

INSTALLATION, OPERATION AND MAINTENANCE MANUAL

FIBERGLASS EXHAUST FAN CENTRIFUGAL FAN - SERIES HPC AND HPCA

Serial Number: _____

Date Manufactured: _____

Drawing Number: _____

Tag: _____

Reference: _____

Project: _____



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Oct, 2007

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INTRODUCTION

This Installation, Operation and Maintenance manual has been written for you, the Installer, Operator and Maintenance Personnel. The installation, operation and maintenance of these fans should be performed by qualified personnel experienced in such work and equipment. In addition, good general practices should be used for all Harrington fans.

1.1 Safety First

The installation, operation and maintenance of machinery of any kind require a person to be cautious and aware of the dangers that exist. The very nature of airhandling fans and their accessories present a hazard to installation and maintenance personnel because they contain high-speed rotating parts. Because of the necessary application of a fan to its functional purpose, it is not always possible to completely protect the careless worker. The following precautions are very important.

1. Never apply power to the fan motor for any reason until the fan has been completely installed in its system, and the system inspected to be sure that no debris has been left in the ducts, and it is known that the guard at the entrance and the discharge of the air passages are in place. The usual procedure is to padlock the disconnect switch open until the installation is completed and inspected.
2. Start the fan momentarily and disconnect it. Observe rotation of the wheel or the drive to be sure rotation is correct. Do not allow the fan to run backward, except momentarily.
3. Do not open access or inspection doors while the fan is running.
4. Do not block the entrance to or the discharge of the fan or its connection system.
5. Always open the disconnect switch and lock it in the open position with a padlock before doing any service or maintenance work on the fan.
6. Never remove air pressure guards or reach into the wheel unless you have locked the disconnect switch open.
7. Never remove air passage guards or reach into the wheel unless you have locked the disconnect switch open.
8. Never remove and replace the wheel or the sheaves without studying thoroughly the section in the general maintenance sheets covering installation and removal of the taper lock bushings.
9. Never remove or replace the shaft without studying thoroughly the section covering the proper assembly of shaft and bearings in the general maintenance sheets, and particularly the method of securing bearing locking collars.
10. Never pry a belt over the edge of the sheave to remove or replace it. Use the belt adjustment screws or loosen the motor mounting bolts to provide the necessary slack; then re-tighten the new belt according to belt adjustment instructions.
11. Never turn any of the adjustment or mounting screws when the fan is running.
12. Be sure all joints in the air passage system are tight, to prevent leakage of corrosive fumes and vapors.
13. After service of any kind makes certain that all adjustments have been properly made, bushing bolts, mounting bolts and adjustments screw have been properly tightened, belt guard and air passage guards have been replaced, access doors closed, there is no debris in the air passages, and all tools have been removed before unlocking the disconnect switch to place the fan in operation.
14. Be sure you are getting proper pick up at the inlet hoods.
15. Be sure the discharge is connected to a suitable fume scrubber or to the atmosphere in such a way that will not present danger to personnel or property.
16. Make a periodic inspection of the fan wheel, bearings and drive to be sure that corrosion has not set in to weaken them.
17. Where there are signs of corrosion, there is danger of mechanical failure. Corroded parts should be replaced.
18. Always use caution in every maintenance or operational procedure. It is highly recommended that each worker have his own padlock and key, and that he place it on the disconnect switch wired to the fan that he is servicing. Lock the switch in the open position before doing any service or maintenance work.
19. Work safely. Be considerate and aware of those people working with you and around you.

1.2 General Information

1. All parts of the fan equipment have been thoroughly inspected and pre-tested at the factory. Upon receipt of shipment, a complete inspection of the equipment is recommended to determine if any damage was sustained during shipment. If any parts are found to be damaged, a claim should be immediately filled against the freight carrier.
2. It is advisable to have the equipment installed by personnel familiar with the installation of air handling equipment. In most cases, our sales representatives can recommend an acceptable contractor.
3. Check the nameplates and tags on fan motors and bearings for special instructions.
4. The fan should be mounted on vibration isolators, or mounted to a solid surface. When the fan is to be mounted on a platform above the floor, the platform should be thoroughly braced. Always mount fans on a flat, level, rigid surface. Shim the fan where necessary. Installing the fan on an uneven surface will result in miss-alignment and the rotating wheel could strike the inlet cone. After mounting the fan, check for free wheel rotation.
5. Air temperatures in the fan should never exceed 160 deg F unless the material of construction has been designed for a higher temperature.
6. Do not use backwardly inclined airfoil centrifugal fans for material handling applications or in applications where the air stream contains sticky or stringy substances.
7. Fans are constructed of fiberglass reinforced plastic. Care must be taken during handling and installation to prevent damage which may be caused by external stress or shock.

INSTALLATION

2.01 Handling

Some fans are provided with lifting lugs. Others must be handled using nylon straps to protect the fiberglass surfaces. Handle your equipment with care. Centrifugal fans should be lifted using one step under the fan scroll and another strap around the bearing base.

CAUTION: NEVER LIFT CENTRIFUGAL FANS BY THE FAN SHAFT, INLET OR FLANGES.

2.02 Storage

If fans are stored for an extended period, store them in a clean, dry location to prevent rust and corrosion. If outdoor storage is required, they should be protected from the elements. Cover the fan inlet and outlet. Keep the bearings, shaft, drives and motor dry and clean.

CAUTION: TO PREVENT BEARINGS FAILURE FAN WHEEL MUST BE ROTATED ONE FULL REVOLUTION AT LEAST ONCE A WEEK

2.03 Installation

The fan should always be mounted on vibration isolators or a solid surface. Shim the fan as necessary to assure proper alignment and smooth operation. After installation, check for free wheel rotation and proper clearance between the inlet cone and fan wheel. Since the material of construction of the fan components are fiberglass, it is possible to distort the fiberglass components.

2.04 Stack Support

It is recommended that stacks be mounted to the fool using guy wire to prevent movement. Avoid mounting the stack on the fan flange. This will prevent the fan from twisting or being deformed. Use flexible duct connections whenever possible to isolate the vibration from the fan to the stack.

2.05 Duct Connections

Duct connections should be independently supported and never be supported by the fan flanges. Use a flexible duct connector to isolate vibration from the fan to the stack.

2.06 Scroll Drain Connection

The fan housing includes a (1) inch threaded hole designated as a scroll drain fitting. This is located at the lowest possible point in the fan scroll housing. This must be connected to a drain line since condensate and moisture will collect in the fan scroll housing. This must be connected to a drain line since condensate and moisture will collect in the fan scroll housing. This should also include a short trap to overcome the negative vacuum in the fan housing during operation. Usually, the trap height should be greater than the total fan static pressure.

2.07 Access Doors

The HPCA fan can include a bolted access door as an option. If one was not included, include access doors in the duct work just ahead of the fan inlet and behind the fan outlet. This will allow wheel inspection and maintenance.

CAUTION: Do not open access doors with the fan running.

2.08 Fan Inlet Conditions

For optimal fan performance, include at least two duct diameters of straight duct on the fan inlet. The inlet duct should be the same diameter as the fan inlet. Avoid turns in the duct inlet and outlet duct closer than one duct diameter away. If an ideal inlet condition can not be provided, an inlet box may be helpful. Contact HEE for this option.

2.09 Preoperative Instructions

1. Rotate the fan wheel by hand to check for free rotation and any shifting of the wheel which might have occurred during shipment and installation. See figure 1 for the relationship between the inlet cone and the fan wheel. If necessary, slide the wheel into correct position. Correct minor rubbing between the inlet cone and the fan wheel by placing addition shims under the fan. Alternately, loosen the attaching hardware on the front stand and move the inlet cone into proper position (the gap should be even) using a rubber mallet.

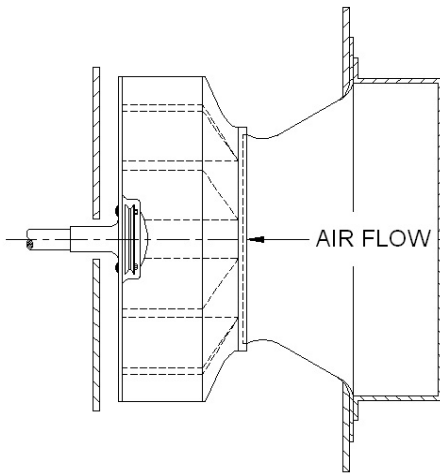


Figure 1 Inlet Cone and Wheel Fit up

2. Check belt tension and belt and sheave alignment (See Belt and Sheave Installation Section)
3. Assure that all bolted connections are tight
 - a. Check tightness of any flanged connection bolts.
 - b. Check tightness of adjustable motor base bolts.
 - c. Check tightness of set screws in motor and fan pulleys sheaves. **IMPORTANT!**

- d. Check tightness of set screws in bearing locking collar.
- e. Check tightness of bearing mounting bolts.

2.10 Electrical Connections and Wiring

Check power supply to make certain that voltage, frequency and current carrying capacity are in accord with the motor nameplate. Motors with nameplates stamped 208-220/440 volts may be operated on 208, 220, or 440 volts lines. When such a motor is operated 208 volts at the motor terminals, the motor will deliver approximately 11% (eleven per cent) less locked motor and breakdown torques and draw up to 4% (four per cent) more line current at rated load as compared to operation with 220 at the terminals.

The motor will perform satisfactorily on voltage variations of 10% (ten per cent), or frequency variations of 5% (five per cent) of the nameplate rating, or a combined voltage and frequency of 10% (ten per cent). The preceding variations do not apply to the 208 volt rating of motors with a nameplate stamped 208-220 440 volts.

Connect the motor to the power supply according to the diagram on the connection plate. Connections should be clean and tightly bolted.

2.11 Overload Devices

An over load device must be installed between the motor and the current supply to protect against an under voltage condition and motor overload. Consult the motor nameplate for the correct motor current.

NOTE: When sizing overload heaters, conditions under which the starters will operate must be considered. Enclosed starters should have heaters one size larger than open starters. Where enclosures are subject to external heat, such as radiant heat from the sun or heat accumulation under a roof, it may be necessary to increase the size even more. Experience with the operating conditions and measurement of the actual line current will aid in proper sizing of heaters.

2.12 Fan Wheel Rotation

Momentarily start the blower motor to check for correct rotation as indicated by arrow on the fan outer shell. Fan wheel must rotate in the direction indicated by the arrow on the outside of the casing. If the arrow has been removed, determine the fan rotation from the drive end, or consult the factory.

If fan wheel rotates in opposite direction, check motor manufacturer's wiring instructions and re-wire accordingly. To reverse the direction of rotation of a three phase motor, interchange any two of the line wires to the motor leads. Two phase motors are reversed by interchanging T-1 and T-3 or T-2 and T-4.

2.13 Motor Amperage

After all accessories have been installed, clean out the duct work and fan electrical power can now be applied. At the time, with the air system completed and in full operation and all ducts and guards

attached, checks the operating amperage of the motor compared to the nameplate full load amps. Do not operate the fan unit with the motor overloaded as this may ruin the motor and void motor manufacturers warranty.

2.14 Fan Vibration

The fan should not require balancing, as it was balanced at the factory before. Several things may cause vibration, such as rough handling in shipment and installation, weak foundations, alignments and operating the fan at the unstable portion of the fan curve. It is recommended that the vibration levels be checked with the vibration analyzer to assure that the levels do not exceed those indicated per Table 1. Vibration readings should be taken on the fan bearings, taking readings in the horizontal, vertical and axial position.

RPM UP TO:	600	900	1200	1800	3000	3000+
ACCEPTABLE	2.5	2.0	1.5	1.0	0.6	0.5
TOLERABLE	4.0	3.0	2.4	1.8	0.75	0.65
CORRECTION INDICATED	6.0	4.7	3.5	2.6	1.3	1.0
IMMEDIATE CORRECTION	12.0	9.0	7.0	5.0	2.3	2.0

Table 1- Vibration Severity Chart (peak-to-peak vibration in mils at various RPM'S)

2.15 Final Check and Re-Check

Check operation of the fan carefully during initial start-up. If excessive vibration is evident, shut fan off immediately, and determine the cause. Do not operate fan until the source of vibration has been eliminated. Re-check all bolts and set screws in one hour and again after 24 hours of operation. Re-check belts tension and make necessary adjustments. After all pre-operative inspection checks have been completed, the unit is ready for operation.

OPERATION

3.1 Wheel Design

The HEE backward inclined Airfoil wheel is the result of years of design and experimentation. This unique Airfoil blade is a composite structure consisting of a premium grade vinyl ester resin fiberglass exterior and a high density light weight interior. This modern construction provides excellent chemical resistance to a wide variety of corrosive chemicals and is practically impervious to most chemicals. This light weight construction and unique Airfoil profile shape allows operation at higher wheel tip speeds up to Class III construction with out distortion or bond separation and allows static pressure up to 18 inches water column. The Airfoil wheel design extremely high static efficiencies and the HEE backward inclined Airfoil wheel achieves static efficiencies up to 83% (eighty-three per cent).

3.2 Fan Performance

The HEE HPCA series centrifugal Airfoil fans are licensed to bear the AMCA seal. The ratings shown are based on test and procedures performed in accordance with AMCA Publication 211 and comply with the requirements of the AMCA Certified Rating Program. The performance tables for the HPCA Airfoil fan are published in the HPCA 300Bulletin. A fan curve can be provided for your application. Sound information is also available from HEE. This data is the result of laboratory testing based on a reverberant room as described in AMCA Standard 300 and processed by the procedures shown in AMCA Bulletin 301.

3.3 Non-Overload Wheel Design

The backward inclined airfoil wheel blades provide a non-overloading performance characteristic allowing the brake horsepower to level off at a point where motors can be economically selected so they will not overload if the system pressure changes.

3.4 Maximum Tip Speed

The maximum safe operating tip speed for Class I, II and III is 10,000, 14,000 and 17,000 feet per minute.

IMPORTANT: Before increasing the fan RPM, contact HEE for the maximum safe operating tip speed of your fan.

IMPORTANT: Do not use backwardly inclined Airfoil centrifugal fans for material handling applications or in applications where the airstreams contains sticky or stringy substances.

MAINTENANCE

4.01 Wheel Maintenance

Inspect wheel and blades for buildup and wear at least every three months, or as required for your application. If a crust or scale buildup has begun on the wheel, fresh water with a course rag or a soft brush will easily remove this buildup. This step will assure the precision static and dynamic balance of the wheel. Buildup and wear can cause excessive vibration which will lead to damage of the impeller and other fan components. The airfoil shaped blade is susceptible to build up and should not be used for material handling applications.

4.02 V-Belt Drive Inspection

Inspect the V-belt drive for proper alignment, tension and excessive wear.

4.03 Wheel and Shaft Assembly

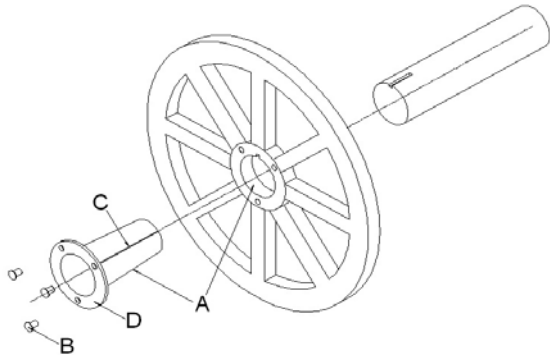
HEE wheels are furnished with split taper bushings for mounting the wheel to the shaft. When properly assembled, the bushing grips the hub of the wheel with a positive clamping action.

The bushing barrel and bore of wheel hub are tapered. This assures concentric mounting and a true running wheel.

Cap screws when tightened lock bushing in wheel hub. Use plated cap screws threaded full length.

Bushing is slit so that when the locking cap screws force bushing into tapered bore, the bushing grips the shaft with a positive clamping fit. This will withstand vibration and pushing loads without being loosened.

Wheel and bushing assembly is keyed to shaft and held in place by compression – this gives added driving strength.



4.04 Wheel Removal from Shaft

Remove fiberglass cap from center on the inside of the wheel.

Remove all cap screws from wheel and hub assembly.

Start cap screws into the threaded holes in the bushing flange.

Tighten each bolt part of a turn successively to force the wheel off the bushing.

Pull the bushing off the shaft. If the assembly has been in place some time it may be necessary to use a wheel puller to remove the bushing. Never use a wheel puller on the wheel.

4.05 Installing Wheel to Shaft

Put bushing loosely into wheel. Do not press or drive. Start cap screws by hand, turning them just enough to engage threads in tapped holes on wheel. Do not use a wrench at the time. The bushing should be loose enough in the wheel to move slightly.

Be sure shaft and key way are clean and smooth. Check key size with both shaft and bushing key ways. Slide wheel and bushing assembly onto shaft, making allowance for endplay of shaft to prevent rubbing. Do not force wheel and bushing onto shaft. If it does not go on easily, check shaft, bushing, and key sizes.

Tighten cap screws progressively with wrench. Do this evenly by taking a partial turn on each cap screw successively until all are tight. These cap screws force the taper bushing into the hub which in turn

compresses the bushing onto the shaft. This makes a positive clamping fit.

Replace fiberglass cap and attach it to the wheel using fiberglass resin, glass and catalyst.

WARNING: Do not attempt to pull bushing flush with hub end – there should be 1/8" to 1/4" clearance when tightened.

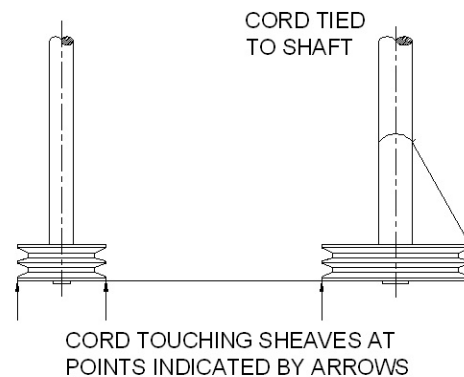
4.06 Installation of Sheaves

Make sure the bore of the sheaves and tapered cone surface of the Sure-Grip bushing are free of all foreign substances such as paint, dirt and lubricants.

Place bushing into sheave. Loosely insert the cap screws into the assembly. Do not lubricate the cap screw threads.

With key in key seat of shaft, slide the sheave/bushing assembly to its desired position with cap screw heads to the outside. (A few small sheaves may have to be installed with the cap screws on the inside.) If the bushing is hard to slide onto the shaft, wedge a screwdriver blade into the screw cut to overcome the tightness.

Align sheaves with a straight edge or a piece of string. If the sheaves are properly lined up, the string will touch them at all points across the sheave. Rotate each sheaves a half a revolution to determine whether the sheaves in installed correctly. With the sheaves aligned, tighten the cap screw evenly and progressively.



4.07 Removal of Sheaves

Release bolt tension, remove bolts. Loosen and remove cap screws.

Insert cap screws into tapped removal holes and progressively tighten each one until mating part is loose on bushing.

Remove mating part from bushing and, if necessary, bushing from shaft. If bushing won't slip off shaft, wedge screwdriver blade into saw cut to overcome tightness.

4.08 Adjusting Variable Pitch Sheave

HEE belt driven fan may be furnished with variable-pitch motor sheaves. Sheaves may be adjusted for lower fan speeds without concern of over-loading motors. When adjusting sheaves to increase fan speed, check motor current to be sure motor is not overloaded. Keep motor current within nameplate and service factor ratings.

The following steps should be taken to adjust the pitch diameter:

Remove power from the fan motor and lock the disconnect.

Release belt tension and remove belt or belts from sheaves.

Loosen setscrew and remove key holding adjustable half of the groove.

Screw adjustable half of sheave out for a smaller pitch diameter (decreased speed), or in for a larger pitch diameter (increased speed). Each one-half turn will change the pitch diameter one-tenth of an inch. Adjust multi-groove sheaves the same amount on each groove.

Replace the key and tighten setscrew to lock sheaves half in position.

Replace the belt and tighten to proper tension. If extreme amount of adjustment has been made, it may be necessary to replace belts with another length.

4.09 Belt Installation

Shorten the center distance between the driven and driver sheaves so the belts may be placed in the sheave grooves without force.

NOTE: Never "roll" or "pry" the belts into the sheave grooves. This can damage the belt cords and lead to belt turnover, short life, or actual breakage

With the belts in their proper grooves, adjust the centers to take up all slack and until the belts are fairly taut. Arrange the belts so that the top and bottom spans have about the same amount of sag. Apply tension to the belts by increasing the center distance until belts are snug and have a live springing action when struck with the hand.

Operate the drive for a few minutes to seat the belts in the sheave grooves.

Observe the operation of the drive under its highest load condition (usually starting). A slight bowing on the slack side of the drive indicates proper tension. Excessive bowing or slippage indicates insufficient tension. If the slack side remains taut during the peak load, the drive is too tight.

Check the belt tension on a new drive frequently during the first day, by observing the slack side span.

Excessive tension reduces belt and bearing life.

Keep the drive free of foreign material which might cause slippage or damage to belt and sheave surfaces.

If V-Belt slips, it is too loose. Increase the Tension by moving the centers. Never apply belt dressing as this will soften the belt and cause early failure.

An alternate method can be used by utilizing a tension gage. Follow the instructions supplied with the tension gage.

NOTE: A common cause of short belt life is unequal distribution of load among the belts on a multiple-belt drive. This unequal distribution can be caused by mismatched sets of belts or by grooves that because of wear and machining error are not matched. Always check for matching belts prior to installation.

4.10 Belt Maintenance

Dirt and grease reduce belt life. Belts should be wiped with a dry cloth occasionally to remove any build-up of foreign material. If the belts have been spattered with grease and/or oil, clean them with methyl chloroform or soap and water. Inflammable cleaners such as gasoline are to be avoided as a matter of safety.

Under no circumstances is the use of belt dressing recommended. The remedial effect is only temporary. It is much better to keep the belts and grooves of the drive clean.

4.11 Proper Belt Tension

Maintaining correct tension is the most important rule of V-belt care. It will give the belt 50% (fifty per cent) to 100% (hundred per cent) longer life.

Belts that are too loose will slip, causing excessive belt and sheave wear. V-Belts that sag too much are snapped tight suddenly when the motor starts or when peak loads occur. That snapping action can actually break the belts, because the added stress is more than the belt was designed to take.

The ideal belt tension is when the belt will not slip under peak load conditions. Over-tensioning shortens belt and bearing life.

Do not use a new or used belt as a replacement for a unit of a set. If a belt breaks, a new set of matched belts is necessary. Always replace belts with the same kind that was on the fan before.

4.12 V-Belt Drives Maintenance

Whether you are just installing new belts or a completely new drive, worn bearings, bent shafts or other components that might cause future problems should be replaced at the time. If installing belts only, check existing sheaves carefully for worn grooves or other damage. (Always use gloves or a rag for feeling

in the sheaves grooves so that you will not cut your finger or nicks or burns.)

Worn grooves can be detected by feel, or by sight. If the grooves are worn excessively, the sheaves should be replaced. Worn grooves can shorten belt life by as much as 50% (fifty per cent), which in turn increases the cost of maintenance.

Rusty or dirty sheaves also impact a drive's efficiency.

Clean existing sheaves thoroughly before installing a new set of belts. A safe cleaning fluid should be used. Keep all sheave grooves smooth and uniform. Burrs and rough spots along the sheave rim can damage belts. Dust, oil and other foreign matter can lead to pitting and rust, and should be avoided as much as possible.

A shiny groove bottom indicates that either the sheave, the belt, or both, are badly worn or the belt is bottoming in the groove.

Badly worn grooves cause one or more belts to ride lower than the rest of the belts, and the effect is the same as with mismatched belts. This is called "differential driving." The belts riding high in the grooves travel faster than the belts riding low. In a drive under proper tension, a sure sign of differential driving is when one or several belts on the tight side are slack.

4.13 Bearing Lubrication Instructions

The bearing manufacturing does not recommend additional lubrication. The major cause of bearing failure is using an excessive quantity of grease. Other causes are not greasing enough or using incompatible greases.

CAUTION: Bearings are lubricated at factory. Additional lubrication is not recommended.

CAUTION: To prevent bearing failure fan wheel must be rotated one full revolution at least once a week.

If you decide to provide additional lubrication, see below for the kind of grease. Avoid the use of a pressure greasing system which tends to fill the bearing chamber completely. Do not over grease. Use only one or two shots with a hand gun in most cases. Rotate bearings during lubrication where good safety practice permits. Bearing must be protected from water and moisture to avoid internal corrosion.

Kind of Grease – Many ordinary cup greases will disintegrate at speeds far below those at which bearings will operate successfully if proper grease is used. Bearings have been lubricated at the factory with No. 2 consistency Lithium base grease which is suitable for normal operating conditions. Re-Lubricate with lithium base grease or a grease which is

compatible with original lubricant and suitable for all-bearing service.

4.14 Bearing Replacement

It's important to follow the assembly and alignment procedure when making an installation of replacement bearings. Inspect the shaft for wear at the bearing mounting position. Shaft diameter should not be undersized more than commercial ground and polished tolerances. Excessive under sizing will result in rapid wear.

1. Remove the motor cover shaft guard to expose the bearings.
2. Loosen the belt by shifting the motor and remove the fan shaft drive assembly.
3. Measure the location of the bearing to the end of the shaft. Note the location of the bearing locked collars.
4. Loosen the bearing setscrews and locking devices. Prior removing the bearings, polish the shaft with fine emery paper (240 grit or finer) and file the setscrews dimples flat.
5. Remove the bearings from the shaft (they may have to be pressed off the shaft).
6. Place new bearings on shaft loosely, with locking collars facing each other on the shaft.
7. Drop the mounting bolts in place, snug them (do not tighten) and adjust the position of shaft.
8. Locate the shaft on the bearing and adjust the distance of the bearing location to the end of the shaft. (Refer Figure 1, for the relationship between the inlet cone and the fan wheel). Center both shaft ends in housing using the clearance in the mounting holes for horizontal adjustment and add shims if necessary for vertical adjustment.
9. Tighten the bearing to the base plate and check the position of the shaft again. Before tightening the locking collars be sure the shaft and bearings are in proper alignment. The shaft should slide freely end to end.
10. Tighten the eccentric cam locking collar of the bearing at the wheel end. (The locking collar design provides a positive lock of the wide inner ring bearing to the shaft. To tighten turn the locking collar in the direction of the shaft rotation to the lock position; then tighten the collar set screws.) Grasp the sheave end of the shaft and pull on it: at the same time tip the locking collar of the sheaves end bearing with a soft mallet in the opposite direction, toward the wheel.

11. With a soft mallet, tap the shaft between the bearings while turning the shaft by hand seat the bearing races. The shaft must turn freely. Tighten all bearing setscrews. Spin the shaft again.

For special heavy-duty bearings a spring locking collar is used. The two curled up-point set screws extend through the inner ring of the bearing and lock firmly onto the shaft. Tighten the propeller end collar first: then take hold of the sheave end of the shaft, pull and then tighten the locking collar. The locking collar is tightened by using the two set screws mentioned above.

4.15 Vibration

Excessive fan vibration can be caused by many things. All possible sources of the excessive vibration must be checked out and corrective action taken immediately to correct the problem. See the fan trouble-shooting chart (Appendix E) for possible causes of excessive fan vibration.

A vibration analyzer will be of great assistance in determining the amount of vibration. The values given in Table 1 (Section 2.14) give an indication of the fan vibration condition. Vibration readings should be taken on the fan bearing. The fan should not be operated unless the maximum vibration is in at least the TOLERABLE range.

4.16 Motor Storage

Storage of motors on equipment and component equipment should be protected from the weather. Keep the motor dry. If the equipment is exposed to the atmosphere, remove the breather-drain plug in the end frame at both ends, and cover the motor with a waterproof cover.

CAUTION: Do not completely surround the motor with the protective covering. The bottom area should be checked with a megohm-meter (Megger) as given under subtitle "Insulation".

Location: For maximum motor life, motor should be located in a clean dry, well ventilated place easily accessible for inspection, cleaning and lubricated. The temperature of the surrounding air should not exceed 104 (40 C.) except for motors with nameplate indicating a higher maximum ambient temperature. Enclosed motors are equipped with condensation vents, located in the bottom center of both end frames. When the motor is exposed to the weather or is subject to high humidity conditions the drain plugs should be removed.

4.17 Motor Maintenance

Cleaning and Inspecting: A CLEAN motor runs COOLER, the motor should be cleaned and inspected at regular intervals. Operating conditions involving continuous running, hot, dirty or dusty surroundings, etc, require frequent attention. Inspect bearings for roughness by uncoupling the motor from driven unit, if possible, and turning shaft by hand. If bearings feel "rough" or stick in spots, replace them. Always check bearings when any unusual noise or vibration develops in motor.

Insulation: The insulation resistance should be checked before placing motor in service after any extended storage period and periodically thereafter especially when in service under severe conditions encountering high humidity. Check the insulation resistance with megohm meter or similar instrument employed a 500 volt d.c. potential. Resistance should be at least 1.5 megohms; if it is less, the motor should be removed from service, dried, rechecked, and the windings given at least two coats of high-grade insulating varnish to assure adequate winding protection.

4.18 Motor Lubrication

Grease – lubricated bearings, as furnished, are adequate for a long period of operation without re-lubrication. A good maintenance schedule for re-greasing will vary widely depending on motor size, speed and environment.

Table 2 shows the suggestions re-lubrication intervals for motor on normal, steady running, light duty indoor loads in relatively clean atmosphere at 104 F (40 C) ambient temperature or less. Fractional horsepower motors follow a similar schedule to that shown under frames 143T to 215T. Motors with no provision for lubrication are equipped with sealed bearings and require no maintenance. Motor mounted in inaccessible locations are provided with extended grease lines to facilitate lubrication. They are equipped with relief fittings to prevent over-lubrication. The grease lines are filled with lubricant at the factory.

Motor Lubrication Chart

Type of Enclosures	Insulation	FRAME SIZE		
		143 to 215T		364 to 449T
Open – DP	B	2 years	18 months	1 year
Enclosed – FC Open - DP	B F	18 Months	1 year	9 months
Enclosed – NV Enclosed – FC Open – DP Enclosed – Lint Free - FC	B F H B	1 year	9 months	6 months
Enclosed – NV Enclosed – FC Enclosed – Lint Free - FC	F H F	9 months	6 months	3 months

Note:
 For motors over 1800 RPM use 1/2 of tabled period.
 For heavy duty – dusty locations use 1/2 of tabled period
 For severe duty – high vibration shock Use 1/3 of tabled period

Volume – Reference Table
 Shaft Diameter (at Face of bracket) Amount of Grease to add
 3/4 to 1 1/4 1/8 cu. In. or 01oz
 1 1/4 to 1 7/8 1/4 cu. In. or 02 oz
 1 7/8 to 2 3/8 3/4 cu. In. or 06 oz
 2 3/8 to 3 3/8 2 cu. In. or 16 oz

4.19 Motor Lubrication Procedure Stop Motor

Remove grease relief plugs in bearing housings. Grease with hand gun until new grease appears at relief hole. Run motor for ten (10) minutes before replacing relief plugs.

CAUTION: Do not over lubricate. This is a major cause of bearing and motor failure. Make sure dirt and contaminants are not introduced when adding grease.

Lubricate with or equivalent to the following greases:
 Chevron BRB-2 – Standard Oil of CA.
 SR1-2 – Standard Oil Company
 Alvania #2 – Shell Oil Company
 For motor lubricated with special greases check lubrication tag on motor.

Appendix A

MAINTENANCE FREQUENCY

Inspect Wheel and Blades for Build-up	Quarterly
Check Belt Tension	First Day/Quarterly
Wipe Belts to Remove Build-up	Quarterly
Rotate Wheel (while in storage)	Weekly
Clean and Inspect Motor	Annually
Check bolts and set screws	First Hour/First Day
Lubricate Motor Bearings	(Table 2)
Check Motor Amps	Quarterly

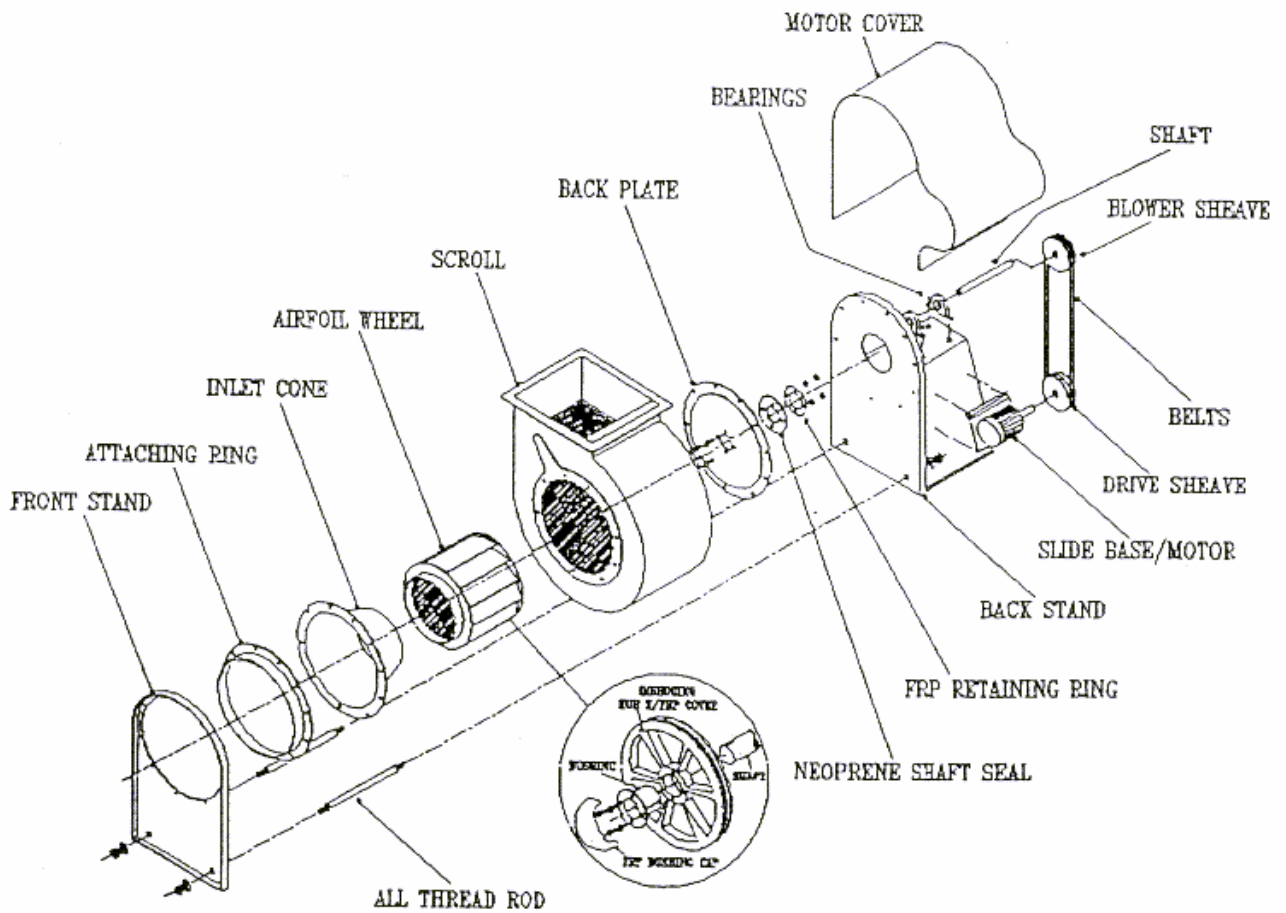
Suggested frequency until same history of your specific application can be created.

Appendix B

CHECK LIST FOR START - UP PROCEDURES

- Mount fan on flat level surface
- Check for free rotation of fan wheel
- Connect scroll Drain
- Make Electrical Connections
- Remove Duct Debris
- Check Wheel Rotation
- Check Amperage
- Check Vibration

Appendix C



EXPLODED DRAWING OF AN HPCA CENTRIFUGAL AIRFOIL FAN

Appendix E

FAN TROUBLE SHOOTING CHART

Problem	Possible Causes
Excessive Vibration	Accumulation of material on impeller Bent Shaft Impeller or sheaves loose on shaft Motor out of balance Impeller out of balance Sheaves eccentric or out of balance Bearing or drive misalignment Mismatched belts Belts too loose or too tight Loose or worn bearings Loose bearing bolts Loose fan mounting bolts Weak or resonant foundation Foundation not flat or level Structures not cross braced System pulsation – fan operating in a stall region
Horsepower to high	Fan speed faster than design Air density higher than design
Too Much Airflow	Oversized duct work Access door open Registers or grilles not installed Actual system is less restrictive than expected Fan speed faster than design
Airflow to Low	Impeller rotating in the wrong direction Fan speed slower than design Actual system is more restrictive than expected Dampers or registers closed Leaks or obstructions in duct work Restricted fan inlet or outlet No straight duct at fan outlet Sharp elbows near fan inlet or outlet
Fan does not Operate	Blown fuses Broken Belts Loose Pulleys Electricity turned off or not wired properly Wrong Voltage Motor too small or overload protector has open circuit
Excessive Noise	Accumulation of material on impeller Worn or corroded impeller Bent shaft Impeller or sheaves loose on shaft Impeller out of balance Bearing or drive misalignment Mismatched belts Belts too loose or too tight Loose bearing bolts Bearings need lubrication Bearings defective or bad Loose fan mounting bolts System pulsation or surge Fan installs condition Vibration duct work Vibration parts not isolated from building Vibration or resonance or surrounding equipment Motor defective Inlet or outlet dampers or conditions Vibration isolation system not adjusted



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