

INSTALLATION, OPERATING AND MAINTENANCE INSTRUCTIONS

MODELS VFBB and VBBB

CENTRIFUGAL FANS - BELT DRIVE

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SHIPPING AND RECEIVING

All CARNES CO. products are carefully constructed and inspected before shipment to assure the highest standards of quality and performance. When received, all components should be compared to the bill of lading or packing list to verify that the proper unit was received. Each unit should be checked for any damage which may have occurred in transit. Any damage should be reported immediately to the carrier and the necessary damage report filed.

HANDLING

Handling of all air moving equipment should be conducted by trained personnel and be consistent with safe handling practice. Verify the lift capacity and operating condition of handling equipment. Maintain handling equipment to avoid serious personal injury.

Units shipped completely assembled may be lifted with slings or spreader bars. Well-padded chains, cables or nylon straps may also be used. On most units, lifting lugs are provided for attaching chains (*see Figure 1*). Lifting the fan should always be done in such a fashion which protects the fan and fan coating from damage. Never lift a fan by the inlet or discharge flange, shafting or drives, wheel or impeller, motor or motor base, or in any other manner which may bend or distort parts.

INTRODUCTION

The purpose of this manual is to provide instructions which supplement good general practices when installing or operating fans made by the CARNES CO.. It is the responsibility of the purchaser to provide qualified personnel experienced in the installation, operation and maintenance of air moving equipment.

Instructions given in the body of this manual are general in nature and apply to a variety of models manufactured by CARNES CO. Most units can be installed and maintained with the instructions given.

Special applications may require additional information. These instructions are supplied in the form of attached appendices. Use the instructions in the appendix if the directions in the manual differs from instructions in the appendix.

As always, follow good safety practices when installing, maintaining and operating your air moving equipment. A variety of safety devices are available. It is the user's responsibility to determine adequate safety measures and to procure the required safety equipment.

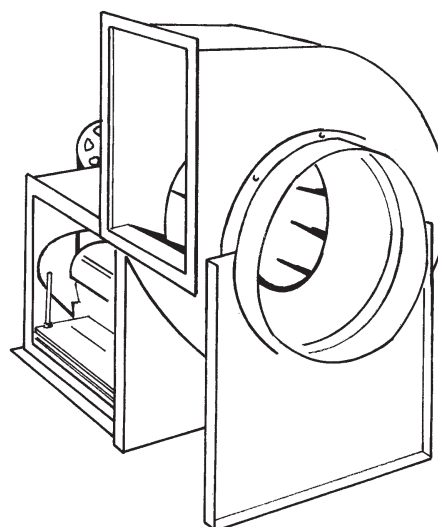


Figure 1

Partial or disassembled units require special handling. All parts should be handled in a fashion which protects the coatings and parts from damage. Components should be handled such that forces are not concentrated and bending or distortion can not occur.

Housing should be lifted using straps and spreaders. Do not distort housing or side plates when lifting.

Bearing pedestals should be lifted using straps or padded chains. Under no circumstances should an attached or separated bearing pedestal be lifted by the shaft, bearings, drives, motor or wheel.

The shaft and wheel assembly may be lifted using a hoist and a spreader with a sling around the shaft at points nearest the wheel (See Figure 2). Take care not to scratch the shaft where the wheel or bearings will be mounted. Never lift or support the assembly by the wheel. Always support the assembly by the shaft when lifting or storing. Do not support the shaft or the wheel on housing sides. Use only the key provided with the shaft and wheel.

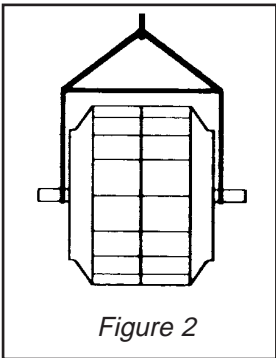


Figure 2

Wheels shipped separately can be lifted by slings running through the blades and around the hub. Never lift the wheel by blades or flanges. Always transport wheels by lifting. Do not roll the wheel as this can damage coatings and change the balance of the wheel.

Bent shafting is a source of vibration and bearing failure, so handle the shaft with care. Any scratches on the shaft may be removed with fine emery cloth or a stone.

UNIT STORAGE

If fan installation is to be delayed, store the unit in an environmentally stable and protected area. Vibration should not exceed 2 mils at the storage site unless the fan is properly isolated from the vibration. The unit should be reasonably protected from any accidental impacts. Cover the fan to protect coatings and to prevent any foreign material or moisture from entering the inlet or discharge. Take care to protect the motor, drives and bearings.

Extended storage requires monthly inspections. Check for corrosion or damage to the unit and for debris within the fan. Rotate the fan wheel a few revolutions. Stop the wheel in a position other than the initial position. Grease the bearings every month with a grease compatible with the grease supplied with the bearings. (See any attachments concerning specific bearings.)

FOUNDATIONS AND SUPPORTING STRUCTURES

Floor mounted fans should be installed on a flat, level, rigid concrete foundation with a mass at least three times that of the assembly supported. The plan area should be no more than twice that required by the equipment. Foundations with larger areas should have correspondingly larger mass. Anchor bolts should be "L" or "T" shaped with sufficient length for nuts, washers, shims, and threads for draw down. Each bolt should be placed in a sleeve or pipe with diame-

ter larger than the bolt to allow for adjustment.

Fans mounted to or within a structure should be placed as close as possible to a rigid member, such as a wall or column. The structure must be designed for rotating equipment—static design for strength is not sufficient to assure proper operation. Supports for suspended fans must be cross-braced to prevent side-sway. Structural resonance should be at least 20% from fan operating speed. Use vibration isolators where applicable.

Any ducting should have independent support - do not use the fan to support ducting. Isolating the fan from ductwork with flex connections eliminates transmission of vibration. Fans handling hot gases require expansion joints at both the inlet and discharge to prevent excessive loads caused by thermal growth.

FAN INSTALLATION - FACTORY ASSEMBLED UNITS

Follow proper handling instructions given earlier.

1. Move the fan to the final mounting position.
2. Remove skids, crates and packing materials carefully.
3. Place vibrations pads or isolation base on mounting bolts. Line up holes in fan base with bolts.
4. Place fan on mounting structure. Carefully level unit using shims as required at all mounting hole locations. Bolt down unit.
5. Any grout may now be used. The fan should already be bolted in position before grout is applied. Do not depend upon grout alone to support rotating equipment.
6. Continue with Operations section.

Additional instructions may be given for some fan models, components and accessories in the appendix.

FAN INSTALLATION - DISASSEMBLED UNITS

A unit is considered "disassembled" if any component required for proper operation is shipped or supplied separately or in pieces. Reference earlier instructions concerning proper handling of fan components.

All units where assembly of the fan housing or bearing pedestal or drive stand is required will have matching symbols on adjacent parts. These symbols are used to identify which components are joined together. Units which require extensive assembly may require additional instructions located in the appendix. Special instructions for some components and accessories are also in the appendix.

Instructions for mounting and assembly of unit:

1. Move lower housing/framework to mounting location.
2. If vibration pads or bases are used, place on bolts first. Place lower housing assembly onto bolts.
3. Level and shim if required. Bolt into place.
4. If separated pedestal or bearing pedestal:
 - a. Bring bearing pedestal to desired location.
 - b. Place any vibration base or pads into place. Set bearing pedestal on bolts.
 - c. Never distort bearing pedestal by forcing it to align

- d. Check bearing centerline height. Change centerline height to match centerline height of housing. High temperature units may require the housing centerline to be lower when cold to that it will be centered when hot.
 - e. Measure from housing to bearing pedestal to bring bearing pedestal into square with housing (a large square may also suffice).
 - f. Bolt into position.
5. Shaft and wheel assembly preparation:
- a. Clean protective coating off shaft with solvent. Do not touch clean areas of shaft with hands. Perspiration can cause rust or pitting over time.
 - b. Remove keys from shaft.
 - c. Clean inside of wheel bore with solvent. Make sure set screws will not interfere when inserting shaft into wheel bore.
6. Arrangement 1, 9 or 10: Drive Component Assembly (See Figure 3):
- a. Insert shaft into wheel from back side of wheel.
 - b. When shaft is flush with wheel hub, put key into keyway and tighten wheel set screws.

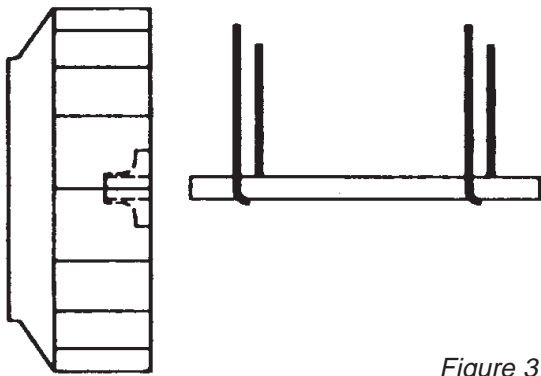


Figure 3

- c. Insert shaft through opening in drive side. (If split housed unit, lower into position.)
 - d. Install bearings onto shaft. Do not tighten bearing set screws at this time. the bearing housing should be perpendicular and the bearing base parallel to the axis of the shaft to prevent loads caused by mis alignment.
 - e. Mount assembly, bolt bearings to drive stand. Shaft must be parallel with side of bearing pedestal. After aligning and bolting bearings to pedestal, tighten bearing set screws. Continue with step 8.
7. Arrangement 3 (Split-housed) units (See Figure 4):

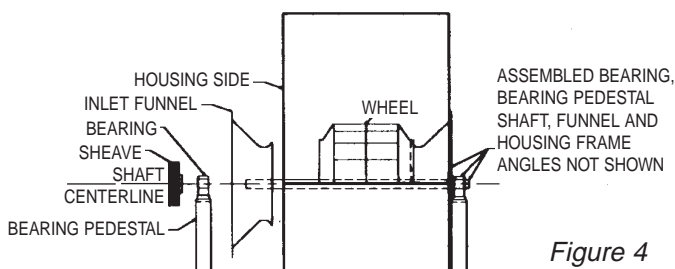


Figure 4

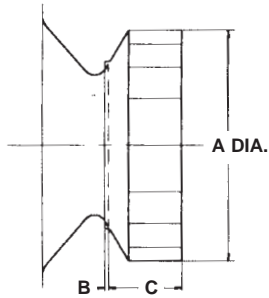
- a. Parts on DWDI unit are assembled in the following order as viewed from opposite drive side: Bearing bar assembly and opposite bearing, funnel, housing side), wheel, (housing side), funnel, drive side bearing bar assembly, drive bearing and sheaves. Mount bearing bar assembly to housing. Center wheel in funnels.
 - b. Parts on SWSI are assembled in the following order as viewed from opposite drive side: Bearing bar assembly and opposite bearing, funnel, (housing side), wheel, (housing side), drive side bearing bar assembly, drive bearing and sheaves. Mount bearing bar assembly to housing. See Figure 6 for wheel funnel overlap.
 - c. Assemble parts in above order on shaft.
 - d. Move assembly into position. Lightly bolt bearings into place.
 - e. Shaft should be parallel with discharge of housing. Move bearings to accommodate.
 - f. Level shaft; shim bearings if required. Tighten bearing set screws.
8. Install motor on base. Carefully align shafts for drive installation.
9. Mount drives as follows:
- a. Slip (do not pound) proper sheave onto corresponding shaft. CAUTION: PLACING FAN SHEAVE ON MOTOR CAN OVERSPEED WHEEL AND CAUSE STRUCTURAL FAILURE.
 - b. Align sheaves with straight edge extended along sheaves, just making contact in two places on out side perimeters of both sheaves (See Figure 5).
 - c. Tighten down sheave bolts.
 - d. Install matched set of belts. Slide the motor to obtain slack and tighten belts. Using a pry will damage belts.
 - e. Tighten belts to proper belt tension. Ideal tension is just enough tension so that belts do not slip under peak load. Recheck sheaved alignment.
 - f. After initial installation of belts, recheck belt tension again after a few days to adjust belt tension. (New belts require a break-in period of operation.)
10. Install any safety devices or accessories supplied. (Accessories commonly used are inlet vane, shaft seals and shaft coolers, plugs, dampers, and inlet or discharge screens. Refer to appropriate documents in appendix.)
11. Grout may now be applied. Grout is used to distribute loads and should not be used as the sole support of any rotating equipment.
12. When connecting fan to system, it is recommended that the inlet and discharge be isolated from the system with flex connections (where practical) to block transmitted vibration. All duct connected to the fan should be independently supported. Do not use fan to support duct.



Figure 5

Wheel-Funnel Overlap

BACKWARD INCLINED



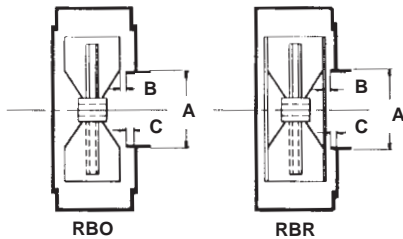
HIB & TRF Wheel Placement			
Size	A	B	C
180	20.50	0.31	5.31
200	22.50	0.34	5.88
220	25.00	0.38	6.47
240	27.50	0.44	7.13
270	30.38	0.47	7.91
300	33.50	0.50	8.72
330	37.00	0.56	9.59
360	41.00	0.63	10.63
400	46.25	0.69	11.75
450	50.00	0.75	12.07
490	56.13	0.81	14.31
540	61.00	0.91	15.84
600	67.50	1.00	17.58
660	74.25	1.13	10.56
730	82.00	1.22	21.56
800	90.75	0.34	23.56

BC, RTF, TSL & BAF SWSI Wheel Placement											
Size	122	135	150	165	182	200	222	245	270	300	330
A	12.25	13.50	15.00	16.50	18.25	20.00	22.25	24.50	27.00	30.00	33.00
B	0.32	0.34	0.38	0.44	0.56	0.63	0.69	0.75	0.88	0.97	1.06
C*	4.28	4.84	5.38	5.81	6.44	7.00	7.84	8.63	9.47	10.56	11.63

Size	365	402	445	490	542	600	660	730	807	890
A	36.50	40.25	44.50	49.00	54.25	60.00	66.00	73.00	80.75	89.00
B	0.94	1.03	1.13	1.25	1.38	1.56	1.69	1.88	2.09	2.28
C*	13.03	14.41	15.94	17.53	19.41	21.41	23.56	26.06	28.84	31.81

Use Dimension "B" for positioning wheel on SSI and TSL.

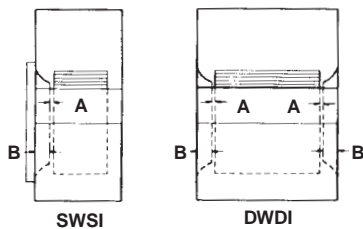
RBO & RBR



RBO & RBR Wheel Placement																
Size	913	915	917	919	921	923	926	929	933	937	941	945	949	954 SD	954 HD	960
A	13.25	15.25	17.25	19.25	21.25	23.38	26.38	30.38	33.63	37.50	41.50	45.50	49.50	54.63	54.63	60.63
B	0.53	0.56	0.59	0.69	0.78	0.88	0.75	0.81	0.97	1.13	1.31	1.44	1.59	1.63	1.56	1.84
C*	0.88	1.16	1.31	1.44	0.88	0.94	1.19	1.22	1.38	1.56	1.69	1.88	1.97	2.25	2.25	2.56

NOTE: On sizes 905-911 wheel is to be centered in housing.

FC & AIR KIT



FC & Air Kit Wheel Placement														
Size	10.5	12	15	18	21	24	27	30	33	36	39	42	48	54
A	0.47	0.25	0.44	0.50	0.69	0.81	0.69	0.75	0.81	0.75	1.06	1.69	1.50	1.00
B	0.69	1.68	2.19	2.25	2.88	3.00	3.13	4.38	5.00	5.00	6.38	7.50	7.13	10.50

NOTE: For oven applications, position DWDI Air Kit wheel so that it is centered at operating condition.

Figure 6

FAN OPERATION - SAFETY

For general safety practices for air moving equipment, see AMCA Bulletin 410 (Contact Carnes for your free copy).

CARNES has many safety accessories available. These safety devices include (but are not limited to) belt guards, shaft guards, inlet and discharge screens. The use, abuse, or non-use of safety devices is the responsibility of the purchaser.

Facility related safety conditions include fans accessibility and location. How easily can non-service personnel access the unit? Is the fan in a hazardous duty environment? Was the unit ordered for this duty? Other concerns must also be addressed. All fans should be powered through switches which are easily accessible to service personnel from the fan. Every switch should have the ability to be "locked-off" by the service person and the key to be retained by this person to prevent accidental power of the fan while service is in process.

FAN OPERATION CHECKLIST

- Proper safety precautions have been followed.
- All electrical power is locked off.
- Fan mechanical components are ready.
 - Nuts, bolts and set screws are tight.
 - System connections are properly made and tightened.
 - Bearings are properly lubricated.
 - Wheel, drives and fan interior are clean and free of debris.
 - Rotate the impeller by hand to verify it has not shifted in transit.
 - Drives on correct shafts.
- Fan electrical components are ready.
 - Motor is wired for proper supply voltage.
 - Motor was properly sized for power and rotational inertia of rotating assembly.
 - Motor is properly grounded.
 - All leads are properly insulated.
- Trial "bump":
 - Turn on power just long enough to start assembly rotating.
 - Check for rotation. Is the direction of rotation correct? Does the assembly make any unusual noise?

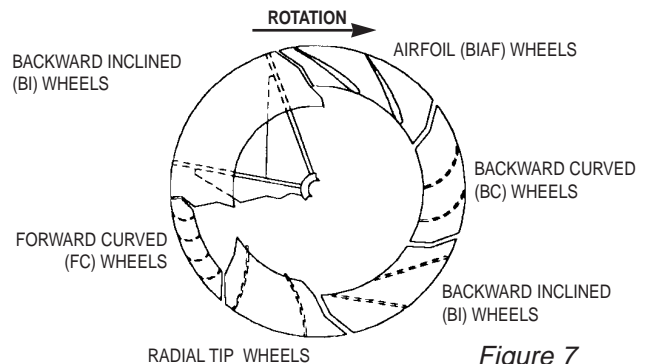


Figure 7

Figure 9: Solid Spherical Roller Bearings

WARNING

- This equipment must not be operated without proper guarding of all moving parts. While performing maintenance be sure remote power switches are locked off. See AMCA Publication 410 for recommended safety practices.
- Before starting: Check all set screws for tightness, and rotate wheel by hand to make sure it has not moved in transit.

RELUBRICATION SCHEDULE (MONTHS) *									
Ball Bearing Pillow Blocks									
SPEED (RPM)	500	1000	1500	2000	2500	3000	3500	4000	5000
SHAFT DIAMETER									
1-3/16" thru 1-7/16"	6	4	4	2	1	1	1	1	1/2
1-11/16" thru 2-3/16"	4	2	1-1/2	1	1/2	1/2	1/2	1/2	1/2
2-7/16" thru 3-7/16"	3	1-1/2	1	1/2	1/2				
3-15/16" thru 4-15/16"	2-1/2	1	1/2						

*Suggested initial greasing interval - relubricate while running, if safety permits, until some purging occurs at seals. Adjust lubrication frequency depending on condition of purged grease. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required.

- Lubricate with a high quality NLGI No. 2 grease having rust inhibitors and antioxidant additives, and a minimum oil viscosity of 500 SSU at 100°F. Some greases having these properties are:

Shell - Alvania No. 2	Texaco - Premium RB2
Mobil - Mobilgrease 28	American - Rykon Premium 2
- Lubricate bearings prior to extended shutdown or shortage and rotate shaft monthly to aid corrosion protection.

expelled from the bearings at the time of relubrication is the best guide as to whether regreasing intervals and amount of grease added should be altered. This observation is particularly important when bearings operate continuously over 160°F.

Greases are made with different bases. There are synthetic base greases, lithium base, sodium base, etc. Avoid mixing greases with different bases. They could be incompatible and result in rapid deterioration or breaking down of the grease.

All bearings are filled with grease before leaving the factory. When the fans are started, the bearings may discharge excess grease through the seals for a short period of time. Do not replace the initial discharge because leakage will cease when the excess grease has worked out. Sometimes the bearing has a tendency to run hotter during this period and one should not get alarmed unless it lasts over 48 hours or gets above 220°F. When relubricating, use sufficient amount of grease to purge the seals. Rotate bearings during relubrication where good safety practice permits.

Figure 10: Split Spherical Roller Bearings

WARNING

- This equipment must not be operated without proper guarding of all moving parts. While performing maintenance be sure remote power switches are locked off. See AMCA Publication 410 for recommended safety practices.
- Before starting: Check all set screws for tightness, and rotate wheel by hand to make sure it has not moved in transit.

RELUBRICATION SCHEDULE (MONTHS) *									
Ball Bearing Pillow Blocks									
SPEED (RPM)	500	1000	1500	2000	2500	3000	3500	4000	Grease to be added at each interval
SHAFT DIAMETER									
1-7/16" thru 1-15/16"	6	4-1/2	4	4	3-1/2	2-1/2	2-1/2	1	1
2-3/16" thru 2-11/16"	5	4-1/2	4	2-1/2	2-1/2	1-1/2	1/2		
2-15/16" thru 3-15/16"	4-1/2	4	3-1/2	2-1/2	1-1/2				
4-7/16" thru 4-15/16"	4	4	2-1/2	1					
5-7/16" thru 5-15/16"	4	2-1/2	1-1/2						

*Suggested initial greasing interval - remove bearing cap and observe condition of used grease after lubricating. Adjust lubrication frequency as needed. Hours of operation, temperature, and surrounding conditions will affect the relubrication frequency required. Clean and repack bearings annually. Remove old grease, pack bearing full and fill housing reservoirs on both sides of bearing to bottom of shaft.

- Lubricate with a multipurpose roller bearing NLGI 2 grease having rust inhibitors, antioxidant additives, and a minimum of viscosity of 500 SSU at 100°F. Some greases having these properties are:

Shell - Alvania 2	Texaco - Premium RB2
Mobil - Mobilgrease 28	American - Rykon Premium 2
- Lubricate bearings prior to extended shutdown or storage and rotate shaft monthly to aid corrosion protection.

STATIC LUBRICATION

- Use only highest quality mineral oil with a minimum viscosity of 100 SSU at the oil's operating temperature. The oil's operating temperature is approximately 10° greater than the bearing's housing. SAE values having this viscosity at the following operating temperatures are: 150°F - SAE 20; 106°F - SAE 30; 180°F - SAE 40.
- Static oil level should be at the center of the lowest most roller (Do not overfill).
- Complete lubricant change should be made manually.

For bearings with oil lubrication, sight gauges are installed so that a proper level can be reviewed and maintained. Sight gauges should be read with bearing not rotating.

WHEEL AND SHAFT MAINTENANCE

Periodically inspect the shaft and wheel for dirt buildup, corrosion, and signs of excess stress or fatigue. Clean the components, and when appropriate, apply new coatings. (Any addition of coatings or weld can create an imbalance.) Check the balance of the assembly.

STRUCTURAL MAINTENANCE

All structural components or devices used to support or attach the fan to a structure should be checked at regular intervals. Vibration isolators, bolts, foundations, etc., are all subject to failure from corrosion, erosion, and other causes. Improper mounting can lead to poor operating characteristics or fan fatigue and failure. Check metallic components for corrosion, cracks, or other signs of stress. Concrete should be checked to insure the structural integrity of the foundation.

TROUBLESHOOTING GUIDELINES

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

TROUBLESHOOTING PERFORMANCE PROBLEMS

The below lists indicate possible areas to check when air or sound values do not match expectations. Most fan problems can be pinpointed to one of these common causes.

Figure 8 illustrates the decal for ball bearings, Figure 9 the decal for solid pillow block spherical roller bearings, and Figure 10 shows the decal for split pillow block spherical roller bearings. Observation of the condition of the grease

AIR CAPACITY PROBLEMS:

1. Resistance of system not at design rating. If resistance is lower than expected, both air flow and horsepower may be up. If resistance is higher than anticipated, air volume will be down.
2. Fan speed is not at design speed.
3. Air density not at design values. Also check air performance measurement techniques/procedures.
4. Devices for air modulation are closed or plugged. Also check filters.
5. Wheel mounted improperly or is rotating in reverse.
6. Parts of system or fan have been damaged or need cleaning.

NOISE PROBLEMS:

1. Air performance is incorrect and fan is not at design point of operation. Fan forced to operate in an unstable flow region.
2. Bearing failure. Check bearings (lubrication).
3. Supply voltage high or inconsistent supply frequency. Adjustable frequency controllers can generate motor noise.
4. Objects which are installed in a high velocity airstream can generate noise. This includes flow sensors, turning vanes, etc.
5. Poor fan inlet conditions.
6. Acoustics or sound measurement procedure incorrect.

VIBRATION PROBLEMS:

1. Misalignment of drive components.
2. Poor foundation or mounting structure (resonances).
3. Foreign material attached to rotating components.
4. Damaged rotating components (bearings, shaft, fan, wheel, sheaves.)
5. Broken, loose or missing set screws.
6. Loose bolts.
7. Vibration transmitted by another source.
8. Water accumulating in airfoil blades.
9. Fan is operating in stall or unstable flow region.

MOTOR PROBLEMS:

1. Incorrect wiring.
2. Speed of fan too high.
3. Parts improperly installed - binding.
4. Bearings improperly lubricated.
5. WR2 capability of motor too low for application.
6. Protection devices may be improperly sized.

DRIVE PROBLEMS:

1. Belts improperly tensioned.
2. Drive alignment is poor.

LIMITATION OF WARRANTIES and CLAIMS

Seller warrants to the original purchaser that the goods sold hereunder shall be free from defects in workmanship and material under normal use and service (except in those cases where the materials are supplied by the buyer) for a period of one year from the date of original installation or eighteen (18) months from the date of shipment, whichever occurs first. The liability of seller under this warranty is limited to replacing, repairing, or issuing credit (at cost, F.O.B. factory and at seller's discretion) for any part or parts which are returned by buyer during such period provided that (a) seller is notified in writing within ten (10) days following discovery of such defects by buyer, or within ten (10) days after such defects should reasonably have been discovered, whichever is less; (b) the defective unit is returned to seller, transportation charges prepaid by buyer; (c) payment in full has been received by seller for said products; and (d) seller's examination of such unit shall disclose to its satisfaction that such defects have not been caused by misuse, neglect, improper installation, repair, alteration, act of God, or accident. No warranty made hereunder shall extend to any seller product whose serial number is altered, effaced or removed. Seller makes no warranty, express or implied, with respect to motors, switches, controls, or other components of seller's product, where such components are warranted separately by their respective manufacturers. THIS WARRANTY IS EXPRESSLY IN LIEU OF ALL OTHER WARRANTIES, EXPRESS OR IMPLIED, WHETHER STATUTORY OR OTHERWISE, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE. In no event shall seller be liable to buyer for indirect, incidental collateral, or consequential damages of any kind. (BUYER'S FAILURE TO PAY THE FULL AMOUNT DUE WITHIN SIXTY (60) DAYS OF DATE OF INVOICE SHALL OPERATE TO RELEASE SELLER FROM ANY AND ALL LIABILITY OR OBLIGATION ARISING PURSUANT TO ANY WARRANTY EXPRESS OR IMPLIED, WHETHER STATUTORY OR OTHERWISE, INCLUDING ANY IMPLIED WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, MADE IN CONNECTION WITH ANY CONTRACT FORMED HEREUNDER. BUYER AGREES THAT SUCH FAILURE TO PAY SHALL CONSTITUTE A VOLUNTARY WAIVER OF ANY AND ALL SUCH WARRANTIES ARISING PURSUANT TO SUCH CONTACT.)

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