General Instructions
(Plenum & Plug Fan)

BNA-ANA- BPA-APA
This manual is to guide the users in the proper storage, installation, operation and maintenance procedures to ensure maximum equipment life and trouble-free operation. **HANDLING AND MAINTENANCE SHOULD ALWAYS BE PERFORMED BY EXPERIENCED AND TRAINED PERSONNEL.**

**RECEIVING, HANDLING AND STORAGE**

Rough handling during shipment and improper storage can cause damage that is not noticeable until the fan is in operation. This can be avoided with proper storage and handling techniques.

Fan should be hoisted with slings placed around the fan housing. Touch up the scratch coated surfaces during lifting, to prevent corrosion to occur at this area. Store the fan in a clean and dry place, preferably indoor to ensure fan shaft, bearing and fan casing are protected against dust and corrosion. Do not store the fan in a location where it will be subjected to vibration. This can cause the internal surface to rub against each other and damage the bearings.

**START-UP CHECK LIST**

Before putting any fan into initial operation the manufacturer’s instruction must be followed. Complete the following checklist to make sure that the fan is ready to run.

- Lock out the primary and all secondary power sources.
- Make sure the foundation or mounting arrangement and the duct connections are adequately designed in accordance with recognized acceptable engineering practices and with the fan manufacturer’s recommendations.
- Check and tighten all hold-down (securing) bolts.
- Check the fan assembly and bearings for proper grounding to prevent static electricity discharge.
- Spin impeller to see whether it rotates freely and is not grossly out of balance.
- Inspect impeller for correct rotation for the fan design.
- Check belt drive or coupling alignment, use recommended belt tension.
- Check belt drive for proper sheave selection and make sure they are not reversed.
- Properly secure all safety guards.
- Switch on the electrical supply and allow the fan to reach full speed.
  
  Check carefully for :-  
  1. Excessive vibration  
  2. Unusual noise  
  3. Proper amperage and voltage values  
  4. Proper belt alignment

If any problem is indicated, SWITCH OFF IMMEDIATELY. Lock out the electrical supply, secure the fan impeller if there is a potential for wind milling. (Impeller turning due to a draft through the system). Check carefully for the cause of the trouble and correct as necessary.
The fan may now be put into operation but during the first 8 hrs of running, it should be periodically observed and checked for excessive vibration and noise. Checks should be made on motor input current and motor & bearing temperature to ensure that they do not exceed manufacturer’s recommendation. After 8 hrs of operation, the fan should be shut down to check the following items:

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

After 24 hrs of the satisfactory operation, the fan should be shut down, and the drive belt tension should be readjusted to recommended tension.

**TROUBLE-SHOOTING**

**Fan is developing or emitting abnormal or excessive noise**

<table>
<thead>
<tr>
<th>Drive system</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fan or motor sheave not properly tightened onto shaft</td>
<td>Re-tighten the sheaves</td>
<td></td>
</tr>
<tr>
<td>Misaligned sheaves</td>
<td>Re-align the sheaves</td>
<td></td>
</tr>
<tr>
<td>Belt hitting Belt Guard</td>
<td>Check fan &amp; motor sheave alignment &amp; belt tension</td>
<td></td>
</tr>
<tr>
<td>Belts are not tensioned enough and are too loose</td>
<td>Increase the belt tension</td>
<td></td>
</tr>
<tr>
<td>Belts too tight</td>
<td>Correct belt tension</td>
<td></td>
</tr>
<tr>
<td>Belts wrong cross section</td>
<td>Change to right type</td>
<td></td>
</tr>
<tr>
<td>Belts worn</td>
<td>Replace belts</td>
<td></td>
</tr>
<tr>
<td>Belts oily or dirty</td>
<td>Clean belts</td>
<td></td>
</tr>
<tr>
<td>Belt guard is not properly fastened</td>
<td>Tighten the fasteners</td>
<td></td>
</tr>
<tr>
<td>Motor, motor base or fan not securely anchored or secured</td>
<td>Tighten the fasteners</td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Motor</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Lean-in cable not secure</td>
<td>Fasten the cable properly</td>
<td></td>
</tr>
<tr>
<td>Noisy motor bearings</td>
<td>Replace bearing</td>
<td></td>
</tr>
<tr>
<td>Single phasing a 3 phase motor</td>
<td>Check power supply</td>
<td></td>
</tr>
<tr>
<td>Low voltage</td>
<td>Check power supply</td>
<td></td>
</tr>
<tr>
<td>Cooling fan striking shroud</td>
<td>Check motor assembly</td>
<td></td>
</tr>
<tr>
<td>Electromagnetic fault in motor</td>
<td>Replace motor</td>
<td></td>
</tr>
<tr>
<td>AC hum in motor or relay</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Starting relay chatter</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Fan Components</th>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Impeller loose on shaft</td>
<td>Tighten impeller</td>
<td></td>
</tr>
<tr>
<td>Impeller unbalance</td>
<td>Balance impeller</td>
<td></td>
</tr>
<tr>
<td>Impeller not center in inlet or housing</td>
<td>Adjust impeller to center of inlet or housing</td>
<td></td>
</tr>
<tr>
<td>Impeller in contact with inlet cone</td>
<td>Correct inlet cone position</td>
<td></td>
</tr>
<tr>
<td>Blades rotating close to structural member</td>
<td>Correct the running clearance</td>
<td></td>
</tr>
<tr>
<td>Cutoff or other parts loose (rattling during operation)</td>
<td>Tighten loose parts</td>
<td></td>
</tr>
<tr>
<td>Cutoff damaged</td>
<td>Replace cutoff</td>
<td></td>
</tr>
<tr>
<td>Cutoff improperly positioned</td>
<td>Reposition cutoff</td>
<td></td>
</tr>
<tr>
<td>Impurities or foreign material inside fan housing</td>
<td>Clean inside fan and impeller</td>
<td></td>
</tr>
<tr>
<td>Bearing defective or worn out</td>
<td>Replace bearing</td>
<td></td>
</tr>
<tr>
<td>Bearing loose on bearing support or shaft</td>
<td>Re-tighten bearing</td>
<td></td>
</tr>
<tr>
<td>Foreign material inside bearing</td>
<td>Clean bearing</td>
<td></td>
</tr>
<tr>
<td>Fretting corrosion between inner race and shaft</td>
<td>Replace bearing or shaft</td>
<td></td>
</tr>
<tr>
<td>Bearing not sitting on flat surface</td>
<td>Re-adjust bearing</td>
<td></td>
</tr>
<tr>
<td>Rubbing noise between bearing seal and inner ring</td>
<td>Replace bearing</td>
<td></td>
</tr>
<tr>
<td>Impeller worn as a result of abrasive or corrosive material moving through passages</td>
<td>Replace impeller</td>
<td></td>
</tr>
<tr>
<td>Blades coinciding with an equal number of structural members</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>
### Fan is vibrating excessively

<table>
<thead>
<tr>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| **Impeller**  | • Impeller unbalanced due to deposits (dirt or grease)  
• Impeller unbalanced due to wear |
| **Drive**     | • Unbalanced pulleys  
• Belts may vibrate excessively |

• Clean impeller, rebalance the system  
• Replace impeller  
• Balance the pulley or the system  
• Proper sheave alignment and adjust to correct belt tension

### Required air volume not achieved

<table>
<thead>
<tr>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| **Impeller**  | • Impeller not centered with inlet collar(s)  
• Impeller/inlet dirty or clogged  
• Improper running clearance  
• Improper inlet cone to wheel fit  
• Impeller installed or running wrong direction  
• Incorrect speed of impeller because of:  
  i) Wrong motor speed  
  ii) Belt drive ratio not correct  
  iii) Too high slip of V-belt  
  iv) Wrong calibration of inverter |
| **Duct System**  | • Shutters or dampers of the system are closed  
• Object obstructs fan or duct  
• Inlet guide vanes are partly close  
• Dampers closed  
• Registers closed  
• Leaks in supply duct  
• Obstructions near fan outlet or inlet  
• Sharp elbows near fan outlet or inlet  
• Improper designed turning vanes  
• Insulating duct liner loose  
• Pressure resistance offered by the system higher than the design value  
• Fluid density higher than the design value  
• Improper set inlet vane or damper  
• Actual system is more restrictive (more resistance to flow) than expected  
• Obstructed fan outlet inlets  
  Elbows, cabinet walls or other obstructions restrict air flow. Inlet obstructions cause more restrictive systems but do not cause increased negative pressure readings near the fan inlet(s)  
  Fan speed may be increased to counteract the effect of restricted fan inlet(s). Caution! Do not increase speed beyond the fan manufacturers recommendations  
• Projections, dampers or other obstruction in a part of the system where air velocity is high  
• Obstructions in high velocity air stream |
| **Remedy**     | • Adjust the impeller to the center of inlet collar(s)  
• Clean the impeller or inlet  
• Change to correct clearance  
• Adjust to correct fit  
• Change to correct rotation by changing poles of electrical feed line to motor  
  i) Change motor or belt drive  
  ii) Change belt drive  
  iii) Increase tension of belts  
  iv) Adjust inverter calibration  
• Open damper or IVC  
• Clear obstructed ducts  
• Open grill/diffuser damper  
• Open Damper  
• Open Register  
• Seal the Leakage  
• Clear obstruction  
• redesign and change elbow  
• redesign and change vanes |

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• Clear obstructed ducts  
• Open grill/diffuser damper  
• Open Damper  
• Open Register  
• Seal the Leakage  
• Clear obstruction  
• Redesign and change elbow  
• Redesign and change vanes
### Fan does not start or operate

<table>
<thead>
<tr>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| **Electrical Supply** | Blown fuses  
Electricity turned off  
Wrong voltage  
Failure of one or two phases  
Low voltage, excessive line drop or inadequate wire size | Check fuses/circuit breakers  
Check for switched off or disconnected  
Check for correct power supply  
Check for correct power supply  
Check for correct wire size |
| **Motor** | Motor not correctly connected  
Load inertia too large for motor  
Motor protection unit or switch are stopping as temperature are too high  
Motor too small and overload protector has broken circuit | Connect the motor according to the motor label  
Change motor  
Reduce temperatures, check and change insulation class, increase motor rating  
Change motor |
| **Drive System** | Broken belts  
Loose pulleys | Replace belt  
Tighten pulley |

### Excessive air flow

<table>
<thead>
<tr>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Fan</strong></td>
<td>Excessive rotational fan speed</td>
</tr>
<tr>
<td><strong>Duct System</strong></td>
<td>Pressure resistance offered by the system lower than the design value</td>
</tr>
<tr>
<td><strong>Gas Density</strong></td>
<td>Gas density higher than the design value</td>
</tr>
</tbody>
</table>

### High power absorption

<table>
<thead>
<tr>
<th>Possible cause</th>
<th>Remedy</th>
</tr>
</thead>
</table>
| **Impeller** | Air flow already rotating in the opposite direction to the fan rotation direction  
Backward curved impeller installed backwards |
| **Motor** | Faults in the motor windings  
Motor power supply voltage lower than the value indicated on the identification plate | Replace motor  
Check with motor supplier |
| **Fan** | Forward curved or backward blade fan operating below design pressures. |
| **System** | Oversized ductwork  
Filter(s) left out  
Access door are open  
Face and by-pass dampers oriented so coil dampers are open at same time by-pass dampers are open | Redesign ductwork  
Add in filter(s)  
Close access door |
| **Gas Density** | Calculated horsepower requirements based on light gas (eg. High temperature) but actual gas is heavy (eg. Cold start up) |
| **Fan selection** | Fan not selected at efficient point of rating | Check selection |
GUIDELINES FOR PLENUM AND PLUG FANS INSTALLATION

Adjacent Walls

The distance between the fan and walls or ceilings will affect the fan performance. The recommended distance between the fan wheel and any wall is a minimum of 0.5 wheel diameter. Multiple walls reduce the performance even more.

Side by Side

When two or more plenum fans are in parallel, there should be at least one fan diameter spacing between the wheels. Applications with less spacing will experience performance losses.

V-BELT DRIVE INSTALLATION

- Remove the protective coating from the end of the fan shaft and assure that it is free of nicks and burrs.
- Check fan and motor shafts for parallel and angular alignment.
- Slide sheaves on shafts – do not drive sheaves on as this may result in bearing damage.
- Align fan and motor sheaves with a straight-edge or string and tighten.
- Place belts over sheaves. Do not pry or force belts, as this could result in damage to the cords in the belts.
- Adjust the tension until the belts appear snug. Run the unit for a few minutes (see section on unit start-up) and allow the belts to "set" properly.
- Switch off the fan, adjust the belt tension by moving the motor base. When in operation, the tight side of the belts should be in a straight line from sheave to sheave with a slight bow on the slack side.
Belt tension is important for long belt life. Too much tension puts excessive loads on the belts and the bearings, reducing the lives of both components. Not enough tension allows belt slippage, which generates heat and drastically reduces the life of the belt.

Belt tensioning gauges can be used to determine whether the belts are tensioned properly. A chart that comes with the gauge specifies a range of force required to deflect the belts a given amount based on the centre distance of the sheaves and the belt cross section. The belts are properly tensioned when the force required to deflect the belt, the specified amount falls within this range.

If a belt tensioning gauge is not available, re-tension the belts just tight enough so that they do not squeal when starting the fan. A short "chirp" is acceptable; a squeal lasting several seconds or longer is not acceptable.

Before starting the fan after tensioning the belts, recheck the alignment and realign the sheaves if necessary. New belts may stretch a little at first, so recheck belt tension after a few days of operation.
**BEARING LUBRICATION**

- Fan equipped with deep grooved ball bearing inserted in rubber damper has sufficient high grade grease sealed in at the time of manufacture, there is no need for replenishment while in use at normal speed & normal condition.

- Fan equipped with deep grooved ball bearing inserted in pillow block also has sufficient high grade grease sealed in at the time of manufacture, there is no need for replenishment while in use at normal speed & normal condition. The pillow block housing has lubrication point suitable for lubricating when the bearing operating temperature exceeding its nominal of 70 degree, or the bearing is used in very dusty or damp or high contamination environment.

- Fan equipped with spherical roller bearings and CARB toroidal roller bearings, assembled in plummer block housings has lubrication point when the life of grease is expectancy.

  Experience from bearing manufacture indicates a first relubrication exercised after a few days of operation is very beneficial to all rollers bearings and may even be a prerequisite if the expected relubrication interval is to be attained when operating speeds are high. For this first relubrication, half of the normal quantity recommended for regular relubrication is sufficient.

- Type of grease used for relubrication should be the same as that used during first fill (mounting). Never mix greases if it is not known whether they are compatible.
Referring to manufacturers' instructions, the amount of grease required for relubrication can be determined from

\[ G_p = 0.006 \times D \times B \]

Where
- \( G_p \) = Grease quantity for periodic relubrication, g
- \( D \) = Bearing outside diameter, mm
- \( B \) = Bearing width, mm

The relubricating interval may be determined from the following diagram. At bearing temperatures above 70°C, relubricating interval obtained from the diagram should be halved for every 15°C increase.

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

Scale a: Radical ball bearing
Scale c: Spherical roller bearings
<table>
<thead>
<tr>
<th>Type of bearing</th>
<th>Type of grease</th>
<th>Temperature</th>
</tr>
</thead>
<tbody>
<tr>
<td>NSK Deep Groove Ball Bearing</td>
<td>Alvania Grease #3</td>
<td>Normal</td>
</tr>
<tr>
<td>SKF Deep Groove Ball Bearing</td>
<td>SKF Grease LGMT 3</td>
<td>Normal</td>
</tr>
<tr>
<td>SKF Spheriodical Roller Bearing</td>
<td>SKF Grease LGMT 3</td>
<td>Normal / High</td>
</tr>
<tr>
<td>SKF Carb Roller Bearing</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**VIBRATION ISOLATOR INSTALLATION**

- Choose proper isolator  
  (Isolator can be selected from Kruger selection programme)

- Adjust deflection based on the selected isolator.

- Maintain the operating / free height at the same level through step 2.  
  (The entire assembly must be levelled)

- Check all the deflection and operating / free height is properly maintained.

**ROUTINE MAINTENANCE**

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

Under normal circumstances, handling clean air, the system should require cleaning only about a Year. However, the fan and system should be checked at regular intervals to detect any unusual accumulation.

The fan impeller should be specially checked for build-up of material or dirt which may cause an Imbalance with resulting undue wear on bearings and belt drives. A regular maintenance program should be established as needed to prevent material build-up.

Periodic inspection of the rotating assembly must be made to detect any indication of weakening of the rotor because of corrosion, erosion, or metal fatigue.
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