessories are attached and connected properly.
 - 3. Verify all guards and safety items are in place and adjusted.
 - 4. Verify all ductwork is in place and is not resting on the fan.
- V. Wheel
 - 1. Verify that the wheel is the correct rotation and in accordance with specifications.
 - 2. Verify wheel is free to turn. Adjust if necessary. Check for inlet spacing around the wheel.
 - 3. Check set screws in hub for tightness to shaft. Check wheel for looseness.
 - 4. Check key for tightness.
- W. Shaft/Bearings
 - 1. Verify shaft appears straight and key is in both ends.
 - 2. Verify bearings are lubricated, set screws or locking collars are tight. Check bearing mounting bolts for tightness.
 - 3. Verify seals and/or cooling wheels are adjusted and properly assembled.
 - 4. Verify fan is aligned properly.
- X. V-Belt Drives
 - 1. Verify fan sheave is on fan and motor sheave on motor and are not switched. Set screws are tight.

- 2. Verify fan and motor sheaves parallel.
- 3. Verify fan and motor sheaves aligned and adjusted to proper diameters if variable speed.
- 4. Verify belts tensioned according to specifications. All belts loaded equally and matched.
- 5. Verify all guards are in place and adjusted.

Y. Direct Drives

- 1. Verify coupling is assembled properly and lubricated. Refer to coupling instructions.
- 2. Verify coupling/fan shaft/motor shaft are aligned properly. Refer to coupling limits.
- 3. Verify allowances have been made for thermal expansion of high temperature fans.
- 4. Verify coupling has been dynamically balanced when used on high speed equipment.

Z. Accessories

- 1. Verify all dampers, inlet vanes or other controls are in working order.
- 2. Verify motor is wired to correct voltage. "Bump" to verify rotation is correct.
- 3. Make sure all tools, personnel and debris are removed from fan/system.

VI. START-UP OPERATION CHECKLIST

Before putting any fan into initial operation the above instructions must be followed. In addition, the following check list must be completed.

- A. Lock out the primary and all secondary power sources.
- B. A complete inspection shall be made of all of the ductwork and the interior of the fan. Make certain there is no foreign material which can be drawn into or blown through the fan or ductwork. Eyes should be protected against undetected foreign material through the use of safety goggles or other appropriate means.
- C. Make sure the foundation or mounting arrangement and the duct connections are adequately designed in accordance with the recognized acceptable engineering practices and with Acme's recommendations.
- D. Check and tighten all hold-down (securing) bolts.
- E. Check the fan assembly and bearings for proper grounding to prevent static electricity discharge.
- F. Spin the impeller to determine whether it rotates freely and is not grossly out of balance.
- G. Inspect impeller for proper rotation for the fan design.
- H. Check all set screws and tighten.
- I. Check belt drive or coupling alignment; use recommended belt tension.
- J. Check the belt drive for proper sheave selection and make sure they are not reversed (excessive speeds could develop).
- K. Properly secure all safety guards.
- L. Secure all access doors to the fan and ductwork.
- M. Momentarily energize the fan to check the direction of rotation.
- N. Switch on the electrical supply and allow the fan to reach full speed. Check carefully for:
 - 1. Excessive vibration
 - 2. Unusual noise
 - 3. Proper belt alignment

4. Proper lubrication
5. Proper amperage and voltage values

If any problem is indicated, SWITCH OFF IMMEDIATELY. Lock out the electrical supply, secure the fan impeller if there is a potential for windmilling (impeller turning due to a draft through the system). Check carefully for the cause of the trouble and correct as necessary.

Even if the fan appears to be operating satisfactorily, shut down after a brief period and re-check items 1 through 5 below as the initial start up may have loosened the bolts and set screws.

The fan may now be put into operation, but during the first eight hours of running it should be periodically observed and checked for excessive vibration and noise. At this time, checks should also be made of motor input current and motor and bearing temperatures to ensure that they do not exceed Acme's recommendations or the motor/bearing manufacturer's recommendations.

After eight hours of satisfactory operation, the fan should be shut down to check the following items and adjust, if necessary (lock-out power and prevent windmilling).

1. All set screws and hold-down bolts
2. Drive coupling alignment
3. Belt drive alignment
4. Bearing housing temperature
5. Belt drive tension

After twenty-four hours of satisfactory operation the fan should be shut down (power locked out) and the drive belt tension should be re-adjusted to recommended tension.

Record fan nameplate information below for permanent records:

Size:

Fan Designation:

Max. RPM:

Max. Temp:

Serial #:

VII. GENERAL OPERATION AND MAINTENANCE

The fans are balanced at the factory before shipping. The vibration level of the fan installed on site is not the responsibility of ACME unless specified in the purchase contract.

ACME requires that the fans are operated within safe limits of vibration (see the table).

Due to the transport, installation, and seismic environment of the fan the vibration levels may change after fan installation. Therefore, the test run with measurement of vibration levels for all new commissioned fans is required. This step will also establish a baseline for future predictive maintenance. It is common case that the fans require trimbalancing to achieve the vibration at or below the start-up level (see the table).

Periodic vibration measurements are required for fans in operation. During operation of the fan, the vibration level will increase with time due to wear and other accumulated effects. The increase of vibration level is reasonable and safe as long as the level does not reach alarm levels.

If the vibration increases to the alarm level, action should be taken to determine the cause. Operation of the fan at this condition should be carefully monitored and steps for eliminating the cause of the increased vibration should be developed within a limited time.

If the vibration level increases to the shut-down level the fan should be taken out of operation. Failure to reduce the vibration over the shut-down level could lead to bearing failure, development of cracks in fan structure, or ultimately a catastrophic failure of the fan.

Furthermore, fans should be checked for vibration levels if the fan sheave, bearings(s), and/or wheel were removed from the fan shaft or the fan was moved from its installation position.

These requirements are in accordance with ANSI/AMCA204 Standard "Balance Quality and Vibration Levels for Fans" where details on the subject can be found.

Vibration Limits for Measurements Conducted On-Site		
Values shown are peak velocities of in./sec, vibration analyzer filter-out		
Condition	Fan rigidly mounted	Fan flexibly mounted
Start-up	0.25 in./s	0.35 in./s
Alarm	0.40 in./s	0.65 in./s
Shut-down	0.50 in./s	0.70 in./s

The vibration measurement has to be made on the housings of the fan bearings

It is advisable to keep a record of vibration measurements in any case but the record is required for warranty claims.

Maintenance should always be performed by experienced and trained personnel. Do not attempt any maintenance of a fan unless the electrical supply has been locked out or tagged out and the impeller has been secured.

Fan wheels having badly worn blades should be replaced or rebuilt. Rebuilt or repaired (including hard metal surfacing) fan wheels require careful balancing before being returned to service. Experienced personnel can give the wheel a running balance operating on its own shaft and bearings.

Standard fans handling corrosive fumes should have the internal parts wire brushed, scraped clean and then painted with an corrosion-resisting paint. This process should be repeated when the paint film begins to show signs of deterioration.

When a V-belt must be replaced, replace the entire set of belts as new belts will not work properly in conjunction with used belts, due to the difference in length.

Good fan maintenance consists of systematic and regular inspection, testing, care and adjustment, together with the repair or replacement of worn parts before failure occurs. Experience will best determine the frequency of the various maintenance operations, since the requirements will vary widely, depending upon the severity of the application and local conditions. However, once a schedule of maintenance operations has been set up, it should be carefully adhered to for best results.

The successful operation of a fan depends to a large extent on the reliable operation of the bearings and the balance of the fan wheel.

A. Bearings

Bearings require maintenance and attention whether in storage or operating. All assembled fan bearings are pre-lubricated at the factory according to the bearing manufacturer's instructions. All bearings should be inspected prior to start-up to insure the fan turns freely. Check the bearings after a short interval of operation, to be certain they are not overheated. Retighten bearing set screws after 300 hours of fan operation.

Split pillow block ball or roller bearings are lubricated at the factory to the bearing manufacturer's instructions. However, if fans are to be stored in a damp, dusty and/or corrosive atmosphere the bearings should be filled completely with grease to keep contaminants out of the bearing cavity. Before start-up be sure the bearings are cleaned and re-lubricated following the instructions of the bearing manufacturer. Oil lube bearings are lubricated at the factory. Before use, clean the bearings with oil and lubricate according to the bearing manufacturer's instructions.

Bearing manufacturer's instructions are provided with each assembled fan in the instruction envelope attached to the fan.

Motors should be lubricated in accordance with the manufacturer's instructions.

B. Vibration Causes

All wheels are statically and dynamically balanced at the factory and alignment is checked. If vibration is noticed, check the following:

1. Bearing and drive alignment
2. Shaft straightness
3. Wheel or sheave loose on shaft
4. Loose or worn bearings
5. Loose mounting bolts
6. Motor out of balance
7. Sheaves out of balance
8. Worn or corroded wheel
9. Accumulation of material on wheel
10. System design problems - One frequent system problem is too high of a static pressure for the fan ordered. In other words, the actual system pressure turns out to be higher

than the pressure assumed at the time the fan was ordered. This leads to the fan operating in the stall region, which can cause excessive vibration and eventual failure of the fan.

WARNING! Care must be taken when cleaning the wheel to remove grease and other foreign particles. Damage to the wheel can occur if it is hit or if pressure is applied causing the wheel to be distorted. Either case can cause serious vibration and damage to the fan.

In the case of accumulated paint spray, the wheel may be removed and cleaned in accordance with the paint manufacturer's instructions for both the coating applied and the underlying metal.

C. Renewal Parts

When continuous fan operation is vital, it is recommended that spare parts such as bearings, V-belts, and in some cases, wheels be kept on hand for emergencies.

Renewal parts should be ordered from the local sales office. All nameplate data should be provided, such as fan type, size, style and serial number. Describe the part accurately and if the equipment appears to be special, or if there is any doubt as to the description, include a dimensional sketch of the part required.

TERMS AND CONDITIONS OF SALE

ACCEPTANCE All orders and sales are subject to written approval and acceptance by an executive officer of Acme Engineering & Manufacturing Corporation at Muskogee, Oklahoma, (the "Company") and are not binding on the Company until so approved.

DELIVERY All shipping and delivery dates are estimated only. No delays in delivery will subject the Company to any costs, damages or fees for late delivery. Delivery of the products herein specified shall be made F.O.B. point of shipment, unless otherwise stated. The Company shall not be liable for delay due to causes beyond its reasonable control, such as Acts of God, acts of the purchaser, acts of civil or military authorities, priorities, fires, strikes, floods, epidemics, war, riots, delays in transportation, car shortages, and inability, due to reasons beyond its reasonable control, to obtain necessary labor, material, or manufacturing facilities. In the event of such a delay, the date of delivery shall be extended for a period equal to the time lost by reason of the delay.

TERMS OF PAYMENT If, in the judgment of the Company, the financial condition of the purchaser at any time does not justify continuation of manufacture or shipment on the terms of payment specified, the Company may require full or partial payment in advance.

Pro rata payments shall become due as shipments are made. Each shipment or delivery shall constitute a separate sale, and the default of any shipment or delivery shall constitute a separate sale, and the default of any shipment or delivery shall not vitiate the contract as to other shipments or deliveries.

PRICE ADJUSTMENT Prices are subject to change until the Purchaser's order has been accepted by the Company.

SALES AND SIMILAR TAXES The Company's prices do not include sales, use, excise, or similar taxes. Consequently, in addition to the price specified herein, the amount of any present or future sales, use, excise,

or other similar tax applicable to the sale of the product herein shall be paid by the Purchaser, or in lieu thereof the Purchaser shall provide the Company with a tax exemption certificate acceptable to the taxing authorities.

CANCELLATION Any contract resulting from the Purchaser's order may be canceled by the Purchaser only by negotiations and upon payments of reasonable cancellation charges which will take into account expenses already incurred and commitments made by the Company.

DESIGN CHANGES The Company reserves the right to make changes in design, improvements and additions in and to its products any time without imposing any liability or obligations to itself to apply or install the same in any product manufactured by it.

TITLE The title and right of possession of the products sold herein shall remain with the Company and such products shall remain personal property until all payments herein (including deferred payments whether evidenced by notes or otherwise) shall have been made in full in cash and the Purchaser agrees to do all acts necessary to perfect and maintain such right and title in the Company.

PRICE ADJUSTMENTS AND PROTECTION Prices on products manufactured by the Company are firm for shipment up to four months from the date of the original order entry. Such prices are subject to adjustment if shipment is made after four months and up to ten months from the date of the original order entry, if products are shipped ten months from the date of the original order entry, prices will be adjusted to the price in effect at the time of shipment automatically. All complete component accessory material manufactured by others and furnished with the Company's products such as motors, drives, vibration equipment, controls or other completely assembled component structures, are subject to adjustment to the price at time of shipment regardless of the date of original order entry.

SAFETY ACCESSORIES The Company manufactures products designed to serve multiple applications and offers a wide range of safety equipment, including guards and other devices, as may be required to meet customer specifications. Without exception, the Company recommends that all orders include applicable safety devices. Products ordered without applicable safety devices is clearly the responsibility of the Purchaser. Further, the Purchaser warrants that it has determined and acquired any and all safety devices required for products sold by the Company. Weather covers and guards for motor and V-belt drives, couplings, shafts and bearings, along with inlet and outlet screens, are optional accessories noted in the price list.

GOVERNING LAW The rights, obligations and remedies of Purchaser and the Company, the interpretation of these terms and conditions and the sale of products by the Company shall be governed by Oklahoma law, without regard to any principles of conflict of laws.

ARBITRATION Any dispute arising under or in connection with these terms and conditions or the sale of products shall be settled by binding arbitration administered by the American Arbitration Association under its Commercial Arbitration Rules, and judgment on the award rendered by the arbitrator may be entered in any court having jurisdiction thereof. The dispute shall be resolved by one neutral arbitrator who shall have no affiliation with either Purchaser or the Company and shall be selected by the American Arbitration Association office in Dallas, Texas. The arbitration proceedings shall be held in Muskogee, Oklahoma.

APPLICABLE DOCUMENTS The agreement between the Company and the Purchaser relating to the products includes these terms and conditions of sale, any applicable installation and maintenance instructions provided by the Company and any terms appearing on the Company's quotation, sales order acknowledgment and invoice.

WARNING Acme products are designed and manufactured to provide reliable performance but they are not guaranteed to be 100% free of defects. Even reliable products will experience occasional failures and this possibility should be recognized by the Purchaser and all End Users. If these products are used in a life support ventilation system where failure could result in loss or injury, the Purchaser and all End Users should provide adequate back-up ventilation, supplementary natural ventilation or failure alarm system, or acknowledge willingness to accept the risk of such loss or injury.

WARNING DO NOT use in HAZARDOUS ENVIRONMENTS where fan's electrical system could provide ignition to combustible or flammable materials unless unit is specifically built for hazardous environments. Comply with all local and national safety codes including the National Electrical Code (NEC) and National Fire Protection Act (NFPA).

CAUTION Guards must be installed when fan is within reach of personnel or within seven (7) feet (2.134 m) of working level or when deemed advisable for safety.

DISCLAIMER The Company has made a diligent effort to illustrate and describe the products accurately in all Company literature; however such illustrations and descriptions are for the sole purpose of identification and do not express or imply any warranty.

LIMITED WARRANTY

WARRANTY AND DISCLAIMER: the Company extends this limited warranty to the original purchaser and warrants that products supplied by the Company, shall be free from original defects in workmanship and materials for two years from date of shipment (except for the warranty periods noted for products listed below), provided same have been properly handled, stored, installed, serviced, maintained and operated. This warranty shall not apply to products which have been altered or repaired without the Company's express authorization, or altered or repaired in any way so as, in the Company's judgment, to affect its performance or reliability, nor which have been improperly installed or subjected to misuse, negligence, or accident, or incorrectly used in combination with other substances. The Purchaser assumes all risks and liability for results of use of all products.

Evaporative cooling pads are warranted to be free of defects in materials and workmanship for a period of two years from date of shipment provided same have been properly handled, stored, installed, serviced, maintained and operated; and further, not subjected to excessive heat, corrosive agents or chemicals, or mechanical abuse that may cause tearing, crushing or undue deterioration, nor used on a system or in a manner other than that for which it was designed as explained in the product literature.

The following products are warranted to be free of defects in materials and workmanship for the periods shown from date of shipment: Acme's exclusive duplex split pillow block bearings and shaft five years, belts one year, Polyethylene tubing 90 days, AIR40 Heater warranty one year, AIR40 Emitter warranty three years and DDP fan lifetime warranty on its propeller, cone, and housing.

LIMITATION OF REMEDY AND DAMAGES: All claims under this warranty must be made in writing and delivered to P. O. Box 978, Muskogee, Oklahoma, 74402, within 15 days after discovery of the defect and prior to the expiration of two years from the date of shipment by the Company of the product claimed defective, and Purchaser shall be barred from any

remedy if Purchaser fails to make such claim within such period.

Within 30 days after receipt of a timely claim, the Company shall have the option either to inspect the product while in Purchaser's possession or to request Purchaser to return the product to the Company at Purchaser's expense for inspection by the Company. The Company shall replace, or at its option repair, free of charge, any product it determines to be defective, and it shall ship the repaired or replacement product to Purchaser F.O.B. point of shipment; provided, however, if circumstances are such as in the Company's judgment to prohibit repair or replacement to remedy the warranted defects, the Purchaser's sole and exclusive remedy shall be a refund to the Purchaser of any part of the invoice price, paid to the Company, for the defective product or part.

The Company is not responsible for the cost of removal of the defective product or part, damages due to removal, or any expenses incurred in shipping the product or part to or from the Company's plant, or the installation of the repaired or replaced product or part.

The warranties set forth above do not apply to any components, accessories, parts or attachments manufactured by other manufacturers; such being subject to the manufacturer's warranty, if any. To the extent not prohibited by the manufacturer's warranty, the Company shall pass through to Purchaser such manufacturer's warranty.

THE COMPANY'S WARRANTY IS IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, ARISING BY LAW OR OTHERWISE, INCLUDING WITHOUT LIMITATION THE IMPLIED WARRANTIES OF MERCHANTABILITY AND FITNESS FOR A PARTICULAR PURPOSE, WHICH ARE HEREBY EXPRESSLY DISCLAIMED AND WAIVED. THIS WARRANTY CONSTITUTES THE COMPANY'S SOLE AND EXCLUSIVE WARRANTY FOR DEFECTIVE GOODS AND PURCHASER'S SOLE AND EXCLUSIVE REMEDY FOR DEFECTIVE PRODUCTS.

No employee, agent, dealer, or other person is authorized to give any warranties on behalf of the Company or to assume for the Company any other liability in connection with any of its products except in writing and signed by an officer of the Company.

REPLACEMENT PARTS If replacement parts are ordered, purchaser warrants that the original components in which these replacement parts will be placed are in satisfactory working condition, and

when said replacement parts are installed, the resultant installation will operate in a safe manner, at speeds and temperatures for which the original product was purchased.

TECHNICAL ADVICE AND RECOMMENDATIONS, DISCLAIMER: Notwithstanding any past practice or dealings or any custom of the trade, sales shall not include the furnishing of technical advice or assistance or system design. Any such assistance shall be at the Company's sole option and may be subject to additional charge.

The Company assumes no obligation or liability on account of any recommendations, opinions or advice as to the choice, installation or use of products. Any such recommendations, opinions or advice are given and shall be accepted at Purchaser's and End User's risk and shall not constitute any warranty or guarantee of such products or their performance.

LIMITATION OF LIABILITY The cumulative liability of the Company to the Purchaser and any other persons for all claims in any way relating to or arising out of the products, including, but not limited to, any cause of action sounding in contract, tort, or strict liability, shall not exceed the total amount of the purchase price paid for those products which are the subject of any such claim. This limitation of liability is intended to apply without regard to whether other provisions of this agreement have been breached or have proven ineffective even if the Company has been advised of the possibility of such claims or demands. In no event shall the Company be liable to the Purchaser or any other person for any loss of profits or any incidental, special, exemplary, or consequential damages for any claims or demands brought by the Purchaser or such other persons.

INDEMNITY The Company's maximum liability to Purchaser and to any end user is as set forth above. The Company makes no warranty to anyone for any products not manufactured by the Company and shall have no liability for any use or installation of any products (whether manufactured by the Company or other manufacturers) not specifically authorized by this sale. Purchaser acknowledges various warnings by the Company regarding the products and its installation and use. If the Company incurs any claims, lawsuits, settlements, or expenses (including attorney fees) for any loss, injury, death or property damage including, but not limited to, claims arising out of the Purchaser's or any end user's installation or use of the products, the Purchaser shall indemnify and hold the Company harmless.



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