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INSTALLATION MAINTENANCE, OPERATING INSTRUCTIONS

IM-500

Heavy Industrial Installation & Maintenance Manual

SECTION "I": PRE-INSTALLATION MANUAL

Table of Contents

A. INTRODUCTION

This section of the NYB O&M manual is intended to assist our customers in planning, storage and pre-installation procedures recommended for NYB fans and replacement parts. Due to the variety of custom options and different arrangements, **USE ALL SECTIONS OF THIS MANUAL WITH THE NYB ASSEMBLY DRAWING** to insure complete and proper instructions are followed. Although many parts of this manual will not apply to a customers' specific fan application, the information can be beneficial in working with fans in general.

Poorly designed ductwork is a major cause for system performance problems and should be addressed early on in the design stages. At the time of fan assembly drawing approval it is suggested the customer refer to AMCA Publication 201 and review the system ductwork for possible system effect factors. NYB is willing to assist in this area but final responsibility always remains with the customer.

These instructions are intended as a guide in installation of centrifugal fan equipment and erection personnel will find the procedures described herein to be satisfactory under normal conditions. These instructions should not be considered complete in themselves, but rather as supplemental to general field erection methods. NYB does not assume responsibility for any omissions in this manual, attached inserts or on the fan assembly drawing of details commonly considered good practice by qualified field erectors.

If there are any questions or suggestions concerning these instructions, please contact us with your question at:

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NYB warrants for one year against defects in material and workmanship, and does not cover erosion, corrosion or poor maintenance. Refer to our complete warranty outlined in our Terms and Conditions of Sale which is the only warranty recognized by NYB unless stated otherwise in writing from the home office of NYB.

Please note that any specific information contained herein or on the certified assembly drawing supersedes that of any sub-vendor mentioned herein or attached with our package.

B. SAFETY PRECAUTIONS

It is the responsibility of the purchaser to ensure that the installation of all equipment is handled by qualified personnel experienced in installing this type of equipment.

Protective devices are standard features on some types of fans, but on many fans these same features are optional accessories. This is because the need for protective devices and their designs are often dependent on the type of system, fan location and plant operating procedures. The customer must determine the proper protective safety devices required to meet company standards, local codes and OSHA requirements and then take the necessary steps to specify and obtain the proper safety devices and see that the fan is not operated without them.

THE FOLLOWING SAFETY PRECAUTIONS SHOULD ALWAYS BE OBSERVED:

1. For basic safety practices as outlined in this manual, obtain a copy of AMCA Publication 410.
2. Fans in operation pose a risk to untrained personnel. The customer should post the area around a fan as: "Dangerous - Rotating Equipment in Operation, Qualified Service Personnel Only. Stay away from rotating shaft, drives and openings of the fan."
3. Prior to operation after initial installation or upon doing any maintenance work check the fan assembly to insure all fasteners are properly tightened, all running clearances are correct, alignment is within tolerance, bearing vibration and temperature limits are acceptable. Newly installed fans should have bolts checked for tightness and drives checked after 8 hours of operation and again in 2 weeks. Failure to do this can result in damage to the fan and/or harm to personnel.
4. The maximum design gas stream temperature and speed of fan equipment must not be exceeded. Refer to the fan assembly drawing for speed and temperature limits of the equipment.
5. The maximum allowed bearing temperature must not be exceeded. Refer to Bearing Temperature limits located in Section "C" titled "Operation". Excessive bearing temperatures will breakdown lubrication and shorten bearing life and void bearing warranty.
6. The maximum allowed bearing vibration must not be exceeded. Refer to bearing vibration limits located in section "C" titled "Operation". Excessive bearing vibration even for short periods will diminish bearing life and void the bearing warranty.
7. Properly protect against electrical hazards relating to motor operation. Refer to specific information supplied with the motor.
8. All fans have moving parts which may require guarding in the same way as other moving machinery. In areas accessible only to trained personnel, a standard industrial guard may be sufficient. Where the fan is accessible to untrained personnel, maximum safety guards should be used. Fans located less than 7 feet above the floor require special considerations by OSHA.
9. Protective guards for shaft, coupling, heat flinger and belts must be provided and in place during operation. If these are not purchased from NYB, they should be supplied by customer.
10. If an inlet or discharge is not ducted, then inlet and/or outlet screens must be provided for by end user and securely mounted in place to prevent entrance of foreign objects, clothing or flesh into rotating parts. The fan area should be posted as "Dangerous - Rotating Equipment in Operation".
11. Do not open access doors to fan or duct system during operation of the fan. Access doors located on the discharge side of the fan may open violently if opened while fan is operating. Vacuum pressure on inlet side of fan will unexpectedly draw items through openings and into the fan.
12. Before opening access doors, removing splits or other components, determine the weight and be properly prepared to handle the weight.
13. In addition to the normal dangers of rotating equipment, fans present another hazard in their ability to suck in solid objects, pass the object through the fan and discharge at the outlet as dangerous projectiles. Fan intakes should be guarded to prevent such solid objects from entering the fan. Personnel should be prevented from standing in front of an open fan discharge.
14. To prevent electrical start up of fan during maintenance, be sure to electrically lock out fan motor starter before working on fan. Keep the lock key in your possession until your work is completed.
15. Beware of hot surfaces. Allow sufficient cool-down period before beginning any maintenance work. Surface temperatures over 150 F are too hot to touch without gloves. Bearing surfaces are often 180 F and fan housings can be much hotter.
16. Prior to entering a fan to perform work for start up or maintenance always check the quality of air inside the fan and provide a watchman outside the fan before anyone enters the fan housing or ductwork. Depending on the system process it is recommended the air quality be monitored for CO and other harmful gases while inside the fan. After completing work on fan remove all loose materials from inside of fan housing and ductwork prior to start up. Check to see if confined space training is required with in-plant safety inspector.
17. Do not wear loose clothing or long hair around rotating equipment.
18. Always follow existing safety precautions specified by in-plant safety inspectors.

C. SHIPPING AND RECEIVING

Shipments are F.O.B. factory New Castle, PA with freight allowed or not allowed as stated in the proposal. It is, therefore, to the interest of the buyer upon receiving the equipment, to carefully check to see that all items on bill of lading and/or invoice have been received. Partial shipments are often made.

Shipments are inspected prior to release from NYB, however, rough handling in route may damage fan components. The receiving party must inspect all shipments for shortage, breakage or damage. Any damaged parts are the responsibility of the carrier and must be reported to the carrier immediately upon arrival.

NYB cannot be held responsible for adjustment of such claims if the delivery receipt is signed without notation of the shortage or damage. Any damages noted after delivery should be reported to the carrier at once and request their inspection of the shipment and fill out a concealed damage inspection report.

NYB must be notified in writing immediately of any lost, undelivered or damaged parts. Complaints issued more than ten days after delivery will not be reviewed by NYB. Any complaint not reported to the carrier at time of delivery is not likely to receive insurance settlement. So it is imperative the equipment be inspected prior to releasing the carrier.

If a fan or item is received with evidence of mistreatment but no evidence of physical damage, then the wheel, bearings, drives and motor should be closely inspected for hidden damage, looseness, etc.

D. HANDLING

UNITS SHIPPED ASSEMBLED

Lifting lugs and man holes are provided for picking up the fan using hook and chains, slings and padding or spreader bars. When handling fans always use methods that will not cause damage. **ALWAYS MAKE SURE THAT ALL LIFTING AND HANDLING EQUIPMENT AND TECHNIQUES CONFORM TO CURRENT AND LOCAL SAFETY STANDARDS.**

Avoid lifting fans or parts of fans in a way that will concentrate stresses which may bend or distort fan parts. Never pass slings or timbers through the inlets of the fan housing or try to lift using the rotor or shaft.

Protect items such as oil cups, sight gauges, grease fittings, damper actuators, mounting brackets, bearings, drive guards and the like from damage due to chains during lifting.

UNITS SHIPPED DISASSEMBLED

Special coatings such as rubber, phenolic enamels, epoxies, etc. require care because they are easily damaged. Even a small chip will break the continuity of the coating and destroy its protective value. Touch up any chips or breaks prior to erection or storage with the proper coating. Refer to the fan assembly drawing and sections on paint and coated fans for more information on specific coatings.

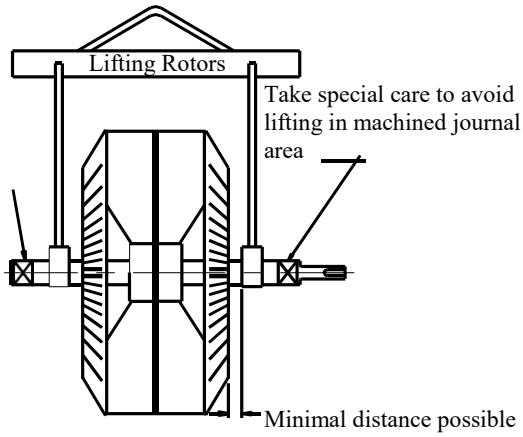
LIFTING WHEELS

Nonmetallic slings or heavily padded chains/wire slings can be used to lift wheel and shaft assemblies. Protect machined journal area of shaft with burlap, heavy paper or the like. Inspect the journal of the shaft after handling and remove any marks with fine emery cloth or stone.

When the fan wheel is shipped separate from the shaft, timber can be placed through the hub for lifting, taking care not to damage the bore finish. A nonmetallic rope sling can also be used if it is passed through the blades and around the hub.

Wheel and shaft assemblies are often shipped on a fabricated wood or steel cradle for ease of handling in shipment and unloading. To remove the wheel and shaft assembly from the cradle, place slings around the shaft as close to either side of the wheel as possible. A spreader bar must be used during lifting to eliminate damage to the wheel. Refer to figure 1.

Figure 1



Take special care not to lift at or mark bearing journal, drive journal or other areas having special machined finish.

THE FOLLOWING ARE ADDITIONAL GUIDELINES TO OBSERVE DURING HANDLING TO PREVENT UNBALANCE OR DAMAGE TO THE WHEEL:

1. Never allow metal chains to be in contact with the wheel during lifting. Use slings or padded chains around shaft.
2. Be sure that slings are not damaged and are rated to lift the weight of the components.
3. Never lift wheel by blades or shrouds.
4. Never roll wheel as this can affect wheel balance.
5. Never rest entire wheel weight on the fan housing side plates, block at shaft and under wheel to prevent this.
6. Never set wheel down so that it supports the shaft, use wood supports under the shaft to support the wheel by the shaft.
7. Never ship wheel leaning over and supported by the shaft, this can result in a bent shaft.
8. Never lift wheel and shaft assembly by shaft sleeves or in bearing journal area (if applicable).
9. Never lift wheel and shaft assembly if there is any other component being supported or carried by the assembly (other than, inlet cones, bearings or coupling).
10. Always try to use lifting lugs or man holes installed by NYB to lift fan housing and components.

11. Never lift a fan housing or component using some sort of grab clamp. The clamp will bend the sheet or plate steel construction and can easily slip.

E. BOLTED INLET BOX DESIGN

When size dictates, inlet boxes may be shipped separate from the fan housing but are then bolted to the housing in the field and field welded after alignment. All welding is to be done after installation of fan unit is complete. Refer to Section "B" Installation under "Bolted Inlet Box Construction" for specific welding instructions.

Components requiring field welding can be the inlet box and inlet flange, box spreader pipes, bracing, split bars or any item that would otherwise require needing a special over width or over height permit to ship the fan.

F. STORAGE

SHORT TERM

NYB fans are suitably prepared at the factory to protect them during shipment to the job site and for at least one (1) month before installation. For disassembled fans this normally includes protecting the shaft with a soluble removable coating and additional physical protection such as wooden slats, plastic or other protective covering on exposed machined bearing journal areas. This must be removed and cleaned before installation.

For shipment of assembled fans, the wheel may be blocked or strapped to avoid rotation during shipment. Be sure to inspect and remove the blocks or straps prior to operation. Openings may have bolted covers that must be removed.

Always store in a dry, ventilated, protected area being sure the fan shaft, bearings and wheel are protected from dust, water and corrosive elements.

If necessary to store outdoors or within a building under construction, special care must be taken to prevent dirt, moisture, corrosion or dust accumulation. Non journal areas may not be shop coated so coat the shaft with grease or rust preventative. Cover and seal bearings to prevent entrance of contaminants.

If stored outdoors for any length of time, cover completely with a protective tarp and block wheel to prevent rotation. Do not pile any material on the fan housing or base and do not walk on the housing or shaft. Block the fan on supports sufficiently above ground level to avoid snow cover or submergence under surface water. See wheel rotation in next section and review for need of long term storage.

LONG TERM

If fans are to be stored for an extended period of time (longer than one (1) month noted above), the storage site should be clean, dry, well ventilated, properly drained and a temperature controlled environment (60-90F). Include room for inspection, lubrication and maintenance such as turning the fan wheel by hand to make certain all parts retain lubrication and that the shaft does not take a set.

Remove shaft protective coating once every two months and inspect shaft journal surface for possible corrosion. Replace the complete protective system prior to returning to storage. Care should be taken not to use plastic as a long term protection for it will trap condensed water and accelerate corrosion. Wood slats are for protection from mishandling during shipping and do not have to be replaced in long term storage. Care should be taken if they are replaced because they do absorb moisture and a thick protective coating is necessary between the wood and journal.

The wheel should be rotated five times every week using the following sequence for final resting position:

A. Week 1: 90 degree

B. Week 2: 180 degree

C. Week 3: 270 degree

D. Week 4: 360 degree

Spare wheel and shaft assemblies are of particular concern because they can set for years at a time outdoors. It is very important to check journals every 2 months.

BEARING PROTECTION (SHORT AND LONG TERM STORAGE)

Link-Belt P200, P300, B-22400 and similar models

Prior to shipment, fans with these type bearings are sometimes factory tested. These bearings are factory lubricated and should not require additional grease for start-up. However it is always recommended to check to insure any bearing has the proper amount of lubrication before start-up.

If the fan is not expected to be put into use immediately, it is advisable to add sufficient lubricant to destroy any air gap in the bearing reservoir which may collect moisture. At start-up, excess lubricant will be released through the seals. This is a normal purging action which will permit cooler operation, and the lubricant should not be replaced. Any time the fan unit is not in operation, the bearings should be protected by waterproof paper to avoid contamination.

Link-Belt 6800 Series, SKF 22500 Series and similar models

These bearings may be factory or field mounted depending on fan size and design. If factory mounted, they may or may not be test run, depending upon fan size. Factory mounted bearings should be lubricated with the correct amount and type of lubricant to permit operation upon installation. As stated before, all bearings should be inspected for lubrication prior to start-up and we recommend that the bearing caps be removed, the bearing inspected for moisture contamination, and lubricant level confirmed.

If field mounted, note that bearings are shipped only with a preservative and that the bearing must be lubricated before operation. If the bearing is not to be put into operation immediately, the pillow block and bearing should be hand packed full of grease. Care must be taken to insure that no

moisture or dirt particles are entrapped during this procedure. Label the bearing that it contains too much lubricant for operation and cover with waterproof paper.

When preparing the unit for operation, the bearing cap is to be removed and all lubricant removed using a clean instrument and clean cloth. Inspect bearings, then apply fresh lubricant as specified. Greasing is complete if grease appears on the opposite side. Pack the bearing housing reservoir to a height roughly even with the bottom of the shaft.

Fafnir SAOL

Prior to shipping, fans with this type bearing may or may not be shop tested. This bearing is usually oil lubricated and must be checked prior to operation. Loss of lubricant can occur from handling during shipment.

Dodge Sleevoil Bearings and similar designs

Fans using Dodge Sleevoils should not be assembled unless the wheel and shaft weight is taken off the sleeve inserts of the bearing. The weight of the wheel and shaft assembly can damage the babbit of the bearing. Refer to specific manufacturers instructions for storage, lubrication, installation, and operation.

NOTE: Extreme caution must be taken not to contaminate any bearing when working on them. Bearings which have top or side caps removed should never be left unprotected.

Upon removal from storage, the following procedures should be followed:

1. Removal of rust preventative from shaft journals and any other machined surface.
2. Thorough examination to insure no build-up of foreign material has occurred from the elements or near-by processes.
3. Examination to make certain that paint or coating is still in first-class condition.
4. Lubricate bearings to specifications as described in lubrication section and on assembly drawing. Do not use substitute lubricants unless approved by NYB.

G. FOUNDATIONS

NYB is not responsible for the design of the foundation on any NYB fan equipment. The natural frequencies of the foundation must be sufficiently removed from the rotational frequency of the fan so the foundation does not amplify vibrations. It is the customers responsibility to see that a proper foundation is used.

A rigid, level foundation is important for every fan installation. This insures quiet operation, good performance, reduces excess vibration and minimizes maintenance costs. The sub-foundation should be firm enough to prevent uneven settlement of the fan support, and have adequate stiffness characteristics to avoid rocking or translational resonance. Foundation bolt locations are found on the fan assembly drawing along with estimated weight distributions.

If fan is to be mounted using a sole plate arrangement under the bearing supports, make allowance for dimensions of the sole plates and 1" grouting. Allow for the top of the concrete pad to be a minimum of 3" larger than the steel pedestal outline in all four directions. Check the fan assembly drawing for clearance before making the pad larger than 3".

Fan foundation must be flat, level, and rigid. Poured concrete under the fan and all drive components is the preferred foundation.

A generally accepted rule of thumb is the weight of the foundation must be at least three times the total weight of the equipment it will support or ten (10) times the weight of the rotating assembly, whichever is greater.. This weight will act as an inertial block to stabilize the foundation. The foundation should be flared or the footing course increased in size to resist settling. The top of the foundation should extend at least 6" outside the outline of the fan base and should be beveled on the edges to prevent chipping.

The drive end and opposite drive end pedestals should each have a minimum weight equal to that of the wheel and shaft assembly. The sides of these pedestals should slope away a minimum of 15 degrees starting at the top, unless the drive end pedestal is common with the motor pedestal. In that case, the sides may be vertical.

Very large fans and/or variable speed drive fans require special foundation considerations. The purchaser may decide to perform a system forced response analysis to determine the natural frequencies and expected vibration amplitudes with expected wheel unbalance forces. (See AMCA Publication 801).

When a structural steel foundation is required, it must be sufficiently rigid to maintain alignment and designed to carry, with minimum deflection, the weight of the fan plus the dynamic loads due to unbalance (generally 25% of the rotating weight).

Fans installed above ground level should be located near or above a heavy column or rigid wall. An overhead platform or support must be rigidly constructed, level and securely braced independently from the fan in all directions. In any above ground installation, design of the structure should permit field revisions (knee braces, etc.) if initial operation indicates a need for increased stiffness. Spring mounted vibration isolation bases are recommended for many fans mounted on structural steel to avoid vibration transmission problems. Refer to Section III "Vibration Isolation".

Anchor bolts in concrete should be "L" or "T" shaped and should be placed in pipe or sheet metal sleeves about 2" larger in diameter than the anchor bolts to allow for adjustment in case the bolts move slightly when concrete is poured. The bolting dimensions should be checked prior to mounting fan, adjust if necessary and the bolt grouted solidly inside pipes. Foundations must be level and allowance made for a minimum of 1" of shimming and grouting when determining the top of the foundation. Jacking bolts must be loosened and hold down

bolts tightened to steel shims prior to grouting. All space under the base angles, and pedestals if present, should be grouted. Foundation bolts should be retightened and base rechecked for level. Shims should be stainless steel and a minimum number for required thickness.

On all large fans, foundations should be keyed to bedrock, and use of pilings may be necessary. A civil engineer should be consulted before such a foundation is constructed. An improperly constructed foundation will cause vibration and possible misalignment of the rotating assembly. Refer to ED-002 “Fan Foundation Guidelines” included as Appendix I.

H. DUCT DESIGN

Expansion joints and/or flexible connections are necessary at the fan inlet and outlet to isolate fan from duct static loads, duct temperature expansion loads and vibration loads. The type of expansion joint is dependent on system operating conditions such as temperature, abrasiveness and corrosiveness of the gas stream. Flexible connections may be multiple bellows expansion joints, banded slip joints, fabric or sheet plastic flexible joints. Ducts must be anchored near the fan and designed to prevent loads from being transferred to the fan.

Flexible connections may require acoustic treatment to reduce noise.

Surging is a common, destructive phenomena that many people do not understand. It is not just a characteristic of the fan but rather a function of the fan and system ductwork design.

Although it is not recommended, most fans can operate stably to the left of the static pressure peak provided the ducting is designed properly. This requires short, straight runs; no large expansion chambers between the fan and the primary pressure drop. It is recommended the duct design be reviewed with the fan manufacturer.

Often aerodynamic turbulence within the fan at low flows is confused with surging but they are different animals. Turbulence is usually not a problem so long as the housing is properly braced.

Avoid elbows or turns located close to the fan inlet or outlet. Butterfly dampers are not recommended for control at the fan inlet. Refer to AMCA Publication 201 "Fans and Systems" for additional information on duct design and system effect factors. See attached Appendix II St-040 “Duct Configurations”

I. MOTOR STARTING PROBLEMS

Motors may be supplied by NYB or the customer. In either case the wheel and shaft WR^2 must be taken into consideration. Motors are often sized for the operating horsepower at process temperatures and are not capable of starting the fan at cold conditions unless the inlet damper (or other system damper) is fully closed throughout the start-up.

Starting switch gear, overload protection and other electrical items are supplied by others unless specifically stated otherwise in the purchase order.

The fan starting time can be estimated using the following formula:

TIME = (WR^2 x RPM Difference)/(307 x Available Torque)

NYB recommends the motor starting capability be confirmed by the motor supplier. The motor supplier should be given the fan WR^2, any radial or axial loads on the motor, ambient temperature and elevation.

The available torque is the difference between the actual motor torque and the torque required by the fan. Most single speed fans will reach full speed in 25 seconds or less. Longer starting time can result in motor overheating. In many cases it is necessary to use time delayed fuses in the motor starter when the standard fuse only allows 10 to 15 seconds. This should always be checked with motor supplier before changing fuses.

The following are some causes of excessively long starting times:

1. Driver torque not adequate for fan WK2.
2. Partially open fan inlet damper or other leakage within system.
3. Colder starting gas stream temperature requiring a higher torque.
4. Low motor supply voltage, reducing motor capacity.
5. Improper electrical connection.

The electrical current during starting is typically 5 to 7 times the motor full load current. Motor thermal overload protection must be selected to allow high current for up to 25 seconds or more depending on the WK2 of the fan. The National Electric Code allows dual element time delay fuses to be rated at 125% of the motor full-load current and in some cases where this rating is not sufficient, the rating of the fuses may be increased up to 148% of the motor full-load current.

Full voltage starting initially connects the motor directly to the power source. The advantages of this are low cost, high starting torque, low maintenance and it may be used with any standard motors.

Reduced voltage starting limits input voltage and reduces initial current. An adjustable timer is provided for switching to full voltage after the motor has partially accelerated, thereby extending starting time.

Wye Start/Delta Run allows starting at reduced phase voltage and has similar effect to reduced voltage. This is not a standard motor setup and must be specified at time of order.

Full load amps and the motor Service Factor are listed on the motor name plate. Always monitor motor current and do not operate the motor in an overcurrent condition. In all cases the fan must be connected to the system ductwork and/or dampers

closed to provide a system resistance before operating the fan. In general, on motors over 200 HP, refer to the motor manufacturer instructions for details on number of starts per hour allowed.

J. Variable Speed Drives

Fans designed to operate over a wide speed range have special considerations. An example is a variable frequency drive that can operate between 10% and 100% rated motor speed. The end user must have a qualified vibration specialist to perform a vibration analysis of the fan/motor/drive and structural support system to identify any problem frequencies. Once identified, the drive must be tuned to prevent operation within a specified range of that frequency.

The analysis must be done under all normal operating conditions. Doing an analysis during a cold start up inspection of the fan will not identify problems that may be temperature sensitive, vibrations set up by specific flow patterns, acoustic resonance, etc.

A little known problem with VFD operated fans is the "hunting" of the motor speed about the set point speed of the VFD. This can occur when a fan operates below 50% rated speed at low motor loads. At some point as the motor load decreases, the motor speed will begin a rapid oscillation around the set speed which will cause drive failures and failures in rotating assembly of the fan.

K. SOUND

Sound Power Level ratings given by NYB are decibels referred to 10-12 Watt and obtained in accordance with AMCA Standard 300. Sound Pressure Level for each band and dbA are calculated per AMCA Standard 301. Values reported do not include motor or auxiliary equipment. The ductwork thickness must be the same as the fan housing thickness to achieve the Sound Levels reported or attenuating material used. Refer to the computer generated NYB Sound Data Sheet for further explanation.

L. ARRANGEMENT, ROTATION, DISCHARGE, AND CLASSES

Refer to Appendix III for information relating to the different drive arrangements, specifying inlet box position, rotation and discharges, motor position on V-belt drive and classes. This information is based on AMCA standards and is intended to assist the designer in communicating with the fan manufacturer.

M. REFER TO SECTION "II" FOR INSTALLATION.

Always keep in mind that all fan equipment should be inspected prior to initial startup. This should be by a qualified service technician and include a minimum of checking bolt tightness, alignment, bearings, drive lubrication and clearances. Bearing vibration and temperature should be recorded to insure the fan is within tolerances and as reference for comparison later. During initial run-in, bearing temperatures may run hot at first, so it is recommended to monitor the temperature until it stabilizes.

Fans shipped assembled need alignment checked, bolts checked for tightness, lubrication checked and complete inspection just as a fan that is shipped disassembled. The reason is because shipping and handling can cause alignment to change, bolts to loosen, or spillage and/or contamination of lubrication.

Checking bolt tightness should include setscrews on the wheel hub, bearings and taper lock hub arrangements. This is very critical because the thrust on a wheel will cause the shaft to shift in a bearing axially or the wheel to move on the shaft if looseness occurs.

Vibration must be checked on all fans prior to startup to insure vibration does not exceed acceptable levels. Even a new fan can need a "Trim" balance to fine-tune the fan/foundation system. This is important and must not be overlooked.

A "Trim" balance requires an initial reading, trial weight reading and correction reading. This may have to be repeated several times to achieve required tolerance. Fans operated without pre-startup inspection as stated above will have their warranty voided.

All fans should be run for 8 hours and again rechecked for bolt tightness, vibration and temperature. This should be repeated in 2 weeks and then be a part of the normal maintenance routine on the fan.

Spare parts such as wheel and shaft assemblies must be stored in a clean, dry area. Periodic inspection is required to insure items are in first class condition. If stored outdoors it is very important they be checked no less than once every 2 months to be sure no damage is occurring to machined surfaces by moisture or other means.

Installation

SECTION "II": INSTALLATION MANUAL

NOTE: <u>BE ABSOLUTELY SURE THAT ALL FAN EQUIPMENT IS ELECTRICALLY LOCKED OUT DURING ALL PHASES OF INSTALLATION UNTIL READY TO ACTUALLY START-UP.</u>

Table of Contents

A. <u>GENERAL</u>

Be sure to review the complete manual and the fan assembly drawing prior to installing the fan. Frequently components are shipped with shipping bracing to prevent distortion and may or may not be tagged for removal. These must be removed. All items are match marked when assembled in the NYB shop to insure proper fit in the field.

This manual assumes the fixed bearing is next to drive or drive side and the float bearing is furthest from drive. Refer to the NYB fan assembly drawing to be sure which bearing is fixed and which is float. Sometimes the bearing manufacturer will recommend revising locations due to bearing life and installer must keep that in mind when reading this manual.

Occasionally distortions occur in shipping and handling that will make it necessary to adjust a component for field fit or open a bolt hole diameter to match another bolt pattern. Follow standard field practices when fitting or doing minor burning or welding unless specific instructions are shown in the manual or on assembly drawing.

CONTACT NYB prior to any modifications or doing burning or welding not specified.

B. <u>RECOMMENDED BOLT/STUD TORQUE</u>

If no specific torque values are shown on the fan assembly drawing or in manufactures literature, then refer to table 1.

Table 1 - Standard Bolt Torque's

Nominal Size (UNC)	Bolts (ft-lb.)	Studs (ft-lb.)
1/4-20	8	5.5
5/16-18	17	11
3/8-16	31	18
7/16-14	49	28
1/2-13	75	40
5/8-11	150	82
3/4-10	266	107
7/8-9	310	165
1-8	370	236
1 1/8-7	480	-
1 1/4-7	650	-

Unless otherwise noted, we stock and use Grade 5 bolts. Refer to fan assembly drawing for special bolt requirements for high temperature, housing splits and corrosion exceptions.

C. HOUSING ALIGNMENT

ARRANGEMENT 1, 4, 8, 9 AND 10

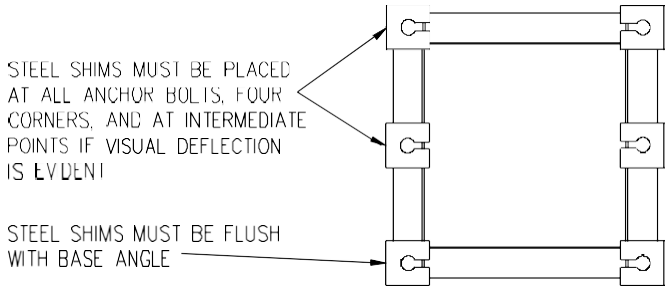
1. Using a spirit level on shaft between bearings, shim at the foundation anchor bolts to attain level. In case of Arr#4 use a horizontal surface on motor.
2. Tighten hold-down bolts on foundation and grout in place.

ARRANGEMENT 3, 7

1. If housing was shipped dismantled, lift bottom half of housing onto foundation. To prevent damage to anchor bolts while housing is being moved, place wooden blocks beside the anchor bolts.
2. Use spreader bars as necessary to minimize distortion while lifting housing. Lift housing from as many points as possible and align over anchor bolts.
3. Once aligned over anchor bolts, set housing one side at a time, remove the block, and carefully lower housing onto foundation. Note that parts are match-marked to aid in assembly.
4. Place "U" shaped shims around anchor bolts. Shims should be approximately 4" wide and flush with the edge of the base angle. Steel shims must be placed at all anchor bolts, four corners and at intermediate points if deflection is noted. Use thicker shims to minimize the number of shims used.
5. It is critical that housing centerline dimensions are set in accordance with fan assembly drawing dimensions or this will cause problems later when trying to properly position the wheel and inlet pieces.

For center supported housings, refer to "High Temperature" section.

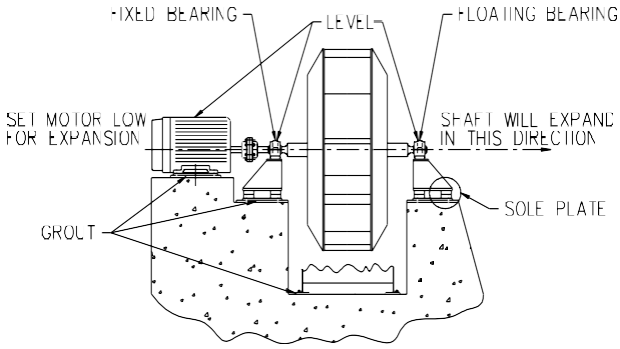
Figure 1 - Shim Placement Detail



D. SETTING AND ALIGNMENT OF BEARING PEDESTALS - Arr#3, 7

1. Use shims to put bearing pedestals in place at the proper bearing centerline height.
2. Level the fixed (drive side) bearing using flat shims under the sole plate. Use of a surveyor's transit is very helpful in this operation. Tolerance = ≤ 0.003in./ft.
3. Adjustment of "L" or "T" anchor bolts is helpful in leveling sole plate. After final leveling is made, place stainless steel shims next to each "L" or "T" bolt and at the shaft centerline (both sides) under the sole plate before grouting.
4. Temporarily bolt down bearing pedestals. Shims running the full length and half the width of the bearing sole plate and slotted to fit around the mounting bolts provide the most solid mounting arrangement for later mounting of bearings.

Figure 2



Note: Refer to fan drawing to be sure fixed and float bearings are not reversed for your specific application.

Figure 3

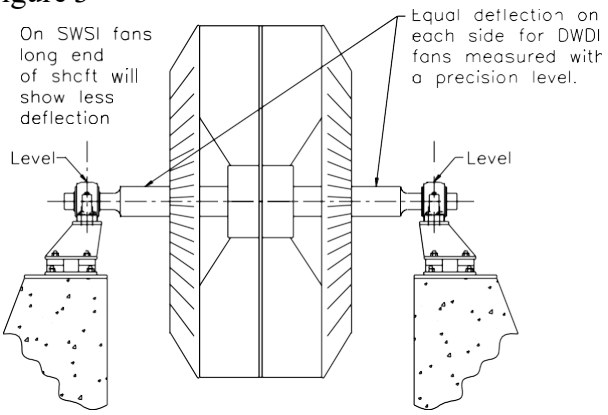
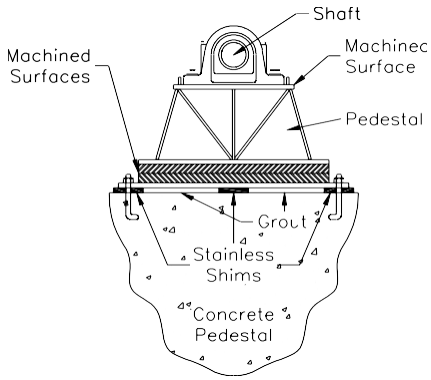


Figure 4

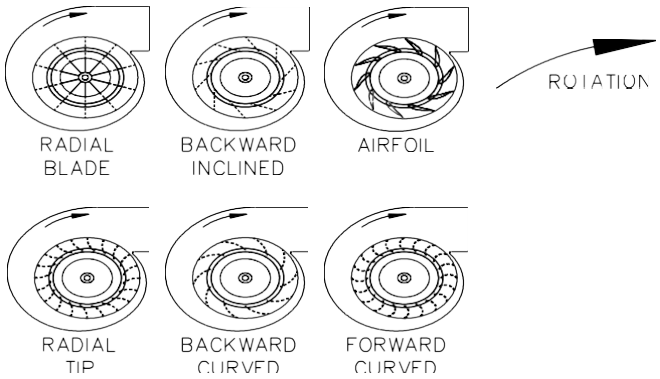


E. WHEEL ASSEMBLY PREPARATION

Most NYB heavy duty rotors are shipped with a shaft shrink fit. Check the assembly drawing for proper wheel rotation.

1. Place wheel on floor, bracing into position.
2. Remove protective coatings (as applicable) from shaft and hub. Inspect for rust, corrosion and nicks.
3. Cleanup may be necessary. Crocus cloth or "Scotchbrite" may be used for cleanup of journal surface. (NEVER use emery cloth on bearing journals.)

Figure 5 - Wheel Blade Types



F. SETTING OF INLET PIECES - Arr #3, 7

The inlet piece (or pieces on DWDI) must be placed over the shaft end before mounting the wheel assembly in the housing. A spreader bar sometimes can be used so the inlet piece can be supported independently from the wheel which makes it easier to work the wheel and inlet piece into position.

If a radial inlet damper is provided, check for proper rotation. Inlet vanes in the half-closed position must prespin the air in the direction of wheel rotation. On a DWDI fan, one inlet vane control is counter-clockwise, the other clockwise. They must not be installed reversed. Secure inlet vane controls to wheel for lifting purposes. If vane center mechanism is allowed to rest on shaft, damage may result.

G. BEARING PREPARATION AND SETTING OF WHEEL ASSEMBLY

The NYB fan assembly drawing will clearly specify the type of lubrication and re-lubrication schedule. When specific information is not shown on the assembly drawing, then follow instructions in this manual. If there seems to be a conflict between the bearing manufacturer, the assembly drawing and this manual; or if you have any questions, contact NYB before proceeding.

The Primary purpose for this section is for installation of new Arr#3,7 fans. However, most information applies to installing new bearings on existing Arr#1, 8, 9 and 10 fans. One important thing to remember with any of the later arrangements is that both the float and fixed bearing must be slid onto shaft before coupling or drive sheave. Otherwise you will be starting over.

ANTI-FRICTION (BALL) BEARINGS - SOLID PILLOW BLOCKS

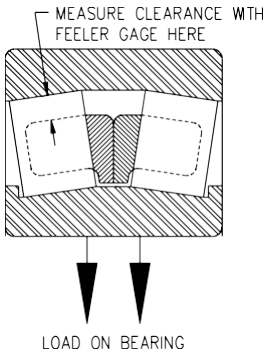
(See bearing manufacturer's literature, attached.) Solid pillow blocks are placed over shaft ends before final alignment. Refer to assembly drawing for floating bearing and fixed bearing location. Note that two fixed bearings are used on some applications. In most cases the bearing to shaft fit is very tight and the shaft must be clean or the bearing will hang up.

ANTI-FRICTION (ROLLER) BEARINGS - ADAPTER MOUNT, SPLIT PILLOW BLOCK

(See bearing manufacturer's literature, attached.) Solid bearing race on drive side must be mounted before putting coupling or v-belt drive sheave in place. This was mounted in the shop if the wheel shaft assembly was shipped with coupling mounted. Refer to assembly drawing for floating bearing and fixed bearing location.

1. Cleaning of internal parts is not necessary since the corrosion preventative compound applied by the manufacturer is compatible with the NYB recommended lubricants. Carefully inspect all internal parts since corrosion, if undiscovered, can lead to mechanical problems.
2. Cover open pillow blocks and bearing parts which are exposed to the atmosphere with a clean cloth to prevent dust or moisture contamination.
3. Replace bearing internals in same order as removed from pillow block.
4. Sling wheel assembly as previously described, and lift into place.
5. Prior to final alignment, replace bearing caps.
6. Pay particular attention to bearing internal clearances before and after tightening. See specific bearing instructions. A copy of the LinkBelt bearing reduction clearance is shown as Table 2
7. Locate floating bearing to allow for shaft axial expansion. For overhung fans the float bearing can be centered in bearing housing. For centerhung fans the float bearing should be set at 1/16” clearance from the side closest to fan.

Figure 6



Adapter mount spherical roller internal clearance tolerances as measured with a feeler gage between the roller element and the outer raceway.

Table 2 - LinkBelt Bearing Clearance Reduction

Bearing Size (Diameter)	Initial (Unmounted) Clearance (C3-FIT)*	Reduction in Internal Clearance	Min. Permissible Final Clearance After Mounting
1-7/16, 1-11/16	0.0024 - 0.0032	0.0010 - 0.0012	0.0012
1-15/16, 2-3/16	0.0030 - 0.0039	0.0012 - 0.0015	0.0014
2-7/8, 2-11/16	0.0037 - 0.0049	0.0015 - 0.0020	0.0016
2-15/16, 3-3/16, 3-7/16	0.0044 - 0.0057	0.0018 - 0.0025	0.0020
3-11/16	0.0053 - 0.0069	0.0020 - 0.0028	0.0025
3-15/16	0.0065 - 0.0075*	0.0020 - 0.0028	0.0037
4-3/16	0.0070 - 0.0080*	0.0020 - 0.0028	0.0042
4-7/16, 4-15/16	0.0070 - 0.0080*	0.0025 - 0.0035	0.0035
5-7/16	0.0071 - 0.0091	0.0030 - 0.0040	0.0035
5-15/16	0.0079 - 0.0102	0.0030 - 0.0045	0.0040

* Special increased clearance fit bearings supplied through NYB. Refer to NYB assembly drawing.

SLEEVE BEARINGS (Refer to DODGE instruction manual if applicable.)

1. Remove bearing caps; clean with solvent. Coat with new oil and cover caps with plastic to avoid contamination.
2. Clean shaft seals and oil rings.
3. Loosely bolt lower half of bearings into place, then cover to avoid contamination.
4. Sling wheel assembly in manner previously described. Wheel assembly is to be placed above bearing journals and liner for drive bearing fastened to shaft. Be sure to check for proper wheel rotation before setting the assembly into the bearings. Lower into housing with wheel assembly. See specific detailed bearing information (inserted).

DODGE Plain and XC Bearings:

Split thrust collars are field mounted during installation. Refer to specific instructions attached.

DODGE RT Bearings:

Thrust collars are either integral to the shaft or split for field mounting into pre-machined grove. Refer to specific instructions attached.

DODGE RXT Bearings:

For special application requiring extremely high bearing oil film stiffness, the Dodge RXT bearing

may be used. This bearing involves machined-in thrust surfaces on the shaft and special assembly and handling procedures. Refer to the separate instruction manual (attached) if your fan is equipped with this type of bearing.

H. LOCTITE ADHESIVE PROCEDURE

This procedure is for use on all fans with setscrew mounting that operate at or above 2500 RPM. Generally applies to ball bearing applications.

1. Spray Loctite Safety Solvent onto the inner bearing race and to fan shaft to flush away oil, dirt, grease. Wipe clean using paper towel. Wait 5 minutes until solvent entirely evaporates. **DO NOT SPRAY INTO BEARING**.
2. **CAUTION! LOCQUIC PRIMER N**: Use this to speed up the set up time. Spray Locquic Primer N onto the inner bearing race only, not to the shaft. **ALLOW PRIMER N TO ENTIRELY EVAPORATE - THIS SHOULD TAKE APPROXIMATELY 5 MINUTES AND IS VERY CRITICAL**.
3. **NOTE: LOCTITE** Adhesive will not set up on stainless shafts unless Primer N is used. Keep out of bearing internals. Using Loctite Adhesive RC/620-400 F - .015" gap maximum, apply the adhesive to the shaft and assemble bearing race to shaft. Wipe off any excess adhesive which may have oozed out from the applied area during assembly. Note, the Loctite Adhesive can be applied through the setscrew holes and the shaft slid back and forth to cover the inner race.
4. Tighten bearing set-screws to proper torque.
5. **ALLOW SHAFT ASSEMBLY TO ACHIEVE PARTIAL CURE, 15 MINUTES IF LOCQUIC PRIMER N WAS USED, 18 HOURS IF NO PRIMER IS USED**.

I. WHEEL AND HOUSING ALIGNMENT

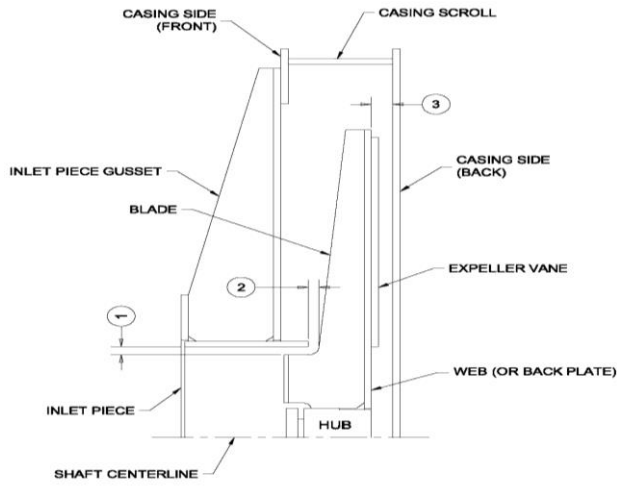
Be sure that shaft centerline is the proper height for connection to the driver. Before proceeding, be sure the housing centerline locating dimensions are as shown by assembly drawing. If any of the housing locating dimensions are wrong final alignment will be difficult or may not be possible at all.

Alignment details of wheel to inlet piece are included on the NYB assembly drawing. The assembly drawing gives a dimension for the inlet piece to rotor fit on all fans and backplate to housing on SWSI units. See figure 7. Check this alignment before final tightening of pedestals, bearing bolts and bearing locking devices.

Because of fabrication tolerances and distortions, neither the inlet piece running clearance nor the web clearance are going to be exact or constant. Both clearance will vary depending on the axial and radial runout of the wheel. The more important setting is the wheel to inlet clearance and it takes priority over the web clearance.

At a Minimum the plane of the inlet should be flush with the plane of the inlet to the wheel and the running gap equally spaced around the inlet. Sometimes it may be necessary to open inlet bolt holes for more adjustment, or bend or grind the end of the inlet piece to fit the wheel. See High Temperature Fan section for special notes.

Figure 7 - Wheel and Housing Clearances



For high temperature fans (above 400°F refer to assembly drawing for special inlet piece to wheel fit-up requirements.

← Critical running clearances - See Assembly Drawing Notes

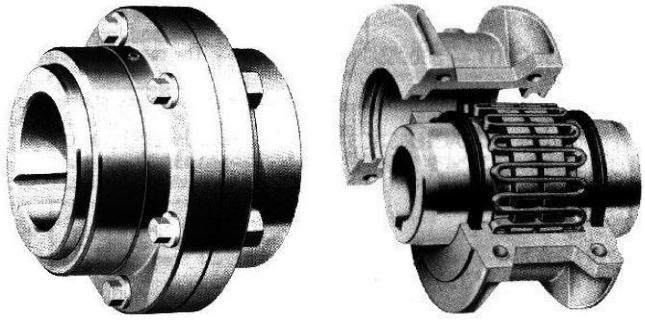
J. SETTING AND ALIGNMENT OF BEARINGS

The driver side bearing, floating bearing, and motor are all to be set level. Check to be sure the bearing seal has equal clearance to the shaft all around. No grouting is to be done until all components are leveled and aligned.

K. COUPLING INSTALLATION AND ALIGNMENT

On completely assembled unit with premounted motor and coupling, alignment must be rechecked after fan is secured onto its permanent foundation. Adjustments regarding alignment must be made and the coupling relubricated if necessary. Although the fan was carefully aligned at the NYB shop, it is possible that movement occurred during shipment or due to foundation variations or mounting. The alignment must be field checked before start-up.

Figure 8 - Courtesy of the Falk Corporation.

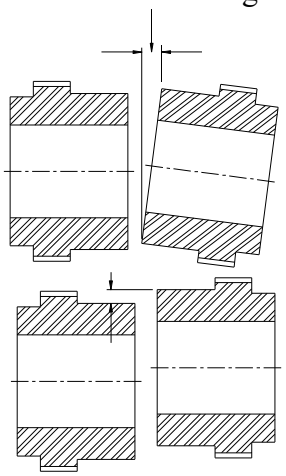


The following is a general description of the installation of grid and gear couplings. For specific information refer to coupling manufacturers instructions. All bearings, inlet vanes, etc. must be installed prior to aligning couplings.

1. Install each coupling half cover with O-ring (if equipped) on its shaft.
2. See coupling manufacturer's manual to determine which direction long/short shank of coupling hub is to be located (if applicable).
3. Using temperature stix and a hot oil bath, electric heater, or oven, heat coupling hub to a temperature of 300°F. A rosebud torch can be used but being careful not to apply direct flame to hub teeth.
4. Install coupling hub(s) on shaft. Hub and shaft face should normally be flush.
5. Key couplings to shafts while hubs are at elevated temperature.
6. Adjust the gap between coupling hub faces. See assembly drawings for proper coupling gap.
7. If using a sleeve bearing motor, and the magnetic center of the motor is not marked, equally divide the maximum play to determine the mechanical center, then align in this position. A limited endfloat coupling must be used with sleeve bearing motors. Refer to assembly drawing.
8. Check to insure that the faces of fan and driver couplings are parallel using a tapered wedge, feeler gauges, dial indicator or laser alignment. See Figure 9 for maximum allowable angular and parallel misalignments.

Figure 9

Angular Misalignment Parallel Offset Misalignment

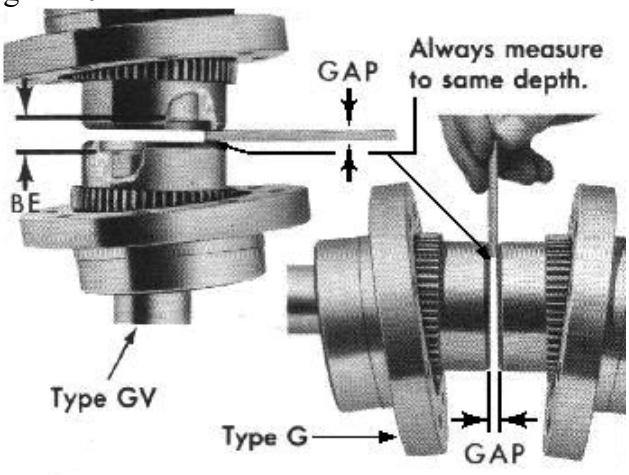


Angular Misalignment (in.)			Speed RPM	Parallel Offset Misalignment (TIR - in.)		
0.000	-	0.001	3600	0.002	-	0.003
0.001	-	0.002	1800	0.004	-	0.005
0.002	-	0.004	1200	0.005	-	0.006

0.002	-	0.004	900	0.005	-	0.006
0.002	-	0.004	720	0.005	-	0.006

9. Align shafts until parallel. Repeat procedure at 90 degree intervals and recheck angular alignment and hub separation. Suggested method of alignment: Using a dial indicator clamped on one hub with the dial indicator button resting on the other hub, rotate hubs in unison and take indicator reading. Repeat the procedure at the three remaining 90 degree intervals.

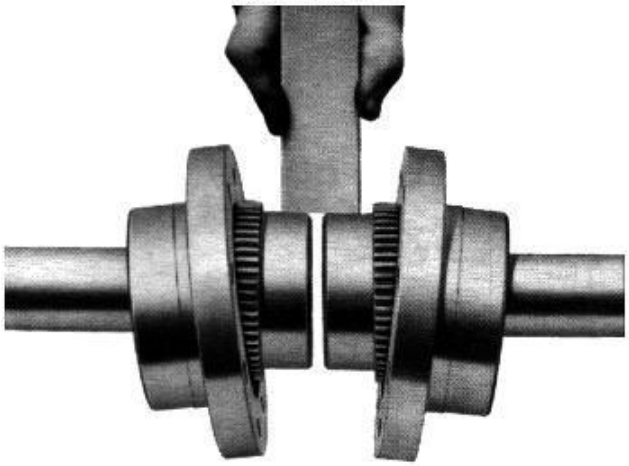
Figure 10



Gap and Angular Alignment

Use a spacer bar equal in thickness to gap specified on NYB drawing. Insert bar, as shown above, to same depth at 90° intervals and measure clearance between bar and hub face with feelers.

Figure 11



Offset Alignment

Align so that a straight edge rests squarely (or within the limits specified in Figure 9) on both hubs as shown above and at 90° intervals. Check clearance with feelers..

10. When using large turbines or motors as drivers, allow for driver vertical expansion during operation: set driver side of the coupling low by a few thousandths; this will bring coupling into alignment during operation. Refer to driver O&M for actual setting. General rule for initial alignment of large motor: Set driver low 0.001" per inch of motor shaft diameter. Use this if no other information is available.
11. Install gasket between coupling halves. Coupling flanges should then be drawn together keeping gasket in line with bolt holes.
12. Bolts, lockwashers, and nuts are now to be inserted and tightened.
13. Lubricate according to specifications as outlined in grease lubrication charts found in maintenance section. Once unit has been in operation and thermal expansion complete, recheck coupling alignment, making adjustments if necessary.
14. Inspect gasket for tear or damage. Coupling misalignment may be a result of these factors, related to installation of the drive unit:
    a) rough or dirty surfaces between motor and foot and base.
    b) short or tilted motor leg (soft foot condition).
    c) angled or warped motor mounting plate.
    d) dirty, bent or oversized shims.
    e) too many shims, or shims with burrs.

If any of these conditions present themselves in your application, it is essential that they be corrected to provide proper alignment.

L. INLET ALIGNMENT

1. Install gasketing in housing split then install split portion of housing.
2. Reposition inlet piece to give correct clearance, inlet piece should be centered around inlet eye of the wheel, unless stated otherwise on assembly drawing.
3. Tighten all remaining fasteners in foundation.
4. Install shaft seals (if applicable).
5. Turn wheel to insure it runs freely.
6. It is often a good practice to butt inlet piece support blocks against the inlet piece flange and tack weld them to the housing sides as a means of "fixing" the inlet piece location.

SEE DETAILED BEARING INSTALLATION INFORMATION (ATTACHED) AND INSTALL BEARINGS.

M. <u>FAN DRIVERS (MOTORS, ENGINES, TURBINES)</u>

(Fan drivers may be supplied by NYB or by others.)

STARTING TIME

The starting time can be estimated as follows:

Time = (WR2 * delta RPM) / (307.2 * avail.torque) time (time is in seconds)

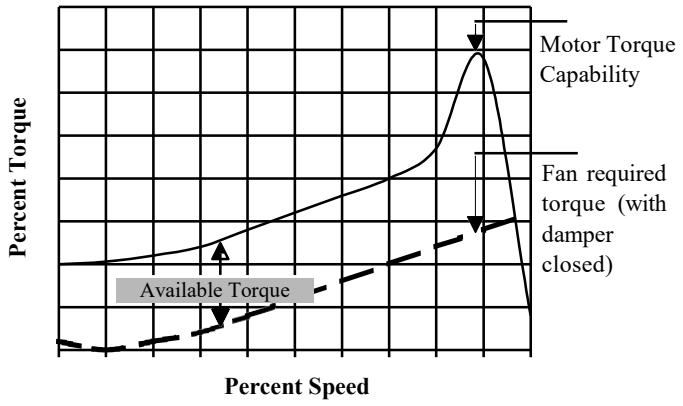
Delta RPM = final RPM - initial RPM (rev/min)

Avail.torque = (motor torque capability)-(fan torque requirement) at all speeds from zero to normal operating speed (lb.-ft)

WR2 = fan wheel rotational moment of inertia (lb-ft2)

Figure 12

Typical Speed/Torque Curves



Notes:

1. Align driver to fan.
2. Determine if the needs to be set low to allow for thermal expansion of the driver. For electric motors, a general guideline is to allow 0.001 inch per inch of motor shaft diameter.

Most single speed fans will achieve full operating speed in 25 seconds or less. Longer starting times can result in motor overheating. The following are typical causes of excessively long starting time:

1. Driver torque not adequate for fan wheel WR2.
2. Low voltage, causing reduction in motor torque capability.
3. Partially open fan inlet damper, causing increase in fan torque requirement.
4. Low temperature (high density gas) causing increase in fan torque requirement.
5. Driver speed-torque curve not providing enough available torque when compared to fan torque requirement (especially on gasoline/diesel engine driver units).

NOTE: Drivers are often sized for the operating horsepower at process temperatures and are incapable of starting the fan at cold conditions unless the inlet damper is fully closed throughout the start-up.

Starting switch gear, overload protection, and other electricals are supplied by others unless specifically stated in the purchase order.

MOTOR OVERCURRENT PROTECTION

The electric current during starting is typically 5 to 7 times the motor full load current. Motor thermal overload protection is recommended to prevent burnout from misapplication or excessive number of starts. Thermal overload protection must be selected to allow high current for up to 25 seconds or more in some cases when starting high-inertia fans. The National Electric Code allows dual element time delay fuses to be rated at 125% of the motor full-load current for all AC squirrel cage motors with full voltage, resistor, reactor, or auto-transformer starting under normal conditions. In

cases where this rating is insufficient for the starting current of the motor, the rating of the fuses may be increased up to a maximum of 140% of the motor full-load current. (Refer to Articles 430-31 through 430-34 of the National Electric Code).

Maximum Inertial Limits and Acceleration Time

Table 3 - ODP

RPM	3600		1800		1200		900	
Hp	WR2	accel time	WR2	accel time	WR2	accel time	WR2	accel time
-	-	-	-	-	-	-	-	-
1	-	-	20	18	70	28	115	35
1.5	5	14	25	16	73	23	135	29
2	6	11	24	17	84	19	150	22
3	9	12	50	19	86	13	215	23
5	14	13	70	15	150	14	300	21
7.5	21	14	100	18	210	17	450	22
10	23	12	124	16	270	17	570	21
15	29	10	185	17	430	19	870	19
20	50	17	260	21	480	16	960	19
25	70	19	300	19	750	21	1330	19
30	80	19	305	16	870	20	1600	21
40	100	18	450	14	930	16	1820	17
50	120	19	490	16	1080	14	2300	18
60	150	21	580	15	1400	15	2700	17
75	170	22	950	20	1600	14	3600	18
100	190	18	1000	16	2100	14	4300	16
125	240	14	1270	15	2600	14	5300	18
150	300	14	1660	21	3100	16	6200	19
200	390	15	2000	18	4100	15	8200	19
250	470	15	2300	17	5000	16	10000	15
300	540	13	2400	19	5800	15	-	-
350	600	16	3000	18	6800	15	-	-
400	650	18	3300	17	-	-	-	-
450	720	16	3600	16	-	-	-	-
500	790	10	-	-	-	-	-	-
600	900	12	-	-	-	-	-	-

Table 4 - TEFC Enclosed

RPM	3600		1800		1200		900	
Hp	WR2	accel time	WR2	accel time	WR2	accel time	WR2	accel time
-	-	-	-	-	-	-	-	-
1	-	-	20	16	70	28	115	37
1.5	8	25	30	17	73	22	135	29
2	10	21	40	17	84	19	150	24
3	10	14	50	19	86	13	215	23
5	15	13	70	17	150	15	300	21
7.5	16	10	100	17	220	17	450	21
10	23	18	124	17	300	19	570	21
15	45	20	185	18	430	20	870	19
20	50	17	270	20	660	22	960	18
25	55	17	300	19	750	21	1330	20
30	100	25	390	20	870	20	1600	20
40	130	24	530	22	980	17	2490	25
50	160	24	640	19	1570	21	3430	26
60	230	30	770	21	2000	21	3900	27
75	260	28	1000	21	2100	17	5500	31
100	350	21	1540	25	3700	28	7500	37
125	420	31	1820	24	4300	26	9000	33
150	630	35	2500	28	5400	26	12000	41
200	740	32	3000	28	7800	33	17000	38
250	940	32	3800	27	10000	28	-	-
300	1150	32	4600	27	-	-	-	-
350	1350	26	5400	24	-	-	-	-
400	1550	18	-	-	-	-	-	-
450	-	-	-	-	-	-	-	-
500	-	-	-	-	-	-	-	-
600	-	-	-	-	-	-	-	-

Intertial Acceleration *(at 100% Voltage)*

WR^2 - (lb. - ft^2) Accel Time - (Seconds)

This chart is typical for our motor supplier's equipment. The actual motor used should be selected for operation with the particular fan it will be driving for every application.

STARTERS AND CONTROLS

Full Voltage Starting (Across-the-Line) initially connects the motor directly to the power lines. The advantages of this method are its low cost, high starting torque, low maintenance and the fact that it may be used with any standard motor. Note that the high starting torque and high starting current may shock the driven fan equipment.

Auto Transformer Starting (Reduced Voltage) limit input voltage and reduces inrush current. Normally an adjustable timer is provided for switching to full voltage after the motor has partially accelerated. Note that motor output torque is reduced by the square of the voltage reduction at the motor and, therefore, starting time is extended.

Wye Start/Delta Run allows starting at reduced phase voltage at reduced load and inrush current. Starting voltage is full voltage divided by the square root of three. High transient currents are possible at the transition from wye to delta. This is a nonstandard motor connection that must be specified at order time.

Note the full load amperage and the motor service factor as listed on the motor name plate. Monitor the motor current and **DO NOT OPERATE THE MOTOR IN AN OVERCURRENT CONDITION**. In most cases the fan must be connected to the system ductwork and/or dampers closed to provide a system resistance before operating the fan. In general, on motors above 200

HP, do not restart more than once every 30 minutes. Detailed start-up limitations are available from the motor manufacturer.

VARIABLE FREQUENCY AC APPLICATIONS

To avoid torsional natural frequency problems, a special coupling may be required. Operation below 30% of the motor normal speed at 60 Hz should be reviewed with the drive supplier. Variable frequency drives should be properly matched to the motor. Belt drives are not recommended for variable speed applications.

SYNCHRONOUS MOTORS

These drivers are designed to eliminate the slip that occurs in induction speeds of 3600, 1800, 1200, 900 rpm, etc. They are rarely used in fan applications. High transient torque pulses are common with synchronous motors and can lead to coupling and/or shaft failures.

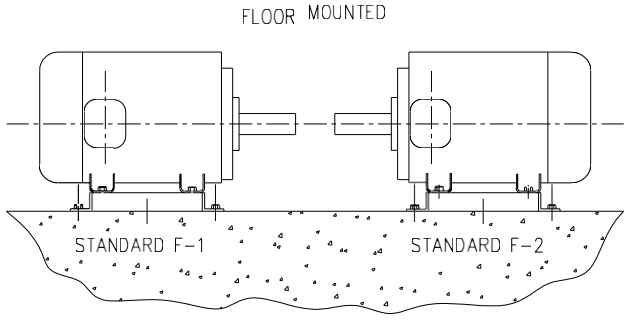
MOTOR BEARINGS

Refer to motor manual for motor bearing lubrication instructions. The recommended vibration alarm and shutdown limits for the motor bearings are the same as the limits for the fan bearings. Motor bearing loads must be adequate for wheel weight on Arrangement #4 and for belt pull on Arrangement #1, #9 and #10. Large horsepower motors are sometimes supplied with sleeve type bearings which allow axial shaft movement. In such cases a limited end-float coupling must be used. (Refer to coupling section). Do not use a sleeve bearing motor on belt driven applications.

OTHER NOTES:

1. Conduit box location is important on Arrangement #1, #9 and #10. F1 is standard; F2 non-standard. See Figure 10
2. Drive rotation must be specified to match required fan rotation. Note that fan rotation is "AS VIEWED FROM THE DRIVE END" and motor rotation is "AS VIEWED FROM THE END BELL" (opposite the shaft end). Gasoline and diesel engine rotation is "as viewed from the shaft end" and are available only in counter clockwise rotation.
3. On all belt driven fans the motor must be mounted on a slide rail base for proper belt tension adjustment.
4. Drivers mounted on concrete pedestals require an auxiliary steel base or soleplate. This mounting plate must be shimmed (during alignment) prior to final grouting.

Figure 13 - Optional Assembly Positions



Conduit Box Locations

N. <u>V-BELT DRIVE ALIGNMENT</u>

To insure proper alignment, tensioning, and long belt life perform the following procedures:

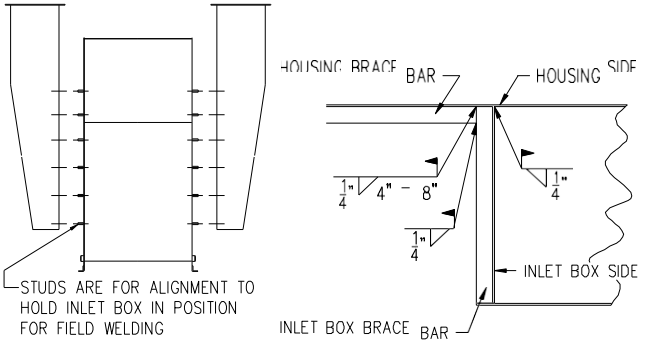
1. Check that motor and fan shafts are parallel. Shim motor as necessary.
2. Check for axial alignment of fan and motor sheaves.
3. Balanced sheaves of special materials are required above 6500 ft/min. peripheral speed.
4. Properly adjust tension of belts:

FORCE DEFLECTION METHOD

1. Move driver unit forward to allow for easy installation of belts onto sheave.
2. Refer to manufacturer's instructions for required force and deflection values.
3. Using a spring scale, apply a perpendicular force to any one of the belts. Increase or reduce the centers as is necessary to obtain proper deflection.
4. It will be necessary to readjust tensioning after the first few hours of operation when new v-belts have been installed.
5. Periodic inspection and alignment of the drive is recommended.

Refer to manufacturer's instructions, attached, for further information.

Figure14 - Bolted Inlet Box Construction



Note: In some cases, inlet boxes will be shipped separate from housing but bolted to the housing in the field and welded, as shown, by others. Housing brace bar and inlet box brace bars are to be welded together where they meet. Also check that the split bars on box line up with respective split bars on casing.

O. BOLTED INLET BOX CONSTRUCTION

(Applies only to large fans shipped with separate inlet box/boxes).

Bolt the inlet box(es) in place during installation and alignment. Only after all installation and alignment procedures are complete is welding of the inlet box(es) to take place. Inlet box is to have continuous weld inside and stitch weld (4-8) outside. Housing brace bars and inlet box brace bars are to be welded together where they meet. Check that split bars on inlet box line up with respective split bars on housing.

Weld inlet box spreader pipes if applicable. Refer to assembly drawing.

P. GROUTING UNIT

Following completion of installation and alignment, it is suggested that NYB check the installation before any grouting is done. NYB service fees are noted on our Field Rate Schedule PS-100. After inspection, grouting may be completed. NYB recommends the use of U.S. Grout 5-Star Epoxy (mix A and B...add C aggregate), Chockfast grouting systems or equal.

Q. SPECIAL FEATURES

DAMPERS

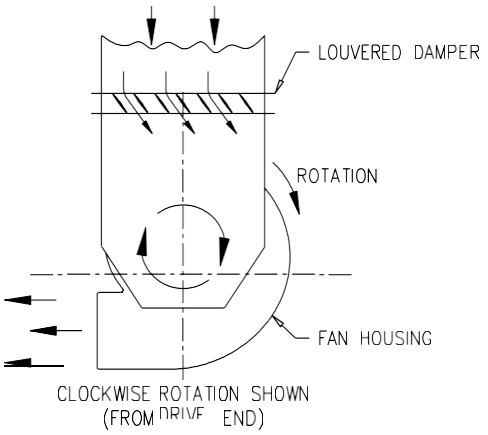
Dampers are furnished in separate channel sections either structural or fabricated. It is best to close the damper when installing to prevent damage to the damper blades. Damper blades and linkage are preset to give a tight fit between blades when the damper is closed. Check the damper operation to insure that all blades can operate without binding and can close tightly. On double inlet fans, dampers are controlled from a common shaft, usually arranged for automatic control.

Check all levers, linkage, and blade hardware to see that they are secure. Mount dampers in place and position control shaft to housing according to assembly drawing.

Information concerning damper bearing lubrication is shown in the table below. Frequency of lubrication per the following table is every 4 weeks. Refer to fan assembly for further information concerning lubrication of damper bearings.

Table 5	
Shaft/Bearing Size (Inches)	Amount of Grease (In3)
1/2 - 1	0.12
1 1/16 - 1 7/16	0.30
1 1/2 - 1 3/4	0.45
1 7/8 - 2 3/16	0.52
2 1/4 - 2 7/16	0.56
2 1/2 - 3	1.36
3 1/16 - 3 1/2	2.24
3 9/16 - 6	5.00

Figure 15



Inlet box damper must be oriented so that it pre-

spins the gas stream in the same direction as impeller rotation.

After installation manually operate the damper several times to insure that nothing interferes with damper operation. Check inlet damper operation for correct rotation relative to the fan. Inlet dampers should spin the gas stream in the same direction as the fan rotor rotation when partially open.

NOTE: Field installation of the connecting rod, couplings and bearings is often required on double inlet fans. Be sure that the dampers are synchronized throughout the full range of operation.

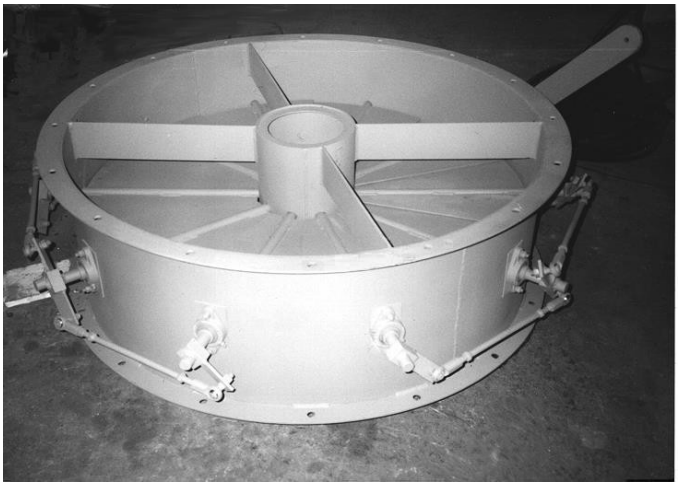
On dirty gas streams, dust build-up may occur and hinder movement of the vanes. If the damper normally requires operation over a small range, and only occasionally is required to move to full open or full closed position, it is recommended that full open and full closed positions be reached daily for the purpose of sweeping accumulated dust from damper vane area.

DAMPER OPERATORS

If the operator was installed at the NYB factory, the unit should be ready for connection to utilities and can be put into operation after reviewing specific product instructions (attached). If operator is to be field installed:

1. Install damper operator bracket if required. This may be required for rotary type actuators. Refer to fan assembly drawing.
2. Adjust operator to damper control arm linkage to allow free operation over the full 90 degree operating range. Cycle several times.
3. Check damper blades (visually) to be sure they fully open and close when the operator indicates that position.
4. On modulating systems, set-up an input signal to the damper operator controller to insure that the operator output responds correctly to variations in the input signal.

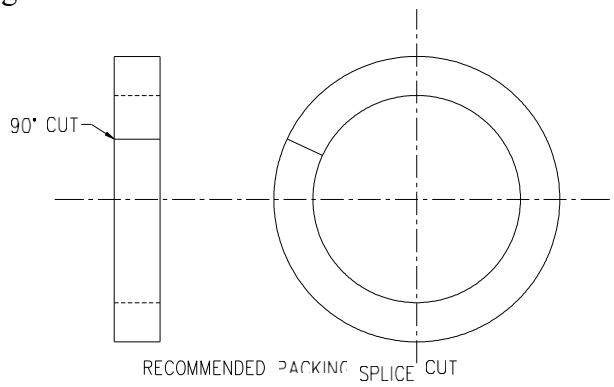
Figure 16 - Typical Radial Inlet Damper



SHAFT SEALS

Standard shaft seals are made from compressed fibrous materials that can expand and contract to compensate for the vertical expansion of a fan housing. Special shaft seals involving carbon rings and/or mechanical seals for gas tight operation may require center-supported housing construction.

Figure 17



On high temperature fans, packing gland type shaft seals often include water-cooled cavities to prevent overheating of the packing. See assembly drawing for your application.

General instructions for installation of packing gland seals:

1. Clean the packing gland thoroughly. If old packing is being replaced make sure all old packing is removed. Check shaft for smoothness. Scored shafts should be repaired or replaced.
2. Install rings one at a time using split ring bushings or packing tamper to be sure that each ring is seated properly before adding next ring.

3. Make sure that the joints are staggered 90 degree apart.
4. Turn shaft by hand to make sure that rings are free and not installed too tightly.
5. Tighten packing gland until finger tight, then start equipment and carefully tighten the gland to reduce leakage. Make sure that during this adjustment period the temperature of the packing gland does not rise. An adjustment of approximately 1/8 turn at a time is maximum. Allow approximately 15 to 20 minutes between adjustments for the packing to adjust to its new load. If, during this period, heating occurs, back off on the gland and allow to run until packing gland cools. This process could take several hours on a high temperature application.
6. In some cases a lantern ring, along with a purge tap, is supplied with a packing gland seal. As an alternate, a purge tap only may be supplied. Refer to the assembly drawing for instructions as the tap may be for a gas purge, or, in some cases, for lubrication, depending on instructions.
7. For replacement seal material information, please refer to the fan assembly drawing or consult NYB.

Figure 18 - Gasket Shaft Seal

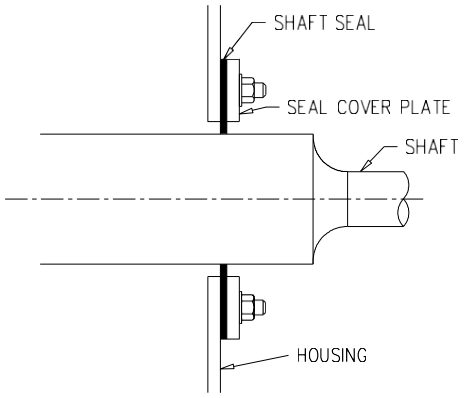


Figure 19 - Packing Gland

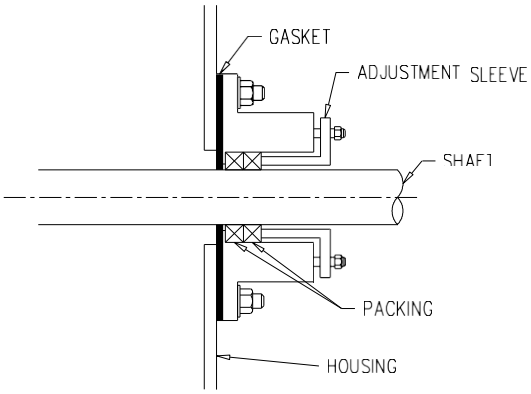
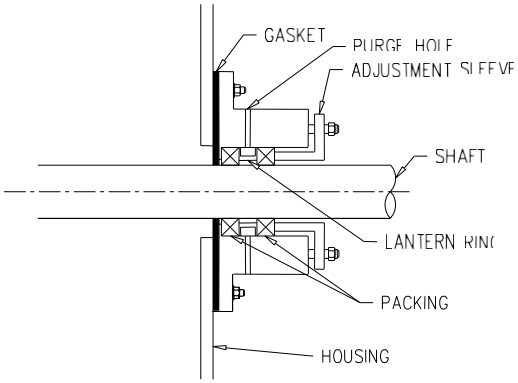


Figure20 - Purged Packing Gland



HIGH TEMPERATURE FANS

HIGH TEMPERATURE DESIGN LIMITS

Observing the maximum operating temperature as noted on the assembly drawing is essential for insuring satisfactory operating life. Material yield strength as well as creep and rupture strength properties drop off dramatically with slight increases in temperature. When designing furnaces, avoid a direct line-of-sight from the heat source to the fan wheel. This radiant energy can greatly increase the actual wheel operating temperature and cause premature failure unless taken into consideration during design stages.

All high temperature fans are furnished with temperature sensitive pellets that serve as a record of the highest temperature to which the wheel has been exposed.

TEMPERATURE RATE-OF-CHANGE

Maximum allowable heating or cooling rate for NYB fan equipment is 100 F./hour unless otherwise specified. If desired, special designs are available to permit temperature changes in excess of 100

F./hour. If temperature rate-of-change is exceeded, loosening of hub to shaft fit may occur, resulting in high vibration, movement of the wheel on the shaft, wheel cracking, etc. Interference or rubbing between the wheel and housing/inlet will result from excess housing distortion caused by excessive temperature rate of change. Thermal fatigue, premature wheel and housing failure can result if extremely rapid changes in temperature continually occur. High temperature fans should not be run at operating temperatures with insulation removed. This will cause excessive distortion which can lead to a number of problems.

HIGH TEMPERATURE EMERGENCY SHUTDOWN AND AUXILIARY DRIVES (TURNING GEARS)

In the event of a power failure or interruption in fan operation at high temperatures, it is important that the fan be rotated by hand or other available means continuously until the gas temperature decreases to 200 F or lower. Failure to do so can result in permanent distortion of the shaft which in turn will cause high vibration.

An auxiliary drive (turning gear) is desirable with large fans for slow rotation of the fan wheel during shutdowns. Auxiliary drives are typically designed to maintain a minimum speed (i.e. 40-60 RPM) as the system cools down. They are not intended for use in starting the fan from a dead stop and require a clutch system. Check with NYB when using Dodge Sleevoil bearings or equal because they need a minimum RPM to maintain a lubricating oil film.

HIGH TEMPERATURE CORROSION

Due to the presence of certain chemical compounds, special alloys or special treatment of material exposed to high temperatures may be required. Sulfication and carburization are two common examples which can occur. Evidences of such problems include metal embrittlement, surface pitting, corrosion of welds, etc. Contact the factory for advice on these problems.

CLEARANCES

Special clearance requirements may be necessary at the shaft seal and inlet piece to wheel fit-up area to allow for the vertical expansion of housing and axial expansion of shaft. The fit-up will be non-symmetric during initial ambient fit-up so that symmetry is achieved during the designed high temperature operation. A larger axial gap/clearance will be needed. See assembly drawing for additional notes.

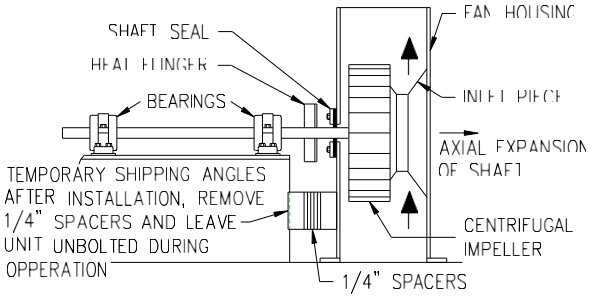
HEAT FLINGERS

Heat flingers of aluminum are often used on fans above 301 F to reduce flow of heat through the shaft to bearings. These are clamped onto the shaft, usually with fins towards fan (away from bearing). Rotate the assembly to be sure the heat flinger turns freely without contacting the guard.

BEARING BASE

Bearing base may be separated from fan housing on some high temperature units. Check assembly drawing to see if shipping angle bolts should be disconnected before the fan is put into operation.

Figure21 - Vertical Expansion of Casing

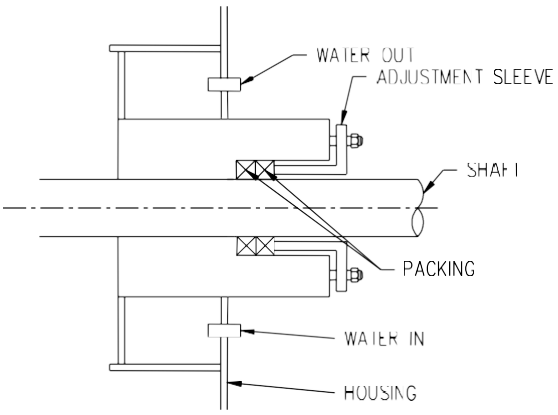


WATER COOLED SHAFT SEAL

A water cooled packing gland may be used on higher temperature applications. Insure that the specified water flow is maintained (typically 1.0 gpm). Refer to shaft seal section for tightening procedure.

Other shaft cooling means may be necessary above 1300 F. This may include air or water-cooling of the shaft. Refer to assembly drawing and special equipment information if applicable.

Figure 22 - Water Cooled Packing Gland



CENTER SUPPORTED HOUSINGS

Center supported housings are sometimes provided on high temperature fans with special shaft sealing requirements. By supporting the fan housing near the shaft centerline, the housing is free to expand radially in all directions about the center without affecting shaft seal clearances. NYB strongly recommends that factory field service personnel be present during the installation of center supported fan equipment.

SPECIAL INSTALLATION PROCEDURES FOR CENTER SUPPORTED FAN HOUSINGS:

NOTE: ALL HOUSING SUPPORT PLATES TO BE AT SAME HEIGHT AND LEVEL. INDEPENDENT BEARING PEDESTAL AND MOTOR SOLE PLATES MAY BE AT DIFFERENT LEVELS AS SHOWN ON DRAWINGS BUT ALSO MUST BE LEVEL.

Figure 23

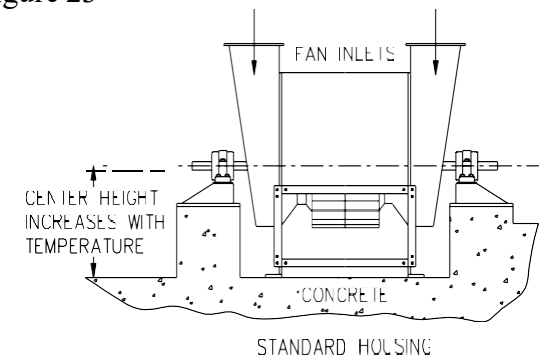
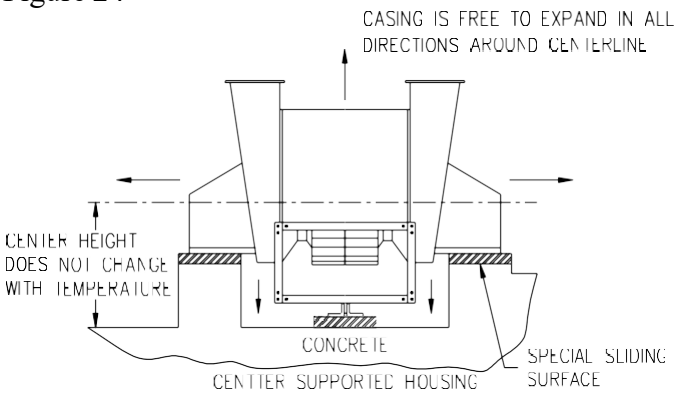


Figure 24



No grouting to be done until all components are leveled and aligned. Refer to other installation procedures for specific details on bearing, coupling, inlet piece, etc.

1. Refer to fan assembly drawing and center support arrangement detail drawing identified with proper NYB factory order and customer number for the fan being assembled.
2. Level and align housing support plates as shown on drawings using full length steel shims.
3. Install bottom half of fan housing to support plates, be sure to install sliding pads. Tighten bolts to proper torque and check outlet flange and inlet flange alignment to ducts. Check fan housing to be sure it is level with support plates.
4. Install independent bearing pedestal and motor soleplates. Level and align. Install bearing pedestals, level and align pedestal unit with U-shaped shim at bolts between sole plate and concrete. Form for grouting.
5. If arrangement #1 or #8 with fabricated bearing base or bearing/motor base, install base, level and align. Use U-shaped shim pack at each

foundation bolt, form for grouting. If bearing base is used for one or more casing supports, this step must be done before step C.

6. Install center anchor plate.
7. Mount bottom half of bearing to pedestal. Refer to "Setting and alignment of bearing pedestal" for further installation instructions.

EXPANSION JOINTS

Expansion joints are essential on all fans operating above ambient temperatures and/or that are mounted on vibration isolators where there are connections to inlet or outlet duct work. Ductwork must be 100% supported by structural members (other than the fan) and expansion joints must have adequate lateral and longitudinal flexibility so that no loads will be transmitted from the ductwork to the fan.

INSULATION

FACTORY INSULATION

Factory insulation can either be with insulation pins or double-walled construction. Using pins, blanket type insulation is pushed over the pins and a light gauge protective cladding is installed to protect the insulation. The customer should specify whether they want clips over the pins to hold cladding in place or riveted in place. Insulation must be removed from splits to remove wheel. If an outdoor installation, caulk cladding seams to prevent water entering.

Double-walled housings use a non-settling insulating material. A heavily braced inner housing is a standard feature. Unless otherwise specified, the housing is typically designed for an external surface temperature of 250 F or less. Take appropriate precautions to avoid burn injuries to personnel.

Typically, the housing can be disassembled and the wheel removed without disturbing much of the insulation. Refer to "**MAINTENANCE**, Wheel and Shaft Removal".

FIELD INSULATION

Field insulation is normally done "by others" over insulation clips similar to shop insulation with pins. Be sure that field mounted insulation does not restrict movement of inlet/outlet expansion joints. The additional weight of the insulation should be considered in sizing springs if a spring isolation base is to be used. Leave adequate clearance in the area around the shaft heat flinger for air circulation cooling.

SPARK RESISTANT FANS

Fans constructed for spark resistance are made to correspond to specifications as outlined in AMCA Standard 401-66. Classifications are:

TYPE CONSTRUCTION

Class A. All parts of fan in contact with the air or gas being handled shall be made of non-ferrous material.

Class B. The fans shall have an entirely non-ferrous wheel and non-ferrous ring about the opening through which the shaft passes.

Class C. The fans shall be so constructed that a shift of the wheel will not permit two ferrous parts of the fan to rub or strike.

NOTES:

1. Bearings shall not be placed in the air or gas stream.
2. The user shall electrically ground all fan parts.

ACCESS AND/OR INSPECTION DOORS

Inspection doors are included on fan housings for inspection of the interior of the fan housing, wheel and shaft. Access doors are provided for inspection and entry into the fan housing and are larger than inspection doors. Doors are to be opened only after the fan has been shut down and has come to a complete stop. In no case should the access doors be open unless the fan is at a complete stop and the driver electrically "locked out".

In the case of doors which are hinged to open vertically, it will be necessary for the user to make provisions for safely opening and closing the door considering its weight. The weight will be indicated on the door prior to shipment or shown on the assembly drawing. If the weight is not shown, obtain it from the factory. Some cases will require

mechanical assistance to open doors.

All hinges and hinge pins are to be periodically checked and lubricated to make certain that they are in satisfactory condition and not damaged or deteriorated. Periodic inspection of the mounting and retaining components must be made to assure that they are in first class condition.

ELASTOMERIC COATINGS (RUBBER BUTYL, NEOPRENE, ETC.)

Due to the corrosive nature of gases flowing through the fan, elastomeric coatings may be used to protect the fan from corrosion, premature aging, etc. These fans have special considerations to be taken into account while fan is in operation and prior to performing maintenance.

No welding is to be done on the outside of housings coated with elastomeric materials. This would result in damage to the coating. Gas stream temperature limits must be strictly observed so as not to damage the coating. Some coatings, especially natural rubber, are flammable, causing potentially hazardous conditions if operating temperature is exceeded. Refer to assembly drawing for maximum operating temperature. Exposure to certain chemical agents in the process environment could cause deterioration of coating. Exposure to gasoline, cleaning fluids, abrasives, paints and other such materials should be avoided with many elastomers.

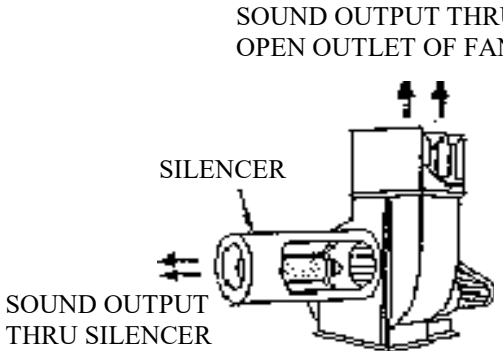
Elastomer coated fans warrant special care in handling to avoid damage to surface. Spark testing should be used to detect holes or imperfections in elastomer coating once every 6 months in highly corrosive environments. Damaged areas should be repaired using a patch kit with proper material, adhesive, and curing conditions as prescribed by the original supplier of the coating.

Should in-field balancing be necessary, consult with NYB for special techniques used on elastomeric coated fans.

TEMPERATURE DETECTORS

It is recommended that bearings be equipped with thermocouples or electrical resistance temperature detectors; this is an option available to customers. TTEC, Thomas A. Edison and RAM electrical resistance detectors or Leeds and Northrup thermo-couples are typical of the detectors available. Both types are mounted by inserting the end of the probe through the tapped hole in the pillow block into the liner on sleevoil bearings or up to the outer race on anti-friction bearings. See "MAINTENANCE, Bearing Temperature Limits" for recommended bearing temperature alarm and shutdown limits. NYB recommends spring loaded detectors. Monitors and wiring are normally supplied by others.

Figure 25



SOUND

Sound Power Level ratings shown are decibels referred to 10-12 Watt and obtained in accordance with AMCA Standard 300. Sound Power Level for each band and dBA are calculated per AMCA Standard 301. Levels shown do not include motor or auxiliary equipment. Refer to Figure 26 for information on additive noise effect due to the fan motor or other equipment in the area.

Data is for use by a system acoustical design engineer for evaluation of the fan singularly and within a system. Because of the infinite variations in system arrangements and the many factors which affect sound pressure levels, it is the designer's responsibility to properly apply this data based on his knowledge of the system. Some guidelines for use of this data are: for "NEAR FIELD" reported data to apply to ducted inlet and outlet installations, any opening in the duct must be a minimum of 100 ft. away from the fan. Openings within this range

are assumed to emit a sound pressure equal to the fan Sound Power Level. This also applies to untreated inlet and outlet expansion joints. Note that for ducted inlet/outlet the ductwork thicknesses must equal the fan housing thickness to achieve the Sound Pressure Levels noted.

Figure 26

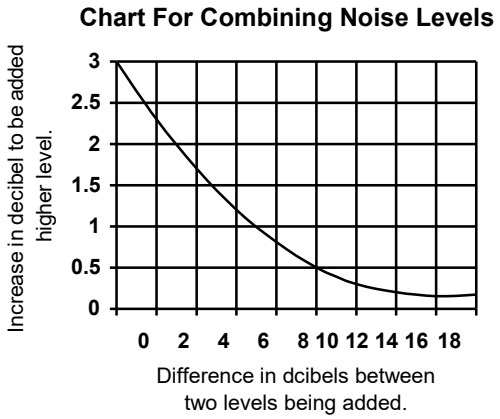
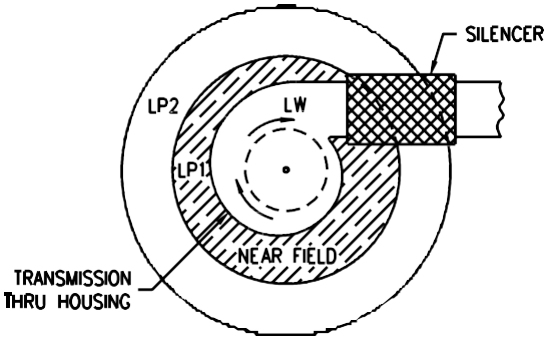


Figure 27



LW = Sound power at accoustic center of fan.

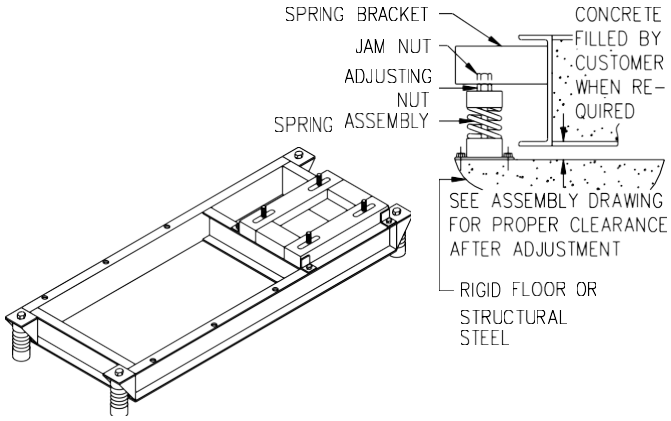
Lp1 = Sound pressure level (Near Field).

Lp2 = Sound pressure level (Beyond Near Field).

NEAR FIELD - A hemispherical space where sound pressure waves from one radiating surface tend to interfere with waves generated by other surfaces. NEAR FIELD boundary, distance from radiating surface, is related to the wavelength of lowest frequency and overall size of source.

FREE FIELD - Area beyond near field, with no obstructions, where Sound Pressure Levels decay 6 dB for each doubling of distance from near field. Effects of the room constant (for indoor installations), background noise levels, and directivity are not considered. The tolerance on Estimated Sound Power and Sound Pressure Levels is typically +/-2 dBA plus the accuracy tolerance of the measuring instrument.

Figure 28



VIBRATION ISOLATION

Vibration isolation bases reduce the transmission of vibrational energy from a rotating fan to the structure on which it is mounted. NYB recommends that all fans which must rest on steel structures with stiffness less than 1.0xE7 lb./in. to be mounted on spring isolation bases. Transmissibility (the degree of isolation, related to the proportion of the disturbing force) is expressed as: T= 1/(((f/fn)2)-1) where f is the fan operating speed, and fn is the spring base natural frequency. Transmissibilities of 5% should be targeted, while transmissibilities which remain under 10% are normally acceptable.

Expansion joints should be fitted to the fan inlet and outlet. Refer to sections on duct design and high temperature fans for more information on expansion joints.

PROCEDURE FOR ADJUSTING AND LEVELING VIBRATION ISOLATION BASE

1. Mount fan securely to base with base resting on a level surface.
2. Position unit to desired location.
3. Raise unit within 1/8" to 1/4" of operating clearance.
4. Block securely.
5. Install spring assemblies.
6. Adjust each spring no more than 1 full turn at a time following the numbered sequence on the assembly drawing. Repeat as required until unit

lifts off all the blocks.

7. Final leveling should be done as in Step #6 except adjust only 1/2 turn at time.
8. Once leveled, lock adjustment of the vibration mounting.

NOTE: Spring isolation bases may be supplied with seismic restraints and/or with provisions for filling with concrete when a high inertia characteristic is required. (Refer to fan drawing)

VIBRATION DETECTORS

It is strongly recommended that bearings be equipped with seismic vibration detectors mounted on the bearing housing or on the bearing pedestal. This is an option available to customers.

Vitec Model #438 electronic vibration alarm/switch is typical of the type that is recommended. Such units have adjustable alarm and shut down vibration set points and are solid state electronic units that are reliable over a long period of time with a high degree of accuracy.

Other available units are IRD Model #544M and Robert Shaw Model #366.

The operation of these vibration pickups should be checked monthly and calibrated at least once every 6 months. The use of these is highly recommended as operation at high vibration levels may result in catastrophic failure with resulting damage to equipment and injured personnel. Vibration monitors and wiring are typically supplied by others.

PAINT

Steel equipment will normally be supplied with one coat of gray primer (suitable for acceptance of a wide range of customer finish coats) unless special paint is requested. No paint will be applied to stainless or aluminum parts. Take care in handling of painted parts to avoid scraping that could result in rusting. Painted steel parts that are to be stored more then two months prior to being placed in service should be stored indoors at reasonable levels of temperature and humidity. Refer to Storage section.

Operation
&
TROUBLE SHOOTING

SECTION "III": OPERATION & TROUBLE SHOOTING

Table of Contents

A. RECOMMENDED OPERATIONAL PARAMETERS

GENERAL OPERATION

Before initial operation after installation every fan must be checked for vibration and bearing/motor temperatures. It may be necessary to align or trim balance the fan before putting into operation if vibration or temperature exceed allowed limits

BEARING VIBRATION LIMITS

Alert supervision is needed when any vibration level increases by more than 50% within one week or if the levels exceed the alarm level as shown by vibration severity chart on page III -3. Shutdown for inspection and balancing is required above this level. If a fan is allowed to run at levels exceeding the alarm levels the warranty will be void. Unnecessary damage to bearing and drive can occur even over short periods of operation.

BEARING TEMPERATURE LIMITS

Type Bearing	Alarm Sounds	Shutdown
anti-friction	190 F	200 F
sleeve	180 F	190 F

Do not run bearings at excessive temperatures; it can result in premature failure.

COOLING WATER FLOW AND TEMPERATURE

See assembly drawing for cooling water flow and temperature. Water flow-rate is important. Too little flow means over temperature operation. Too much flow can lead to higher lubricant viscosity and reduced film stiffness. Refer to assembly drawing for proper flow.

PRE-START-UP CHECK LIST

1. Lock out the power source.
2. Check and tighten hold-down bolts.
3. Check and tighten wheel set-screws.
4. Rotate wheel to see that it does not rub and maintains proper inlet piece/wheel clearances.
5. Check lubrication of bearings, couplings, drive unit, etc.
6. Check that bearings are set properly and secured to shaft.
7. Check coupling and bearings for proper alignment. If V-Belt drive, check sheaves for proper alignment and tightness.
8. Check fan and ducts for any foreign material or dirt buildup.
9. Secure all access doors.
10. Secure and check safety guards for clearance.
11. Bump start and check for proper rotation (after lubrication system is operating).
12. Close dampers for adequate system resistance to prevent drive unit from overloading. Insure dampers are closed by a visual check inside.
13. Supply water to water-cooled bearings as instructed.
14. Start the equipment according to recommendations of drive unit and of starting equipment manufacturers.
15. Allow fan to reach full speed, then shut down. Make immediate corrections if any vibrations or unusual sounds have been detected.
16. During a run-in period of at least eight hours, make observations of bearings at least once an hour. Higher bearing temperatures may result if bearings are over-lubricated
17. Retightening of V-Belt drive may be necessary. Check all bolts for retightening.
18. Refer to Trouble-Shooting Guide for any unusual occurrences encountered during the run-in period. Only after any vibration, misalignments, etc. have been corrected may the fan be restarted.

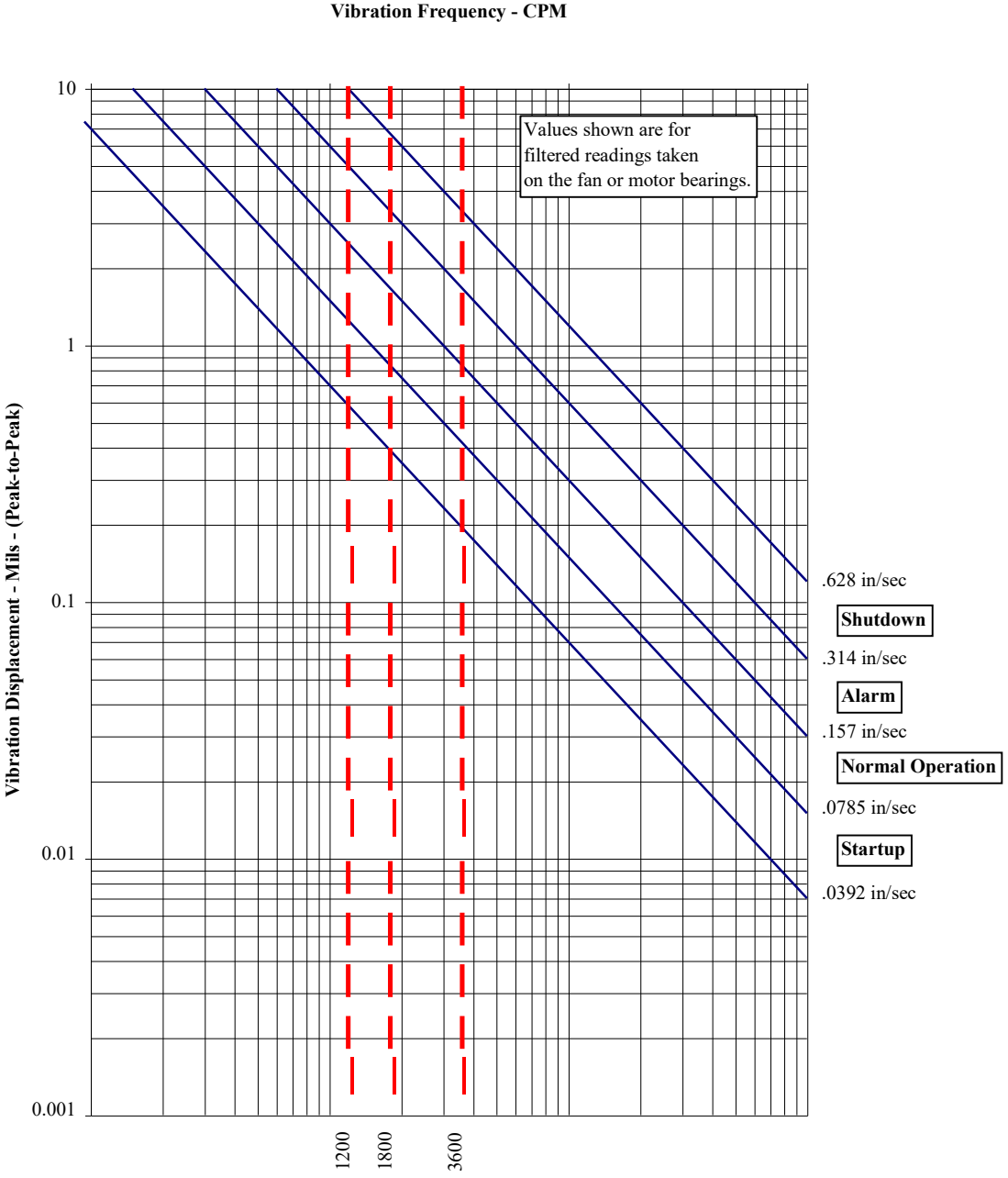
NOTE: Be sure to lock out power source when making corrections to system operation.

STATEMENT CONCERNING ALLOWABLE TURNDOWN OF ENGINEERED FANS

This fan is designed for long term operation at the customer specified maximum volume and pressure requirement. Operation for long periods of time (i.e. 15 minutes or more) with the fan damper less than 20% open or with the system throttled so that the fan is passing less than 20% of its rated volume is not recommended. Operation in this highly throttled condition for long periods of time can possibly lead to:

GENERAL MACHINERY VIBRATION SEVERITY CHART

For us as a GUIDE in judging vibration as a warning of impending trouble.



A. Mechanical damage to the fan housing and connected duct work.

B. Excessive heat build up.

It is recommended that one of the following alternatives be considered to eliminate the possibility of problems at high turn down conditions:

1. Variable speed drive or two-speed motor (reduce speed to achieve reduced volume).
2. Blow down a side stream to atmosphere (so that the fan handles the normal volume even though system volume is reduced).
3. Recycle a portion of the gas stream back to the inlet of the fan.

C. **TROUBLE-SHOOTING**

TROUBLE-SHOOTING GUIDE

PROBLEM - Vibration. Check for:

1. Loose bolts in bearings and pedestals, or improper mounting.
2. Defective bearings.
3. Improper alignment of bearings and coupling.
4. Out of balance fan wheel.
5. Loose set-screws holding wheel to shaft.
6. Weld cracking.
7. Improper fan wheel clearance to inlet piece(s).
8. Material build-up and/or wear on wheel.
9. Insure expansion joints in ductwork are not fully compressed.
10. Misaligned v-belt drive.
11. Improper wheel rotation.
12. Operation near system critical speed.
13. Shaft bent or distorted during high-temperature shutdown.
14. Defective motor.
15. Resonant frequencies of structural steel mounting.
16. Loose v-belts.
17. Beat frequency with other fans on common base.
18. Loose hub to shaft fit.

PROBLEM - Duct Pulsation. Check For:

This often occurs when a centrifugal fan is operated on a system with high resistance. The fan is forced to operate far below the normal or design volume. If the operating volume is lower than the value corresponding to the fan's peak static pressure, instability (surge) can occur. Possible solutions include:

1. Increase operating volume (reduce system resistance).
2. Control volume with a radial inlet damper.
3. Add a "blow-down" valve on fan discharge to allow discharge of part of the gas stream to atmosphere.
4. Recirculate a portion of the gas stream back to the fan inlet.
5. Change to a special "surgeless" blower design.

PROBLEM - High Motor Temperature. Check For:

1. Improper ventilation of cooling air to motor, (may be blocked by dirt).
2. Input power problems, (especially low voltage).
3. High amperage.
4. High ambient temperature.
5. Motor cooling fan is incorrect rotation for full cooling.

PROBLEM - Noise. Check For:

1. Squealing v-belts, due to misalignment or improper tensioning.
2. Defective bearings, or bearing seal rubbing.
3. Misaligned bearing seal.
4. Misaligned housing shaft seal.
5. Foreign material in fan housing.
6. Rubbing of shaft seal, wheel to inlet piece, or wheel to housing.
7. Heat flinger is contacting guard.
8. Coupling failure.
9. Untreated expansion joints.
10. Ductwork is thinner than housing.

PROBLEM - Poor Performance. Check For:

1. Incorrect fan rotation.
2. Wheel is off-center; poor inlet piece fit-up allows recirculation of air.
3. Fan drive sheaves selected for too low or too high RPM.
4. Poor duct design. Installation of elbow splitters or turning vanes could remedy problem.
5. Prespin condition at fan inlet; add splitter plate to inlet box.
6. Inlet damper installed backwards (counter-rotation).

7. System resistance is excessive compared to design requirements, (partially closed damper may be the cause).
8. Fan speed too low/high.
9. Density may be different than design density.

PROBLEM - High Bearing Temperature. Check For:

1. Defective bearings.
2. Over lubrication.
3. Improper lubrication or contaminated lubricant.
4. Lack of lubrication, cooling fluid, or circulation.
5. High ambient temperatures or direct exposure to sunlight.
6. V-belts too tight or too loose.
7. Insufficient room for free axial movement of floating bearing in its housing at elevated temperatures.
8. Low cooling water flow rate.
9. Heat flinger missing.

PROBLEM - Excessive Starting Time. Check For:

1. Motor improperly sized for fan wheel WR2.
2. Inlet dampers not closed during start-up.
3. Properly selected time-delay starter-fusing required, (many industrial fans take up to 20-25 seconds to reach operating speed).
4. Temperature at inlet is excessively low (high density).
5. Low voltage at motor terminals.
6. Inadequate system resistance.

NOTE: Do not exceed motor manufacturer's specified number of starts per hour.

VIBRATION DIAGNOSTIC CHART

Probable Source	Disturbing Frequency	Dominant Plane	Comments
Rubbing	Sub-harmonic	Radial	Surging; aerodynamic symptoms can occur at reduced flow rate. Inspect wheel & inlet piece & for possible, shaft seal.
Unbalance	1 x RPM	Radial	Field balance.
Motor Problems	120 Hz	All	Peak disappears instantly when power to motor is cut off.
Misalignment	Parallel (1x2xRPM) Angular (1x2xRPM) Both (1x2xRPM)	Radial Axial Radial & Axial	Most misalignments will be combination. Errors are most common in the vertical plane. Through use of laser alignment devices, NYB can check for alignment accurately.
Mechanical Looseness	Many multiples of 1 x RPM, as high as 10 x RPM	Radial	The presence of 1/2 X RPM peals are a sign of progressed mechanical looseness. Check for loose bolts and bearing, etc.
Defective Bearings:			
Anti-friction	Early stages: 30k-60k cpm depending on size & speed. Late stages: high 1x and multiple harmonics	Radial, except higher axial on thrust bearings.	Bandwidth broadens as bearings degrade. check for “bumping” or other unusual sounds in the other bearings. Also look for overheating (190F and above). Check inner race to shaft fit, loose attachment.
2. Sleeve	Early stages: sub-harmonics Late stages: will appear as mechanical looseness (see above)	Radial	High baseline energies below 1x,2x,3x RPM. Look for poor babbitt to housing fit, improper plunger screw torque, worn thrust collars, scoring, dirty lubricant.
Blade/Vane Pass Frequency	(# of blades) x RPM	Radial	Aerodynamic related
Resonance	Requires only a small forcing function to excite its natural frequency	Axial or Radial	Vibration amplitude varies with time or temperature. System shows extreme sensitivity to slight amount of unbalance. Structure can be bump tested natural frequency.
Belt Drive:			
1. Mis-matched worn or stretched (also applies to adjustable sheaves applications)	Many multiples of belt frequency, but 2x belt frequency usually dominant.	Radial - especially, high in line with belts.	Check each belt for appropriate tension. Replace worn belts with matching type.

2. Eccentric and or unbalanced sheaves	1x (shaft speed)	Radial	Balancing possible with washers applied to taper lock bolts.
3. Drive belt or sheaves face misalignment	1x (driver speed)	Axial	Check sheaves face alignment (refer to "V-belt Drive" section for method). Confirm alignment with strobe light and belt excitation techniques.
4. Drive belt resonance	Belt resonance at only particular operating speeds.	Radial	Adjust belt tension or belt length to eliminate problem. Belt stretch natural frequency is excited at particular operating speed. Avoid these speeds.

D. **MAINTENANCE**

WATER SPRAY CLEANING SYSTEMS

The following are recommendations for use of water spray cleaning systems:

1. Use only drinking quality (city) water (40 psig required).
2. Requirements at fan inlet: 1 GPM/16000 CFM/each inlet - FULL JET SPRAY.
3. Requirements at web and shroud: 1 GPM/32000 CFM/each inlet - FULL JET SPRAY.
4. Initially, use water spray system intermittently to determine the exact amount of time (and thus the amount of water) required for satisfactory cleaning.
5. A periodic check of the wheel for erosion is mandatory.
6. Piping from supply line to spray unit must include a manual or automatic valve for shutoff and regulation; installation is to be consistent with good piping practice.
7. Provide proper drainage from housing and inlet box(es) when using sprays. To drain inlet boxes, a vertical seal loop below the drain point must be used to provide a height equal to the fan negative pressure.
8. Allow for approximately a 5% increase in horsepower when sprays are in use.

BALANCING

NYB field servicemen are recommended for performing field balancing. Balance weights must be of the same material as the rotor. Welding of balance weights should be done using NYB approved field welding procedures for the type of material involved. "Trim Balance" is often necessary on a new installation or when replacing a wheel/shaft assembly. This is necessary to fine tune the fan/foundation system.

FIELD REPAIRS

Fans for heavy duty operation require inspection to insure continuity of operation. When an inspection reveals the presence of corrosion or erosion to fan components, it is advisable to analyze the cause and take steps to provide replacements or repairs. Your local NYB representative can be of assistance in such cases and obtain factory recommendations that might be needed. Under no circumstances should any welding be attempted on rotors except with specific written welding recommendations from NYB.

BEARING LUBRICATION

Protective circuits should be set to alarm when bearing temperature exceeds the values shown in "MAINTENANCE Bearing Temperature Limits" page: III-2. Alert supervision if bearing temperatures change abruptly or if circulating oil flow rate is less than the required flow (see bearing operating conditions).

TYPICAL LUBRICATION SYSTEMS

In most cases the fan assembly drawing will clearly spell out the type of lubricant and relubrication schedule. When specific information is not shown on assembly drawing, then follow instructions in

this manual. If there seems to be a conflict with bearing manufacturer then contact NYB.

GREASE LUBRICATION SCHEDULES

Typical for Ambient Temperature Horizontal Shaft Fans)

...Also refer to Assembly Drawing and manufactures manual.

Link-Belt Spherical Roller Bearing Units - Series P-LB6800
Lubrication Guidelines for Horizontal Shaft, Grease Lubricated Fan, Blower or Other High Speed Rotating Equipment.

Relubrication interval				6 mon.	4 mon.	2 mon.	1 mon.
Shaft size range		Vol. Of Grease		Operating speed (RPM)			
Inches	MM	IN^3	CM^3	Up to	Up to	Up to	Up to
1-7/16 - 1-1/2	40	0.3	4.9	2400	3600	5000	5500
1-11/16 - 1-3/4	45	0.3	5.0	2200	3300	4500	5000
1-15/16 - 2	50	0.4	6.6	2000	3000	4000	4500
2-3/16 - 2-1/4	60	0.8	12.7	1700	2500	3400	3800
2-7/16 - 2-1/2	65	0.8	12.3	1450	2200	3000	3400
2-11/16 - 2-3/4	70	0.9	14.3	1350	2000	2800	3200
2-15/16 - 3	75	1.2	19.7	1300	1900	2600	3000
3-3/16 - 3-1/4	80	1.7	27.4	1200	1800	2400	2700
3-7/16 - 3-1/2	90	2.3	37.7	1100	1650	2200	2300
3-11/16 - 4	100	3.1	50.0	1000	1500	1950	2100
4-3/16 - 4-1/4	110	4.3	70.0	900	1350	1850	1900
4-7/16 - 4-1/2	115	5.5	90.1	840	1250	1700	1800
4-15/16 - 5	125	6.4	105	780	1150	1600	1700
5-3/16 - 5-1/4	135	9.7	130	730	1100	1500	1600
5-7/16 - 5-1/2	140	10.1	165	680	1000	1400	1500
5-15/16 - 6	150	12.2	200	640	970	1300	1400
6-7/16 - 6-1/2	160	12.7	207	610	910	1200	1300
6-15/16 - 7	170	15.3	250	570	860	1100	1200
7-3/16 - 7-1/4	180	21.4	350	550	820	1000	1100
7-1/2 - 8	200	26.8	438	500	750	900	1000
Clean and Repack Interval				5 years	3 years	2 years	1 years

Link-Belt Ball Bearing Units - Series 200
Lubrication Guidelines for Horizontal Shaft, Grease Lubricated Fan, Blower or Other High Speed Rotating Equipment.

Relubrication interval				6 mon.	4 mon.	2 mon.	1 mon.
Shaft size range		Vol. Of Grease		Operating speed (RPM)			
Inches	MM	IN^3	CM^3	Up to	Up to	Up to	Up to
½ -1	17-25	0.12	2.0	3200	4800	7200	9600(1)
1-1/16 - 1-7/16	30-35	0.30	4.9	2200	3400	5100	6800(1)
1-1/2 - 1-3/4	40-45	0.45	7.4	1700	2600	4000	5300(1)
1-7/8 - 2-3/16	50-55	0.52	8.5	1400	2100	3200	4300(1)
2-1/4 - 2-7/16	60	0.56	9.2	1300	2000	3000	4000(1)
2-1/2 - 3(2)	65-75	1.36	22.3	1000	1600	2400	3200
3-1/16 - 3-1/2(2)	85	2.24	36.7	900	1400	2100	2800
3-9/16 - 4(2)	100	5.00	81.9	800	1200	1800	2300

Link-Belt Ball Bearing Units - Series 300
Lubrication Guidelines for Horizontal Shaft, Grease Lubricated Fan, Blower or Other High Speed Rotating Equipment.

Relubrication interval				6 mon.	4 mon.	2 mon.	1 mon.
Shaft size range		Vol. Of Grease		Operating speed (RPM)			
Inches	MM	IN^3	CM^3	Up to	Up to	Up to	Up to
¾ - 1	20-25	0.3	4.1	2800	4400	6400	8400
1-1/16 - 1-7/16	30-35	0.7	10.7	2000	3100	4500	6000
1-1/2 - 1-3/4	40-45	1.0	16.4	1500	2400	3500	4600
1-13/16 - 2-3/16	50-55	1.7	28	1200	2000	2900	3800
2-1/4 - 2-7/16	60	2.1	34	1100	1800	2600	3500
2-11/16 - 2-15/16	70-75	3.3	54	900	1400	2100	2800
3 - 3-3/16	80	4.5	74	800	1300	2000	2600
3-7/16 - 3-1/2	85	6.6	108	800	1200	1800	2400
3-15/16	100	10	170	700	1100	1600	2100

Link-Belt Spherical Roller Bearing Units - Series B22400H and B22500H
Lubrication Guidelines for Horizontal Shaft, Grease Lubricated Fan, Blower or Other High Speed Rotating Equipment.

Relubrication interval				6 mon.	4 mon.	2 mon.	1 mon.
Shaft size range		Vol. Of Grease		Operating speed (RPM)			
Inches	MM	IN^3	CM^3	Up to	Up to	Up to	Up to
¾ - 1	25	0.4	6.4	1400	2200	5000	6800
1-1/16 - 1-1/4	30	0.5	7.7	1150	1800	4500	5600
1-5/16 - 1-1/2	35	0.6	9.2	1000	1550	3800	4800
1-9/16 - 1-3/4	40	0.8	13.1	870	1350	3300	4200
1-13/16 - 2	45-50	0.9	14.6	700	1100	2700	3400
2-1/16 - 2-1/4	55	1.1	17.9	630	1000	2400	3000
2-5/16 - 2-1/2	60	1.3	21	580	910	2250	2800
2-9/16 - 3	65-75	2.4	40	460	730	1800	2200
3-1/16 - 3-1/2	80-85	3.9	64	410	640	1550	2000
3-9/16 - 4	90-100	5.7	94	350	550	1350	1700
4/1/16 - 4-1/2	110-115	6.5	106	300	470	1150	1500
4-9/16 - 5	125	10	164	280	440	1050	1400

The most common lubricant for fan bearings is grease and the recommended lubricant for bearing operating temperatures below 190°F is Texaco Premium RB #2. (Sometimes called Texaco 1939 Premium RB).

Other acceptable lubricants: (Grease, for under 190°F)	For bearings operating temperatures of 180°F - 220°F
Mobilgrease 28	Mobil SHC-220
Amoco Rykon Premium #2	Mobil SHC-100
Mobilgrease 532	
Shell Alvania #2	
Gulfcrown #2	

You should determine exactly how many pumps of your grease gun is equivalent to the volume of grease required. If the recommended lubrication schedule and type of grease is adhered to, you should have satisfactory life from the bearings. If substitute greases are used (without our written approval) or the lubrication frequency is haphazard, our experience shows that premature bearing failures can result. **Do not mix greases!**

SPECIAL INSTRUCTIONS FOR VERTICALLY MOUNTED FAN ASSEMBLIES:

Whenever possible, each vertically mounted fan unit is test run in the vertical position before leaving our plant. The bearings are equipped with seals for retaining the grease lubrication. These bearings are described on the assembly drawing.

It has been our experience that vertically mounted units can have bearing failures if they are not lubricated on strict schedules. It will be necessary to lubricate bearings more frequently with this arrangement than if the unit were mounted horizontally. If the lubrication frequency is inadequate, the roller elements can become grease-starved and this will lead to a bearing failure.

The more frequent lubrication schedule may result in a somewhat higher bearing operating temperature. This should not be a significant problem as long as the ambient temperature near the bearing is less than 120 F. The consequences of the more frequent lubrication schedule are much less severe than the result of under lubrication in such applications.

STATIC OIL LUBRICATION

Static oil lubrication and oil mist lubrication provide other optional methods of lubrication. For specifications on oil refer to the NYB assembly drawing.

NOTE: During shutdowns in cold weather be sure to either drain or blow out all water from water cooled bearing liners. Freezing will cause cracks in the bearing liner that lead to contamination of the lubricant with water. (Alternatively add an antifreeze to the water to prevent freezing). Heat tracing of water lines may be required.

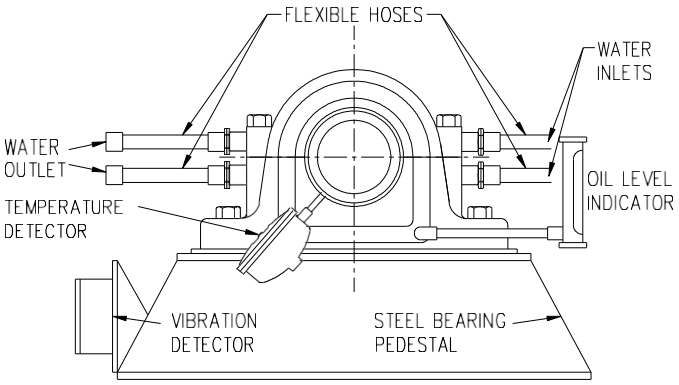
CIRCULATING OIL SYSTEMS

Circulating oil systems are recommended for fans operating on critical equipment when downtime must be minimized. Such systems provided a continuous flushing of filtered lubricant at controlled temperature and pressure which is very desirable for maximizing the life of bearings. These systems are typically furnished with redundant pumps that activate automatically to insure continuous lubrication. Local and/or remote monitoring of lubricant level, temperature, flow rate, pressure, etc. is available.

Piping for the lubricant return (from the bearing to the lubricant reservoir) should be large diameter (approximately 1-1/2" to 2") and sloped at a minimum of 1/2 inch vertical in 10 feet horizontal run. The flow to the bearing must be controlled (by valves or an orifice) to prevent flooding the bearing housing. Maximum distance from the bearing housing to the lubricant reservoir is 40 feet. The maximum height from the pumps to the bearing housing is 10 feet. Oil heaters and tracing may be supplied (by others) if low ambient temperatures are anticipated.

Figure

Static Oil Lubrication



COUPLING LUBRICATION

If a specific lubricant is not referenced in the coupling literature then, for applications with ambient temperatures below 150 F., use a grease as recommended below. for higher ambient temperatures, contact NYB for specific recommendations. Greases listed below are in response to request for specific recommendations. This list is not complete and is not intended to restrict the use of equivalent lubricants manufactured by companies not listed, nor is it intended to exclude improved lubricants developed since publication of this list. Relubrication every two months based on typical industrial applications is recommended.

GREASES FOR COUPLINGS:

Amoco	Coupling Grease
Arco	Litholine HEP #1
BP	Energrease LS-EP #1
Brooks	Klingfast 370
Chevron	Dura-lith #1
Citgo	HEP #1
Exxon	Pen-o-led, EP
Gulf	Gulfmill EP-S
Mobil	Mobilux EP #1
Shell	Alvania EP #1
Sohio	Bearing Guard MK
Texaco	Marfak #1
Union	Hi-Temp #2

Viscosity	Viscor 1429 EP

For spacers with limited end float thrust plates and for floating shaft arrangements, each end must be separately lubricated.

E INSPECTION

At least once every six months the fan should be shutdown for inspection. Carefully inspect all anchor bolts for tightness and foundation/grouting for loosening or cracking. Repair any deficiencies. Check the wheel for wear, especially near the inlet piece and along the center web plate. Any significant decrease in thickness of structural parts (i.e. less than 90% of the original material thickness) remaining should be reported. It may be necessary to repair these areas - contact NYB.

Drain a sample of lubricant from the bearings. Any milkiness may indicate the presence of water contamination. Remove the top half of the bearing housing and inspect surface conditions for damage or scars. Be sure to reassemble using proper procedure. Drain oil and change. (See bearing operating instructions and assembly drawing for type of oil.)

Check coupling bolts, bearing pedestal bolts, and bearing mounting bolts for tightness. Check mounting pad hole clearance (on center supported housings) to be sure ample clearance exists for expansion and that hold-down bolts are properly torqued.

WHEEL AND SHAFT REMOVAL

1. Lockout the fan and damper drive systems electrically.
2. Disassemble the coupling using proper procedure.
3. Unbolt and remove the inlet piece(s).
4. Locate the "pie-shaped" section of housing designated for wheel and shaft removal (refer to assembly drawing). Remove all necessary split and flange bolts.
5. Carefully remove pie-shaped portion of housing, exposing housing internals wheel and shaft.
6. Remove top half of bearing housings. Inspect liner and housing, then store in a clean, dry area.

SPARE PARTS LIST

NYB recommends that the customer have the following spare parts on hand: wheel and shaft, one pair of bearings, one set of V-belts (or coupling). Refer to assembly drawing for specific sizes of parts.

PREDICTIVE MAINTENANCE

Routine vibration monitoring and trend analysis is recommended. This allows early detection of problems so that potentially hazardous operation or unscheduled shutdowns can be avoided. Contact NYB for more information on this service.

F WARRANTY

NOTE: CUSTOMER MUST CONFORM EXACTLY TO SPECIFICATIONS AS OUTLINED IN WARRANTY, FAILURE TO DO SO VOIDS NYB WARRANTY.

TERMS AND CONDITIONS OF SALE

All products are warranted by **nyb** to be free from defects in materials and workmanship for a period of one (1) year after shipment from its plant, provided buyer demonstrates to satisfaction of **nyb** that the product was properly installed and maintained in accordance with **nyb**'s instructions and recommendations and that it was used under normal operating conditions.

This warranty is limited to the replacing and/or repairing by **nyb** of any part or parts which have been returned to **nyb** with **nyb**'s written authorization and which in **nyb**'s opinion are defective. Parts not manufactured by **nyb** but installed by **nyb** in equipment sold to the buyer shall carry the original manufacturer's warranty only. All transportation charges and any and all sales and use taxes, duties, imports or excises for such part or parts shall be paid for by the buyer. **nyb** shall have the sole right to determine whether defective parts shall be repaired or replaced.

This warranty does not cover any customer labor charges for replacement of parts, adjustments or repairs, or any other work unless such charges shall be assumed or authorized in advance, in writing, by **nyb**.

This warranty does not cover any product which, in the judgment of **nyb,** has been subject to misuse or neglect, or which has been repaired or altered outside **nyb**'s plant in any way which may have impaired its safety, operation or efficiency, or any product which has been subject to accident.
This warranty shall be null and void if any part not manufactured or supplied by **nyb** for use in any of its products shall have been substituted and used in place of a part manufactured or supplied by **nyb** for such use. There are no warranties, other than those appearing on the acknowledgment form INCLUDING NO WARRANTY OF MERCHANTABILITY OR FITNESS FOR A PARTICULAR PURPOSE, given in connection with the sale of the goods sold hereunder. The buyer agrees that his sole and exclusive remedy, and the limit of nyb's liability for loss from any cause whatsoever, shall be the purchase price of the goods sold hereunder for which a claim is made.

COMMON FAN PROBLEMS

Excessive Vibration

A common complaint regarding industrial fans is "excessive vibration". **nyb** is careful to ensure that each unit is precisely balanced prior to shipment; however, there are many other causes of vibration including:

1. Loose mounting bolts, setscrews, bearings or couplings.
2. Misalignment or excessive wear of couplings or bearings.
3. Misaligned or unbalanced motor.
4. Bent shaft due to mishandling or material impact.
5. Accumulation of foreign material on the wheel.
6. Excessive wear or erosion of the wheel.
7. Excessive system pressure or restriction of
8. airflow due to closed dampers.
   Inadequate structural support, mounting procedures or materials.
9. Externally transmitted vibration.

Inadequate Performance

1. Incorrect testing procedures or calculations.
2. Fan running too slowly.
3. Fan wheel rotating in wrong direction or installed backwards on shaft.
4. Wheel not properly centered relative to inlet cone.
5. Damaged or incorrectly installed cut off sheet or diverter.
6. Poor system design, closed dampers, air leaks, clogged filters, or coils.
7. Obstructions or sharp elbows near inlets.
8. Sharp deflection of airstream at fan outlet.

Excessive Noise

1. Fan operating near "stall" due to incorrect system design or installation.
2. Vibration originating elsewhere in the system.
3. System resonance or pulsation.
4. Improper location or orientation of fan intake and discharge.
5. Inadequate or faulty design of supporting structures.
6. Nearby sound reflecting surfaces.
7. Loose accessories or components.
8. Loose drive belts.
9. Worn bearings.

Premature Component Failure

1. Prolonged or major vibration.
2. Inadequate or improper maintenance.
3. Abrasive or corrosive elements in the airstream or surrounding environment.
4. Misalignment or physical damage to rotating components or bearings.
5. Bearing failure from incorrect or contaminated lubricant or grounding through the bearings while arc welding.
6. Excessive fan speed.
7. Extreme ambient or airstream temperatures.
8. Improper belt tension.
9. Improper tightening of wheel setscrews.

REPLACEMENT PARTS

It is recommended that only factory-supplied replacement parts be used. **nyb** fan parts are built to be fully compatible with the original fan, using specific alloys and tolerances. These parts carry a standard **nyb** warranty.

When ordering replacement parts, specify the part name, **nyb** shop and control number, fan size, type, rotation (viewed from drive end), arrangement and bearing size or bore. Most of this information is on the metal nameplate attached to the fan base.

For assistance in selecting replacement parts, contact your local **nyb** representative or visit: http://www.nyb.com.

Example: Part required: Wheel

Shop/control number: B-10106-100 Fan description: 33" PLR Clockwise rotation
Arrangement: 1
Bearing: Link-Belt P335, 2-3/16 Bore

Suggested replacement parts include:

Wheel	Component parts: Damper
Shaft	Motor
Bearings	Coupling
Shaft Seal	Sheaves
Inlet Cone	V-Belts