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1.0 Introduction

This manual will assist AirPro customers in the storage, installation, operation, and maintenance of AirPro centrifugal fans. Our skilled factory personnel thoroughly inspect and test each fan prior to shipment. When properly installed and maintained, your AirPro fan will afford you years of reliable, trouble-free service.

This manual applies to all AirPro fans and is general in nature, and items in this document may not apply to every fan. Due to the wide variety of products, specially engineered fans for unique applications will require additional instructions. In those cases, we will include these instructions, when necessary with the fan shipment.

We design and build quality and reliability into all our products, and we back it up with our industry-leading 3-year warranty. Our commitment to you is firm. Equally important for reliability and longer fan life is the user's responsibility to follow the instructions in this manual and to employ commonly considered good practices for fan and blower handling, storage, installation, operations and maintenance, even if not covered in detail in this manual.

2.0 Safety Precautions

Fans are specialized equipment which involve high speed rotating elements and can be dangerous. Fans are sold with the understanding that customers will recognize this risk and only people aware of the risk should be permitted to work on them. Depending on the specific customer purchase order, we may furnish your AirPro fan with safety accessories. However, it is the responsibility of the installer or user to ensure the necessary safety accessories are provided.

For general safety practices for air moving equipment, refer to AMCA Bulletin 410. (Air Movement & Control Association International Inc. www.amca.org).

ALWAYS follow the following safety practices:

1. Protect against electrical hazards by following lockout/tagout procedures per OSHA.
2. Do not exceed the maximum fan operating temperature and the maximum design speed stated on the assembly drawings and nameplate.
3. Do not exceed the maximum vibration levels. *(See section 18)*
4. Do not exceed the maximum bearing temperature. *(See section 19)*
5. Do not operate the fan without protective guards in place, including belt/drive, shaft/bearing, and screens for open inlets.
6. Do not operate the fan with an open access door.
7. Do not attempt to troubleshoot fan related problems by touching any part of the fan while it is running.
8. Allow enough cool-down time before beginning work on a hot air fan.
9. Perform inspections on a regular basis to ensure that no cracking, erosion, or other structural damage has occurred due to the centrifugal force, vibration, and particulate that can affect the rotor.

3.0 Shipping & Receiving

AirPro thoroughly inspects and documents all products prior to shipment, and it is the responsibility of the carrier to deliver the product in perfect condition. Rough handling in route may damage the fan components. When the carrier accepts a shipment and signs the bill of lading, it becomes responsible for any subsequent shortage or damage, evident or concealed, and any related claim. Immediately upon receipt of a shipment, the consignee's representative should carefully inspect for damage and shortage and ask the carrier to conduct an inspection if they suspect or detect any damage and/or shortage. The consignee's representative should not accept shipment without a notation on the delivery receipt indicating any items not delivered or the extent of apparent damage. Then immediately file a damage-loss report with the carrier and notify AirPro.

If the consignee's representative opens a shipment and finds concealed damage not noted at time of receipt, it is mandatory to request an immediate inspection by the carrier and promptly file a claim against the final carrier.

AirPro requires immediate written notification of any lost or undelivered parts and will not consider complaints issued more than 15 days after delivery.

4.0 Handling

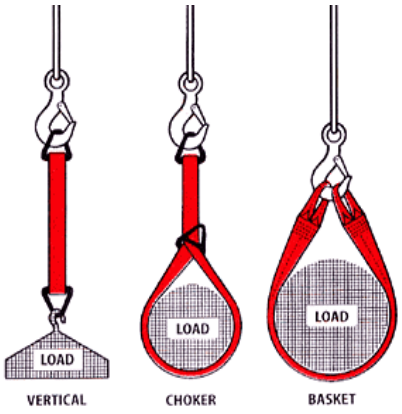
Utilize trained personnel for lifting/rigging decisions. Never lift a fan by the wheel, shaft, motor, motor bracket, housing inlet, outlet, or any fan part not designed for lifting. Always and only lift the fan by the base, mounting supports, or lifting eyes provided on the fan assembly. When lifting units which arrive assembled, always and only lift the unit using suitably rated spreader bars and padded chains or straps. Never pass slings or timbers through the inlet of the fan housing. Check the forklift/crane for lifting capacity. Handle fan wheels and housings that are furnished with special coverings such as rubber, phenolic enamels, or other protective coatings with extreme care as many of these coatings are easily damaged. Even a small chip in the coating will break the continuity of the coating and may destroy its value as a protective covering for the metal.

Partial or disassembled units require special handling. Avoid lifting components in a way that will concentrate stresses that will cause bending or distortion.

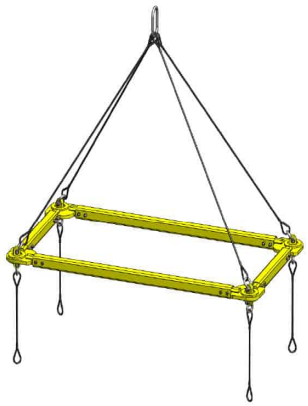
A wheel and shaft may arrive as an assembly, take extreme care when handling this balanced component. Never lift the wheel/shaft assembly by one of the blades. Lift the assembly with a sling; around the shaft; and near the center of gravity. Help eliminate damage to the rotor by using a spreader bar during lifting. A bent shaft is a very common source of vibration and bearing failure.

Lift any wheels shipped separately by slings that run between the blades or through the hub, never by a single blade or single point on the flange/shroud. Always protect the hub bore.

Always transport a wheel by lifting, do not roll the wheel.



Sling Rigs



Spreader Bar Rig

5.0 Storage

AirPro suitably prepares fans at the factory to protect them during shipment to the job site and for a reasonable time period before installation. If the fan installation is to be delayed for more than 30 days, follow these important storage steps:

1. Store the unit in a protected area that is clean, dry, and well ventilated.
2. Cover the fan with a tarp, (avoid black plastic as it can promote condensation).
3. Rotate the fan wheel by hand once a week. This will prevent the shaft from taking a set and redistribute the bearing grease.
4. Release belt tension on fans to be stored for a prolonged period.
5. Isolate the fan from any near-by vibration. High overall vibration levels in the fan storage area can prematurely damage the fan and motor bearings.
6. Rotate the motor rotor at the same time as the fan wheel to assure the bearing parts are well greased. Shafts on motors equipped with shaft grounding rings must remain rust free as this could render the grounding feature inoperative and result in bearing failure under VFD operation. Consult the motor manufacturer IOM for further details on motor storage and start up after long periods of storage.
7. Before startup, after extended storage time, purge the bearings and extended grease lines with new grease to operating level according to the bearing manufacturer specifications. *(See section 19)*

6.0 Foundations

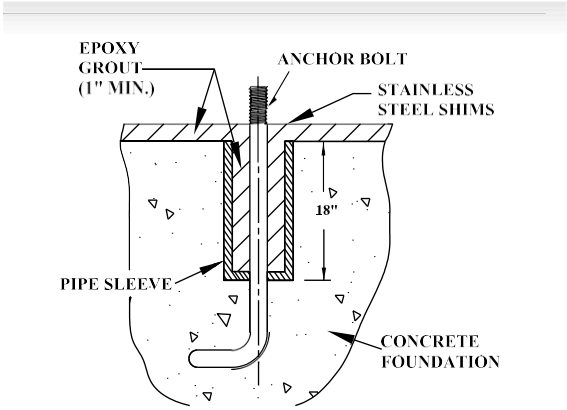
To ensure smooth operation, reduce vibration, and lower maintenance costs, mount fans on rigid level foundations. Reinforced concrete provides an excellent foundation and is the preferred fan foundation. Substantial steel frame supports are another option. The mass of the base must maintain the fan to driver alignment and absorb normal vibration. Two important foundation specifications:

1. The overall dimensions of the concrete base should extend at least 6 inches beyond the base of the fan.
2. The weight of the slab should be at least 5 times the fan/motor assembly weight. This weight acts as an inertia block to stabilize the foundation. However, it should be not more than twice the area required for the equipment. If made larger, the mass needs to be increased accordingly.

If the fan will be installed on a structural steel base, design the structure to support, with minimum deflection, the weight of the equipment plus the loads imposed by the centrifugal forces set up by the rotating element (generally 50% of the rotating weight). A fabricated steel base that does not have adequate stiffness can affect alignment of fan components. An implied twist to the fan base can cause the fan wheel to rub on the inlet, causing severe damage at start up. Design the natural frequency of the steel structure so that it does not coincide with the fan frequency. Inertia bases are optimal to provide adequate mass and stiffness.

When installing fans above ground level, make sure to locate them near a rigid wall or heavy column. The overhead platform must be rigidly constructed and securely braced independently from the fan in all directions. In any above-ground installation, the design of the structure should permit convenient field revisions if the initial operation indicates the need for additional stiffness.

Use J or T type anchor bolts placed in pipe sleeves 2 to 2-1/2 times the bolt diameter when pouring the concrete to allow for final adjustment. The foundation surface must be smooth and level to allow for good shim contact. Allowance must be made for a minimum of 1" of shimming, grouting, leveling, etc.



7.0 Install Factory Assembled Fans

When AirPro installs/assembles the driver and we have adequate power supply to match the specifications of the driver, we will test-run the fan at the factory. However, necessary precautions are required prior to the startup of the fan. Improper operation of a fan can be lethal.

AirPro statically and dynamically balances all fan wheels at the factory. Any fan not supplied with a driver must have final trim balancing performed in the field at the buyer's expense after the motor and/or drives are installed. All fan assemblies should have the installed vibration level confirmed during commissioning to ensure good installation and to provide PM reference data.

Never exceed the maximum design speed shown on the fan nameplate tag.

Procedure

1. If vibration isolation is being used, locate the vibration isolation base and/or isolators. Line up holes in fan base with isolation base or isolator bolts.

2. Place the fan on the mounting structure. Do not force the fan to the mounting structure/foundation, as this may cause bearing misalignment.
3. Align the holes in the base with anchor bolts.
4. Carefully level the unit using stainless steel shims on both sides of each anchor bolt as required.
5. When using grout, shim the fan at least 1" above the concrete base.
6. Tighten the foundation bolts to the torque values shown in table 1.
7. Proceed to Start-Up. *(See section 12.0)*

8.0 Install Partially Assembled Fans

A unit is considered partially assembled if any component required for proper operation is shipped or supplied separately or in pieces. Units requiring assembly of the fan housing or bearing pedestal/drive stand will have tagging on adjacent parts. Units that need extensive assembly may require additional instructions located in other sections of this manual. The shipment may include special instructions for some components or accessories.

Procedure

1. Arrangements 1 and 8: Follow basic procedure outlined in section 7.0. You can now complete the assembly process. If there is a split housing, properly seal the flanges, bolt the sections together, and install the shaft seals when applicable.
2. Arrangements 3 and 7:
    a) Place the lower housing on the mounting surface and level on the foundation shimming as necessary. Use stainless steel shims on each side of the anchor bolts.
    b) If there are loose bearing pedestals, install them next.
        - Set pedestal on bolts. Use shims between the foundation and pedestal to allow the bearing centerline height to match the housing centerline. NOTE: the pedestal may include a machined sole plate that provides bolted separation for removal of bearing pedestal without disturbing the foundation.
        - Level the pedestals using stainless shims. Square the bearing pedestal with the housing.
        - Bolt the bearing pedestals into position.
3. The rotor-shaft assembly is now ready for installation.
    a) Remove protective coatings from shaft and hub. Inspect for any nicks or corrosion. Clean with Scotch-Brite or very fine steel wool as required.

b) Inlet vanes, inlet box pieces, inlet cone, and shaft seals need to be installed on the shaft before installing and bolting the bearings into place. *(See figure 1)*

c) Clean and oil shaft where it will contact the bearings.

d) Solid Pillow Block Bearings: Confirm fixed and floating locations and place bearings over shaft ends.

e) Split Pillow Block Bearings: Remove bearing caps and protect bearing internals. Loosely bolt lower half of bearing housing into place on bearing pedestal. Replace bearing internals in the same order as removed. *(See bearing IOM)*

f) Sleeve bearings: Remove bearing caps and clean with solvent. Coat with oil and clean shaft seal and oil rings. Loosely bolt lower half of bearing housing into place. *(See bearing IOM)*

g) Sling/rig the rotor assembly, check for proper rotation, and set assembly onto pedestal / into bearing housing. Take care not to damage thrust bearings, collars, and liners. *(See bearing IOM)*

h) Verify that the shaft centerline is the proper height for connection to driver.

i) Precision shim bearings as required.

j) Confirm dimensions for location of inlet cone to wheel and wheel to backplate. Locate wheel and inlet cone accordingly. Fasten cone to housing. *(See submittal drawing for dimensions)*

k) Tighten bearing pedestal bolts. *(See table 1)*

l) Complete bearing installation. Make sure the floating bearing is set to allow for thermal expansion. *(See bearing IOM)*

4. Motor and drive installation.

   a) Install motor on base.

   b) Level and carefully align to fan shaft.

   c) Proceed with V-belt *(See section 9)* or coupling installation. *(See section 10 and coupling IOM)*

5. Complete assembly of fan sections using proper gasketing on mating surfaces.
6. Tighten all remaining fasteners in foundation. *(See table 1)*
7. Install shaft seals (if applicable).
8. Follow steps 12-17 in section 7.0.
9. Proceed with start-up

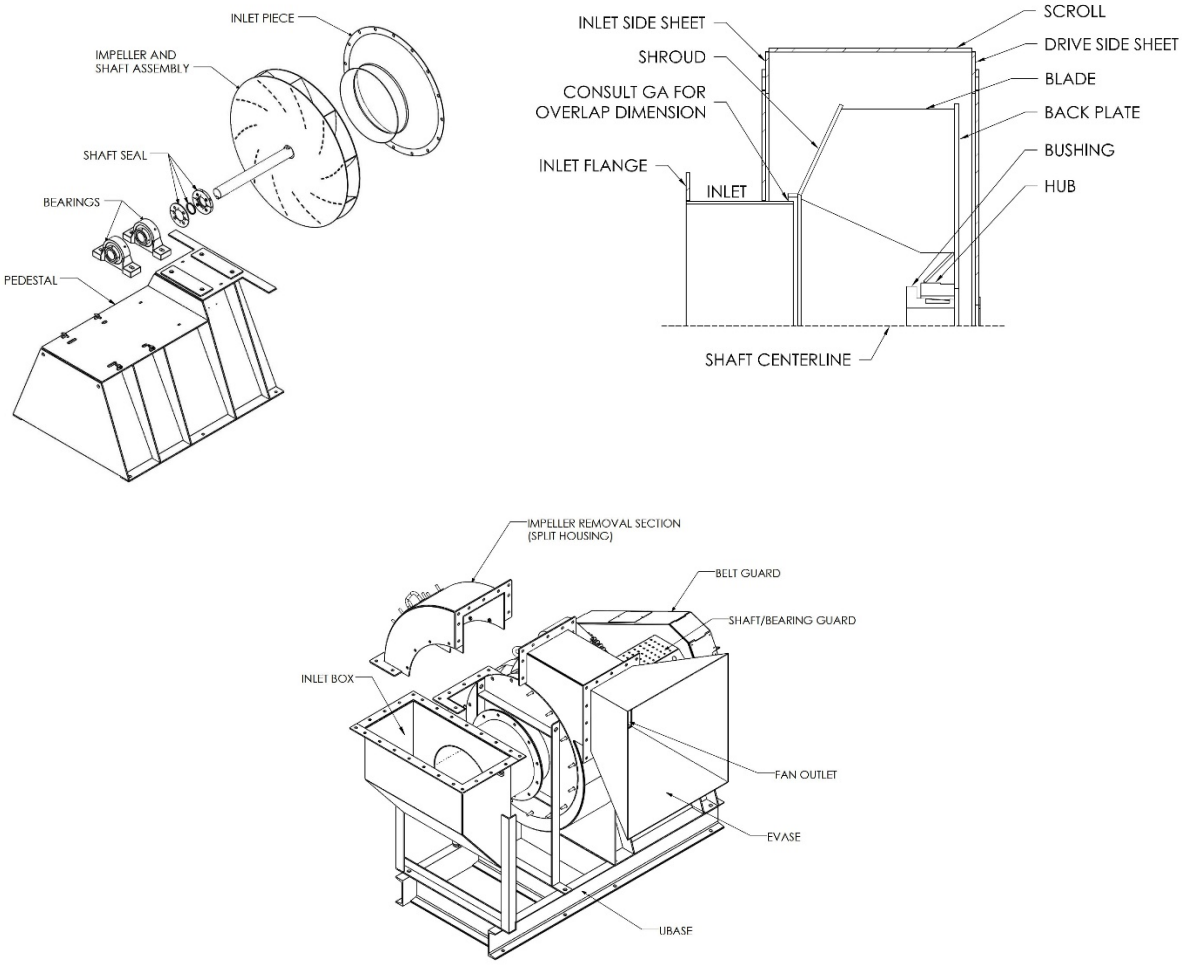


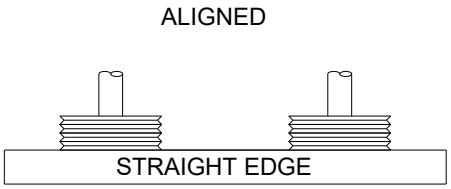
Figure 1 Schematics for Reference Only

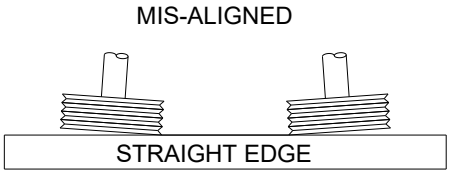
9.0 V-Belt Drive Installation

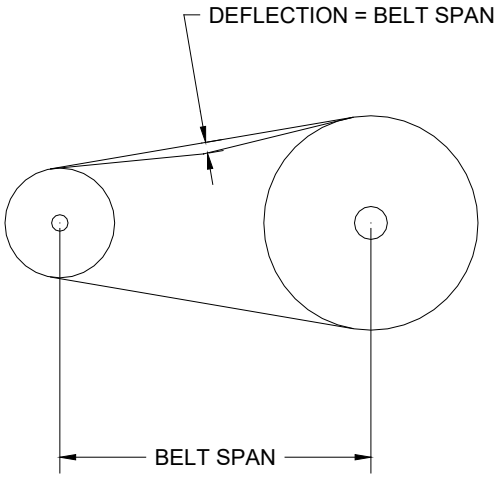
1. A protective grease coating was applied before shipping to preserve the fan shaft surface finish. Clean the shaft. Check the sheave bores and bushing bores for nicks or scratches and remove if found. Be certain the fan and motor sheaves are in the correct position. Occasionally both the fan and motor sheaves use the same bushing type, in which case it is possible to reverse the fan and motor sheaves when installing. **If the fan and motor sheaves are reversed the fan speed may be drastically exceeded and cause wheel damage at start up.**
2. Align the sheaves by adjusting the angle of the motor shaft. The faces of the sheaves must be in plane. Use a straight edge placed across the flange faces or laser align.

3. Check the belt tension with a tensioning gauge and adjust using the motor slide base (reference installed force and deflection data supplied on the GA drawing). For initial tensioning, the proper belt deflection halfway between the sheaves is 1/64 inch for each inch of belt span.

4. Move the motor on the motor slide base to its closest position to the fan shaft. Install the v-belts one at a time rolling them over the sheave groove flanges until they are all in the proper position. Never pry the belts into place.





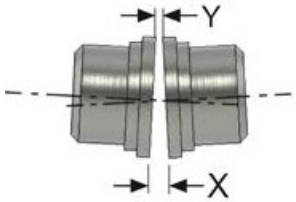


If the belt tension is too great, the fan and motor bearing life is greatly reduced. If the tension is too little, belt slippage can occur. This reduces belt life and reduces fan speed, causing performance problems and increased overall vibration. The belts may slip during start up but slipping should stop as soon as the fan reaches operating speed. For more information on belt tensioning, consult the drive manufacturer.

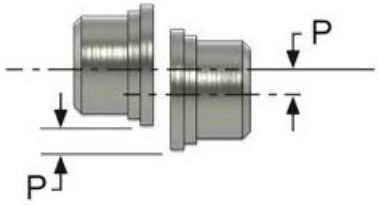
10.0 Coupling Installation

These instructions are general in nature. There are many types of flexible couplings available. The coupling manufacturer's instructions are provided with the coupling and should be followed. *(See coupling IOM)*

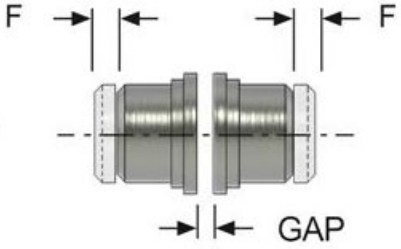
Coupling gap is illustrated below. Adjust the alignment by moving and shimming the motor. Do NOT move the fan shaft in order to achieve better alignment. The fan wheel has been aligned to the inlet and this alignment should not be disturbed. Set the gap as specified by the manufacturer.



Angular Misalignment



Parallel Misalignment



Gap and End Float

The two types of misalignment are illustrated above. Check angular alignment using feeler gauges. Adjust angular alignment to the manufacturer's specification. Adjust parallel alignment using a dial indicator or straight edge and feeler gauges on the OD of the hub. When adjustment has brought parallel alignment within specification, check angular alignment and gap again and adjust as necessary.

A general rule for initial alignment of large motors: set motor low 0.001" per inch of motor shaft diameter to allow for driver expansion.

A laser alignment tool may be used in lieu of the above instruments to provide more accurate readings and documentation.

11.0 Fastener Torque Values

NOTE: the metric unit for torque is N-m and is given alongside the Imperial units.

TABLE 1

Foundation / Bearing / Motor, Hold Down Bolts, Torque values Ft-lb (dry) (N-m)

CAP SCREW SIZE	GRADE 5	GRADE 8
3/8-16	36 (48)	44 (59)
1/2-13	80 (108)	98 (132)
5/8-11	165 (223)	210 (284)
3/4-10	285 (386)	335 (454)
7/8-9	430 (583)	500 (678)
1-8	650 (881)	760 (1030)

TABLE 2

Wheel Set screw Torque Values (dry)

Set Screw Size	Ft-lb (N-m)	In-lb
1/4	6.2 (8.4)	75
5/16	12 (16.2)	144
3/8	21 (28.4)	252
7/16	33 (44.7)	396
1/2	50 (67.7)	600
5/8	97 (131.5)	1164
3/4	168 (227.7)	2016
7/8	267 (362)	3204
1	400 (542.3)	4800

TABLE 3

Browning Taper Bushing Bolt Torque Values (dry)

Bushing Size	Ft-lb (N-m)	In-lb
G & H	7.9 (10.7)	95
P	16 (21.7)	192
Q&R	29 (39.3)	348
S	70 (94.9)	840
U	140 (189.8)	-
W	250 (338.9)	-

TABLE 4

Bearing Set Screw Torque Values (dry)

Set Screw Size	Ft-lb (Nm)	In-lb
#10	3.3 (4.4)	40
1/4	7.5 (10.2)	90
5/16	15.4 (20.8)	185
3/8	27 (36.6)	325
7/16	38 (51.5)	460
1/2	57 (77.3)	680
5/8	112 (151.8)	1350
3/4	196 (265.7)	2350

TABLE 5

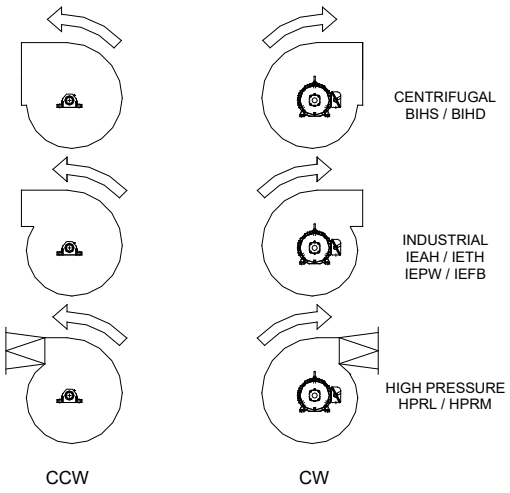
Dodge Taper Bushing Bolt Torque Values (dry)

Bushing Size	Ft-lb (N-m)	In-lb
H	7.5 (10.2)	90
JA	5 (6.7)	60
SH/SDS/SD	9 (12.2)	108
SK	15 (20.3)	180
SF	30 (40.6)	360
E	60 (81.3)	720
F	75 (101.6)	900
J	135 (183)	-
M	225 (305)	-
N	300 (406.7)	-
P	450 (610.1)	-
W	600 (813.5)	-
S	750 (1016.8)	-

12.0 Start-Up

1. Lock out the power source.
2. Follow guidelines in sections 7.0 and 8.0 as required.
3. On belt driven fans, the V-Belt Drive alignment and belt tension should be checked (see 9.0 V-Belt Drive Installation).
4. On direct-coupled fans, the coupling is aligned at the plant within the manufacturer's tolerances. Always check this alignment following transit and installation to ensure that it remains within the manufacturers parallel and angular tolerances (typically within 0.002" offset and parallel). See coupling IOM.
5. Check the tightness of the wheel on the shaft. See tables 2 and 3.
6. Check bearings for proper alignment.
7. Check bearing set screw tightness. See table 4.
8. Check lubrication of bearings, couplings, driver, etc.
9. Check and tighten hold-down bolts.
10. Rotate wheel manually to see that it does not rub and maintains proper inlet cone to wheel clearance.
11. Check fan and ducts for any foreign material or dirt build-up.
12. Secure all access doors.

13. Secure and check safety guards for clearance.
14. Have a qualified electrician verify the voltage and check all electrical connections. All wiring must be done in accordance with NEC and local code requirements.
15. Clear all unauthorized personnel from the area.
16. Bump start the driver and check for proper wheel rotation. A rotation arrow provided on the fan indicates the rotation direction. If the rotation arrow has been covered, removed, or defaced, the proper rotation can be determined by the shape of the fan housing. (see diagrams below)
17. If the ductwork is not fully installed, the motor may overload and cause damage if the fan is run at full speed. If the initial startup of the fan must occur before the ductwork is completed, be sure to block off or dampen the inlet of the fan. This will eliminate the chance of the motor overloading. NOTE: The fan is not designed to support ductwork. Inlet and outlet ducts must be supported independently of the fan. The fan can become distorted and twisted from additional loads applied from improperly supported ductwork. This could cause interference of close running rotating elements. Field installed duct transitions, silencers, discharge stacks etc. must be independently and adequately supported.
18. Start the fan according to the recommendations of the drive unit and starting equipment manufacturer.
19. Bring the fan up to full speed, let it run for one minute, and shut it down. During this start up and coast down period the fan should be quiet. Listen for bearing noises, unusual sounds, metal to metal contact, etc. The fan may shake and vibrate during the coast down period. This is a common occurrence and is caused by resonant frequencies. However, at the fan operating speed the fan must run smoothly. **NEVER EXCEED THE MAXIMUM DESIGN RPM OF THE FAN.**
20. Restart the fan and run for 1 hour. Monitor the fan during this period, noting the bearing temperatures and vibration levels until stable. Then record the installed maximum vibration level and bearing temperatures to establish the installed, new performance levels. The stable bearing temperature is usually under 225F. Shut down the fan and check all fasteners for tightness.



FAN ROTATION
VIEWED FROM DRIVE SIDE
(OPPOSITE INLET SIDE)

21. Make any repairs/adjustments required to make the performance levels within spec.
22. Once the operating conditions are determined to be stable and within specifications, the fan can now be put into service.

13.0 Access Doors

Access doors are furnished on most fans for the inspection of the interior of the fan housing, wheel, and shaft. Access doors should be closed prior to starting the fan and are to be opened only after the fan has been shut down and has come to a complete stop and the driver de-energized. In no case should the access door be opened when the fan is running or the driver energized.

14.0 Vibration Isolation

Vibration isolators reduce the transmission of vibrational energy from the rotating fan to the structure on which it is mounted. When vibration isolators are used for the fan base, expansion joints must be supplied at the fan inlet and outlet connections.

For fans controlled by a variable frequency drive (VFD), we recommend installing with neoprene pads located at the anchor points. These pads help in reducing the effects of possible resonant vibration incurred by fans operating over a range of frequencies.

15.0 Flexible Connectors

Flexible connectors are required on all fans operating above 250°F and for fans mounted on vibration isolators. Install flexible connectors on the fan inlet and/or outlet according to the following minimum guidelines:

1. Maintain flange face to face dimension (usually 12 inches) shown on fan assembly drawing +/- ½ inch.
2. Maintain alignment at +/- ½ inch lateral movement.

16.0 High Temperature Fans

Monitoring the maximum operating temperature as noted on the GA drawing and nameplate is essential for insuring satisfactory operating life. Material yield, creep, and rupture strength drop off dramatically with only slight increases in temperature.

AirPro fans are generally designed for a maximum process air temperature increase/decrease rate of 15°F/Minute. Alternate designs are available for higher rates of temperature change. Do not exceed the maximum temperature change rate, as thermal fatigue and premature rotor failure can result.

In the event of power or system failure, or interruption in fan operation at high temperature, it is critical that the fan be rotated by any means possible until the gas temperature decreases to 250°F or lower. Likewise, never heat up the airstream without the fan running, and NEVER start the fan hot.

Special clearance requirements may be necessary to align the inlet cone and rotor for vertical expansion of the housing and axial expansion of the shaft. The alignment may be non-symmetric during initial ambient placement so that symmetry is achieved during the designed high temperature operation.

Aluminum shaft coolers (heat slingers) are often used on fans above 250°F to reduce heat transfer through the shaft to bearings. These are clamped to the shaft between the housing shaft seal and inboard bearing. NOTE for grease lubricated bearings, the fins must face the bearings; for oil lubricated bearings, the fins must face the fan housing.

In the event the fan requires disassembly, make sure to apply a suitable high-temperature sealant at any fan housing connection point in contact with the hot airstream before reassembly.

17.0 Maintenance

Developing a maintenance schedule is critical in helping prolong the life of the fan. The frequency of inspection depends on many variables including the cleanliness of the environment, the contaminants the fan may be handling, the duty cycle of operation, etc.

Never attempt troubleshooting or maintenance on a fan unless the electrical supply is completely disconnected and locked out. The rotating assembly should also be securely blocked to eliminate the potential for wheel rotation.

Inspections should include the following:

1. Check V-Belt drives for alignment, belt tension, dirt buildup, and wear.
2. On arrangement 8 fans, lubricate couplings and check alignment.
3. Lubricate the fan per bearing lubrication schedule.
4. Inspect the fan wheel and shaft for wear, corrosion, or material build up. Clean or replace as required.
5. Check all other metallic components for corrosion, cracks, or other signs of stress.
6. Check all fasteners for tightness. See tables 1-5 for torque values.
7. Check vibration isolators for freedom of movement. Replace broken springs and deteriorated rubber elements.
8. Replace worn shaft seals.
9. It is important not to stop the fan while it is at elevated temperature. With fans that are handling air temperatures above 250°F, allow the process gas to cool with the fan running. Once the temperature is cool, the fan can be stopped.
10. On hot gas fans, never heat up the air stream without the fan running. If hot operating conditions were used to establish the motor size, use dampers to start the fan cold or start at a slower speed and increase gradually as the air temperature rises. Never, under any circumstance, start a fan hot.

11. Keep the motor clean, dry, and lubricated. Often motor lubricants are not the same as fan bearings. Follow the motor manufacturers IOM recommendations.

18.0 Vibration

All AirPro wheels are factory balanced to minimum quality grade G6.3 in accordance with ISO1940/1 standard. More stringent grades are available as required for specific applications.

Rough handling, shipment damage, and installation oversights may impact the factory balance. Record vibration readings at start-up to compare factory levels and for your own maintenance records. Adhere to the following table and perform a trim balance if the fan exceeds vibration limits in the table.

Maximum Field Vibration Limits (filter IN at fan operating speed)		
Fan Rpm	Total Displacement (Mils-Peak-to-Peak)	Peak Velocity In/Sec (mm/sec)
3600	.66	.124 (3.15)
2700	.88	.124
1800	1.32	.124
1200	1.97	.124
900	2.63	.124
700	3.38	.124

Bearings equipped with vibration detectors mounted on the bearing housing are a recommended option available from AirPro**.** These units provide continuous data monitoring and are reliable over a long period of time with a high degree of accuracy. An alternate method is the use of a vibration switch mounted on the fan pedestal. This device has an adjustable set point that can trigger an alarm or shut down the fan.

For best results, install fans controlled by a variable frequency drive with neoprene pads located on each side of the anchor points. These pads help in reducing the effects of possible resonant vibration incurred by fans operating over a range of frequencies.

19.0 Bearings

Fan bearings support the wheel and shaft on all fans except where the wheel is installed directly on the motor shaft. They are typically ball or spherical roller elements with varying housing designs and shaft connection details.

Lubrication is one of the most significant factors affecting bearing life. In the factory, fan bearings may be filled with several different lubricants based on application. The standard lubrication is an NLGI #2 lithium complex, mineral oil based multipurpose grease such as Mobil Ronex MP. Multipurpose synthetic greases like Shell's Aeroshell 7 or Mobil's SHC 222

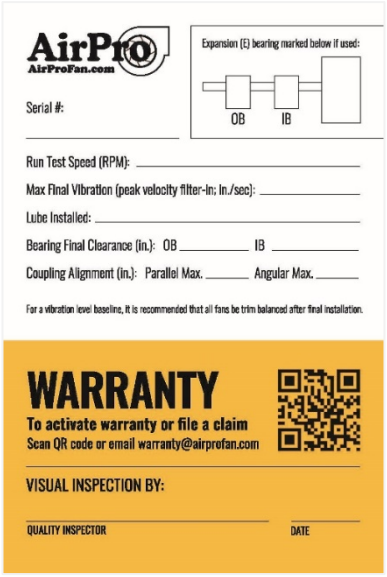
Polyrex are used on some fans for low or high temperature considerations. Mineral oil based and synthetic greases should not be mixed. The quality decal found on the fan assembly will indicate the factory-installed lubricant.

Determine the re-lubrication frequency and amount from the GA drawing or from tables included in the bearing IOM document. The fan's installed environment can affect the re-lubrication frequency, with the presence of dirt, moisture, chemical fumes, or temperature extremes requiring more frequent re-lubrication. Standard lubrications are usually acceptable with ambient temperatures ranging from 0°F to 100°F.

Bearing cap temperatures can indicate bearing health and affect the lubricant viscosity, so monitor them periodically to maintain proper bearing life. Bearing cap temperatures may be elevated for a few hours at start-up and then should stabilize at a slightly lower level. If the bearing cap temperatures increase significantly in any period after start-up, 20°-30°F above normal, investigate and correct the cause of the condition. It is common that the caps will be very hot to the touch (over 140°F) If the bearing temperature exceeds 225°F, shut down the fan as temperatures elevated to this level will likely lead to rapid bearing deterioration, and ultimately premature failure.

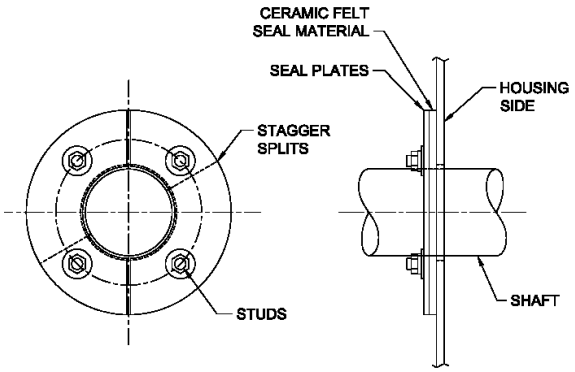
To replace your fan bearings, disconnect all power to the fan and lock it out. Remove all guards and drive components. Block up the wheel in the fan housing or remove the wheel/shaft assembly through the split housing if so equipped. Note which bearing, if any, is the floating bearing and be sure to reinstall the correct bearings in the correct places. Remove the bearings and replace them, following the manufacturer's instructions for disassembly and assembly of bearings. Lubricate the bearings with the appropriate grease. Reinstall the wheel/shaft assembly or remove wheel blocking. Install the drive components and unlock the power source. Test run the fan, checking vibration levels and trim balance as necessary. Monitor bearing temperature and performance over the initial break-in period as indicated above.

Below is a copy of the label that is attached to the fan:



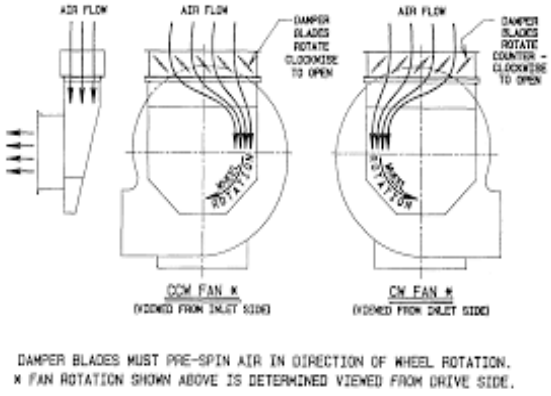
20.0 Special Features / Accessories

a) **Shaft Seals** – The standard shaft seal is a ceramic felt seal as shown below. Other seals such as Teflon, stuffing boxes, carbon ring seals, and mechanical (purge) seals are available. Acceptable leakage rates will vary according to application requirements and the specific seal being applied. Consult the separate seal mfr IOM when applicable.



b) **Inlet Vane Dampers** - Provided as assemblies in a flanged ring external to the fan inlet and are available in a variety of materials. They are provided to control volume and as a means to save power. They are typically provided with a control arm for a field installed operator/acuator. If provided with an operator, refer to the operator IOM for proper operation.

c) **Inlet Box and Inlet Box Dampers** – An engineered product designed to improve the transition of air into the fan. Dampers may be provided for volume control and should be built with the damper axles parallel to the fan shaft and provide proper pre-spin of the air into the fan. They are available in a variety of materials.



d) **Outlet Dampers** – Provided for volume control and/or energy savings. They are available in a variety of materials.

e) **Dampers with Actuators** – If AirPro installed the operator/actuator, it should be ready for connection to the air or power supply and can be put into operation according to the actuator IOM. If an actuator is to be field installed, make sure it operates over the full operating range. Before putting into service, confirm that the damper blades open and close fully without binding when the operator cycles through its full range. Dampers shipped in multiple sections need to be assembled using the hardware supplied. After bolting the linkage bars together, check for proper blade rotation and that the blades in the entire damper assembly open and close properly. Seal weld sections to prevent leakage and to insure there is not movement between sections. Unless cycled under normal operations, cycle damper at least every 3-months. The unit must be kept clean and free from any foreign matter that may impede normal movement and seating of blades and seals (if applicable). During normal fan maintenance, lubricate bearings as needed, inspect blade seals, and check all linkages and flange bolts.

f) **Shaft Cooler** – Also known as “heat slingers” or “cooling wheels”, these are small, split wheels that are bolted to the fan shaft between the inboard bearing and fan housing. They reduce shaft heat transfer and provide cooling air to the bearing in high temperature applications.

g) **High Temperature Fans** – The standard maximum design temperature for AirPro fans is 150°F. Anything above that requires special design and construction considerations. AirPro routinely builds fans to 2000°F using special materials and features. AirPro can provide factory installed insulation to the fan housing suitable for inside or outside installation, with an option for cladding. Refer to section 16.0 and the design and submittal documents for specific information.

h) **Spark Resistant Construction** – Fans can be provided with AMCA A, B, or C configurations as required for the fan duty.

i) **Vibration Isolation** – When specified, AirPro can provide spring or rubber/pad type vibration isolators for the fan base.

j) **Insulation** – Factory insulation can be provided for both surface temperature retention/personnel protection and/or sound reduction. It is available as an encapsulated removeable section type, as a standard sheet product with aluminum or stainless-steel cladding, or with a welded housing shell with insulation filling the cavity between the outer shell and the primary fan housing in direct contact with the airstream.

k) **Sound Attenuators** – Inlet or outlet sound attenuators are available in a variety of materials and protective coatings. They can be designed per the project sound requirements.

21.0 Spare Parts

Spare parts are available and recommended. Reduce costly down time and large production losses by having spare parts on hand.

A complete set of rotating components is recommended for critical applications. This would include a wheel, shaft, and set of bearings depending on your assembly.

Stocking spares of other drive components, (i.e. V-Belts, Coupling, Motor, Etc.) can also eliminate costly down time.

Recommended spare parts and costs may be provided at time of order. If not, contact your local AirPro representative or 715-365-FANS for price and delivery.

22.0 Troubleshooting

General safe practices and performance troubleshooting guidelines can be found in AMCA Publications 410 and 202, respectively. Fan application and field measurement procedures can be found in AMCA publications 201 and 203.

AirPro publishes air and sound performance data according to AMCA Standards 210 and 300. The test procedure incorporates an open inlet and a straight outlet duct. Avoid elbows immediately adjacent to the fan inlet and outlet. Any installation with inlet or outlet configurations that deviate from this standard may result in fan performance that differs from the published data. Restricted or unstable flow at the fan inlet can cause pre-rotation of incoming air or uneven loading of the fan wheel producing large system losses and increased sound levels. Likewise, free discharge or turbulent flow in the outlet ductwork will result in actual fan performance below the published data. Refer to AMCA Standard 201 for additional information regarding system effect factors and losses. (Air Movement & Control Association International Inc. www.amca.org). Also refer to AMCA 203 and 803 for field performance measurement guidelines as you attempt to reconcile actual field measurements to the published performance data.

Here is a list of common problems, causes, and possible solutions.

A) AIR CAPACITY PERFORMANCE PROBLEMS

1. **The system resistance is not at the design condition**.
    a) If the system resistance is lower than design, both airflow and horsepower may be higher than expected. If the system resistance is higher than design, both airflow and horsepower will be lower than expected.
    b) The system resistance can be modified using dampers or duct modifications.

2. **The fan speed does not match the design speed**.
    a) The actual fan speed rarely matches exactly with the original fan performance data due to limited sheave/belt combinations and/or motor slippage.
    b) Increase or decrease the fan speed via a sheave diameter change or adjust the variable frequency drive.
    c) For fans controlled by a VFD/VSD, check that the drive frequency is set properly.

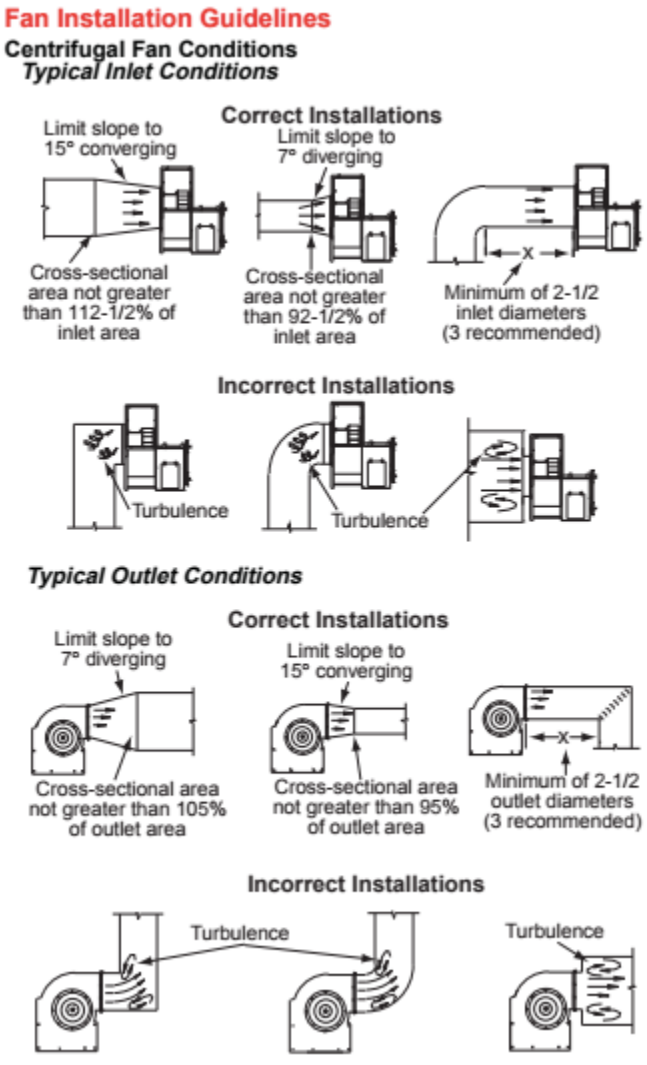
3. **The fan inlet density is not at the design inlet density**.
    a) A lower density will produce lower static pressures and lower horsepower's. A higher density will produce higher static pressures and higher horsepower's.
    b) The flow can be reduced by closing a damper or reducing the fan speed to reduce the horsepower requirement.

4. **The fan wheel is rotating the wrong direction.**
    a) This is a common cause of drastically reduced performance.

b) Reverse the rotation electrically. Follow the rotation arrow on the fan.

5. **Verify operation of accessory items.**
   a) Make sure dampers are installed and operating properly.
   b) Make sure filters are clean.
   c) Make sure all controls are operating properly.

6. **Poor duct design.**
   a) Poor duct design can cause "system effect", which can dramatically affect fan performance. Below are some centrifugal fan installation guidelines that show both correct and incorrect inlet and outlet orientations.



B) VIBRATION PROBLEMS

1. **There is material build up on the wheel components.**
   a) Wheel balance is greatly affected by the accumulation of foreign material on the wheel components. A small amount of buildup can result in enough weight to cause the wheel balance to deteriorate drastically.
   b) Clean the wheel. Scrape, wire brush or power wash the accumulation off the wheel and the balance may be restored.

2. **The fan wheel is worn out.**
   a) Abrasive and or corrosive conditions will eventually cause a wheel to go out of balance. This will cause further damage to the shaft, bearings, and eventually the entire fan. Rebuild, replace, and rebalance the wheel as required.

3. **Loose fasteners**
   a) Bearing and motor hold down bolts, wheel set screws, taper lock bushing bolts, and fan foundation bolts can all contribute to vibration. Mechanical looseness is a very common cause of excessive vibration.
   b) All the fasteners must be properly tightened. See Tables 1-5

4. **Misalignment of drive components**
   a) Check belt or coupling alignment.

5. **Bearings are defective.**
    a) Check bearings on both fan and motor.

6. **Fan operation near system critical speed or in stalling or unstable flow region.**
    a) Change the fan operating speed if the issue is resonance. If the fan is operating in the unstable/stalling flow region of its performance range, then the fan may need to be changed for one that would operate in a stable flow zone.
    b) Do not exceed fan maximum RPM listed on nameplate.

7. **Fan is operating in or near a resonant frequency.**
    a) If fan is controlled by a VFD, program that frequency out to avoid resonance.
    b) Add vibration pads under the fan base at the mounting locations.
    c) Poor foundation or mounting structure. Stiffening of the structure and/or the addition of concrete to the base or pedestal may be required.

C) NOISE PROBLEMS

1. **Squeal on start-up**
    a) Check belt tension and wear.

2. **Squeal, grinding, or growling sound**
    a) Inspect fan and motor bearings.
    b) Check all rotating member clearances.

3. **Loud high-pitched whine from motor**
    a) Check VFD operation and power supply integrity.

4. **Pulsating sound emanating from ductwork**
    a) Fan may be operating in region of instability due to excessive pressure forcing the fan to operate far below design volume. Increase volume (reduce system resistance).

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5. **Poor fan inlet conditions**
    a) Refer to “Poor Duct Design” *(See section above)*

6. **Rubbing of wheel to inlet or wheel to housing**
    a) Check wheel placement within housing for proper clearing to housing and wheel to inlet cone overlap.

AirPro engineers can help diagnose performance issues and other problems. The following information will be required:

- Picture of fan nameplate
- Static pressure readings across the fan only.
- A duct velocity profile, and corresponding duct size, taken in a clear straight duct as far from the fan as possible to allow for laminar flow.
- Air temperature
- Motor amp draw and FLA from the motor nameplate.
- RPM and/or VFD drive setting.

- Fan duty
- Pictures of the fan installation showing all connecting ductwork.
- Maintenance records to show historical trends

23.0 AirPro Field Service

AirPro offers on site factory service for trouble shooting, assembly supervision, start-up assistance, and balancing needs. Phone 715-365 FANS to schedule service.

24.0 Warranty

LIMITED PRODUCT WARRANTY:

All AirPro products are warranted against defects in workmanship and materials for **(36) months** from Manufacture Date.

To activate the 3-Year Gold Standard Warranty, customers should complete the Product Registration form online.

To receive Warranty service, customers should complete the AirPro Warranty Report online and submit for service. The Report must be accompanied by proof that the product was properly installed and maintained in accordance with AirPro' s instructions and recommendations and that it was not operated in excess of operational limits set forth in AirPro's Order Acknowledgement, Quotation, or Design Documentation.

If the AirPro product is defective due to workmanship or materials and the defect occurs during the warranty period, then AirPro will either repair the product or replace it with a new one, whichever AirPro believes to be appropriate under the circumstances. AirPro is not responsible for removal and shipping of the AirPro product to any off-site service center, the re-installation of the AirPro product upon its return to the customer, or any incidental or consequential damages resulting from the defect, removal, re-installation, and shipment or otherwise.

Parts installed by AirPro but not manufactured or supplied by AirPro shall carry the original manufacturer's warranty only and must be serviced through them.

This warranty does not cover customer labor charges for replacement of parts, adjustments or repairs, or any other work unless such charges are authorized in advance, in writing, by AirPro.

This warranty does not cover abrasion, erosion and wear, nor does it cover any product which, in the judgment of AirPro, has been subject to misuse or neglect, or which has been repaired

or altered outside AirPro'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 AirPro for use in any of its products shall have been substituted and used in place of a part manufactured or supplied by AirPro for such use.

This warranty does not apply to merchantability or fitness for a particular purpose given or assumed by others in connection with the sale of the AirPro products beyond what is stated on the AirPro Order Acknowledgement, Quotation, or Design Documentation.

This warranty does not guarantee sound pressure levels or dBA which are environmentally dependent.