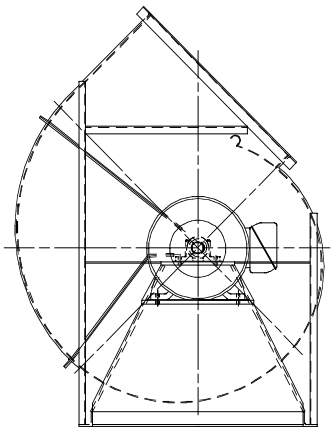
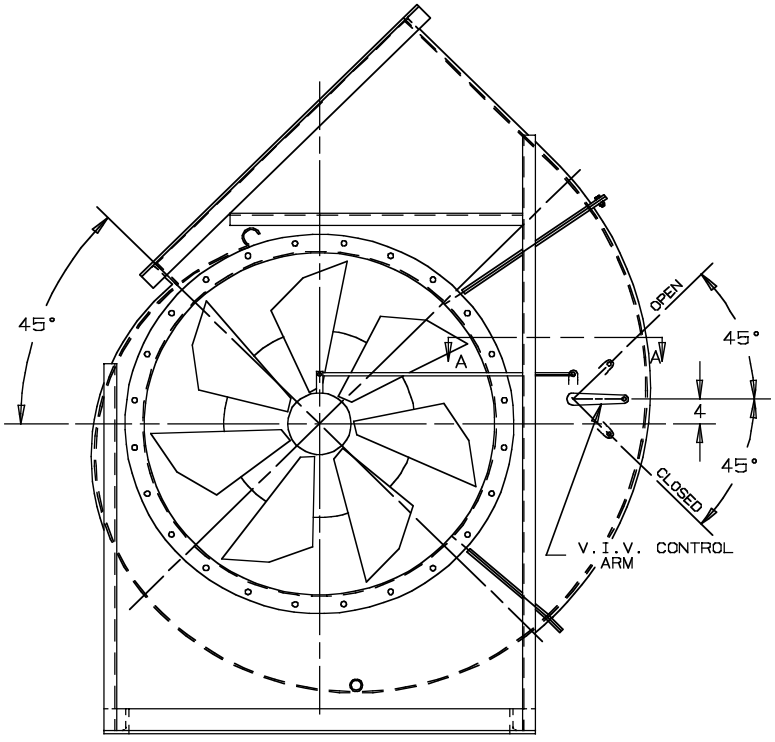


Client: Sample
Serial No. ?????

Fan Serial Number. ??????

Aireng Fan Equipment Operation and Maintenance Manual



Published by
Aireng Pty Ltd
A.C.N. 060 583 164
Telephone 613 9738 1999
Facsimile 613 9738 1766
E-mail. fans@aireng.com.au
BAYSWATER, VICTORIA
AUSTRALIA 3153

OPERATION MANUAL - FAN EQUIPMENT.....4

SAFETY PRECAUTIONS.....4

INSTALLATION, OPERATION & MAINTENANCE

OF AIRENG PTY LTD FAN EQUIPMENT.....5

Introduction.....5

Shipment & Receiving.....5

Handling 5

Storage 6

General Installation of Fan Equipment.....6

Operation of Fan Equipment 7

Maintenance of Fan Equipment 8

Vibration 9

FAN TROUBLE-SHOOTING CHART 11

Standard Terms and Conditions.....12

Warranty 13

Fan Drawing

Fan performance curves

Spare Parts List

Appendix A	Special instructions
Appendix B	Bearing and lubrication
Appendix C	V-belt drives
Appendix D	Coupling
Appendix E	Flow Control Devices
Appendix F	Silencers / Acoustic Enclosures
Appendix G	Instrumentation
Appendix H	Flexible mounting Equipment
Appendix I	Motors
Appendix J	MDR extracts
Appendix K	Other data / Alarm trip points

AIRENG PTY LTD
OPERATION MANUAL - FAN EQUIPMENT

SAFETY PRECAUTIONS

FAN EQUIPMENT CAN BECOME A SOURCE OF INJURY AND DEATH IF NOT PROPERLY INSTALLED, OPERATED OR MAINTAINED. Do not exceed the maximum operating temperature or speed limits for which the fan equipment was designed. Limits for some lines of fan equipment are given in AIRENG PTY LTD. ("AIRENG") catalog. Limits for non-catalogued lines of fan equipment should be obtained in writing directly from AIRENG and not otherwise. Do not rely on limits obtained in any other manner.

The user should make all personnel who operate or maintain the fan equipment aware of all possible hazards.

THE RESPONSIBILITY FOR PROVIDING SAFETY ACCESSORIES FOR FAN EQUIPMENT SUPPLIED BY AIRENG IS THAT OF THE USER OF THE FAN EQUIPMENT. AIRENG sells its fan equipment with or without safety accessories, and accordingly, it can supply standard safety accessories upon receipt of an order. Ensure that all necessary safety accessories have been installed before operation of the fan equipment.

The warning notice set out below should be affixed upon the fan equipment:

AIRENG PTY LTD

SAFETY WARNING

This fan has rotating parts and may be hot. Keep body, hands and foreign objects away from inlet and outlet. Do not touch fan or motor during operation.

Operate, install and maintain only in strict accordance with safety practices and instructions in manufacturer's Operation Manual Do not exceed the maximum operating temperature, speed or vibration level identified in AIRENG'S catalogues and Operation Manual. Untrained personnel should never operate, install, adjust or maintain fan or motor.

ADDITIONAL SAFETY ACCESSORIES FOR THE FAN EQUIPMENT ARE AVAILABLE FROM THE MANUFACTURER. THE RESPONSIBILITY FOR PROVIDING SUCH ADDITIONAL ACCESSORIES IS THAT OF THE USER OF THE EQUIPMENT. CONSULT THE MANUFACTURER'S OPERATION MANUAL FOR GUIDANCE.

Before starting maintenance work, lock disconnect switch in the off position, de-energise and disconnect all power sources to the motor and to accessory devices and secure fan impeller. Cleanout door and split casing sections must be secure during operation. Unsecured components may shoot open during operation due to pressure build up inside the fan.

Do not start-up when fan impeller is rotating backwards.

FAILURE TO FOLLOW MANUFACTURER'S INSTRUCTIONS AS TO THE OPERATION, INSTALLATION, ADJUSTMENT, MAINTENANCE, SAFETY EQUIPMENT OR APPROPRIATE OPERATING CONDITIONS COULD RESULT IN DAMAGE TO THIS EQUIPMENT, DAMAGE TO OTHER EQUIPMENT, PERSONAL INJURY OR DEATH.

Should the warning notice not be affixed to the fan equipment purchased, AIRENG will supply such a warning notice upon request made to its head office.

The user of the fan equipment, in making its determination as to the appropriate safety accessories to be installed and any additional warning notices to be affixed upon the fan equipment, should consider (1) the location of the installation of the fan equipment, (2) the accessibility of employees and other persons to the fan equipment, (3) any adjacent equipment, (4) applicable building codes, and (5) applicable health and safety legislation.

No Welding on the fan assembly be carried out without approval from Aireng, as many fans contain specialised materials. Incorrect welding procedure / materials can cause catastrophic fan failure.

Users and installers of the fan equipment should read "RECOMMENDED SAFETY PRACTICES FOR AIR MOVING DEVICES" which is published by the Air Movement and Control Association, 30 West University Drive, Arlington Heights, Illinois, U.S.A., 60004.

INTRODUCTION
The purpose of this manual is to aid in the proper installation, operation, and maintenance of AIRENG fan equipment. It is intended that a copy of this manual is obtained and maintained by the operators or maintenance personnel responsible of this equipment. These instructions are intended to supplement good general practices and are not intended to cover detailed instruction procedures.

The receipt, handling, installation, operation and maintenance of AIRENG fan equipment are the responsibility of the user. It is important that the installation and start-up of the fan equipment be supervised or inspected by personnel experienced in such work and equipment. Trained personnel are available from AIRENG, and arrangements for such supervision and inspection (at a fee) should be made through your local AIRENG representative or at AIRENG's Bayswater office. Failure to arrange for such supervision or inspection may affect or void the AIRENG Warranty (please refer to paragraph 13 of AIRENG's Warranty).

SHIPMENT & RECEIVING
AIRENG has thoroughly inspected the fan equipment at its factory and has prepared the fan equipment for shipment in accordance with the uniform freight classification followed by all carriers. The fan equipment should be in perfect condition when received, unless damaged in transit. Upon acceptance by the carrier, as evidenced by a signed bill of lading, the carrier accepts responsibility for all shortages or damage, whether concealed or evident. Claims covering shortages or damage must be made to the carrier by the purchaser. Any shortages or damage should be noted by the user on the delivery receipt.

The fan equipment may contain components manufactured by manufacturers other than AIRENG. Such other manufacturers may have furnished instructions and/or other literature concerning their component. A list of such instructions and/or other literature is forwarded with the fan equipment (see **Appendix section of this manual**). If any of the items on the list are missing, please contact your AIRENG representative, AIRENG at it's head office or contact the component's manufacturer directly.

HANDLING
The fan equipment should be handled with care. Some fans are provided with lifting lugs or holes for easy handling. Others must be handled using nylon straps or well-padded chains and cables, which protect the fan's coating and housing. Spreader bars should be used when lifting large parts.

Axial fans should be lifted by using straps around the fan housing only. DO NOT LIFT AXIAL FANS BY THE MOTOR, MOTOR BASE, IMPELLER OR FLANGES.

Centrifugal fans are best-lifted using straps attached to structural base members of the fan. DO NOT LIFT CENTRIFUGAL FANS BY THE FAN SHAFT, IMPELLER, FLANGES OR INLET SUPPORTS.

Roof ventilators should be lifted by using straps attached to lifting lugs or base only. Spreader bars should also be used to avoid damage to the butterfly damper assembly or the weather hood. DO NOT LIFT ROOF VENTILATORS BY THE BUTTERFLY DAMPER ASSEMBLY OR WEATHERHOOD.

Centrifugal rotor assemblies (i.e. impeller and shaft assemblies) have been designed to be supported by the shaft, and should be lifted by slings around the shaft as close as possible to the hub on each side of the impeller (wheel). Slings should not press against the side plates of the wheel as this may damage and distort the wheel. A spreader bar should be used when lifting the rotor assembly (Figure 1). The wheel should never rest on the side plates or blades, nor should the rotor assembly be lifted by any components of the fan wheel. To do so may damage the rotor assembly and destroy the dynamic balance that is necessary for low vibration operation. If this balance is destroyed, rebalancing of the rotor assembly will be necessary. If the wheel and shaft have not been assembled, the fan wheel may be lifted by a timber or wrapped bar of sufficient strength passed through the hub. The finished bore of the hub and the bearing surfaces of the shaft must also be protected from damage.

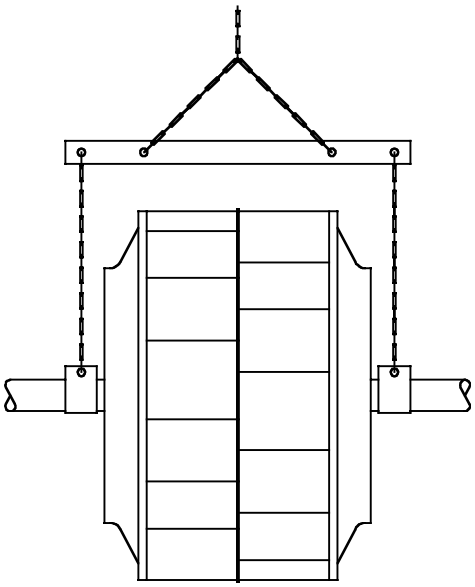


Fig. 1 Correct use of spreader bar when lifting centrifugal rotor assembly

STORAGE
If fan equipment is not installed immediately, fans should be protected so as to remain dry at all times.

(1) If temporary storage is necessary:

Store in a dry area, which is free of any vibration, and protect from extremes and rapid changes in humidity and temperature.

(A) Temperatures: between 10°C (50°F) and 50°C (120°F).

(B) Maximum relative humidity: 60%.

(C) Shock or vibration: 2 mils displacement maximum to prevent bearings from brinellng. Exceeding this limit will require vibration-dampening material under the fan equipment.

(2) If extended storage is necessary:

Motor bearings and fan bearings are to be lubricated at the time of placement into extended storage. Motor shafts and fan shafts are to be manually rotated every month by _ of a revolution these monthly rotations should be recorded in a logbook. Additional lubricant added, purging some of the lubricant in the bearing cavity every six (6) months. LUBRICANT IN THE BEARINGS IS TO BE PURGED AT THE TIME OF REMOVAL FROM STORAGE, ENSURING THAT AN AMPLE SUPPLY OF FRESH LUBRICANT IS IN EACH LUBRICANT CAVITY. LUBRICANT USED MUST BE COMPATIBLE WITH THE LUBRICANT ALREADY IN THE MOTOR AND FAN BEARINGS.

Electric motors in storage may absorb moisture in their windings, which may result in a significant loss of insulation resistance. If motors are fitted with anti condensate heaters these should be powers with required power. When removed from storage the insulation resistance of all motors should be checked in accordance with the motor manufacturer's instructions or in accordance with IEEE standard 43-1974 "IEEE Recommended Practice for Testing Insulation Resistance of Rotating Machinery". Motors with insufficient insulation resistance must be cleaned and dried in accordance with motor manufacturer's instructions or IEEE standard 43-1974 to return the insulation resistance to acceptable levels. THE APPLICATION OF POWER TO A MOTOR WITH INSUFFICIENT INSULATION RESISTANCE MAY RESULT IN DAMAGE TO THE MOTOR OR DAMAGE TO OTHER EQUIPMENT.

On v-belt drive fans, belts should be checked at the time of removal from storage for proper v-belt tension. Tighten belts if necessary (refer to the "V-BELT DRIVE INSTALLATION" Appendix C of this manual).

When installing fan equipment after storage, follow the instructions contained in the "INSTALLATION OF FAN EQUIPMENT " and "OPERATION OF FAN EQUIPMENT" appearing at pages 7 and pages 8 of this manual respectively.

Storage records evidencing compliance with the above requirements should be maintained by the purchaser.

INSTALLATION OF FAN EQUIPMENT

(1) Safe and smooth operation of the fan equipment requires a proper foundation that is level, rigid, and of sufficient structure and mass to support the equipment. IT IS ALWAYS IMPERATIVE TO CONSULT A QUALIFIED STRUCTURAL ENGINEER IN ORDER TO DESIGN A PROPER FOUNDATION.

A properly designed concrete base is the preferred foundation. The concrete base mass should be a minimum of four times that of the fan equipment when the plan view area of the concrete base is no more than twice the plan view area of the fan equipment.

Steel platforms or bases are good alternatives when properly designed. Steel platforms must be braced in all directions. Care must be taken to ensure that the natural frequency of all steel base components differs significantly from the rotating speed of the fan and the driver. FAILURE TO HEED THIS GOOD DESIGN PRACTICE MAY RESULT IN A RESONANT CONDITION AND CONSEQUENT LIFE THREATENING CATASTROPHIC STRUCTURAL FAILURE.

Fans mounted off ground level should be rigidly mounted to a structural platform and should be placed as near as possible to, or over, a solid wall or column (refer to paragraph 1 of this section).

Supports for suspended fans must be cross-braced to prevent side sway.

(2) Fan equipment must be level prior to operation. Do not twist or distort fan equipment. Shim / Pack fan support points before tightening foundation bolts to help ensure distortion does not occur. An allowance of 50mm for grouting / packing is recommended for leveling. **Important notice: Packers are not supplied with this equipment.**

(3) For roof mounted fans, place the fan curb panel on the roof curb. Level and then anchor the unit to the curb using lag screws, neoprene washers and flat washers. DO NOT MOUNT UNSUPPORTED STACKS ON THE FAN. STACKS MUST BE INDEPENDENTLY MOUNTED TO THE ROOF. Anchor independently mounted stacks with guy wires to prevent side sway.

(4) Ducts must be independently supported, and must never be supported by the fan. Use flexible duct connections wherever possible, as this reduces vibration in the ductwork. The independent mounting of stacks and ducts to the fan will ensure that the fan will not be twisted or deformed with the addition of external loads. This is particularly critical were temperatures in or around the duct cause expansion.

(5) It is recommended that access doors be placed in ductwork just ahead of the fan inlet and just behind the fan outlet for ease of inspection and maintenance. IN ORDER TO AVOID EQUIPMENT DAMAGE AND PERSONAL INJURY ACCESS DOORS IN A DUCT SYSTEM SHOULD BE SECURELY CLOSED AND SHOULD NEVER BE OPENED WITH THE FAN RUNNING.

(6) Lubricate fan bearings in strict accordance with bearing manufacturer's recommendations. Lubricate bearings upon receipt of fan. Do not over-lubricate. Bearings should be locked to the shaft. Ensure that locking mechanisms on bearings are in correct position and that locking mechanisms are fastened before operation of fan.

(7) Flexible couplings must be installed and maintained in accordance with the coupling manufacturer's instructions. Refer to fan submittal drawings for details of drive arrangements and the general location of the coupling halves on the fan and motor shafts.

(8) Remove all brinell lockers (if fitted) from the motor shaft and fan shaft. Failure to remove these locked voids warranty.

OPERATION OF FAN EQUIPMENT

(1) Lock out all power sources.

(2) Ensure that bearings are properly aligned and lubricated with special attention to the locking mechanisms, cleanliness, and possible corrosion. Bearings showing signs of corrosion must be replaced prior to operation of fan equipment.

(3) Check set screws and keys (taper lock hubs or ringfedders if present) in fan impeller, and bolts on cooling wheel.

(4) Check foundation bolts and other hardware for tightness.

(5) Ensure that the fan housing, ducts, etc., are free of foreign objects.

(6) Ensure that all access doors are secure in the closed position.

(7) Check the impeller to inlet cone and impeller to fan housing clearance to ensure that there is no interference. Turn the impeller by hand, ensuring that it rotates freely.

(8) On belt drive / coupling drive fans, check pulley / coupling alignment and v-belt tension (refer to the section entitled "Appendix C / Appendix D " respectively of this manual).

(9) If the fan is equipped with damper or variable inlet vane, close same to lessen starting load on motor. Ensure any dampers or variable inlet vanes furnished with the fan, or used in conjunction with the fan, do not stick or bind. If an automatic control mechanism is used to operate the damper or variable inlet vane, adjust the limits of travel of the automatic control mechanism in accordance with the control manufacturer's instructions to avoid putting force on the damper or variable inlet vane when it is fully opened or fully closed.

(10) If the fan is driven by an electric motor, read instructions of motor and starter manufacturer. Ensure that the motor and starter are set up in compliance with the motor and starter manufacturers' instructions prior to any application of electric power. If the fan is powered by some other form of driver, read the manufacturer's instructions prior to start-up.

(11) If the fan is equipped with water-cooled bearings turn on the water supply to the bearings prior to starting the fan. Consult the water-cooled bearing manufacturer's instructions.

(12) If the fan is equipped with oil lubrication system turn on the oil supply to the bearings prior to starting the fan. Consult the oil lubrication section (Appendix B) or the oil lubrication system manufacturer's instructions.

(13) If the fan is to handle a "hot gas" (i.e. a gas with a temperature greater than 65°C [150°F]) it is imperative that the fan be subject to only a slow gradual rate of gas temperature change, not to exceed a rate of 8°C/minute (15°F/minute). When the fan is being put in operation the temperature of the gas must not rise at a rate greater than 8°C/minute (15°F/minute). Never subject a "cold" fan to a "hot" gas stream. When the fan is **being** taken out of operation the temperature of the gas must not decline at a rate greater than 8°C/minute (15°F/minute), and when the gas temperature has reached a level of 65°C (150°F) or less it is imperative that the fan be operated at this temperature for a period of time sufficient to allow the entire fan structure to reach an equilibrium temperature of 65°C (150°F). Only when the entire fan structure has reached an equilibrium temperature of 65°C (150°F) or less can the fan be shut off and removed from operation. Failure to follow these instructions may result in damage to the fan equipment. NEVER EXCEED THE MAXIMUM OPERATING TEMPERATURE OR SPEED FOR WHICH THE FAN WAS DESIGNED.

(14) Connect the power source.

(15) Fan impeller should always be stationary prior to startup. Startup while fan impeller is rotating backwards can cause damage.

(16) Apply power to the driver momentarily (i.e. “bump”) to check for proper rotation. Confirm this with the directional arrows fitted to the fan. Any dampers or other air control devices in the system should be at least partially closed during starting periods to reduce power requirements. Damper closure is particularly important in the case of a fan designed for high temperature operation being “run in” at a temperature less than design temperature.

(17) Apply power to the driver and allow the fan to come up to design speed. Turn off. Look and listen for any unusual noise or mechanical action while the impeller is still spinning. If any are noticed, lock out all power sources, locate cause and correct, then repeat procedure from point (1) of this section.

(18) Lock out all power sources and recheck tightness of all setscrews, keys, foundation bolts and any other hardware. The initial start up will tend to relieve their tightness and they may require re-tightening.

(19) Reconnect all power sources.

(20) It is recommended that upon fan installation, the operating vibration levels be checked to ensure that the levels do not exceed the levels set forth in the “Vibration” section (page 9-10) of this manual.

Once it has been determined that the fan equipment is operating satisfactorily, it should be operated, if practical, for at least eight (8) continuous hours. Operation should be monitored at least once each hour during this period. Inspection should be made for any change of operation during this period. Some bearings will have to “run in” and will heat up during this period. The maximum bearing temperature should not exceed 93°C (200°F). It is normal for bearings lubricated with grease to purge a small amount of the grease through the bearing seals during run-in.

NOTE THAT ALL BOLTS, SETSCREWS AND V-BELTS SHOULD BE RE-TIGHTENED AFTER TWO (2) DAYS OF INITIAL OPERATION.

MAINTENANCE OF FAN EQUIPMENT

BEFORE STARTING MAINTENANCE WORK ON FAN EQUIPMENT LOCK MOTOR, LOCK DISCONNECT SWITCH IN THE OFF POSITION, DE-ENERGIZE AND DISCONNECT ALL POWER SOURCES TO THE MOTOR AND TO ACCESSORY DEVICES, AND SECURE FAN IMPELLER. IN ADDITION, OBSERVE ALL RELEVANT PROCEDURES FOR THE PLANT IN, WHICH EQUIPMENT IS INSTALLED.

Bearings and Lubrication

Selection of the correct fan bearing lubricant and lubrication intervals depends on several factors. Extreme high or low temperatures and dirty or damp surroundings are all conditions that will create a requirement for lubrication that is more frequent or special lubricants.

READ THE BEARING MANUFACTURER'S INSTRUCTIONS TO DETERMINE THE TYPE AND FREQUENCY OF BEARING LUBRICATION REQUIRED.

THE MOTOR BEARINGS SHOULD BE LUBRICATED IN ACCORDANCE WITH MOTOR MANUFACTURER'S LUBRICATION INSTRUCTIONS AND RECOMMENDATIONS SHOULD BE FOLLOWED CLOSELY.

Bearing failure may be caused by failure to lubricate as often as required, use of an excessive quantity of lubricant or the use of incompatible lubricants. Excessive vibration, especially if the bearing is not rotating, will also cause bearings to fail. Bearings must also be protected from water and moisture to avoid internal corrosion.

Bearings are susceptible to damage from exposure to excess shaft heat transfer, which may occur when a fan operating at a temperature greater than 93°C (200°F) is shut down without a sufficient period of gradual temperature reduction. See section (13) of "Operation of Fan Equipment" set forth on page 8 of this manual.

Bearing Replacement
Replacement of fan bearings should not be required for many years if cared for strictly in accordance with bearing manufacturer's instructions. The procedure used to replace fan bearings will vary depending on the type of fan and the type of bearing. It is important that the replacement of bearings be supervised or inspected by personnel experienced in such work and equipment. Trained personnel are available from AIRENG and arrangements for such supervision or inspection (at a fee) should be made through your local AIRENG representative or at AIRENG's head office.

Variable Inlet Vane
Once a year, the variable inlet vane cover plate should be removed and the moving parts re-packed with grease. The lubrication interval should be increased where moisture or particles are present in the air stream.

CAUTION: Where automatic control mechanisms are used to operate the variable inlet vane, care should be taken to correctly adjust control mechanism stroke limits as OVERTRAVEL MAY DAMAGE THE VARIABLE INLET VANE OPERATING MECHANISM.

Motors
DO NOT OPERATE THE MOTOR WITHOUT FIRST READING THE MOTOR MANUFACTURER'S INSTRUCTIONS. OPERATE THE MOTOR ONLY IN ACCORDANCE WITH THE INSTRUCTIONS.

The fundamental principle of electrical maintenance is to KEEP THE MOTOR CLEAN AND DRY. This requires periodic inspection of the motor. The frequency of the inspections depends upon the type of motor, the service and the motor manufacturer's instructions.

Periodic checks of voltage, frequency and current of a motor while in operation are recommended. Such checks ensure the correctness of frequency and voltage applied to the motor and yield an indication of the fan load. Comparison of this data with previous data will give an indication of the fan performance. Any serious deviations should be investigated and corrected.

Spare Parts
Spare parts may be ordered through your AIRENG sales office by providing the following information:

(1) Part name (e.g. impeller, shaft, motor, bearing, etc).

(2) Fan Serial Number from the nameplate.

(3) If possible, the fan shaft diameter or bearing size together with the fan class specified on the nameplate.

Spare parts lists are available upon request.

Vibration
A vibration analyzer must be used to accurately determine the level of fan vibration. Vibration readings should be taken by personnel experienced with vibration analysis and vibration analysis equipment. Trained personnel are available from AIRENG, and arrangements for vibration analysis (at a fee) may be made through your local AIRENG representative or at AIRENG's head office.

The fan should <u>not</u> be operated if the **vibration velocity** of the fan is in the "Not Permissible" section in the table below.

If the vibration analyzer is being used to measure vibration levels, make sure the measurements being recorded are R.M.S. (Root Mean Squared). As this is the standard adopted by most countries apart from the United States were Peak-to-Peak is the preferred method.

MACHINE MOUNTING CLASSIFICATION

Machine Conditions		Mounting Category Speed r/s	
Mounting	Drive	> 10 ≤ 30	> 30 ≤ 200
Rigid	Rigid	I	II
Rigid	Flexible	II	III
Flexible	Rigid	II	III
Flexible	Flexible	III	IV

Table 1

To determine the acceptable limits for vibration for this machine firstly determine the "Machine Mounting Classification". Table 1 is used e.g. for a fan on a Flexible mount i.e. R.I.S. (rubber In Shear) / spring mounts with a cone ring coupling, would be considered Flexible Rigid with a speed of 20r/s would be class II. Most couplings are considered Rigid, V-belts are considered flexible. Once this has been determined use the chart below to determine the acceptable limit. If permanent vibration equipment is fitted to the fan when commissioning, it can good to set the levels higher to minimize unnecessary trip points until experience is gained on the equipment. This does not negate the need to have the fan operating at the "Not Permissible" vibration levels.

<table>
<tr><td rowspan="3">Velocity range
(r.m.s.)
mm/s</td><td colspan="4">Quality Judgments</td></tr>
<tr><td colspan="4">Machine Mounting Classification</td></tr>
<tr><td>Category I</td><td>Category II</td><td>Category III</td><td>Category IV</td></tr>
<tr><td>> 0.18 ≤ 0.25</td><td rowspan="3">Good</td><td rowspan="4">Good</td><td rowspan="5">Good</td><td rowspan="6">Good</td></tr>
<tr><td>> 0.28 ≤ 0.45</td></tr>
<tr><td>> 0.45 ≤ 0.71</td></tr>
<tr><td>> 0.71 ≤ 0.1.12</td><td rowspan="2">Satisfactory</td></tr>
<tr><td>> 1.12 ≤ 1.8</td><td rowspan="2">Satisfactory</td></tr>
<tr><td>> 1.8 ≤ 2.8</td><td rowspan="2">Just Tolerable</td><td rowspan="2">Satisfactory</td></tr>
<tr><td>> 2.8 ≤ 4.5</td><td rowspan="2">Just Tolerable</td><td rowspan="2">Satisfactory</td></tr>
<tr><td>> 4.5 ≤ 7.1</td><td rowspan="6">Not
Permissible</td><td rowspan="2">Just Tolerable</td></tr>
<tr><td>> 7.1 ≤ 11.2</td><td rowspan="3">Not
Permissible</td><td rowspan="2">Just Tolerable</td></tr>
<tr><td>> 11.2 ≤ 18</td><td rowspan="3">Not
Permissible</td></tr>
<tr><td>> 18 ≤ 28</td><td rowspan="3">Not
Permissible</td></tr>
<tr><td>> 28 ≤ 45</td></tr>
<tr><td>> 45 ≤ 71</td></tr>
</table>

Table 2

(1) The **vibration frequency** in cycles per minute (generally taken as the fan speed in rpm).
(2) The **vibration measurement points** should be on the fan bearing housings. Generally in the horizontal plane.

DO NOT OPERATE THE FAN if these values lie in the region labeled "Not Permissible". Corrective action must be taken to reduce the vibration velocity below this value before the fan is returned to normal operation.

These levels are considered as a very conservative guide only, other factors such as motor size, type of fan (narrow width fans generally have higher vibration levels). Each machine has its own allowable limits and these can be confirmed by Aireng.

Fan Trouble Shooting Chart

The two most common causes of fans not operating are, 1. The impeller is rotating in the wrong direction, 2. Inadequate transitions or elbows on the inlet or outlet of the fan, this can reduce performance by 60%.

Problems	
Insufficient Air Flow	. duct elbows near fan inlet or outlet . restricted fan inlet or outlet . impeller rotating in wrong direction . fan speed lower than design . system resistance higher than design . dampers shut . faulty ductwork . dirty or clogged filters and/or coils . inlet or outlet screens clogged
Excessive Air Flow	. system resistance less than design . fan speed too high . filters not in place . registers or grilles not installed . improper damper adjustment
Excessive Power Draw	. fan speed higher than design . gas density higher than design . impeller rotating in wrong direction . static pressure less than anticipated . fan size or type not appropriate for application
Excessive Vibration	. accumulated material on impeller . worn or corroded impeller . bent shaft . impeller or pulleys loose on shaft . motor out of balance . impeller out of balance . pulleys eccentric or out of balance . bearing or drive misalignment . mismatched belts . belts too loose or too tight . loose or worn bearings . loose bearing bolts . loose fan mounting bolts . weak or resonant foundation . foundation unlevel . structures not cross braced . fan operating in unstable system condition . worn coupling
Inoperative Fan	. blown fuse . broken belts . loose pulley . motor too small . wrong voltage
Overheating Bearings	. Excessive amount of lubricant . Contaminated lubricant . Old lubricant

STANDARD TERMS AND CONDITIONS

(1) TERMS OF PAYMENT: Terms of payment are net thirty (30) days subject to the prior approval of the AIRENG PTY LTD. ("AIRENG") Credit Department. Notwithstanding such approval, if in AIRENG's judgment the customer's financial condition does not warrant the continuation of production or shipment on the original terms, AIRENG reserves the right to request payment in advance. Overdue accounts will bear interest at the prevailing bank rate charged to AIRENG.

(2) ACCEPTANCE AND PRICES: Prices quoted for products manufactured by AIRENG are subject to acceptance by the purchaser no later than thirty (30) days from the date of the Quotation - Proposal.

Prices quoted for items, which are not, manufactured by AIRENG such as motors and drives, etc. are subject to change at any time the cost of such items charged to AIRENG changes.

Prices on orders for products manufactured by AIRENG are firm provided approval and release for production and shipment is received from the customer within ninety (90) days of the date of AIRENG's receipt of the customer's order and the products are shipped within twelve (12) months of the date of AIRENG's receipt of the customer's order. When such approval and release for production and shipment is received after ninety (90) days of the date of AIRENG's receipt of the customer's order or products are shipped after twelve (12) months of the date of AIRENG's receipt of the customer's order, such prices are subject to adjustment to AIRENG prices in effect on the date approval and release from customer is received by AIRENG or at time of shipment.

Orders for non-stock equipment released for production and scheduled by AIRENG cannot be rescheduled by the customer unless it is done at least eight (8) weeks before the AIRENG scheduled shipping date. If production is started, the customer must accept delivery when the order is ready for shipment.

(3) CANCELLATIONS: Accepted orders cancelled by the customer are subject to cancellation charges for all expenses incurred and commitments made by AIRENG. The cancellation charges on completed items will be one hundred (100%) percent of the selling price. The aforementioned cancellation charges shall not in any way whatsoever limit AIRENG's other remedies it may have at law including, without limiting the generality of the foregoing, the ability of AIRENG to claim and recover any amounts or damages to which AIRENG would otherwise be entitled by reason of accepted orders cancelled by the customer.

(4) FREIGHT CLAIMS: Unless otherwise expressly agreed in writing, delivery of the product is made FOB AIRENG Plant. The liability and responsibility of AIRENG for the product ceases upon delivery of the product in good order to the carrier. **All claims for damage and shortage in transit are the customer's responsibility and the customer must file the claim against the carrier.** Claims for factory shortage will not be recognized unless such alleged shortage is reported to AIRENG in writing within ten (10) days after receipt of the product.

(5) TAXES: The amount of any present or future taxes shall be added to the price contained herein and shall be paid by the customer in the same manner and with the same effect as if originally added thereto.

(5) DELAYS: AIRENG shall not be liable to the customer or to any third party for any delays caused by riots, strikes, lockouts, weather, fire, floods, lack of transportation, accidents, the failure of AIRENG's suppliers to meet their contractual obligations, breakdowns, or any other contingency beyond AIRENG's reasonable control and receipt of the product by the customer shall constitute a waiver of all claims for loss or damage due to delay.

(6) PRODUCT CHANGES: AIRENG reserves the right to change or modify the product in the interest of continuous product improvement without liability.

(7) RETURNED GOODS: Goods may not be returned except by the written permission of the General Manager or General Sales Manager of AIRENG and when so returned will be subject to a handling charge and transportation costs.

(8) MODIFICATION: These Standard Terms and Conditions may not be modified except by written agreement signed by the General Manager or General Sales Manager of AIRENG. **The failure of AIRENG to object to provisions contained in the customer's purchase orders or other communications shall not be deemed waiver of the Standard Terms and Conditions hereof or acceptance of such provisions.** No other terms and conditions other than the Standard Terms and Conditions contained herein and those terms and conditions with respect to the description of product, quantity and price contained in the "Quotation-Proposal" shall be binding upon AIRENG unless made in writing and signed by the General Manger or General Sales Manager of AIRENG. Without restricting the generality of the foregoing, agents and sales representatives of AIRENG do not have authority to modify these Standard Terms and Conditions.

WARRANTY

AIRENG PTY. LTD. (the “Seller”) warrants products of its manufacture (the “product”, "goods", “equipment” or “fan”) to be free of defects in material and workmanship if properly installed, and cared for, and operated under normal conditions, and with competent supervision, all in accordance with the Seller’s Operation Manual. If any questions exist as to whether the proposed operation of the Seller's equipment is within "normal conditions" for such equipment, details of such proposed operation should be provided to the Seller at its Bayswater factory. The Seller will review the proposed operation of the equipment (at a fee) and advise if the proposed operation is acceptable.

(1) The Vendor's liability for goods supplied is limited to making good any defects by repairing the defects or at the Vendor's option by replacement within a period not exceeding twelve [12] calendar months after the goods have been dispatched provided that; -
[a] Defects have arisen solely from faulty materials or workmanship.
[b] The goods have not received maltreatment, inattention or interference.
[c] Accessories of any kind used by the purchaser and manufactured by or approved by the Vendor.
[d] The defective goods are promptly returned free of cost to the Vendor.

The Vendor shall not be liable for and the Purchaser releases the Vendor from any claims in respect of faulty or defective design of any goods supplied and in any event, the Vendor's liability shall be strictly limited to the replacement of defective goods.

Except as provided herein all express and implied warranties, guarantees and conditions under statute or general law as to merchantability, description, quality, suitability or fitness of the goods for any purpose or as to design, assembly, installation, materials or workmanship or otherwise are hereby expressly excluded and the Vendor shall not be liable for physical or financial injury, loss or damage or for consequential loss or damage of any kind arising out of the supply, assembly, installation or alteration of the goods or arising out of the Vendor's negligence or in any way whatsoever.

The Vendor's liability for breach of a condition or warranty implied by Division 2 of Part 5 of the Trade Practices Act 1974 [other than Section 69] is hereby limited to; -

1. In the case of goods, one or more of the following; -
[a] The replacement of the goods or the supply of equivalent goods;
[b] The repair of the goods;
[c] The payment of the cost of replacing the goods or acquiring equivalent goods;
[d] The payment of the cost of having the goods repaired.

2. The Vendor's liability under Section 74H of the Trade Practices Act 1974 is expressly limited to a liability to pay to the purchaser an amount equal to; -
[a] The cost of replacing the goods;
[b] The cost of obtaining equivalent goods; or
[c] The cost of having the goods repaired whichever is the lowest amount.

(2) The Seller shall not be liable for the repair or replacement of any such defective part or parts, or for loss, damage, or any expense of repairs when any adjustment, alteration or repair shall have been made or attempted upon delivery of the goods, except if such adjustment, alteration or repair outside its factory is made or attempted after the Seller’s written consent is first obtained.

(3) The Seller shall not be liable for any corrosion or fouling caused by any foreign substance deposited in or on the equipment upon delivery of the goods.

(4) Because the Seller is unaware of any forms of construction, materials, alloys or coatings which will successfully resist all abrasion, erosion, corrosion, or deterioration from excessive heat, the Seller’s warranty does not apply when any of its products or equipment are subjected to conditions which cause such abrasion, erosion, corrosion or deterioration from excessive heat or any damages similar or related thereto.

(5) The performance of the Seller's fan equipment outside of the laboratory may vary widely and differ from the performance specifications contained in its sales literature. Therefore, the Seller cannot and does not guarantee or warrant the performance of its fan equipment at the Purchaser's location.

(6) ALL WARRANTIES OF THE SELLER, EXPRESS OR IMPLIED, WITH RESPECT TO MOTORS, SWITCHES, CONTROLS OR OTHER ACCESSORIES NOT MANUFACTURED BY THE SELLER, INCLUDING WARRANTIES OF MERCHANTABILITY, QUALITY OR FITNESS FOR ANY PARTICULAR PURPOSE, ARE HEREBY EXCLUDED.

(7) The Seller shall have no liability under the terms of this Warranty or otherwise where the Purchaser undertakes the responsibility of mounting the fan wheel directly to the motor or turbine shafts without the Seller having inspected and tested the assembled unit (at a fee) before the fan is operated in any fashion. If the Seller does not inspect and test the assembled unit within ten (10) days of being requested to do so by the

Purchaser and receipt of payment of the aforementioned fee, the Seller shall be deemed to have waived its requirement to inspect and test the assembled unit.

(8) The Seller shall have no liability under the terms of this warranty or otherwise until the Purchaser has made full payment to the Seller for the product or equipment to which this warranty is to apply.

(9) NO WARRANTIES WHATSOEVER, EXPRESS OR IMPLIED, INCLUDING WARRANTIES OF MERCHANTABILITY, QUALITY OR FITNESS FOR ANY PARTICULAR PURPOSE, ARE MADE BY THE SELLER EXCEPT AS EXPRESSLY PROVIDED HEREIN.

(10) The terms of this warranty may not be modified except by written agreement signed by the General Manager or General Sales Manager of the Seller. The Seller's failure to object to provisions contained in the Purchaser's purchase orders or other communications shall not be deemed waiver of the terms and conditions hereof nor acceptance of such provisions. No representations or warranties other than those contained herein shall be binding upon the Seller unless made in writing and signed by the General Manager or General Sales Manager of the Seller. Without restricting the generality of the foregoing, agents and sales representatives of the Seller do not have authority to modify the terms of this Warranty or make representations or warranties other than those contained herein.