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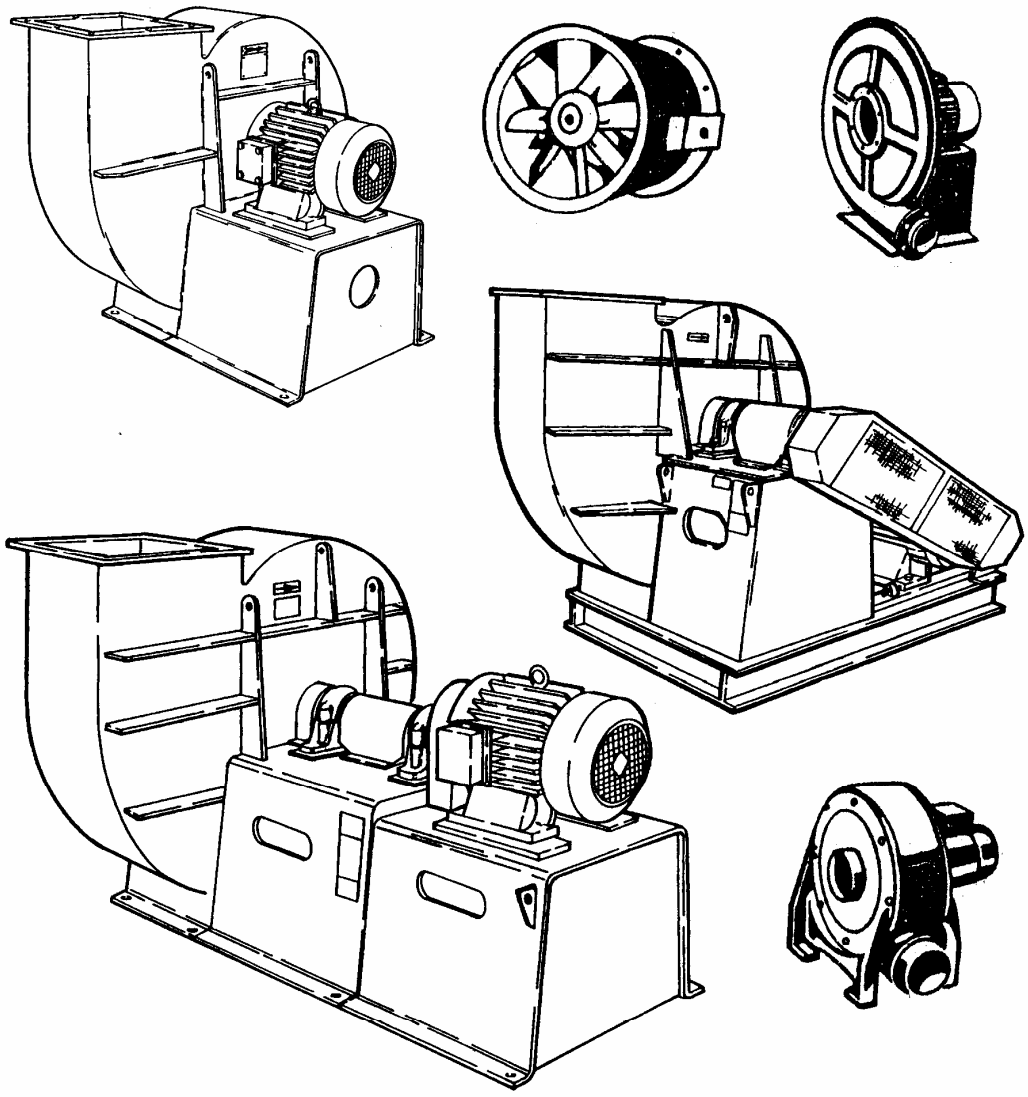
INSTALLATION , OPERATING & MAINTENANCE INSTRUCTIONS



INDEX

1. INTRODUCTION

This operating manual is intended to assist the end user with basic installation and operation of the fan unit. Process, interfacing and system control equipment is supplied by others, however, be sure to follow all instructions carefully and pay special attention to safety procedures.

HAZARDS/WARNING/SIGNS USED

Important information throughout this manual is shown as per example below
A box around the text to group the information to raise the reader's awareness to the critical information

Warning Take care never to leave objects inside the fan (damage to the impeller may result).

2. SAFETY INFORMATION

THE FOLLOWING SAFETY PRECAUTIONS MUST ALWAYS BE OBSERVED

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

- Maximum operating temperature and speed for which the fan equipment was designed must not be exceeded. Maximum operating limits must be obtained from Aerotech Fans in writing.
- No modifications on the fan equipment is allowed without approval from Aerotech Fans.
- Do not start the fan while fan impeller is rotating backwards
- Ensure all protective guards are fitted in place during operation.
- Access doors on the fan must never be opened during operation of the fan.
- Ensure during maintenance that all equipment has been completely isolated from the power supply.
- Remove all loose materials from inside of fan housing and ductwork prior to start up.
- Do not clean moving parts when fan is in operation. Ensure that the fan cannot be switched on accidentally. Isolate fan from power supply.

ELECTRICAL CONNECTION

The fan must never be connected to the electrical network without including one or more circuit breaking devices enabling human intervention for examination or maintenance to be carried out safely.

In the same way, electrical protection must be provided for the motor to prevent overloading or two-phase operation in the event of an incident occurring. Isolator switches, differential circuit-breakers, heat relays, fuses (etc..) should be used to achieve this.

In all cases use adequately sized power cables having an external dimension compatible with the size of the motor terminal box glands.

Depending on the network voltage, consult the diagram inside the motor terminal box before deciding on the required wiring position of the connecting strips.

3. SHIPMENT AND RECEIVING

Before leaving our factory this fan was carefully inspected and passed for workmanship and dimensional accuracy. On arrival at site, each item should be inspected for any shortages or damage that may have occurred during transit. Any shortages or damage must be noted by the purchaser on the delivery receipt and reported to the carrier and Aerotech Fans. In the event of any such damage, no rework should be done without our written approval.

HANDLING

All fans must be handled by a trained personnel and must follow safe handling practices. Verify the lifting load of the fan and use suitable handling equipment to avoid any serious injury. Some fans may be provided with lifting lugs or holes to facilitate lifting. Use padded chains, cables or straps to protect the fan and fan coating from getting damaged. Do not sling lifting straps to the fan inlet or outlet, fan shaft, impeller or motor. The eyelet on the motor should not be used for lifting the fan.
For centrifugal fans, attach lifting straps to lifting lugs and or structural base members.
For axial flow fans, attach lifting straps around the fan housing.
The fan impeller and shaft assembly should not be lifted by any of the impeller components. It should be lifted using spreader bars with straps attached to the shaft on either side of the impeller, as close as possible to the wheel**.** Impellers shipped separately can be lifted by slings running through the blade section and around the hub. Do not roll the impeller on the floor, this could affect the balance of the impeller.

Warranty claims will not be accepted for any damage caused by improper transport or handling.

4. STORAGE OF EQUIPMENT

SHORT TERM STORAGE
Store the fan in a covered area and protect the bearings from moisture.

LONG TERM STORAGE
Long-term storage prior to installation requires the following attention:

a) Coat the shaft with an easily removable rust preventative.
b) Cover and seal all bearings, components and ancillaries including motor etc. to prevent entrance of contaminants and moisture.
c) Block the wheel to prevent any unscheduled rotation.
d) It is important that the wheel be rotated at least once a month to circulate lubricant to the bearings.
e) The impeller should be left 180^0 from that of the previous month to prevent the impeller assembly to take up a set position on the bearings
f) Do not allow material of any kind to be stored on the fan.

FOR EXTENDED STORAGE / SHUT DOWN

Units that have been installed, but not operated for several months, should either have ductwork disconnected or the duct openings covered. All drains, pipe connections and conduit must be covered with plastic caps or tape. Openings in the fan housing or unit

casing should be covered and sealed to keep out dust, dirt and moisture. Check that all doors are closed.

Motor storage per the manufacturer's instructions, should include care in keeping motor dry (space heater should be used if necessary).

5. SITE REQUIREMENTS

DUCT CONNECTIONS

Ductwork should be attached to the fan with flexible connections wherever possible to reduce vibration and must be independently supported. Connecting ductwork directly to the fan may distort the fan components causing vibration and contact between moving parts.

This is critical where temperatures, either by the gas being handled or the surrounding ambient air causes the ductwork to expand on contract. As a general rule, flexible connections are required on all fans operating above 120^0 C and for fans mounted on anti-vibration mounts.
When fitting the flexible connection ensure that it is not forced onto the fan. If it does not fit exactly, then the adjoining ductwork must be moved or the expansion joint modified so that it does, or undue vibration of the fan and/or ductwork may result.

SUPPORT STRUCTURE

A correctly designed concrete base is the best means for installing floor mounted fans. Ensure that the concrete base extends at least 150mm beyond the base of the fan. The weight of the concrete base should be at least 2 to 3 times the weight of the fan assembly, including the motor. The fan should be securely fastened to the base using anchor bolts or expansion fasteners for less demanding applications. Shim and grout as required to level the fan.

Steel platforms can be used for elevated applications. Steel platforms must be adequately braced in all directions to prevent side sway.

Axial flow fans and inline centrifugal fans can be duct mounted provided the supporting duct is structurally adequate.

Roof units must be mounted on top of pre-prepared curb.

RESONANCE – Extreme care should be taken to ensure that the natural frequency of the fan support structure differs significantly (at least 30%) from the rotating speed of the fan to avoid resonance. Resonance will cause structural failure.

6. INSTALLATION PROCEDURE

MOUNTING ON CONCRETE

Ensure foundations are level and conform to the foundation plan on the arrangement drawing.
Set the fan unit into position on to its support and bolt in place.

If rubber mounts are used , jack up the fan and position the rubber mounts onto their foundations under the fan mounting feet. Lower the fan unit base onto the rubber mounts. Level and shim if required and bolt into position, ensuring that it is level.

Make all necessary duct connections If they cannot be moved to make exact connection they must be modified to suit.

It is a good practice to provide access doors in the ductwork adjacent to the fan inlet and outlet to facilitate fan inspection and maintenance.

7. OPERATION CHECK LIST

Before undertaking any checks on the fan, ensure that electrical power is isolated.

Check electrical wiring to motor. All motors should be connected as shown on motor nameplate. Be sure power supply (voltage, frequency and current carrying capacity of wires) is in accordance with the motor nameplate. Always check to make sure motor bearings are lubricated.

Refer Appendix E	***Motor Manual***

Check inlet cone / wheel overlap

Check safety guards are all securely fastened to prevent rubbing

Check all fastener tightness in case they have come loose during shipment or installation.
All securing bolts for motor, bearing assemblies, impeller, foundations, guards and connecting ductwork must be tight.

Check pulley alignment for belt driven fans. Check belt tension. Belts tend to stretch after a few days of operation. Recheck belt tension.

Refer Appendix C	***Pulley Manual***

Check flexible couplings on coupling driven fans.

Refer Appendix D	***Coupling Manual***

Check bearing alignment and make certain they are properly locked to the shaft and lubricated. Do not over lubricate

Refer Appendix B	***Bearing Manual***

Touch up all paint work where required.

Access doors should be tight and sealed

Turn the rotating section by hand to ensure that the impeller turns freely and does not strike or bind the fan housing or inlet bell.

Remove all foreign material such as anti-brinelling locks from the fan and motor shaft.

Discharge damper or variable inlet vanes (if provided) - close vanes or damper during starting periods to reduce power use.

The fan is now ready for commissioning / operation.

8. OPERATION

STARTING FOR THE FIRST TIME

If the fan is run on cold gas initially then measures should be taken, eg. restriction of flow through dampers, etc., to ensure that the motor power limit is not exceeded.

Turn the power just long enough (bump) to start the impeller rotating. Check impeller rotation to agree with rotational arrow. Check for unusual noises, rubbing or vibration. Correct any problems after electrical power is isolated.

If no problems are experienced fan may now be brought up to full speed.

Check vibration and bearing temperature for normal conditions.

NORMAL STARTS

Apply power to the main drive and bring fan to full speed or to required duty point. If the fan is run on cold gas initially then measures should be taken, eg. restriction of flow through dampers, etc., to ensure that the motor power limit is not exceeded.

STOPPING THE FAN

Please note that the impeller may continue rotating several minutes after stopping the motor. Make sure that the fan is at a complete stand still before attempting to service it. Fan impeller must be locked (wedged) before attempting any internal access or maintenance.

Warning Check fan impeller is stopped before opening Fan Casing for Maintenance

Warning Check Wedge & any tools and debris is removed before closing Fan Casing.

HIGH TEMPERATURE EMERGENCY SHUTDOWN

For high temperature fans operating above 150^0 C, the fan should only be stopped when the gas temperature drops below 150^0 C. If power failure occurs, the fan should be rotated by other auxiliary means continuously until the gas temperature decreases to 150^0 C or lower. Failure to do this may distort the fan shaft permanently which can cause severe vibration. For large fans, an auxiliary drive (turning gear) can be used to run the fan slowly (approximately 50 RPM) during shutdowns.

INITIAL RUNNING OF BEARINGS

On initial start-up, listen to the bearing for abnormal noises and monitor the temperature rise. The grease used is suitable for temperatures up to 100^oC and bearing temperatures from 30^oC to 50^oC above ambient may be considered normal. If a rapid temperature rise is encountered, stop fan and remove some of the grease from the bearing and try again. It cannot be emphasised that the most common cause of rapid temperature rise on start-up of fans is excessive greasing of bearings.

If high temperature is still encountered, it is sometimes quite successful to just UN-tighten the bearing cap bolts about a quarter of a turn and re-tighten whilst the fan is running. (This can relieve minor misalignment of the outer track to housing when it was initially tightened).

VIBRATION

A fan running in an unbalanced condition can lead to problems such as, bearing damage, weakening the motor supports, loosening of ducting and surrounding equipment, springing the motor shaft and possibly damaging the impeller itself.

The most common causes of vibration are wear, dirt build up on blades or hub, bent shaft, worn bearings and misalignment of components.

Vibration analysers can be used to measure the level of fan vibration. The vibration velocity is measured as “Root Mean Squared” or RMS. The table below outlines acceptable limits for various situations. The fan should not be operated if its vibration velocity is in the ”Not Permissible” area.

<table>
<tr><th rowspan="2">Velocity Range (r.m.s.) mm/s</th><th colspan="4">Fan Mounting Classification</th></tr>
<tr><th>Category 1</th><th>Category 2</th><th>Category 3</th><th>Category 4</th></tr>
<tr><td>0.18 < mm/s = 0.71</td><td>Good</td><td rowspan="2">Good</td><td rowspan="3">Good</td><td rowspan="4">Good</td></tr>
<tr><td>0.71 < mm/s = 1.12</td><td rowspan="2">Satisfactory</td></tr>
<tr><td>1.12 < mm/s = 1.8</td><td rowspan="2">Satisfactory</td></tr>
<tr><td>1.8 < mm/s = 2.8</td><td rowspan="2">Just Tolerable</td><td rowspan="2">Satisfactory</td></tr>
<tr><td>2.8 < mm/s = 4.5</td><td rowspan="2">Just Tolerable</td><td rowspan="2">Satisfactory</td></tr>
<tr><td>4.5 < mm/s = 7.1</td><td rowspan="3">Not Permissible</td><td rowspan="2">Just Tolerable</td></tr>
<tr><td>7.1 < mm/s = 11.2</td><td rowspan="2">Not Permissible</td><td rowspan="2">Just Tolerable</td></tr>
<tr><td>11.2 < mm/s = 18.0</td><td rowspan="2">Not Permissible</td></tr>
<tr><td>18.0 < mm/s = 71</td><td>Not Permissible</td></tr>
</table>

Fan Condition		Fan Mounting Category	
		Fan Speed - rpm	
Mounting	**Drive**	**600 < rpm = 1800**	**1800 < rpm = 12000**
Rigid	Direct	1	2
Rigid	Belt or Coupling	2	3
On anti-vibration mounts	Direct	2	3
On anti-vibration mounts	Belt or Coupling	3	4

If the impeller balance requires adjustment, it is preferable to use weights bolted to the impeller, but if electrically welded balance weights are used, it is essential to earth the impeller immediately adjacent to the weld area and not the fan casing. Failure to adopt this procedure may result in damage to bearings due to the passage of the welding current to earth.

VEE DRIVE

It is important that the correct tension be maintained on the belts at all times, if power is to be transmitted as efficiently as possible, over the life of the belts.

The consequences of an under tensioned drive are excessive belt flap, slippage and overheating of the belts, premature belt wear and even belt breakage. On the other hand, an over tensioned drive can result in a premature bearing or shaft failure or belt breakage.

After running for the first hour, the belts are to be re-tensioned to the correct value and after a further few hours of running, the belts are to be re-tensioned again.

This procedure is necessary to take up the initial stretch that occurs with new belts and after this stretch has been taken up; the drive should perform satisfactorily provided that periodic adjustments to the belt tension are maintained.

FUNCTIONAL CHECKS
During this initial commissioning period and the first week of operation, checks should be made of bearing temperatures, vibration levels and motor winding temperatures.

After operation for the first week, the fan should be well settled in its operation.

9. MAINTENANCE PROCEDURES

MAINTENANCE REQUIREMENTS
Proper care and maintenance is indispensable in the successful operation of any fan. The amount of maintenance depends upon the kind of operation and care given, as well as the duty the fan will perform and how essential a part it plays in the functioning of other equipment in the plant. Since this is precise engineering equipment, the following instruction should be closely adhered to as any negligence could lead to extensive damage to the unit.

PERIODIC INSPECTION
The fan will require periodic inspection and records should be kept of conditions, such as the amount of wear, balance, lubrication and paintwork. When the fan is 'shut down', ensure that the **electrical power is isolated**. Check and clean all components. Special attention should be paid to parts in the airstream, especially the impellers since build up on these sections could adversely affect balance and bearing life. Check all parts for wear and alignment repair or replace as necessary.

STATIC PARTS
If possible disconnect the fan from the ductwork. Then proceed as follows.:
Carefully clean the inner plates of the casing, the inlet cone and (if possible) the upstream and downstream ducts.
Clean the impeller and then refit the inlet cone. Reconnect the ductwork where applicable. Do not leave any objects inside the fan, this would seriously damage the impeller.
Finally, clean the outside of the fan.

Warning Take care never to leave objects inside the fan (Damage to the impeller may result).

Warning Check fan impeller is stopped before opening Fan Casing for Maintenance.

Warning Check any tools and debris is removed before closing Fan Casing

IMPELLER
An inspection door on the casing allows periodic inspection of the impeller.
Inspect the fan rotor on a regular basis. The rotor is subjected to stresses from centrifugal force and vibration. Remove any traces of build up which could lead to significant and dangerous imbalance of the impeller. Check the condition of welds. Make sure there is no trace of corrosion or rubbing.

Note If cracking corrosion or wear is starting, note the position and the dimension of the defects and repair as required. Then have the impeller balanced in situ.

METHOD OF ADJUSTING BLADE PITCH ON TITAN AXIAL FLOW FAN IMPELLERS

The pitch angle on the axial flow fan can be altered without requiring fan removal from the motor shaft.
Ensure power supply has been disconnected.
The instrument used to adjust pitch angle is a simple protractor with a pendulum and a degree scale on the bottom edge.
The protector is positioned across the chord of the fan blade such that, when held vertically, the pendulum pointer is allowed to hang down freely indicating a particular angle on the degree scale.
The position of the protractor on the fan blade is indicated by a small triangle cast into the top surface of the blade approximately 200mm from the fan hub.

NOTE: The pitch is not read at the blade tip. The protractor should be laid on the blade at the triangle mark so that its face is perpendicular to the blade axis.

The blades themselves can be rotated in the hub by loosening all the blade retaining bolts. The blades can be moved in small increments by gently tapping with a rubber mallet near the blade boss. When all the blades in the hub have been adjusted, the bolts should be re-tightened and the pitch angles re-checked.
These steps will ensure trouble free operation.

PULLEYS/DRIVE BELTS

Remove the drive belts and proceed as follows:
Carefully clean the drive belts on all sides and check for signs of wear.
Carefully clean the pulleys, paying particular attention to the grooves.
Check pulley alignment and correct any defects which may come to light.
Check belt tension and correct where necessary

Warning	***If belt tension has to be corrected it is essential to use the method described in Section 9 Vendor Manual Fenner Manual***

Clean the inside surfaces and the ventilation openings of the belt guard and its cover
Refit the drive guard cover, making sure to replace all the screws.

Important	***Do not use any solvent which may damage the belts during these cleaning operations.*** ***In case of asymmetrical wear on the belts sides, or if one of the belts shows signs of damage (wear, aging, start of splitting etc..), change the belt set completely.***

BEARING HOUSINGS

For grease lubricated bearings:
Remove the shaft guard
Remove the excess grease which accumulates at the grease outlet hole
(at the bottom of the bearing housing)
Clean the grease nipples
Clean the outside of the bearing housing
Remove their caps.
Remove the used grease
Clean the inside of the bearing housing and the bearings and inspect visually.

Warning	***A polluted bearing will have a much shorter life span and could even deteriorate quickly. It is therefore important to take particular care and to use clean surroundings and clean materials for these operations (rags brushes etc..)***

DISCHARGE DAMPER / VARIABLE INLET VANES

The Discharge damper / variable inlet vanes require periodic inspection. Check all linkages, bolted connections, etc. remain properly secured. Also check moveable joints remain free. If signs of wear are evident, repair or replace as required. Re lube damper bearings if required.

ELECTRIC MOTOR

The three basic rules of motor maintenance are: keep it clean, dry and properly lubricated. Proceed as follows after disconnecting the power:

Clean outside paying particular attention to the ventilation openings.
Visually inspect the power supply cable and its cable gland.
Remove the terminal box cover.
Check the connections of the power supply cable on the terminal block.
Tighten the cables if necessary.
Carefully close the terminal box replacing all seals.

Note	***Refer to Appendix C Motor Manual for detailed maintenance instructions.***

LUBRICATION DETAILS

Fan Shaft Bearings

The most common grease type is *Shell Alvania R3* grease or equivalent.

Note:	**It is preferable to re-lubricate the bearings while the shaft is rotating, as this assists in the eviction of any degenerated grease and its ultimate discharge from the bearings.**

Bearings For Damper Or Variable Inlet Vanes

Relubricate every 6 months with Shell Alvania R3 Lithium base grease or equivalent
Change grease every 12 months.

Electric Motor

Lubricate in accordance with Motor Manufacturer's instructions.

Refer to Appendix C Motor Manual

10. DISMANTLING & REASSEMBLING

Before attempting any maintenance on the fan or other ancillary items, ensure that all items are isolated from the main power supply.

BELT REMOVAL

Remove belt guard
Undo motor fixing bolts and move motor so that belts become slack enough to be removed from the pulley.
Do not use a lever to force the belt out of the pulley groove. This could permanently lengthen and damage the belt.

PULLEY REMOVAL
Take out the two (or three for larger pulleys) screws tightening the taperlock bush to the pulley. Insert one of these screws into the hole for extracting the bush. Tighten this screw until the bush is released. Slide the pulley and bush out of the shaft.
i

IMPELLER REMOVAL

(a) Unbolt and remove all duct work from inlet side of fan.

(b) Remove bolts connecting inlet cone assembly to housing.

(c) Remove inlet cone away from housing assembly.

(d) Remove taper lock bush from end of shaft centre

Refer Appendix A Taperlock instructions

(e) For impellers with straight bores, Two tapped holes on the impeller hub (keeper plate) can be used for removing the impeller with a suitable puller.

(f) Then withdraw impeller away from shaft and casing.

IMPELLER REPLACEMENT
Generally the impeller will be assembled in the reverse order to which it was removed. However, the following points are to be adhered to:

a) Before fitting impeller to shaft, clean the motor or fan shaft and impeller bore of dirt or burrs. Burrs can be removed with emery cloth.

b) For impellers with straight bores, impellers usually come supplied with two securing bolts, one over the keyway and the other at 90^0. Ensure that securing bolts do not protrude into the impeller bore

c) When assembling the impeller onto the shaft be sure to lubricate the shaft before fitting. Align match marks.

d) Ensure the correct gap between inlet and impeller back plate is maintained before tightening the taper lock or securing bolts.

BEARING REMOVAL for Belt or Coupling Driven Fans

For changing bearing only, the impeller need not be removed from the shaft. However, ensure that the shaft is straight and in good order. The impeller weight should be supported before loosening the bearings. Remove bearing to fan shaft fastener and bearing to fan pedestal fastener. Ensure that the shaft is clean and smooth to facilitate the bearings to slide out at the end of the shaft.

SHAFT AND BEARING REMOVAL & REPLACEMENT for Belt or Coupling Driven Fans

Remove all guards. Remove drive belts and fan pulley for belt driven fans. For coupling driven fans, remove shaft guard and coupling guard then remove coupling driving element. Remove shaft seal bolts. Remove the fan impeller from the shaft. Note the length of the keyway at each end of the shaft so that the new shaft can be mounted in the proper orientation.

Remove bearing bolts from support pedestal. Withdraw shaft, shaft seal and bearings complete from fan assembly. Use heavy canvas to protect the shaft**.** Remove the bearing caps then remove bearing races from the shaft. Note : Mark location of races on shaft .

Bearings are to be assembled onto the shaft with the adapter nuts of both bearings facing the fan housing and lightly tightened to allow for adjustment. The bearings are to be assembled in clean surroundings and no dirt is to be permitted into the bearings

Tighten bearings to fan pedestal. Do not tighten the bearings to fan shaft. Mount impeller to new shaft but do not tighten hub to shaft in case impeller need to be adjusted axially.

Reinstall fan inlet and adjust inlet/impeller clearance.

Fit belt drive pulley to shaft, but do not tighten. Align with motor pulley using straight edge.

Once all alignments and adjustments are complete, tighten impeller to shaft and pulley to shaft.

Tighten only one bearing to shaft. Apart from the second bearing to shaft not being tightened, all other fasteners and connections can be secured. Check all safety aspects of fan operation. Unlock power source and run the fan for a few seconds. Once the impeller comes to a complete stop, tighten the second bearing to shaft. Restart fan check vibration levels before running the fan continuously.

TYPICAL BEARING ASSEMBLY PROCEDURE

Two types of bearings are generally used by Aerotech Fans. They are:

1. Ball Bearing
2. Spherical Roller Bearing

Ball Bearings are self aligning bearings and basically do not present aligning problems. Common failure arises from mounting bolts becoming loose and allowing the fan shaft to turn within the bearing.

Spherical Roller Bearings are also self aligning and good alignment allows the bearing to operate without getting over heated. Good alignment is very critical for bearings operating at high speeds. Improper installation is a common cause for bearing failure. Premature failure can be caused by removing too much clearance from the bearing and not removing enough clearance results in the fan shaft turning within the bearing.

1. Check that the bearing housing seats on fan pedestal are flat.

2. Check the shaft is not worn or damaged where the adaptors are to be fitted (wear on shaft in this area would indicate that previously fitted adaptors have been turning on the shaft).

3. Before fitting bearings, measure the internal clearance of the bearings on the bench after cleaning out preservative oil.

4. Clean adaptors.

5. Assemble seal carriers, 'V' ring, metallic rotating seals, adaptor sleeve, race, locking washer and locknut to the shaft

6. Tighten the adaptor nut enough to halve the internal clearance. The bearing should always be rotated a few times before each measurement is made.

7. Properly pack grease into the bearings and fit into housings. The fixed bearing race is to be positioned in the bearing housing so that the fixing ring can be inserted into the bearing housing, on both sides of the race. The floating bearing race is to be positioned central in the bearing housing.

8. Remove bearing cap and bend tag of lock washer to sufficiently engage in the lock nut, but not hammered down flat so that it will be difficult to pry open in a subsequent bearing refit.
9. Pack the bearing housing with grease. **It is only necessary to pack about 50% of the housing with grease.** Excessive greasing will cause an immediate high temperature of the bearing on start-up.
10. Re-tighten bearings caps, rotating shaft if possible whilst nipping up the bearing caps tightly

BELT DRIVE INSTALLATION & MAINTENANCE

1. Fit the fan & motor pulleys to their shaft

2. Tighten the taper lock bush grub screws of the fan shaft pulley. Using a straight edge, align the motor pulley and when satisfied that the positioning of the motor pulley is correct, tighten the taper lock bush grub screws.

3. Loosen the motor holding down bolts and move the motor so that the belts can be installed without forcing them over the pulleys.

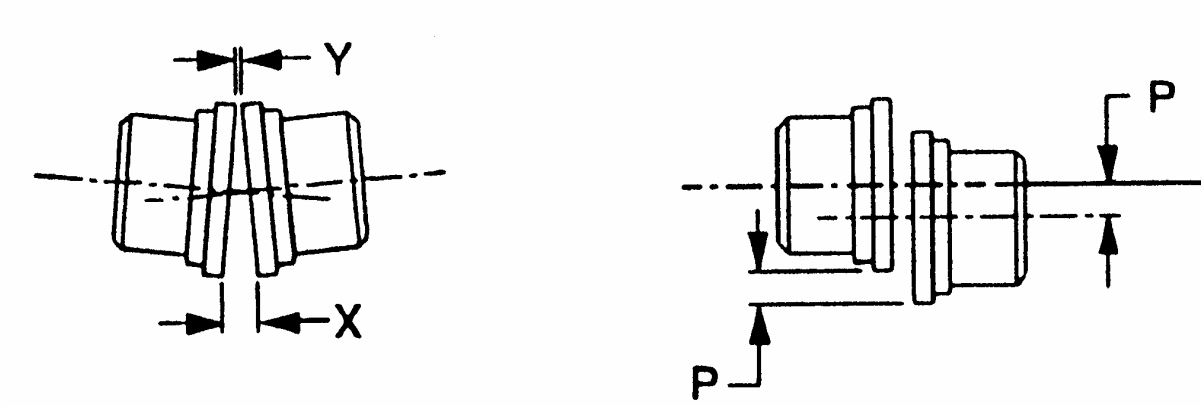
   Adjust the drive

   Once the drive has been correctly tensioned and run in, check the tension again and readjust if necessary

5. Install the belt guard

COUPLING ASSEMBLY & ALIGNMENT

Ensure that the faces of the fan (shaft) coupling and motor coupling are parallel using tapered wedge, feeler gauges, dial indicator or laser alignment.



Angular Misalignment **Parallel Misalignment**

RECOMMENDED COUPLING MISALIGNMENT FIGURES

Alignment Condition	Rotation Speed	Tolerances	
	RPM	**thou (0.001 in)**	**mm**
Parallel offset misalignment between coupling halves (P)	0 -1000	5.00	0.13
	1 - 2000	4.00	0.10
	2 - 3000	3.00	0.07
	3 - 4000	2.00	0.04
	4 - 6000	1.50	0.03
	RPM	**thou /inch**	**mm/100mm**
Angular misalignment between coupling halves (X-Y)	0 -1000	1.00	0.1
	1 - 2000	0.80	0.08
	2 - 3000	0.70	0.07
	3 - 4000	0.60	0.06
	4 - 6000	0.50	0.05

Note: The above figures are to be used if they are tighter than coupling manufacture tolerances.

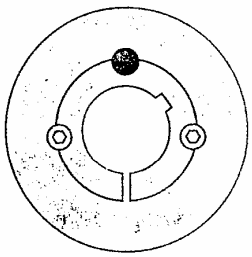
11. FAN TROUBLE SHOOTING GUIDE

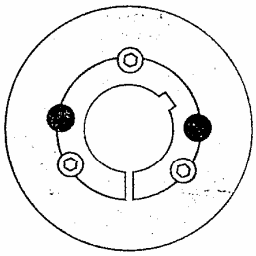
Symptom	**Possible Cause**
1. Fan will not start	Blown fuses Broken belts Loose Pulleys Impeller touching housing Wrong voltage
2. Excessive noise and vibration	Misalignment of bearings, coupling, wheel or drive Unstable foundation Foreign material in fan causing unbalance Worn bearings Worn coupling Damaged impeller or motor Broken or loose bolts Bent shaft Fan wheel or driver unbalanced Fan delivering more than rated capacity Speed too high or fan rotating in wrong direction
3. Air volume too small	Wrong fan rotation Fan speed too slow Pulley mounted back to front Dampers closed too much Coils and filters dirty Inlet or outlet obstructions Fan too small for application Improperly designed turning vanes Air leaks in system Damaged impeller Wheel mounted backwards on impeller System resistance higher than design
4. Air volume too large	Wrong fan rotation Fan speed too high Pulley mounted back to front Dampers not installed Access door open Fan too large for application Oversized ductwork System resistance lower than design
5. Overload on motor	Speed too high Discharging over capacity due to existing system resistance being lower than original rating. Specific gravity or density of gas above design value. Wrong direction of rotation Bent shaft Poor alignment Wheel wedging or binding on inlet belt Bearings improperly lubricated Motor improperly wired Incorrect motor selection
6. Overheated bearings	Too much grease in bearings Poor alignment Damaged impeller or drive Dirt in bearings Abnormal end thrust Bent shaft Incorrect lubricant

APPENDIX A

TAPER LOCK INSTALLATION INSTRUCTIONS

Taper-Lock® Bushes - Installation procedure





To Install

1. Remove the protective coating from the bore and outside of bush, and bore of hub. After ensuring that the mating tapered surfaces are completely clean and free from oil or dirt, insert bush in hub so that holes line up.
2. Sparingly oil thread and point of grub screws, or thread and under head of cap screws. Place screws loosely in holes threaded in hub, shown thus ◎ in diagram.
3. Clean shaft and fit hub and bush to shaft as one unit and locate in position desired, remembering that bush will nip the shaft first and then hub will be slightly drawn on to the bush.
4. Using a hexagon wrench tighten screws gradually and alternately until all are pulled up very tightly.
5. When a key is not used, hammer against large end of bush using block or sleeve to prevent damage. Screws will now turn a little more. Repeat this alternate hammering and screw tightening once or twice.
6. If a key is to be fitted, use a parallel key that is side fitting with top clearance.
7. After drive has been running under load for a short time, stop and check tightness of screws.
8. Fill empty holes with grease to exclude dirt.

To Remove

1. Slacken all screws by several turns, remove one or two according to number of jacking off holes shown thus ● in diagram. Insert screws in jacking off holes after oiling thread and point of grub screws or thread and under head of cap screws.
2. Tighten screws alternately until bush is loosened in hub and assembly is free on the shaft.
3. Remove assembly from shaft.

Bush size		1008	1108	1210	1610	2012	2517	3020	3525	4030	4535	5040
Screw tightening torque (Nm)		5,6	5,6	20	20	30	50	90	115	170	190	270
Screw details	qty	2	2	2	2	2	2	2	3	3	3	3
	size (BSW)	1/4"	1/4"	3/8"	3/8"	7/16"	1/2"	5/8"	1/2"	5/8"	3/4"	7/8"
	Hex. socket size (mm)	3	3	5	5	5	6	8	10	12	14	14
Large end dia. (mm)		35,0	38,0	47,5	57,0	70,0	85,5	108,0	127,0	146,0	162,0	177,5
Approx Mass (kg)		0,1	0,1	0,2	0,3	0,7	1,5	2,7	3,8	5,6	7,5	11,1

APPENDIX B BEARING MANUAL

Page No

SINGLE ROW WIDE INNER RING BALL BEARINGS

Mounting procedure

SET SCREW LOCKING

The set screw type bearing is locked on the shaft by merely tightening the set screws with the proper amount of torque. The types of set screws used are shown below and are highly resistant to loosening even under vibratory loads.

When a set screw is tightened it is pressed into the shaft and consequently raises a ridge around the indentation. If the clearance between the shaft and the bearing bore is very small it is advisable to file a slight flat spot on the shaft at the set screw contact area as illustrated in Figure 7. By so doing any ridge caused by the set screw indentation in the shaft will not interfere with subsequent removal of the bearing unit.

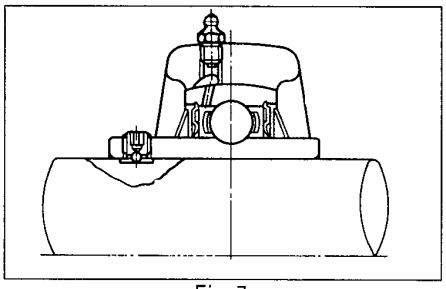
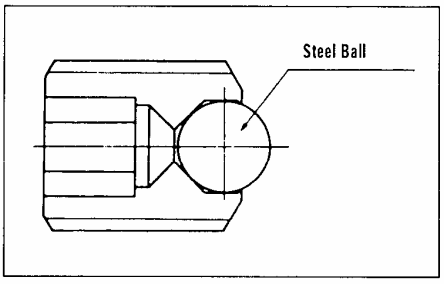
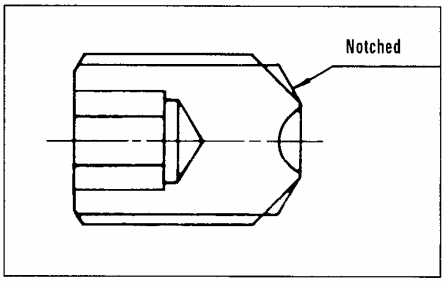


Fig. 7



Ball insert set screw



Knurled cup point set screw (W3)

When mounting the bearing unit hold it at right angle to the shaft. Push the unit onto the shaft. If additional force is necessary, press through the inner ring. Do not push or tap on the slinger or shield. After mounting the unit on the shaft, turn the shaft and rotate the housing several times by hand, then hold the shaft and tighten the set screws evenly using the torque shown in Table 3.

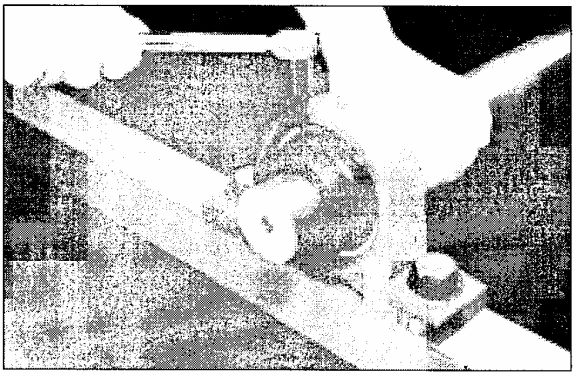


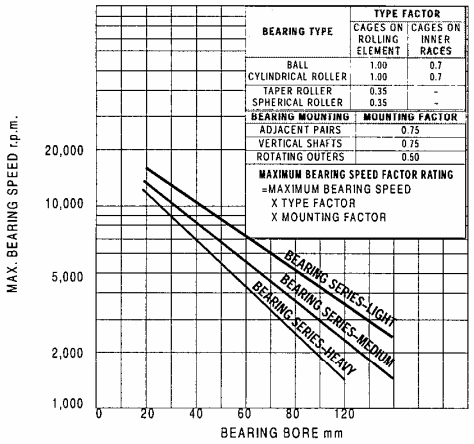
Table 3 Recommended tightening torque for set screws

BEARING No.		SET SCREW	SET SCREW TIGHTENING TORQUE
		Metric	Nm
UC201 to UC205	-	M5 x 0.80	3.0-3.9
UC206	UC305 to UC306	M6 x 0.75	3.9-4.9
UC207	-	M6 x 0.75	4.9-5.8
UC208 to UC210	-	M8 x 1.00	6.8-7.8
UC211	UC307	M8 x 1.00	8.9-9.8
UC212	-	M10 x 1.25	14.8-16.6
UC213 to UC215	UC308 to UC309	M10 x 1.25	17.8-19.6
UC216	-	M10 x 1.25	20.8-22.5
UC217 to UC218	UC310 to UC314	M12 x 1.50	26.8-29.4
-	UC315 to UC316	M14 x 1.50	31.7-34.3
-	UC317 to UC319	M16 x 1.50	49.6-53.9
-	UC320	M18 x 1.50	53.5-58.8

SINGLE ROW WIDE INNER RING BALL BEARINGS

Lubrication for bearing units

All units are prepacked with an optimum amount of 'Lithium' base grease, chosen for its mechanical and chemical stability. It is preferable to re-lubricate when the shaft is rotating as this assists the eviction of any degenerated grease and its ultimate discharge from the bearing at the outer edge of each flinger. Fresh grease may be fed directly into the path of the cage pockets until a slight bead of used grease forms around the periphery of the flinger. This indicates the bearing is filled to capacity.



BEARING TYPE	TYPE FACTOR: CAGES ON ROLLING ELEMENT	TYPE FACTOR: CAGES ON INNER RACES
BALL	1.00	0.7
CYLINDRICAL ROLLER	1.00	0.7
TAPER ROLLER	0.35	-
SPHERICAL ROLLER	0.35	-

BEARING MOUNTING	MOUNTING FACTOR
ADJACENT PAIRS	0.75
VERTICAL SHAFTS	0.75
ROTATING OUTERS	0.50

MAXIMUM BEARING SPEED FACTOR RATING
=MAXIMUM BEARING SPEED
X TYPE FACTOR
X MOUNTING FACTOR

Fig.1 Approximate maximum bearing speed for grease lubrication

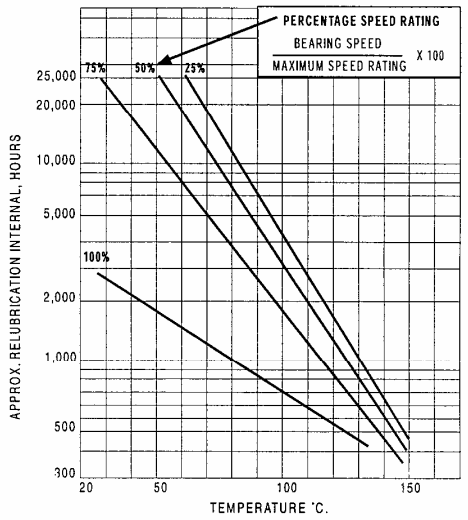


Fig. 2 Relubrication interval Shell Alvania Grease R3

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MAXIMUM SPEED RATING FOR GREASE-LUBRICATED BEARINGS

The dynamics of grease flow and supply to critical surfaces limit the speed at which a bearing may be rotated. Fig. 1 indicates the maximum speed for light, medium or heavy series bearings of the ball or spherical roller types having cages located by the rolling elements. The speed must be reduced by the factors shown when the cages rub on the inner race or for spherical roller bearings. A further reduction is required for critical mounting arrangements as shown. The allowable speeds for CBC Bearing units, under normal operating conditions, are listed in the bearing tables.

GREASE RE-LUBRICATION INTERVALS

Fig. 2 indicates the approximate relubrication intervals for Shell Alvania Grease R3 depending on operating temperature and percentage speed rating. Lines must not be extrapolated beyond the upper temperatures shown.

SEALED BEARINGS

AEL, UCS and AS series bearings, do not require relubrication and are sealed for life.

STANDARD RELUBRICATION FREQUENCIES

TYPE OF UNIT	SYMBOL	dn VALUE	ENVIRONMENT-AL CONDITIONS	OPERATING TEMP.°C	RELUBRICATION FREQUENCY	
					HOURS	PERIOD
Standard	D1	40000 and below	Ordinary	-15 to 80,	1500-3000	6 -12 mo.
Standard	D1	70000 and below	Ordinary	-15 to 80,	1000-2000	3- 6 mo.
Standard	D1	70000 and below	Ordinary	80 to 100,	500-700	1 mo.
Heat- resistant	HT1D1	70000 and below	Ordinary	100 to 140,	300-700	1 mo.
Heat- resistant	HT2D1	70000 and below	Ordinary	140 to 170,	300-700	1 mo.
Heat- resistant	HT2D1	70000 and below	Ordinary	170 to 200,	100	1 wk.
Cold- resistant	CT1D1	70000 and below	Ordinary	-60 to 80,	1000-2000	3 - 6 mo.
Standard	D1	70000 and below	Very dusty	-15 to 100,	100-500	1 wk.-1 mo.
Standard	D1	70000 and below	Exposed to water splashes	-15 to 100,	30-100	1 day-1 wk.

Mounting SNL housings with V-ring seals

Before starting installation work, the following instructions should be carefully read

1. Ensure that the environment is clean Check the dimensional and form accuracy of the shaft seating.

2. Check that the surface roughness of the support surface $R_a \leq 12{,}5$ µm. The flatness (planicity) tolerance should be to IT7. For moderate demands IT8 may be satisfactory.

3. If the bearing is mounted on an adapter sleeve, determine the position of the housing. The grease nipple arranged at one side of the housing cap (for improved lubrication) should always be at the side opposite to the sleeve nut. It is necessary to consider the complete housing as the base and cap will only fit together as supplied.

4. Position the housing on the support surface. Fit the attachment bolts but do not tighten them.

5. Arrange the one V-ring with sealing washer on the shaft. The V-ring should be furthest away from the bearing and seal against the washer, i.e. the lip should point inwards towards the washer.

6. Mount the bearing on the shaft – either directly on a stepped shaft or using an adapter sleeve. Completely fill the bearing with grease. The remainder of the recommended grease quantity should be put in the housing base at the sides (→ **Table** [illegible], **page 28**)

7. Arrange the second sealing washer and V-ring on the shaft at the other side of the bearing. If the housing is to be used at the end of a shaft, mount an end cover instead.

8. Lay the shaft with bearing and sealing washers in the housing base

9. Put one locating ring (when needed) at each side of the bearing.

NB. Locating rings are only used for locating bearing arrangements, except for CARB bearings which, although always non-locating, must always be mounted with locating rings.

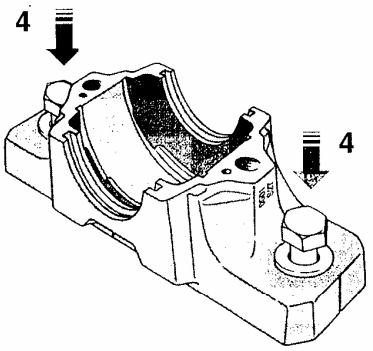
10. Carefully align the housing base Vertical markings at the middle of the side faces and ends of the housing base can facilitate this. Then lightly tighten the attachment bolts.

11. The housing cap should be placed over the base and the cap bolts (to join cap and base) tightened to the torque specified in **Table** [illegible] on **page 46**. The cap and base of one housing are not interchangeable with those of other housings. The cap and base should be checked to see that they bear the same identification.

12. Fully tighten the attachment bolts in the housing base. Recommended tightening torques are given in **Table** [illegible] on **page 46**.

13. Coat the V-ring counterfaces on the sealing washers with grease

14. Finally, push the V-ring seals into their correct position. This can be done using a screwdriver at the same time as the shaft is turned.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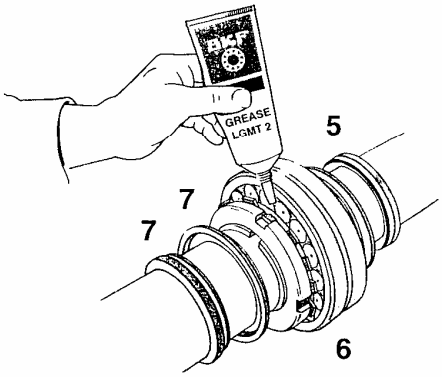
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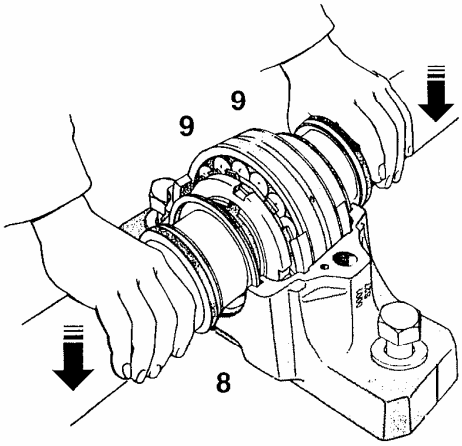
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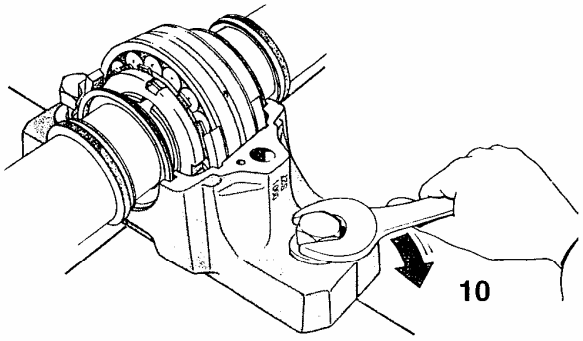
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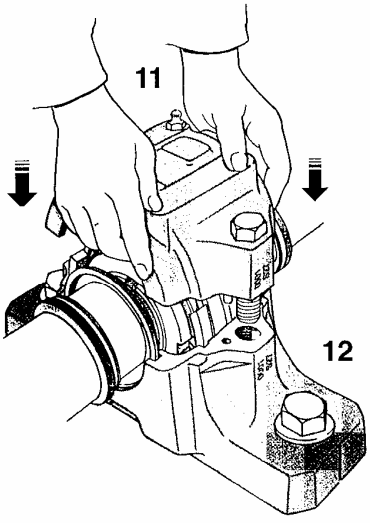
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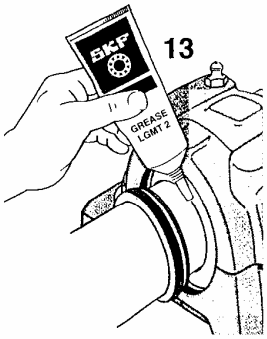
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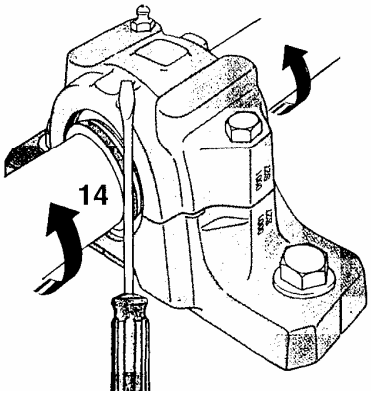
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Mounting SNL housings with labyrinth seals

Before starting installation work, the following instructions should be carefully read.

1. Ensure that the environment is clean. Check the dimensional and form accuracy of the shaft seating.

2. Check that the surface roughness of the support surface $R_a \leqq 12{,}5$ µm. The flatness (planicity) tolerance should be to IT7. For moderate demands IT8 may be satisfactory.

3. If the bearing is mounted on an adapter sleeve, determine the position of the housing. The grease nipple arranged at one side of the housing cap (for improved lubrication) should always be at the side opposite to the sleeve nut. It is necessary to consider the complete housing as the base and cap will only fit together as supplied.

4. Position the housing on the support surface. Fit the attachment bolts but do not tighten them.

5. Mount the first labyrinth seal on the shaft in the correct position.

6. Mount the bearing on the shaft – either directly on a stepped shaft or using an adapter sleeve. Completely fill the bearing with grease. The remainder of the recommended grease quantity should be put in the housing base at the sides (→ **Table 7**, **page 28**).

7. Mount the second labyrinth ring on the shaft in the correct position. If the housing is to be used at a shaft end, the second labyrinth ring is omitted and an end cover inserted in the housing base instead.

8. Lay the shaft with bearing and labyrinth ring(s) in the housing base.

9. Put one locating ring (when needed) at each side of the bearing.

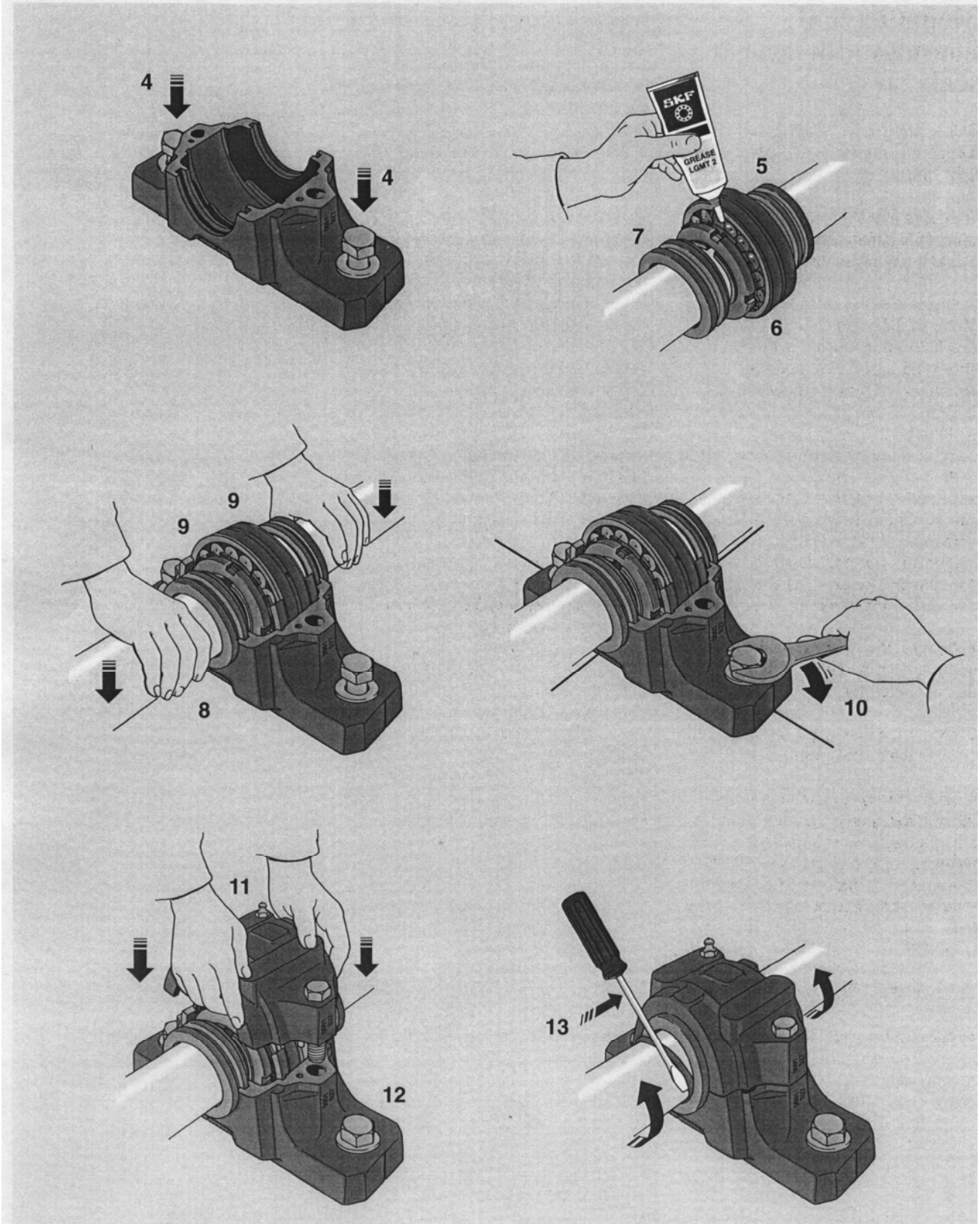
NB. Locating rings are only used for locating bearing arrangements, except for CARB bearings which, although always non-locating, must always be mounted with locating rings.

10. Carefully align the housing base. Vertical markings at the middle of the side faces and ends of the housing base can facilitate this. Then lightly tighten the attachment bolts.

11. The housing cap should be placed over the base and the cap bolts (to join cap and base) tightened to the torque specified in **Table 12** on **page 46**. The cap and base of one housing are not interchangeable with those of other housings. The cap and base should be checked to see that they bear the same identification.

12. Fully tighten the attachment bolts in the housing base. Recommended tightening torques are given in **Table 12** on **page 46**.

13. Finally insert the hollow O-ring cord of synthetic rubber in the grooves in the labyrinth rings. This can be done using a screwdriver while turning the shaft.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Mounting SNL housings with taconite seals

Before starting installation work, the following instructions should be carefully read.

1. Ensure that the environment is clean. Check the dimensional and form accuracy of the shaft seating.

2. Check that the surface roughness of the support surface $R_a \leqq 12{,}5$ µm. The flatness (planicity) tolerance should be to IT7. For moderate demands IT8 may be satisfactory.

3. If the bearing is mounted on an adapter sleeve, determine the position of the housing. The grease nipple arranged at one side of the housing cap (for improved lubrication) should always be at the side opposite to the sleeve nut. It is necessary to consider the complete housing as the base and cap will only fit together as supplied.

4. Position the housing on the support surface. Fit the attachment bolts but do not tighten them.

5. Mount the first V-ring together with one labyrinth seal on the shaft in the correct position. The lip of the V-ring should point towards the bearing. Place the split ring over the V-ring and labyrinth ring and screw together. The two parts of this split ring are not interchangeable. They should be checked to see that they carry the same identification.

6. Mount the bearing on the shaft – either directly on a stepped shaft or using an adapter sleeve. Completely fill the bearing with grease. The remainder of the recommended grease quantity should be put in the housing base at the sides (→ **Table 7**,

7. Mount the second seal according to point 5. If the housing is to be used at a shaft end, the second seal is omitted and an end cover inserted in the housing base instead.

8. Use the hollow O-section cord to fix the labyrinth ring in position on the shaft. A screwdriver can be used to fit the cords whilst rotating the shaft. Mount the O-ring on the seal outer diameter.

9. Lay the shaft with bearing and seals in the housing base taking care that the O-rings are not damaged.

10. Put one locating ring (when needed) at each side of the bearing.

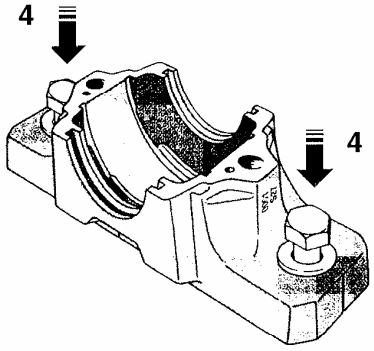
NB. Locating rings are only used for locating bearing arrangements, except for CARB bearings which, although always non-locating, must always be mounted with locating rings.

11. Carefully align the housing base. Vertical markings at the middle of the side faces and ends of the housing base can facilitate this. Then lightly tighten the attachment bolts.

12. The housing cap should be placed over the base and the cap bolts (to join cap and base) tightened to the torque specified in **Table 12**
The cap and base of one housing are not interchangeable with those of other housings. The cap and base should be checked to see that they bear the same identification.

13. Fully tighten the attachment bolts in the housing base. Recommended tightening torques are given in **Table 12**

14. Finally, before the first test run, rotate the shaft and supply grease via the nipple until it exudes from the labyrinth rings. The same grease as that used for the bearing should also be used to lubricate the labyrinth rings.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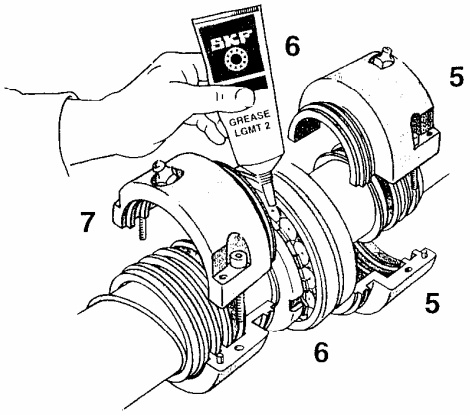
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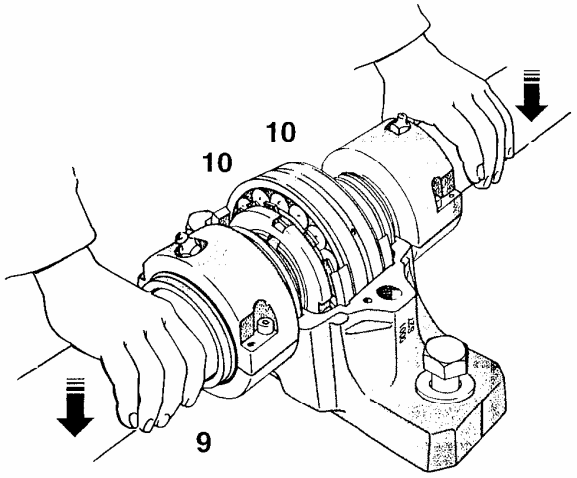
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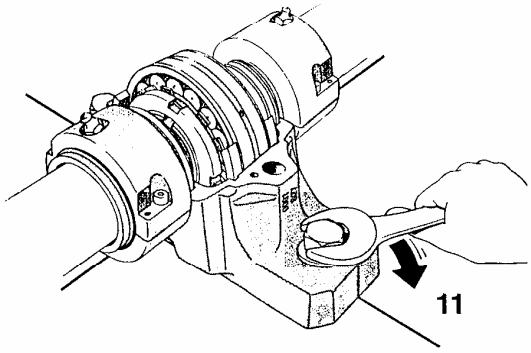
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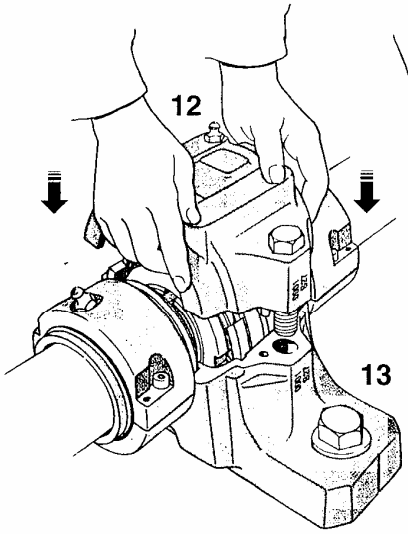
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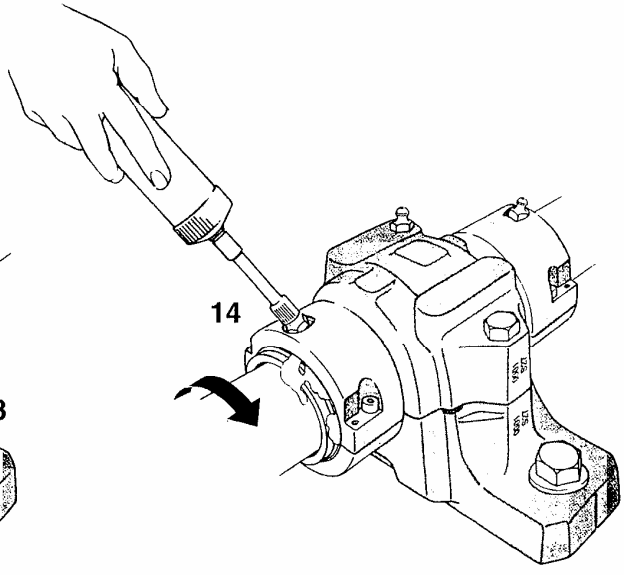
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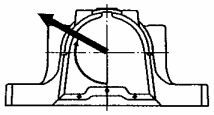
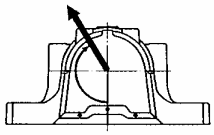
Load carrying ability

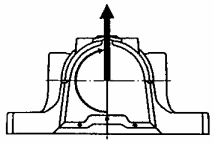
Table 12



$Q_{120°}$
$F_{120°}$



$Q_{150°}$
$F_{150°}$



$Q_{180°}$
$F_{180°}$

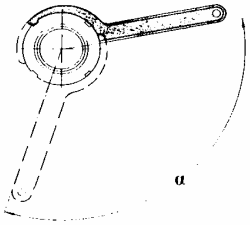
Housing Size	Cap bolts Yield point for both bolts			Maximum load for both bolts			Tightening torque	Designation to EN 24014	Attachment bolts Size	Tightening torque
	$Q_{120°}$	$Q_{150°}$	$Q_{180°}$	$F_{120°}$	$F_{150°}$	$F_{180°}$				
–	kN			kN			Nm	–	–	Nm
SNL 205	150	85	75	50	30	25	50	M 10×40	M 12	90
SNL 206-305	150	85	75	50	30	25	50	M 10×40	M 12	90
SNL 207	150	85	75	50	30	25	50	M 10×50	M 12	90
SNL 208-307	150	85	75	50	30	25	50	M 10×50	M 12	90
SNL 209	150	85	75	50	30	25	50	M 10×50	M 12	90
SNL 210	150	85	75	50	30	25	50	M 10×55	M 12	90
SNL 211	220	125	110	80	45	40	80	M 12×60	M 16	220
SNL 212	220	125	110	80	45	40	80	M 12×60	M 16	220
SNL 213	220	125	110	80	45	40	80	M 12×65	M 16	220
SNL 215	220	125	110	80	45	40	80	M 12×65	M 16	220
SNL 216	220	125	110	80	45	40	80	M 12×70	M 20	430
SNL 217	220	125	110	80	45	40	80	M 12×80	M 20	430
SNL 218	400	230	200	170	100	85	150	M 16×90	M 20	430
SNL 505	150	85	75	50	30	25	50	M 10×40	M 12	90
SNL 506-605	150	85	75	50	30	25	50	M 10×40	M 12	90
SNL 507-606	150	85	75	50	30	25	50	M 10×50	M 12	90
SNL 508-607	150	85	75	50	30	25	50	M 10×50	M 12	90
SNL 509	150	85	75	50	30	25	50	M 10×50	M 12	90
SNL 510-608	150	85	75	50	30	25	50	M 10×55	M 12	90
SNL 511-609	220	125	110	80	45	40	80	M 12×60	M 16	220
SNL 512-610	220	125	110	80	45	40	80	M 12×60	M 16	220
SNL 513-611	220	125	110	80	45	40	80	M 12×65	M 16	220
SNL 515-612	220	125	110	80	45	40	80	M 12×65	M 16	220
SNL 516-613	220	125	110	80	45	40	80	M 12×70	M 20	430
SNL 517	220	125	110	80	45	40	80	M 12×80	M 20	430
SNL 518-615	400	230	200	170	100	85	150	M 16×90	M 20	430
SNL 519-616	400	230	200	170	100	85	150	M 16×90	M 20	430
SNL 520-617	620	360	310	260	150	130	200	M 20×100	M 24	750
SNL 522-619	620	360	310	260	150	130	200	M 20×100	M 24	750
SNL 524-620	620	360	310	260	150	130	200	M 20×110	M 24	750
SNL 526	900	500	450	380	220	190	350	M 24×130	M 24	750
SNL 528	900	500	450	380	220	190	350	M 24×130	M 30	1 400
SNL 530	900	500	450	380	220	190	350	M 24×130	M 30	1 400
SNL 532	900	500	450	380	220	190	350	M 24×130	M 30	1 400

Easy to follow mounting instructions . . . .

Mounting a self-aligning ball bearing on an adapter sleeve

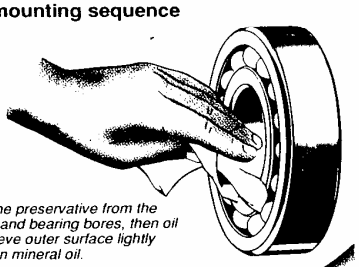
Often a self-aligning bearing on an adapter sleeve is mounted against a spacer. It is unlikely that the bearing will be in contact with the spacer at the same moment when the drive-up clearance is correct. Therefore, the bearing initially should be fitted loosely on the adapter sleeve, so the bearing makes contact with the spacer. Then the adapter sleeve should be pulled under the bearing by the nut and spanner until the bearing is sufficiently tight on the sleeve.

An easy method of mounting bearings on adapter sleeves is based on the tightening angle α through which the nut is turned and the procedure is described in the following. Guideline values for the tightening angle α are given in the table on page 18. Before mounting, the thread and the side face of the nut which is to

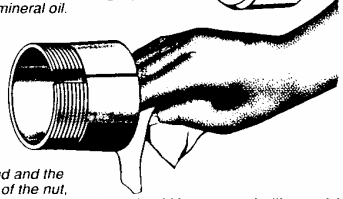


abut the bearing should be smeared with a molybdenum disulphide paste or similar lubricant, and the shaft and the outside diameter of the sleeve smeared with a thin oil. The bearing is then pushed on to the sleeve and the nut screwed on. By turning the nut through the given angle α the bearing will be pressed up on the tapered seating of the sleeve. As the bearing has a tendency to skew when being pressed up it is advisable to reposition the hook spanner in a slot at 180 ° to that used for tightening and then apply a light hammer blow to the spanner. The bearing will straighten up on its seating. The nut is then removed, the locking washer inserted and the nut replaced, tightened and locked by bending down one of the tabs of the locking washer. The residual clearance of the bearing should be checked.

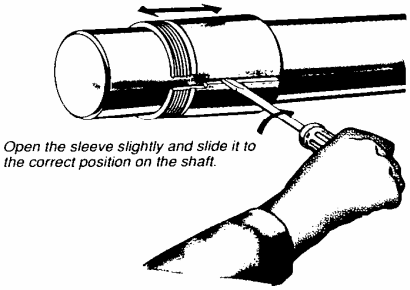
The mounting sequence



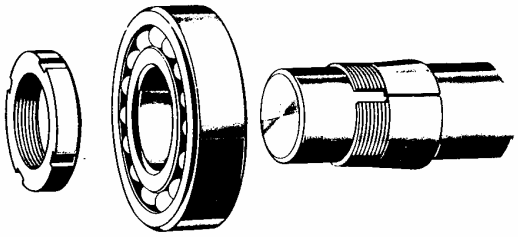
Wipe the preservative from the sleeve and bearing bores, then oil the sleeve outer surface lightly with thin mineral oil.



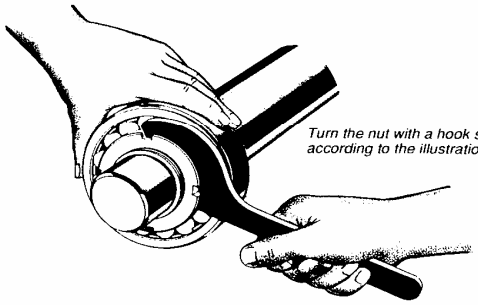
The thread and the side face of the nut, which is to abut the bearing, should be smeared with a molyb denum disulphide paste or similar lubricant.



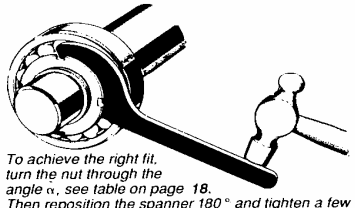
Open the sleeve slightly and slide it to the correct position on the shaft.



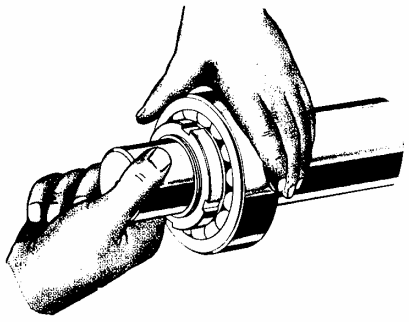
Place the bearing on the sleeve and screw on the nut with the nut chamfer toward the bearing. Tighten the nut just enough to ensure that the bearing and shaft make contact with the sleeve, but do not tighten to drive the bearing further up the sleeve.



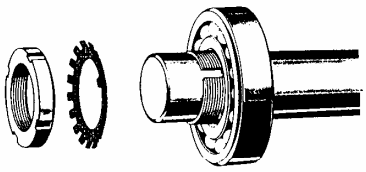
Turn the nut with a hook spanner according to the illustration.



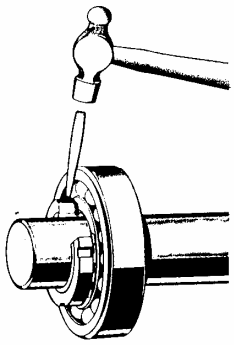
To achieve the right fit, turn the nut through the angle α, see table on page 18. Then reposition the spanner 180 ° and tighten a few more degrees by tapping on the spanner with a hammer. SKF has a set of lock nut spanners which are clearly marked with the correct tightening angle.



For a self-aligning bearing with normal clearance the drive-up is correct when the outer ring easily rotates but resists swiveling.



Unscrew the nut, place the locking washer in position and then tighten the nut firmly again, making sure the bearing is not driven up any further.

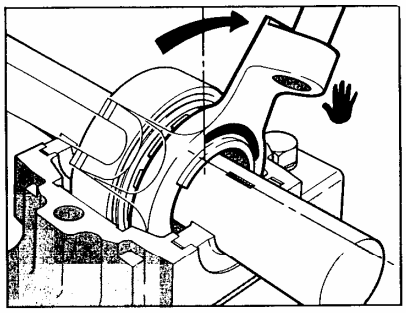


Lock the nut by bending one of the tabs from the locking washer down in the nut slot, but do not slacken the nut to get the tab to fit.

If the nut is placed inboard of the bearing, the locking washer must be mounted together with the nut.
Lubricate the surfaces that slide against each other during tightening.

AN ALTERNATIVE MOUNTING METHOD

For mounting self-aligning ball bearings on an adapter sleeve.



Designed to mount self-aligning ball bearings on adapter sleeves is the SKF Locknut Spanner Kit.

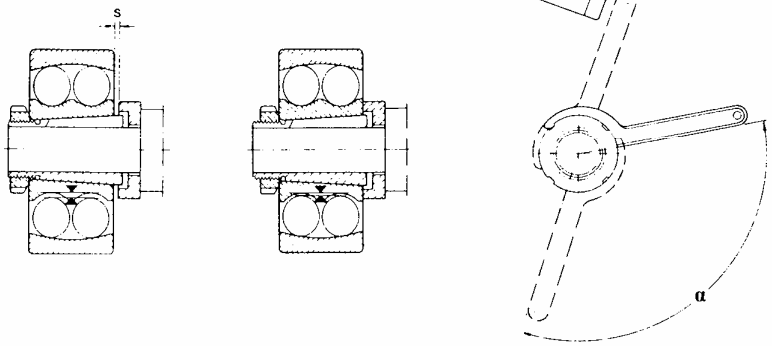
Seven different sized spanners made of spheroidal cast iron are supplied complete with handle for fast and accurate mounting.

Each spanner is clearly marked with the correct tightening angle, ensuring correct drive-up is used and the recommended radial clearance remains after locking the sleeve nut into position.

WARNING

Safety equipment should be worn at all times e.g. Safety Glasses

TABLE 11. Mounting self-aligning ball bearings with tapered bore.



Bearing bore diameter d	Tightening angle α	Axial displacement s Bearings of series 12 K	13 K	22 K	23 K	Mean residual clearance after mounting Normal	C3
mm	degrees	mm				µm	
20	70	0,22	0,23	–	–	10	20
25	70	0,22	0,23	0,22	0,23	10	20
30	70	0,22	0,23	0,22	0,23	10	20
35	70	0,30	0,30	0,30	0,30	10	20
40	70	0,30	0,30	0,30	0,30	10	20
45	70	0,31	0,34	0,31	0,33	15	25
50	70	0,31	0,34	0,31	0,33	15	25
55	90	0,40	0,41	0,39	0,40	15	30
60	90	0,40	0,41	0,39	0,40	15	30
65	90	0,40	0,41	0,39	0,40	15	30
75	120	0,45	0,47	0,43	0,46	20	40
80	120	0,45	0,47	0,43	0,46	20	40
85	120	0,58	0,60	0,54	0,59	20	40
90	120	0,58	0,60	0,54	0,59	20	40
95	120	0,58	0,60	0,54	0,59	20	40
100	120	0,58	0,60	0,54	0,59	20	40
105	120	0,67	–	0,66	–	25	55
110	120	0,67	0,70	0,66	0,69	25	55
120	120	0,67	–	–	–	25	55

Mounting spherical roller bearings

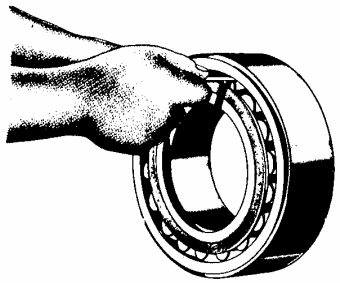
Before mounting the bearing, measure the radial internal clearance with a feeler gauge, since the reduction of internal clearance is used as a measure of interference.

Stand the bearing on a clean work surface and rotate the inner ring a few times. Use a blade slightly thinner than the minimum value of the clearance before mounting, refer Table

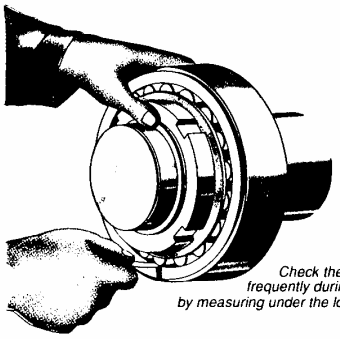
Insert it over the roller next to the uppermost roller. In that position measure with an increasingly thicker blade until, when attempting to pull out the blade, there is a slight resistance.

Push the bearing up on to the shaft and check the reduction in internal clearance during drive-up under the lowest roller, see table on page for guidelines. The minimum values for internal clearance given in the table apply mainly to bearings in which clearance is close to the lower limit. This will give the minimum permissible clearance.

To ensure proper shaft fitting when driving up bearings with greater clearance than Normal—for example, C3 or C4—it is recommended to keep to the upper half of the clearance reduction range.



Before mounting a spherical roller bearing, measure the clearance using a feeler gauge



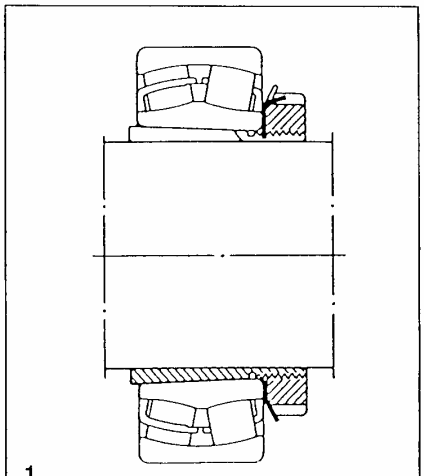
Check the clearance frequently during drive-up by measuring under the lowest roller.

Adapter sleeves

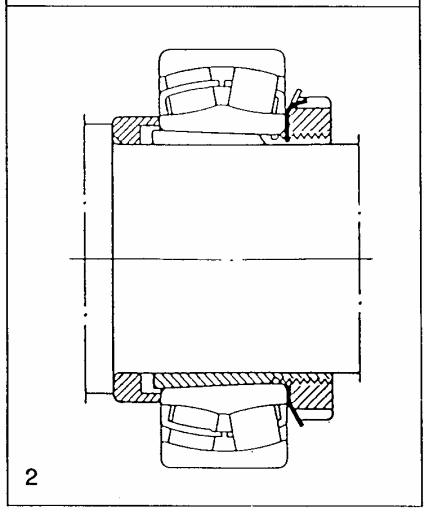
Adapter sleeves are used to secure bearings having a tapered bore on to cylindrical shaft seatings. They facilitate bearing mounting and dismounting and often simplify bearing arrangement design Adapter sleeves are the more popular as they enable bearings to be mounted on smooth shafts (1) as well as stepped shafts (2) and require no additional location on the shaft.

When using adapter sleeves on smooth shafts it is possible to locate the bearing at any position on the shaft. When used on stepped shafts together with a support ring, exact axial positioning of the bearing can be achieved and bearing dismounting facilitated.

As adapter sleeves adapt to the shaft diameter, less stringent shaft tolerances can be permitted. However, the accuracy of form should be within narrow limits as this influences the running accuracy of the bearing arrangement.



1



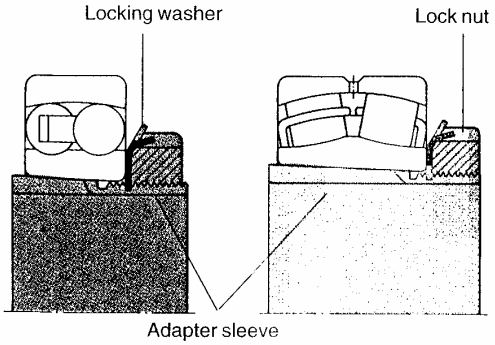
2

TABLE 4 Mounting Spherical Roller bearings with tapered bore.

Bearing bore diameter d		Radial internal clearance before mounting						Reduction in radial internal clearance		Axial drive-up [1]				Minimum permissible residual clearance [2] after mounting bearings with initial clearance		
		Normal		C3		C4				Taper 1:12 on diameter		Taper 1:30 on diameter				
over	incl.	min	max	min	max	min	max	min	max	min	max	min	max	Normal	C3	C4
mm		mm						mm		mm				mm		
24	30	0.030	0.040	0.040	0.055	0.055	0.075	0.015	0.020	0.3	0.35	-	-	0.015	0.020	0.035
30	40	0.035	0.050	0.050	0.065	0.065	0.085	0.020	0.025	0.35	0.4			0.015	0.025	0.040
40	50	0.045	0.060	0.060	0.080	0.080	0.100	0.025	0.030	0.4	0.45	-	-	0.020	0.030	0.050
50	65	0.055	0.075	0.075	0.095	0.095	0.120	0.030	0.040	0.45	0.6			0.025	0.035	0.055
65	80	0.070	0.095	0.095	0.120	0.120	0.150	0.040	0.050	0.6	0.75			0.025	0.040	0.070
80	100	0.080	0.110	0.110	0.140	0.140	0.180	0.045	0.060	0.7	0.9	1.75	2.25	0.035	0.050	0.080
100	120	0.100	0.135	0.135	0.170	0.170	0.220	0.050	0.070	0.75	1.1	1.9	2.75	0.050	0.065	0.100
120	140	0.120	0.160	0.160	0.200	0.200	0.260	0.065	0.090	1.1	1.4	2.75	3.5	0.055	0.080	0.110
140	160	0.130	0.180	0.180	0.230	0.230	0.300	0.075	0.100	1.2	1.6	3.0	4.0	0.055	0.090	0.130

Sleeve-mounted bearings

Self-aligning ball bearings and spherical roller bearings are often mounted on an adapter or withdrawal sleeve. There are several advantages to this mounting technique: the shaft seating does not need such accurate machining, and mounting and dismounting are accomplished easily.



Bearings on adapter sleeves

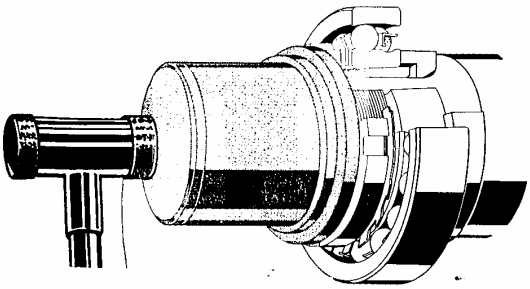
Small and medium-size bearings on an adapter sleeve can be dismounted by hammer blows applied directly to a sleeve abutting the lock nut or the inner ring. Do not use a drift, since the bearing or adapter sleeve may be easily damaged.

Mark the position of the adapter sleeve on the shaft so that it can be remounted in the right spot. Then disengage the tab of the locking washer. A suitable dismounting sleeve, such as those provided by SKF in the fitting tool kit, should have a cover so that hammer blows will be dampened.

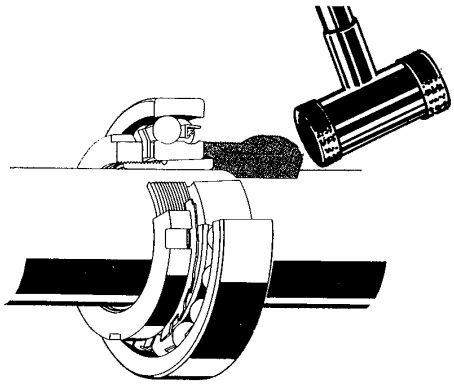
Loosen the lock nut a few turns. Place the sleeve against the nut and give it a couple of sharp blows so that the bearing comes loose. Use a dead blow hammer and strike firmly in the center.

If the lock nut is mounted inward, place the sleeve against the inner ring.

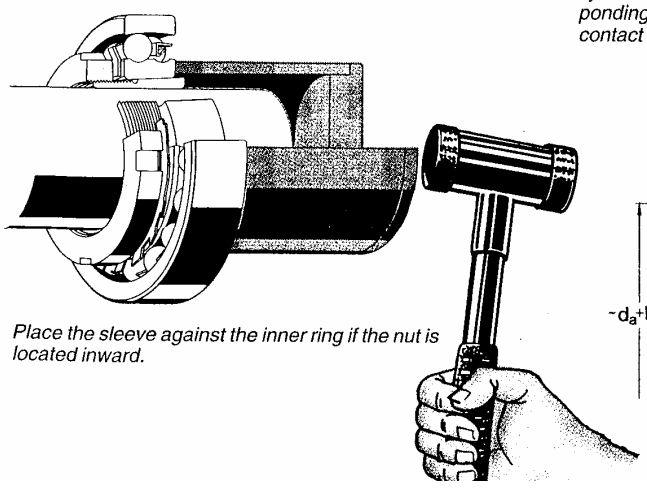
Small and medium-size bearings on adapter sleeves



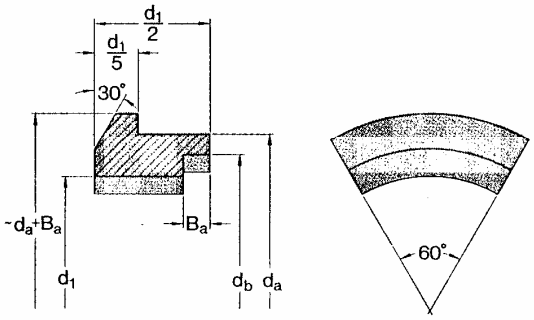
To dismount small and medium-size bearings, use a hammer and a sleeve abutting the lock nut or the inner ring.



When a sleeve cannot be used, employ a steel block made according to the sketch below. The sketch shows a segment of a turned ring. To determine the numerical values for symbols used in the sketch, see bearing tables for corresponding bearing type in the current SKF Catalogue, or contact your SKF representative.



Place the sleeve against the inner ring if the nut is located inward.



SKF

Lubrication

SNL plummer block housings are so designed that the bearings in them can be lubricated with grease or oil, although grease lubrication is generally preferable. The lubricant should be selected with reference to the operating conditions. Relevant information will be found in the SKF General Catalogue and other SKF publications.

Grease lubrication

In the majority of applications, the amount of grease applied to the SNL housings when mounting (first fill) or after an inspection is adequate until the next planned inspection.

Certain operating conditions, e.g. high speeds, high temperatures or heavy loads, may mean that more frequent relubrication is necessary. **Table 7** gives guideline values for the grease quantities to be applied for the first fill and for relubrication. Seven markings will be found on the housing cap of which six show where holes can be drilled and tapped to take grease nipples.

There is also a drilled and tapped hole for the grease nipple AH 1/8-27 PTF which is supplied with the housing. This hole is closed by a plastic plug. The two markings at the outer sides of the central ridge indicate the position for lubrication holes for the seals.

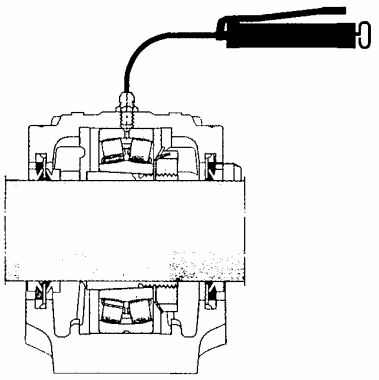
It is recommended that spherical roller bearings having a lubrication groove and three holes in the outer ring (designation suffix E or W33) be lubricated via this feature (→ **fig 12**). A hole should be drilled at one of the middle markings on the three bars for this purpose. SNL housings having a drilled and tapped hole in the middle of the cap together with a lubrication nipple can be supplied on request. They are identified by the designation suffix NM, e.g. SNL 511-609 NM.

It should be noted that when spherical roller bearings are to be relubricated via the outer ring, they should be rotated. If outer ring relubrication is not possible or if self-aligning ball bearings or CARB bearings are used the standard grease nipple supplied with the housing should be inserted in the hole provided and used for this purpose (→ **fig 13**). If it is desired to use a grease nipple other than that supplied with the housing, adapters are available which make a reworking of the available drilled and tapped hole unnecessary.

Where V-ring seals are used, the efficacy of relubrication can be much improved if an additional V-ring is mounted inside the housing at the side

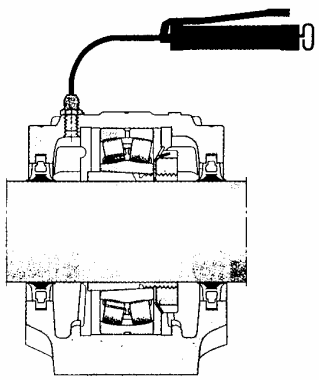
Lubricating the bearing via the outer ring

Fig 12



Bearing lubrication via the standard nipple

Fig 13



Grease quantities

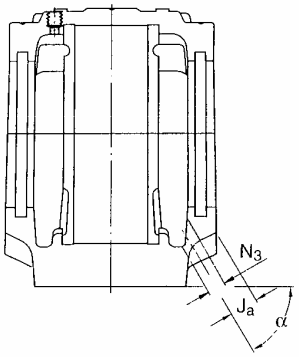
Table 7

Housing Size	Grease quantities First fill[1]	Relubrication
–	g	
SNL 205	25	5
SNL 206-305	40	5
SNL 207	50	10
SNL 208-307	60	10
SNL 209	65	10
SNL 210	75	10
SNL 211	100	15
SNL 212	150	15
SNL 213	180	20
SNL 215	230	20
SNL 216	280	25
SNL 217	330	25
SNL 218	430	40
SNL 505	25	5
SNL 506-605	40	5
SNL 507-606	50	10
SNL 508-607	60	10
SNL 509	65	10
SNL 510-608	75	10
SNL 511-609	100	15
SNL 512-610	150	15
SNL 513-611	180	20
SNL 515-612	230	20
SNL 516-613	280	25
SNL 517	330	25
SNL 518-615	430	40
SNL 519-616	480	50
SNL 520-617	630	55
SNL 522-619	850	70
SNL 524-620	1 000	80
SNL 526	1 100	95
SNL 528	1 400	110
SNL 530	1 700	130
SNL 532	2 000	150

[1] Fills approximately 40 % of the free space in the

Table 8

Recommended dimensions for grease escape hole



Housing Size	Dimensions J_a	N_3	α
–	mm		degrees
SNL205	8,5	10	45
SNL 206-305	10	10	45
SNL 207	10	10	45
SNL 208-307	9	10	45
SNL 209	10	10	45
SNL 210	11	10	45
SNL 211	10	12	45
SNL 212	9	12	45
SNL 213	13	12	45
SNL 215	12,5	12	45
SNL 216	14	16	45
SNL 217	17	16	45
SNL 218	20	16	40
SNL 505	8,5	10	45
SNL 506-605	10	10	45
SNL 507-606	10	10	45
SNL 508-607	9	10	45
SNL 509	10	10	45
SNL 510-608	11	10	45
SNL 511-609	10	12	45
SNL 512-610	9	12	45
SNL 513-611	13	12	45
SNL 515-612	12,5	12	45
SNL 516-613	14	16	45
SNL 517	17	16	45
SNL 518-615	20	16	40
SNL 519-616	20	16	50
SNL 520-617	21	16	50
SNL 522-619	21	20	50
SNL 524-620	24	20	55
SNL 526	22	20	55
SNL 528	23	20	50
SNL 530	25	20	55
SNL 532	25	20	60

The dimensions are those recommended when the standard grease nipple AH 1/8-27 PTF is used (supplied with the housing) but can also be applied if nipples having threads R 1/8, KR 1/8 or M 10×1 are used. An adapter is available which fits the SNL standard lubrication hole, designation LAPN 1/8. Using this adapter nipple with thread G 1/4 and grease dispensers, e.g. SKF System 24, can be applied.

where the grease is applied, so that grease can only exit at the opposite side of the housing. For this purpose a set comprising a V-ring and a splash plate, which covers a sector of more than 180° (→ **fig 14**), can be supplied. This V-ring and splash plate set is designated by the prefix ASNA followed by the housing size identification and the suffix V, e.g. ASNA 511 V.

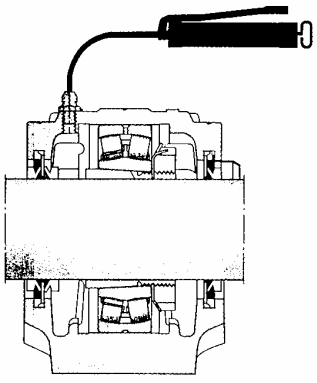
Where the bearings are mounted on adapter sleeves, the grease should be introduced at the side opposite to the lock nut of the sleeve. Where housings are mounted at shaft ends, grease should be applied at the end cover side.

Where G or C-design seals are used it should be noted that grease cannot escape via the seals. If frequent relubrication is required when such seals are used, it is advisable to provide the housing with a grease escape hole (→ **fig 15**) through which excess grease can escape. Recommended dimensions will be found in **Table 8**. SNL housings with a grease escape hole in the base can be supplied. This housing design is identified by the suffix V, e.g. SNL 511-609 V.

If housings fitted with the G-design double-lip seals are periodically relubricated the seals can only be operated at peripheral speeds up to 4 m/s as otherwise the sealing lips may overheat and wear.

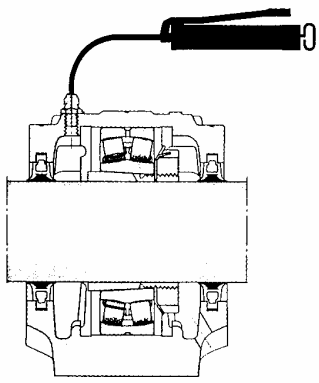
Housing with additional V-ring and splash plate

Fig 14



Housing with grease escape hole

Fig 15



APPENDIX C PULLEY MANUAL

Fenner Wedge & V-Belt Tensioning Instructions

ONE SHOT TENSIONING

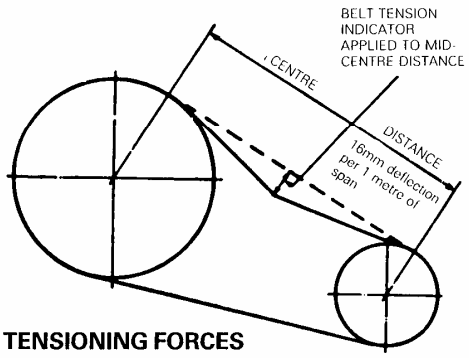
Fenner PB Belts are built right from the start to ensure totally precise inherent length, to stay matched during storage and on the drive. Now, after extensive field tests, our claim of genuine "one-shot" tensioning has been endorsed by satisfied customers all over the world on all belt sections.

Simply put the belts around the pulleys, set them to the appropriate tension value stated in the "Tensioning Forces" table opposite (using the Belt tension indicator as shown), run the drive under load for 30 minutes, stop the drive, check the tension, re-setting to catalogue value if necessary. On a properly designed drive for the application there will be no need for any further attention during the life of the drive.

Cogged raw edge belts should be tensioned to the higher values given in the table opposite.

The setting tensions opposite are designed to cover a wide range of drives. A precise setting force for individual applications can be calculated. Please consult Fenner Technical Services.

For short centre distance drives where the deflection of the belt is too small to measure accurately it is recommended that both deflection and applied force be doubled.



Fenner PB

Why settle for anything but the Best?

TENSIONING FORCES

Belt Section	Force required to deflect belt 16 mm per metre of span		
	Small Pulley Diameter (mm)	Newton (N)	Kilogram-force (kgf)
SPZ	56 to 95	13 to 20	1,3 to 2,0
	100 to 140	20 to 25	2,0 to 2,5
SPA	80 to 132	25 to 35	2,5 to 3,6
	140 to 200	35 to 45	3,6 to 4,6
SPB	112 to 224	45 to 65	4,6 to 6,6
	236 to 315	65 to 85	6,6 to 8,7
SPC	224 to 355	85 to 115	8,7 to 11,7
	375 to 560	115 to 150	11,7 to 15,3
8V	335 & above	150 to 200	15,3 to 20,4
Z	56 to 100	5 to 7,5	0,5 to 0,8
A (& HA banded)	80 to 140	10 to 15	1,0 to 1,5
B	125 to 200	20 to 30	2,0 to 3,1
C	200 to 400	40 to 60	4,1 to 6,1
D	355 to 600	70 to 105	7,1 to 10,7

Method of Belt Tensioning using Fenner Belt Tension indicator

- Calculate the deflection in mm on a basis of 16mm per metre of centre distance. Centre distance (m)x16=deflection (mm).
- Set the lower marker ring at the deflection distance required in mm on the lower scale.
- Set the upper marker ring against the bottom edge of the top tube.
- Place the belt tension indicator on top of the belt at the centre of span, and apply a force at right angles to the belt deflecting it to t he point where the lower marker ring is level with the top of the adjacent belt.
- Read off the force value indicated by the top edge of the upper marker ring.
- Compare this force to the kgf value shown in the table opposite.
- If a Fenner Belt Tension Indicator is not available, a spring balance and rule will suffice.
- With banded belts use a bar across the band width to ensure even distribution of the force and divide the force measured by the number of belts in the band for comparison with the values in the table above

Deflection in mm | Deflection Force in kgf | Product Code 230A0000

NOTE: For single belt drives a straight edge should be placed across the two pulleys to act as a datum for measuring the amount of deflection.

If the measured force falls within the values given, the drive should be satisfactory. A measured force below the lower value indicates under-tensioning.

A new drive should be tensioned to the higher value to allow for the normal drop in tension during the running-in period.

After the drive has been running for 30 minutes, the tension should be checked and re-adjusted to the higher value, if necessary.

TROUBLE SHOOTING

Small cracks on V-Belt side and base

Generally caused by shortage of belt tension but excessive heat and/or chemical fumes can also be give same failure.

V-Belt swelling or softening

Caused by excessive contamination by oil, certain cutting fluids or rubber solvent.

Whipping during running

Usually caused by incorrect tensioning, principally on long centre drives. If a slightly higher (or lower) tension does not cure the problem there may be a critical vibration frequency in the system which requires re design or a Banded belt. Consult Fenner Technical Services.

Installation & Operation of Wedge & V-Belt Drives

Although comparatively old in principle today's belt drive is an extremely efficient method of transmitting power between prime mover and machinery.

It owes its present high performance standards to many years of research and development by engineers and technologists. This has led to significant refinements in materials and processes.

To derive maximum benefit from such advances it is important that the simple installation and operation procedures set out here are closely followed. Making these routines standard practice will enable you to obtain optimum performance and long, trouble-free life from your Fenner belt drives.

INSTALLATION

■ PULLEYS

Before assembling the drive, check the pulley grooves are free from scores or sharp edges, and all dimensions conform to the relevant standard.

The Taper Lock® bush is your starting point when it comes to assembly and installation. Drive installation is a straight forward job with Taper Lock® – but the stages set out on the installation leaflet provided with every Taper Lock® bush should be followed closely.

■ ALIGNMENT

Good alignment of pulleys prior to belt installation is important to avoid belt flank wear. The diagrams opposite show some of the common alignment faults. You should only be satisfied if the conditions in sketch 4 prevail.

■ BELTS

When the pulleys have been correctly positioned on the shafts, the belts can be installed to complete the drive.

The drive centre distance should be reduced prior to the installation of the belts so that they may be fitted without the use of force. Under no circumstances must belts be prised into the grooves. Belts and pulley grooves can easily be damaged by using sharp tools to stretch the belts over the pulley rim.

The installation allowance given in the table below is the minimum recommended reduction in centre distance for the various belt section and lengths to allow for correct fitting.

The take-up allowance given in the same table should be added on to the calculated centre distance to allow for belt stretch.

■ GUARDS

Where guards are necessary it is desirable to use the mesh type to permit adequate ventilation.

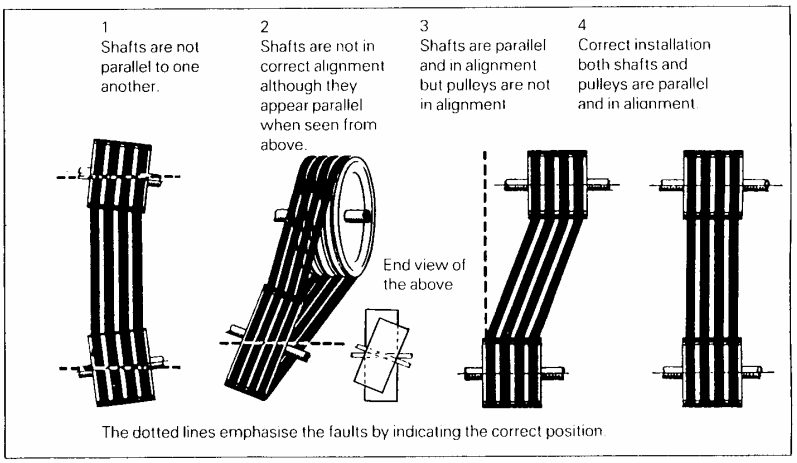
■ TENSIONING PULLEYS

If tensioning (jockey) pulleys are to be used on Wedge-Belt drives, they must be fitted with a grooved pulley bearing on the inside of the drive, preferably on the slack side. The pulley should be positioned as close as possible to the large pulley. Flat tensioning pulleys, bearing on the outside of the drive are permissible only with V and not with Wedge-Belts. They should be positioned within one third of the centre distance from the small pulley.

The tensioning pulley must be at least the same diameter as the small pulley of the drive.

Tensioning pulley movement can only be determined by laying out the drive to scale. It must allow for passing the belts over the outside diameter of one of the pulleys on installation and should also allow for belt stretch.

The modern V-Drive is a highly efficient method of transmitting power – but optimum performance will not be achieved unless the correct tensioning procedures are carried out.

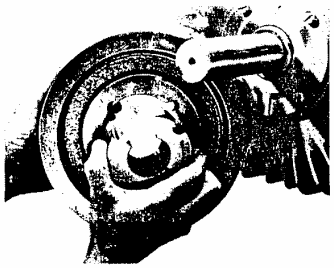


The dotted lines emphasise the faults by indicating the correct position

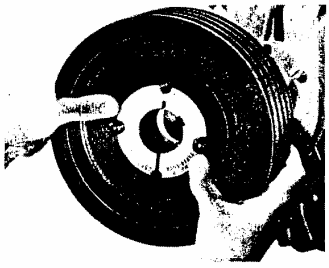
INSTALLATION AND TAKE-UP ALLOWANCE

Belt Pitch Length (mm)	Installation Allowances					Take -up (mm)
	SPZ Z	HA SPA A	SPB B	SPC C	8V D	
410 to 530	20					5
530 to 840		25	30			10
850 to 1160				50		15
1170 to 1500						20
1510 to 1830						25
1840 to 2170						30
2180 to 2830					65	40
2840 to 3500						50
3520 to 4160						60
4170 to 5140						70
5220 to 6150						85
6180 to 7500						105
7600 to 8500						125
8880 to 10170						145
10600 to 12500						175

Taper Lock® Installation Instructions

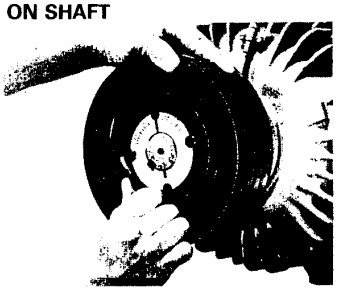


INSERT BUSH

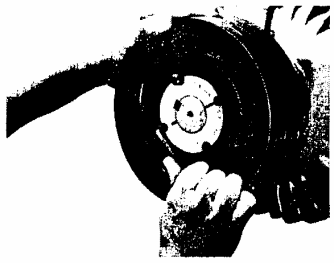


INSERT SCREWS and LOCATE ON SHAFT

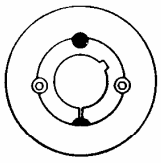
TIGHTEN SCREWS FINGER TIGHT

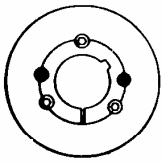


TIGHTEN SCREWS ALTERNATELY



REMOVING A TAPER LOCK® BUSH





TO INSTALL

1. Remove the protective coating from the bore and outside of bush, and bore of hub. After ensuring that the mating tapered surfaces are completely clean and free from oil or dirt, insert bush in hub so that holes line up.
2. Sparingly oil thread and point of grub screws, or thread and under head of cap screws. Place screws loosely in holes threaded in hub, shown thus ◎in diagram.
3. Clean shaft and fit hub to shaft as one unit and locate in position desired, remembering that bush will nip the shaft first and then hub will be slightly drawn on to the bush.
4. Using a hexagon wrench tighten screws gradually and alternately to torque shown in table below.
5. Hammer against large-end of bush, using a block or sleeve to prevent damage. (This will ensure that the bush is seated squarely in the bore.) Screws will now turn a little more. Repeat this alternate hammering and screw tightening once or twice to achieve maximum grip on the shaft.
6. If a key is to be fitted place it in the shaft keyway before fitting the bush. It is essential that it is a parallel key and side fitting only and has TOP CLEARANCE.
7. After drive has been running under load for a short time stop and check tightness of screws.
8. Fill empty holes with grease to exclude dirt.

TO REMOVE

1. Slacken all screws by several turns, remove one or two according to number of jacking off holes shown thus ● in diagram. Insert screws in jacking off holes after oiling thread and point of grub screws or thread and under head of cap screws.
2. Tighten screws alternately until bush is loosened in hub and assembly is free on the shaft.
3. Remove assembly from shaft.

Bush size		1008	1108	1210	1610	2012	2517	3020	3525	4030	4535	5040
Screw tightening torque (Nm)		5,6	5,6	20	20	30	50	90	115	170	190	270
Screw details	qty	2	2	2	2	2	2	2	3	3	3	3
	size (BSW)	¼"	¼"	⅜"	⅜"	7/16"	½"	⅝"	½"	⅝"	¾"	⅞"
	Hex. socket size (mm)	3	3	5	5	5	6	8	10	12	14	14
Large end dia. (mm)		35,0	38,0	47,5	57,0	70,0	85,5	108,0	127,0	146,0	162,0	177,5

APPENDIX B COUPLING MANUAL

Page No

HRC™ Couplings - Heavy Duty S.G. Iron

These semi-elastic couplings designed for general purpose use, permit quick and easy assembly by means of Taper Lock bush fixing.

Fully machined outside diameters allow alignment by simple straight edge methods.

Shaft connection is "fail safe" due to interacting dog design.

SELECTION

(a) Service Factor
Determine appropriate Service Factor from table (below).

(b) Design Power
Multiply running power of driven machinery by the service factor. This gives the design power which is used as a basis for coupling selection.

(c) Coupling Size
Refer to Power Ratings table (below) and read across from the appropriate speed until a power equal to or greater than the design power is found. The size of coupling is given at the head of that column.

(d) Bore Size
From Dimensions table on (page **115**) check that the required bores can be accommodated.

EXAMPLE

A shaft coupling is required to transmit 70kW between a 1200 rev/min diesel engine and a hoist running over 16hrs/day. Engine shaft is 70mm and the hoist shaft is 75mm.

(a) Service Factor
The appropriate service factor is 2,5.

(b) Design Power
Design power 70 x 2,5=175kW.

(c) Coupling Size
Reading across from 1200 rev/min in the speed column of Power Ratings table below, 251kW is the first power to exceed the required 175kW (design power). The size of the coupling at the head of this column is 230.

(d) Bore Size
The Dimensions table (page **115**) shows that both shaft diameters are within the bore range available.

SERVICE FACTORS

SPECIAL CASES For applications where substantial shock, vibration and torque fluctuation occur, and for reciprocating machines e.g. internal combustion engines, piston type pumps and compressors, refer to your local branch with full machine details for torsional analysis.	**Type of Driving Unit**					
	Electric Motors Steam Turbines			Internal Combustion Engines Steam Engines Water Turbines		
	Hours per day duty			Hours per day duty		
Driven Machine Class	8 and under	over 8 to 16 inclusive	over 16	8 and under	over 8 to 16 inclusive	over 16
UNIFORM Agitators, Brewing machinery, Centrifugal blowers, Centrifugal compressors†, Conveyors, Centrifugal fans and pumps, Generators, Sewage disposal equipment.	1,00	1,12	1,25	1,25	1,40	1,60
MODERATE SHOCK* Clay working machinery, Crane hoists, Laundry machinery, Wood working machinery, Machine tools, Rotary mills, Paper mill machinery, Textile machinery, Non-uniformly loaded centrifugal pumps.	1,60	1,80	2,00	2,00	2,24	2,50
HEAVY SHOCK* Reciprocating conveyors, Crushers, Shakers, Metal mills, Rubber machinery (Banbury mixers and mills), Reciprocating compressors, Welding sets.	2,50	2,80	3,12	3,12	3,55	4,00

* It is recommended that keys (with top clearance if in Taper Lock bushes) are fitted for applications where load fluctuation is expected.

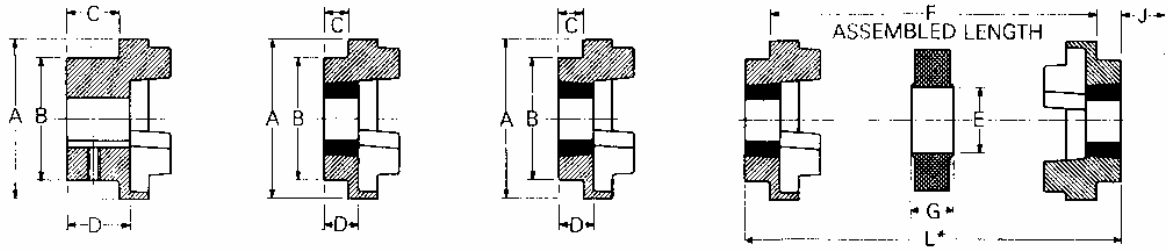
† For Centrifugal Compressors multiply Service Factor by an additional 1,15.

POWER RATINGS (kW)

Speed rev/min	Coupling Size							
	70	**90**	**110**	**130**	**150**	**180**	**230**	**280**
100	0,33	0,84	1,68	3,30	6,28	9,95	20,9	33,0
200	0,66	1,68	3,35	6,60	12,6	19,9	41,9	65,0
400	1,32	3,35	6,70	13,2	25,1	39,8	83,8	132
600	1,98	5,03	10,1	19,8	37,7	59,7	126	198
720	**2,37**	**6,03**	**12,1**	**23,8**	**45,2**	**71,6**	**151**	**238**
800	2,64	6,70	13,4	26,4	50,3	79,6	168	264
960	**3,17**	**8,04**	**16,1**	**31,7**	**60,3**	**95,5**	**201**	**317**
1200	3,96	10,1	20,1	39,6	75,4	119	251	396
1440	**4,75**	**12,1**	**24,1**	**47,5**	**90,5**	**143**	**302**	**475**
1600	5,28	13,4	26,8	52,8	101	159	335	528
1800	5,94	15,1	30,2	59,4	113	179	377	594
2000	6,60	16,8	33,5	66,0	126	199	419	660
2200	7,26	18,4	36,9	72,6	138	219	461	726
2400	7,92	20,1	40,2	79,2	151	239	503	
2600	8,58	21,8	43,6	85,8	163	259	545	
2880	**9,50**	**24,1**	**48,3**	**95**	**181**	**286**		
3000	9,90	25,1	50,3	99	188	298		
3600	11,9	30,1	60,3	118	226			
Nominal Torque (Nm)	31,5	80	160	315	600	950	2000	3150
Max Torque (Nm)	72	180	360	720	1500	2350	5000	7200

Fire Resistant/Anti-Static (F.R.A.S.) inserts are available to special order.
For speeds below 100 rev/min and intermediate speeds use nominal torque ratings.
* Maximum coupling speeds are calculated using an allowable peripheral speed for the hub material. For selection of smaller sizes with speeds in excess of 3600 rev/min – Consult your local branch.

HRC™ Couplings - Dimensions



B FLANGE **F** FLANGE **H** FLANGE

PHYSICAL DIMENSIONS AND CHARACTERISTICS

	Common Dimensions					Type F & H							Type B		
							Max. Bore					Bore Dia's			
Size	A	B	E	F ‡	G	Bush size	mm	ins.	C	D	J †	Max.	Pilot H9	Screw overkey	C	D
70	69	60	31	25	18	1008	25	1	20,0	23,5	29	32	8	M 6	20	23,5
90	85	70	32	30,5	22,5	1108	28	1⅛	19,5	23,5	29	42	10	M 6	28	30
110	112	100	45	45	29	1610	42	1⅝	18,5	26,5	38	55	10	M10	37	45
130	130	105	50	53	36	1610	42	1⅝	18,0	26,5	38	60	15	M10	39	47,5
150	150	115	62	60	40	2012	50	2	23,5	33,5	42	70	20	M10	46	56
180	180	125	77	73	49	2517	60	2½	34,5	46,5	48	80	25	M10	58	70
230	225	155	99	85,5	59,5	3020	75	3	39,5	52,5	55	100	25	M12	77	90
280	275	206	119	105,5	74,5	3525	100	4	51,0	66,5	67	115	30	M16	90	105,5

† 'J' is the wrench clearance required for tightening/loosening the bush on the shaft. A shortened wrench will allow this dimension to be reduced.
‡ F_1 refers to combinations of flanges: FF, FH, HH, FB, HB, BB.
Bore limits H7 unless specified otherwise.

Size	Assembled Length (L*) Comprising Flange Types			Mass (kg)	Inertia Mr^2 (kgm^2)	Dynamic Stiffness ($Nm/^c$)	Maximum Misalignment		Nominal Torque (Nm)
	FF FH, HH	FB.HB	BB				Parallel	Axial	
70	65	65	65	1,00	0,00085	–	0,3	+0,2	31
90	69,5	76	82,5	1,17	0,00115	–	0,3	+0,5	80
110	82	100,5	119	5,00	0,00400	65	0,3	+0,6	160
130	89	110	131	5,46	0,00780	130	0,4	+0,8	315
150	107	129,5	152	7,11	0,01810	175	0,4	+0,9	600
180	142	165,5	189	16,6	0,04340	229	0,4	+1,1	950
230	164,5	202	239,5	26,0	0,12068	587	0,5	+1,3	2000
280	207,5	246,5	285,5	50,0	0,44653	1025	0,5	+1,7	3150

All dimensions in millimetres unless otherwise stated.
All HRC Elements have an angular misalignment capacity of up to 1°.
Mass is for an FF, FH or HH coupling with mid range Taper Lock Bushes.

ORDERING CODES

Size	Type F	Type H	Type B	Standard element Temp: -40°C/+100°C
70	**0173 0007**	**0175 6706**	**0231 3818**	**0172 0703**
90	**0173 0201**	**0175 6803**	**0231 4011**	**0172 1605**
110	**0173 1501**	**0175 6900**	**0231 4215**	**0172 2002**
130	**0173 2403**	**0175 7006**	**0231 4419**	**0172 2701**
150	**0173 2607**	**0175 7103**	**0231 4516**	**0172 4806**
180	**0173 7301**	**0175 8102**	**0231 4613**	**0172 7308**
230	**0174 6703**	**0175 8209**	**0231 4710**	**0172 8501**
280	**0175 6609**	**0175 9402**	**0231 4817**	**0172 9801**

Note: For details of HRC couplings suitable for application to drives involving SAE engine flywheels, consult your local branch.
Type B flanges can be supplied finished bored, with keyway if required.
Material: S.G. Iron.

SHAFT ALIGNMENT

Appropriate alignment of the coupled shafts (or driven shaft to flywheel) is a fundamental requirement for any coupling installation.

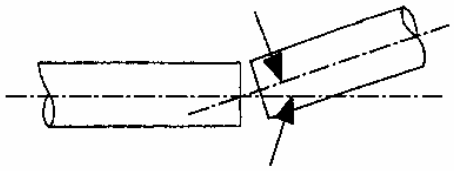
The three basic modes of shaft misalignment are shown right.

Composite i.e. more than one mode, misalignment is available for some couplings (detailed elsewhere in this Manual).

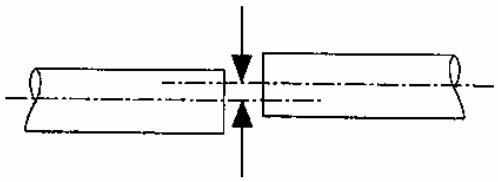
Details of the degrees of misalignment that can be accommodated by different types and sizes of coupling are given throughout this Manual.

With some couplings, axial shaft orientation (DBSE) is not critical, whereupon coupling component orientation (given as an 'assembled length' or 'distance between faces') becomes crucial.

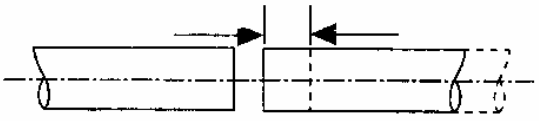
Excepting Universal Joints under angular misalignment, it should be remembered that misalignment can cause extra loading on coupled shaft support bearings and can reduce the operational life of some couplings. Best practical alignment is therefore desirable. Taper Lock Rigid Couplings cannot accommodate misalignment.



ANGULAR MISALIGNMENT – shafts are at an angle to one another



PARALLEL MISALIGNMENT – shafts are in line angularly and parallel to each other, but are off-set.



AXIAL MISALIGNMENT – includes applicational "end float" – shafts move axially increasing or decreasing the distance between shaft ends.

OTHER CRITERIA

Fenaflex – tyre gap and seating. Tyre/element clamping bolt torque.
HRC – do not use to couple resiliently mounted machinery.
All Elastomeric Couplings – consider ambient conditions (FRAS or other alternative element material required?)
All Taper Lock Couplings – remember bush grips shaft first and draws hub on to taper. This may affect axial alignment.
All applications – ensure shaft diameter tolerances are correct.

TAPER LOCK

Most of the Fenaflex and HRC couplings, and all Rigid couplings featured in this section use Taper Lock shaft fixing.
For detailed instructions on the fitting and dismounting of Taper Lock products see Shaft Fixings.

Note: When fitting Taper Lock coupling flanges it should be noted that the bush grips the shaft initially and draws the flange up the tapered surface.
This may have a small effect on the final axial positioning of flanges on machine shafts, and the resultant distance between coupling flanges, where this is important to the fit and function of flexible coupling elements.

Fenaflex® Couplings – Selection

Fenaflex® couplings provide all the desirable features of an ideal coupling, including Taper Lock® fixing.

The Fenaflex® coupling is a "torsionally elastic" coupling offering versatility to designers and engineers with a choice of flange combinations to suit most applications.

The flanges are available in either F or H Taper Lock® fitting or bored to size.

With the addition of a spacer flange the coupling can be used to accommodate standard distance between shaft ends and facilitate pump maintenance.

Fenaflex® couplings can accommodate simultaneous maximum misalignment in all planes without imposing undue loads on adjacent bearings and the excellent shock-absorbing properties of the flexible tyre reduce vibration and torsional oscillations.

Fenaflex® tyres are available in natural rubber compounds for use in ambient temperatures between –50°C and +50°C. Chloroprene rubber compounds are available for use in adverse operating conditions e.g. oil or grease contaminations and can be used in temperatures of –15°C to +70°C. The chloroprene compound should also be used when fire-resistance and anti-static (F.R.A.S.) properties are required.

(a) Service Factor
Determine the required service factor from table 6 below.

(b) Design Power
Multiply the normal running power by the service factor. This gives the design power which is used as a basis for selecting the coupling.

(c) Coupling Size
Refer to page 7 table 7 and from the appropriate speed read across until a power greater than that required in step (b) is found.
The size of Fenaflex coupling required is given at the head of that column.

(d) Bore Size
Check from table 8 or 9 that chosen flanges can accommodate required bores.

EXAMPLE
A Fenaflex coupling is required to transmit 45kW from an A.C. electric motor which runs at 1440 rev/min to a rotary screen for 12 hours a day. The motor shaft is 60mm diameter and the screen shaft is 55mm diameter. Taper Lock® is required.

(a) Service Factor
From table 6, the service factor is 1,4.

(b) Design Power
Design Power=45 x 1,4=63kW

(c) Coupling Size
By reading across from 1440 rev/min in table 7the first power figure to exceed the required 63kW in step (b) is 75,4kW
The size of coupling is F90 Fenaflex.

(d) Bore Size
By referring to table 8 (page 8) it can be seen that both shaft diameters fall within the bore range available

TABLE 6: SERVICE FACTORS

SPECIAL CASES For applications where substantial shock, vibration and torque fluctuations occur, and for reciprocating machines e.g. internal combustion engines, piston pumps and compressors, refer to Fenner with full machine details for analysis.	Type of Driving Unit					
	Electric Motors Steam Turbines			Internal Cumbustion Engines Steam Engines Water Turbines		
	Hours per day duty			Hours per day duty		
Type of Driven Machine	10 and under	over 10 to 16 incl.	over 16	10 and under	over 10 to 16 incl.	over 16
CLASS 1 Agitators, Brewing machinery, Centrifugal compressors and pumps. Belt conveyors, Dynamometers, Lineshafts, Fans up to 7,5kW. Blowers and exhausters (except positive displacement), Generators.	0,8	0,9	1.0	1,3	1,4	1,5
CLASS 2* Clay working machinery, General machine tools, Paper mill beaters and winders, Rotary pumps, Rubber extruders, Rotary screens, Textile machinery, Marine propellers and Fans over 7,5kW.	1,3	1,4	1,5	1,8	1,9	2,0
CLASS 3* Bucket elevators, Cooling tower fans, Piston compressors and pumps, Foundry machinery, Metal presses, Paper mill calenders, Hammer mills, Presses and pulp grinders, Rubber calenders, Pulverisers and Positive displacement blowers.	1,8	1,9	2,0	2,3	2,4	2,5
CLASS 4* Reciprocating conveyors, Gyratory crushers, Mills (ball, pebble and rod), Rubber machinery (Banbury mixers and mills) and Vibratory screens.	2,3	2,4	2.5	2,8	2,9	3,0

* It is recommended that keys with top clearance are fitted on applications where load fluctuation is expected.

Fenaflex® Couplings – Power Ratings

TABLE 7: POWER RATINGS (kW)

Speed rev/min	Coupling Size														
	F40	**F50**	**F60**	**F70**	**F80**	**F90**	**F100**	**F110**	**F120**	**F140**	**F160**	**F180**	**F200**	**F220**	**F250**
100	0,25	0,69	1,33	2,62	3,93	5,24	7,07	9,16	13,9	24,3	39,5	65,7	97,6	121	154
200	0,50	1,38	2,66	5,24	7,85	10,5	14,1	18,3	27,9	48,7	79,0	131	195	243	307
300	0,75	2,07	3,99	7,85	11,8	15,7	21,2	27,5	41,8	73,0	118	197	293	364	461
400	1,01	2,76	5,32	10,5	15,7	20,9	28,3	36,6	55,7	97,4	158	263	391	486	615
500	1,26	3,46	6,65	13,1	19,6	26,2	35,3	45,8	69,6	122	197	328	488	607	768
600	1,51	4,15	7,98	15,7	23,6	31,4	42,4	55,0	83,6	146	237	394	586	729	922
700	1,76	4,84	9,31	18,3	27,5	36,6	49,5	64,1	97,5	170	276	460	684	850	1076
720	**1,81**	**4,98**	**9,57**	**18,8**	**28,3**	**37,7**	**50,9**	**66,0**	**100**	**175**	**284**	**473**	**703**	**875**	**1106**
800	2,01	5,53	10,6	20,9	31,4	41,9	56,5	73,3	111	195	316	525	781	972	1229
900	2,26	6,22	12,0	23,6	35,3	47,1	63,6	82,5	125	219	355	591	879	1093	1383
960	**2,41**	**6,63**	**12,8**	**25,1**	**37,7**	**50,3**	**67,9**	**88,0**	**134**	**234**	**379**	**630**	**937**	**1166**	**1475**
1000	2,51	6,91	13,3	26,2	39,3	52,4	70,7	91,6	139	243	395	657	976	1215	1537
1200	3,02	8,29	16,0	31,4	47,1	62,8	84,8	110	167	292	474	788	1172		
1400	3,52	9,68	18,6	36,6	55,0	73,3	99,0	128	195	341	553	919			
1440	**3,62**	**9,95**	**19,1**	**37,7**	**56,5**	**75,4**	**102**	**132**	**201**	**351**	**568**	**945**			
1600	4,02	11,1	21,3	41,9	62,8	83,8	113	147	223	390	632				
1800	4,52	12,4	23,9	47,1	70,7	94,2	127	165	251	438					
2000	5,03	13,8	26,6	52,4	78,5	105,5	141	183	279						
2200	5,53	15,2	29,3	57,6	86,4	115	155	202							
2400	6,03	16,6	31,9	62,8	94,2	126	170								
2600	6,53	18,0	34,6	68,1	102	136	184								
2800	7,04	19,4	37,2	73,3	110	147									
2880	**7,24**	**19,9**	**38,3**	**75,4**	**113**	**151**									
3000	7,54	20,7	39,9	78,5	118	157									
3600	9,05	24,9	47,9	94,2											

The figures in heavier type are for standard motor speeds. All these power ratings are calculated at constant torque. For speeds below 100 rev/min and intermediate speeds use nominal torque ratings.

PHYSICAL CHARACTERISTICS – FLEXIBLE TYRES

Characteristics	Coupling Size														
	F40	**F50**	**F60**	**F70**	**F80**	**F90**	**F100**	**F110**	**F120**	**F140**	**F160**	**F180**	**F200**	**F220**	**F250**
Maximum speed rev/min	4500	4500	4000	3600	3100	3000	2600	2300	2050	1800	1600	1500	1300	1100	1000
Nominal Torque Nm T_{KN}	24	66	127	250	375	500	675	875	1330	2325	3770	6270	9325	11600	14675
Maximum Torque Nm $T_{K\,MAX}$	64	160	318	487	759	1096	1517	2137	3547	5642	9339	16455	23508	33125	42740
Torsional Stiffness Nm/°	5	13	26	41	63	91	126	178	296	470	778	1371	1959	2760	3562
Max. parallel misalignment	1,1	1,3	1,6	1,9	2,1	2,4	2,6	2,9	3,2	3,7	4,2	4,8	5,3	5,8	6,6
Maximum end float mm±	1,3	1,7	2,0	2,3	2,6	3,0	3,3	3,7	4,0	4,6	5,3	6,0	6,6	7,3	8,2
Approximate mass, kg	0,1	0,3	0,5	0,7	1,0	1,1	1,1	1,4	2,3	2,6	3,4	7,7	8,0	10	15
Alternating Torque ±Nm @ 10Hz T_{KW}	11	26	53	81	127	183	252	356	591	940	1556	2742	3918	5521	7124
Resonance Factor V_R	7	7	7	7	7	7	7	7	7	7	7	7	7	7	7
Damping Coefficient ψ	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9	0,9

Alternative stiffness tyres F70 to F250 can be supplied depending on the nature of the application.
Maximum torque figures should be regarded as short duration overload ratings for use in such circumstances as direct-on-line starting.
All flexible tyres have an angular misalignment capacity up to 4°.

NOTES ON ORDERING

(a) Flanges 'H', 'F' and SM use Taper Lock® Bushes. Sizes are quoted in the flange dimension tables. The bush should be ordered separately, quoting the bush bore required.

NOTE: *Pay particular attention to the Bush Size in 'F' and 'H' flanges as these can differ.*

(b) 'B' Flanges are supplied pilot bore, or if required finished bore (H7) and keywayed at extra cost.

(c) Spacer couplings are supplied as an assembly consisting of spacer shaft, the rigid flange with associated screws, washers and shaft key. The Fenaflex

SHAFT TO SHAFT COUPLING USING FLEXIBLE TYRE

COMPRISES
2–Flanges
2–T/L bushes (unless bored to size)
1–Flexible tyre

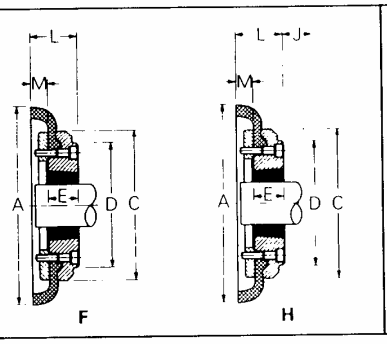
EXAMPLE ORDER
Fenaflex coupling F90BH comprises
1–F90B flange bored 70mm
1–F90H flange
1–2517 T/L Bush
1–F90 Flexible tyre

Fenaflex spacer couplings consist of a standard Fenaflex coupling (using B, F or H flanges as desired) together with a spacer flange and a third Taper Lock® bush.

EXAMPLE ORDER
F110F/SM30/140
2–110F flanges
1–F110 flexible tyre
1–SM30 x 140mm spacer flange
1–3020 T/L bush to suit motor shaft
1–3020 x 60mm T/L bush (dimension 'T')
1–3030 T/L bush to suit driven shaft

Fenaflex® Couplings – Dimensions

SIZES F40 – 60



SIZES F70 – 220

F250 available in B Flange only.

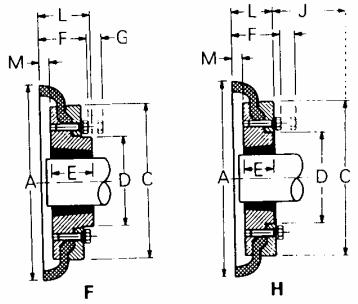
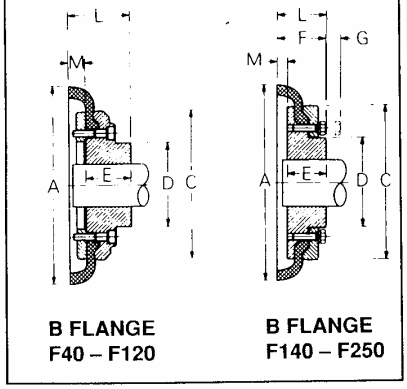


TABLE 8: DIMENSIONS OF FENAFLEX FLANGES TYPES F & H

Catalogue Code	Size	Type	Bush No.	Max Bore		Types F & H			A	C	D	F	G§	M¶	Mass* kg	Inertia* kgm²
				Metric	Inch	L	E	J†								
033A0802	**F40**	F	1008	25	1"	33	22	29	104	82	–	–	–	11	0,8	0.00074
033A0803	**F40**	H	1008	25	1"	33	22	29	104	82	–	–	–	11	0,8	0,00074
033B0802	**F50**	F	1210	32	1¼"	38	25	38	133	100	79	–	–	12,5	1,2	0,00115
033B0803	**F50**	H	1210	32	1¼"	38	25	38	133	100	79	–	–	12,5	1,2	0,00115
033C0802	**F60**	F	1610	42	1⅝"	42	25	38	165	125	103	–	–	16,5	2,0	0,0052
033C0803	**F60**	H	1610	42	1⅝"	42	25	38	165	125	103	–	–	16,5	2,0	0,0052
033D0802	**F70**	F	2012	50	2"	44	32	42	187	144	80	50	13	11,5	3,1	0,009
033D0803	**F70**	H	1610	42	1⅝"	42	25	38	187	144	80	50	13	11,5	3,0	0,009
033E0802	**F80**	F	2517	60	2⅜"	58	45	48	211	167	95	54	16	12,5	4,9	0,018
033E0803	**F80**	H	2012	50	2	45	32	42	211	167	98	54	16	12,5	4,6	0,017
033F0802	**F90**	F	2517	60	2⅜"	59,5	45	48	235	186	108	60	16	13,5	7,0	0,031
033F0803	**F90**	H	2517	60	2⅜"	59,5	45	48	235	188	108	60	16	13,5	7,0	0,031
033G0802	**F100**	F	3020	75	3"	65,5	51	55	254	216	120	62	16	13,5	9,9	0,055
033G0803	**F100**	H	2517	60	2½"	59,5	45	48	254	216	113	62	16	13,5	9,4	0,054
033H0802	**F110**	F	3020	75	3"	63,5	51	55	279	233	134	62	16	12,5	11,7	0,078
033H0803	**F110**	H	3020	75	3"	63,5	51	55	279	233	134	62	16	12,5	11,7	0,078
033J0802	**F120**	F	3525	100	4"	79,5	65	67	314	264	140	67	16	14,5	16,5	0,137
033J0803	**F120**	H	3020	75	3"	65,5	51	55	314	264	140	67	16	14,5	15,9	0,130
033K0102	**F140**	F	3525	100	4"	81,5	65	37	359	311	178	73	17	16	22,3	0,255
033K0103	**F140**	H	3525	100	4"	81,5	65	67	359	311	178	73	17	16	22,3	0,255
033L0102	**F160**	F	4030	115	4½"	92	77	80	402	345	197	78	19	15	32,5	0,380
033L0103	**F160**	H	4030	115	4½"	92	77	80	402	345	197	78	19	15	32,5	0,380
033Q0302	**F180**	F	4535	125	5"	112	89	89	470	398	205	94	19	23	42,2	0,847
033Q0303	**F180**	H	4535	125	5"	112	89	89	470	398	205	94	19	23	42,2	0,847
033M0102	**F200**	F	4535	125	5"	113	89	89	508	429	205	103	19	24	53,6	1,281
033M0103	**F200**	H	4535	125	5"	113	89	89	508	429	205	103	19	24	53,6	1,281
033N0302	**F220**	F	5040	125	5"	129,5	102	92	562	474	223	118	20	27,5	72,0	2,104
033N0303	**F220**	H	5040	125	5"	129,5	102	92	562	474	223	118	20	27,5	72,0	2,104

TABLE 9: DIMENSIONS OF BORED TO SIZE FLANGES (TYPE B)



B FLANGE F40 – F120

B FLANGE F140 – F250

Size	Bore		A	C	D	E	F	G§	L	M¶	Set Screw over key	Approx. Mass (kg)*
	Max.	Min.										
F40	30	13	105	83	–	22	–		33.5	11	M5	0.8
F50	38	18	133	100	79	32	–	–	44.5	12.5	M5	1,4
F60	45	18	165	125	70	38	–	–	55	16,5	M6	2,3
F70	50	19	187	144	76	44	49,5	10	64,5	20	M10	3,5
F80	63	25	211	167	95	51	52,5	13	72	21,5	M10	5,3
F90	75	32	235	189	111	57	58,5	13	80	23	M12	7,6
F100	80	32	254	216	124	60	61	13	84	24	M12	10,6
F110	90	32	279	233	140	65	62,5	13	87,5	22	M12	13,7
F120	100	38	314	264	152	76	70,5	13	101	24,5	M16	17,2
F140	125	60	359	311	195	89	85,5	14	100	13,5	M20	28,3
F160	140	65	395	346	216	102	91,5	15	112,5	11	M20	42,7
F180	150	70	470	398	200	114	99	19	137	23	M20	49,1
F200	180	75	508	429	267	114	128	16	131	16,5	M20	83,0
F220	160	80	562	474	218	127	118	20	154,5	27,5	M20	79,6
F250	190	90	628	532	254	132	125	25	161,5	29,5	M20	104,0

Dimensions in millimetres unless otherwise stated.

§ G is the amount by which clamping screws need to be withdrawn to release tyre.

† J is the wrench clearance to allow for tightening and loosening the bush on the shaft and the clamp ring screws on sizes F40, F50 and F60. The use of a shortened wrench will allow this dimension to be reduced.

SHAFT ALIGNMENT

Appropriate alignment of the coupled shafts (or driven shaft to flywheel) is a fundamental requirement for any coupling installation.

The three basic modes of shaft misalignment are shown right.

Composite i.e. more than one mode, misalignment is available for some couplings (detailed elsewhere in this Manual).

Details of the degrees of misalignment that can be accommodated by different types and sizes of coupling are given throughout this Manual.

With some couplings, axial shaft orientation (DBSE) is not critical, whereupon coupling component orientation (given as an 'assembled length' or 'distance between faces') becomes crucial.

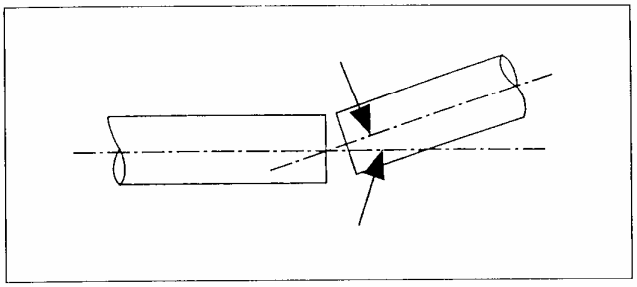
Excepting Universal Joints under angular misalignment, it should be remembered that misalignment can cause extra loading on coupled shaft support bearings and can reduce the operational life of some couplings. Best practical alignment is therefore desirable.

Taper Lock Rigid Couplings cannot accommodate misalignment

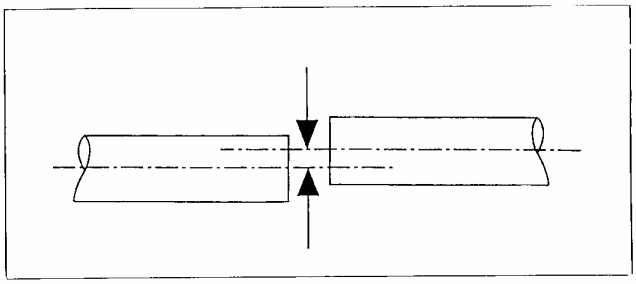
OTHER CRITERIA

Fenaflex - tyre gap and seating. Tyre/element clamping bolt torque.
HRC - do not use to couple resiliently mounted machinery.
All Elastomeric Couplings - consider ambient conditions (FRAS or other alternative element material required?)
All Taper Lock Couplings - remember bush grips shaft first and draws hub on to taper. This may affect axial alignment.
All applications - ensure shaft diameter tolerances are correct.

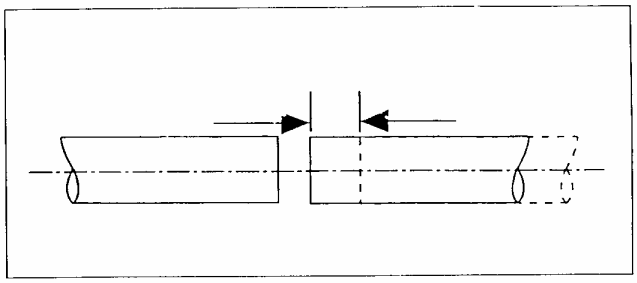
NOTE: Fenaflex tyres and flywheel elements are accompanied by detailed installation data.



ANGULAR MISALIGNMENT – shafts are at an angle to one another



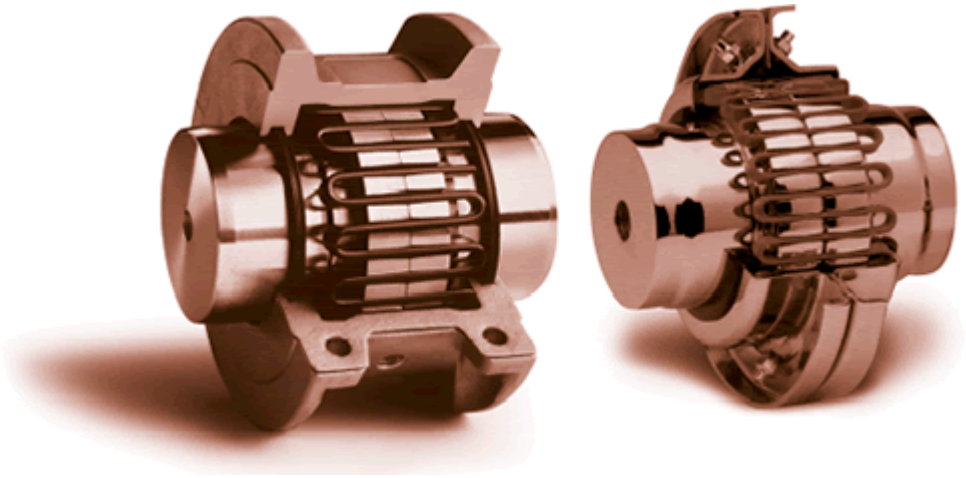
PARALLEL MISALIGNMENT – shafts are in line angularly and parallel to each other, but are off-set.



AXIAL MISALIGNMENT – includes applicational "end float" – shafts move axially increasing or decreasing the distance between shaft ends.

Bibby Transmissions Taper Grid Resilient Couplings

Series 2000H and Series 2000V



Dr James Bibby originally invented the Resilient Coupling in 1917 and the 2000 series is the latest level of this well accepted product. This Bibby Transmissions product has become universally accepted where reliable protection against shaft misalignment and vibration is desirable.

Since those early days refinements in design and material specifications have kept pace with advancing technology, achieving significant improvements in power/weight ratios.

2000H

- ***Horizontally Split Cover***
- ***General purpose***
- ***Easy access to grid minimises downtime***
- ***Ideal for limited space applications***
- ***Stop lug in cover prevents spinning during reversing service***

2000V

- ***Vertically Split Cover***
- ***General purpose***
- ***Ideal for higher running speeds***

High Performance

The Bibby Transmissions Series 2000 Taper Grid Coupling continues that tradition. The tapered grid is made from high tensile alloy steel which is carefully formed to the grid shape before hardening and tempering under controlled conditions. The grid surface is then shot-peened. This process leaves the grid spring with a residually stressed surface layer which is in compression and which impedes the propagation of cracks. Since nearly all fatigue and stress corrosion failures originate at the surface of a part, the layer of compressive stress induced by shot-peening produces a dramatic increase in the working life and fatigue strength of the grid. This technological improvement in manufacturing process coupled with precise monitoring of raw material specification and control of trapezoidal shape, permits Bibby Transmissions to offer state of the art grid springs of high performance and reliability.

Scientific Design

The hub is precision manufactured from high quality materials, with the hub tooth profile scientifically designed to permit progressive loading under torsional shock conditions. The combination of tapered grid and precision manufactured hub provides a high performance transmission arrangement which is easily assembled, extremely capable of cushioning shock loads and allowing for compensation for drive misalignments.

Long Life

Whilst the coupling is designed for long life under arduous conditions, maintenance and taper grid replacement can be performed quickly and easily without the need to move and realign connected equipment.

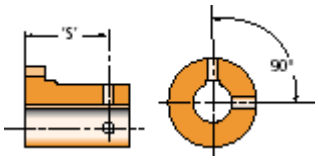
Two cover design options are available in the Bibby Transmissions Series 2000 range of couplings. Both designs have beencarefully engineered to match the qualitystandards of the key components and to provide a shaft coupling which is highlyreliable and easy to install.

Recommended Fits between Shafts and Hubs

Coupling bore tolerances for sizes up to and including 2090T can be specified to suit a transition fit with the shaft. In these instances axial restraint of the hub should be provided by set screws. Relative sizes and positions are given in the following table.

For sizes above 2090T or where interference fits are preferred for smaller coupling sizes, bore tolerances should provide an interference fit between shaft and hub of 0.0002 to 0.0007mm per mm of diameter

Set Screw Ø x Length (Cone Point)	Position from Hub Faces
M5 X 5	35 40
M6 X 6	40 45 53
M8 X 8	54 65
M10 X 10	72

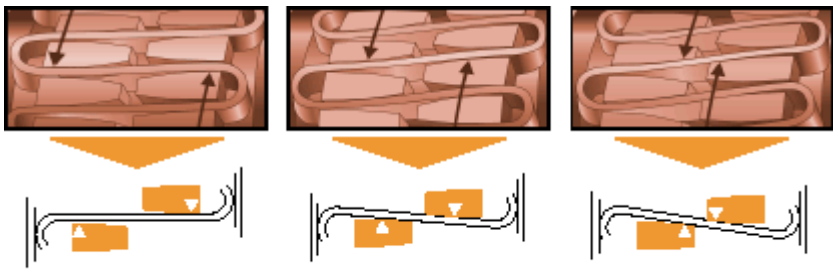


Bibby Transmissions Taper Grid Resilient Couplings

Principle

Positive protection against the damaging effects of shock loads, impact loads and vibration.

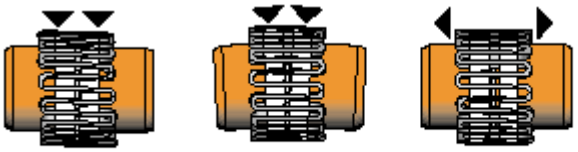
The Series 2000 is torsionally flexible. The circumferential flexibility is progressive due to the curved profile of the grooves - 'state-of-the-art' in resilient coupling design.



Light load *Normal load* *Shock load*

Accommodating Shaft Misalignment and End-Float

The Series 2000 will accommodate combinations of misalignments present at set-up or occurring during machine displacement, settlement etc.

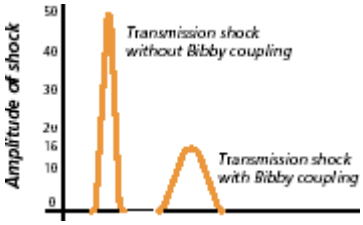


Parallel *Angular* *End-Float*

Limited End-Float kits are available on request.

Effectiveness of Torsional Damping

As the Series 2000 coupling transmits torque, the flexing of the tapered grid spring de-tunes vibrations and cushions shock loads.



This unique charecteristic is due to the torsional flexibility of the coupling being proportionate to the unsuppotred length of each flexible grid rung. since this varies with every variation of torque, a powerful de-tuning action is produced which continuously alters the natural frequency of the system and prevents a build-up of resonance in the system. The resultant reduction in peak loading protects and extends the life of the transmission equipment.

Versatile Design

Both 2000H and 2000V couplings feature identical hubs and grid springs, the different cover styles endowing the units with great versatility - one is horizontally split, the other is vertically split.

All coupling components are designed to be interchangeable with other taper grid couplings.

The stock coupling can be used vertically or horizontally without modification.

Easy Installation and Maintenance

The grid springs are easily installed by hand or with a soft mallet. The cover fasteners can be tightened with standard wrenches. Every Bibby Transmissions' Series 2000 coupling is delivered with detailed installation instructions.

Periodic lubrication of the coupling is required and each cover half is supplied with standard plugs which can be easily removed for re-lubrication. Extended lubrication periods and enhanced coupling life can be achieved by using high performance lubricants referred to in the maintenance instructions.

Selection Examples

1. Nominal Torque (simple selection method)

A 4 cyl. diesel engine driven generator set of 280 kW runs at 1000 rpm. Output and input shafts are identical being 90mm dia x 130mm long. A Bibby type TH, horizontally split, coupling is specified for ease of assembly.

- The service factor from page 2, Table 1 = 1.0: Additional factor (engine) from Table 1A = 1.0: Total = 2.0
- From Table 1A (SF = 2): equivalent: kW = 560
- From Table on page 12, coupling to transmit 560 kW @ 1000 rpm = 2100
- From Table on page 12, allowable speed for 2100T = 2440 rpm Max bore and overall dimensions are satisfactory.

2. Nominal Torque (formula method)

An electric motor of 300 kW is to be coupled to drive a rotary screw compressor at 1000 rpm. Motor shaft is 85mm dia x 110mm long. Compressor shaft 75mm x 100mm long. A Bibby type TV, vertically split, coupling is required.

- From Table 1 service factor = 1.0. Calculate torque:-Nm = Transmitted kW x SF x (9550/rpm) = 300 x 1 x (9550/1000) 2867 Nm.
- From the table on page 13, coupling 2090 has rating in excess of required torque. Max rpm = 4000; Max bore 95mm; bore length 98.4mm make the 2090 selection satisfactory.

3. Peak Torque (formula method)*

An extruder drive running at 300 rpm has a known peak torque of 11000 Nm. The connected shafts are each 120mm dia x 160mm long. Select a Bibby type TH, horizontally split, coupling to suit the known peak unidirectional torque of 11000 Nm. From the table on page 12, coupling 2120 has torque exceeding calculated peak torque. Coupling max rpm is 2025. Max bore 137mm is greater than shaft diameter. Overall length is satisfactory.

*1. The system peak torque is the maximum load created by the driving or driven equipment.

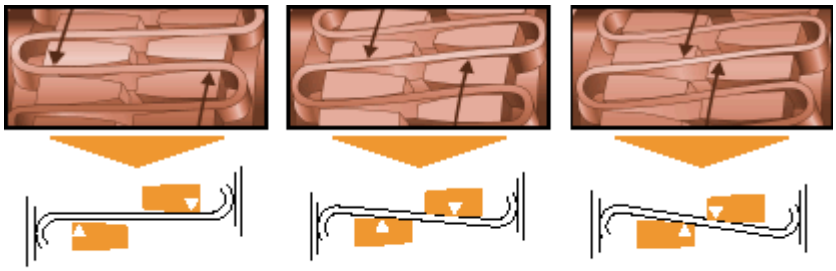
2. Occasional peak torques of twice the catalogue rating can be accommodated providing they occur less than 1000 times during the life of the coupling.

Bibby Transmissions Taper Grid Resilient Couplings

Principle

Positive protection against the damaging effects of shock loads, impact loads and vibration.

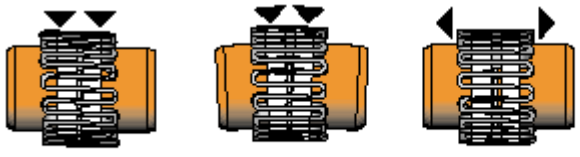
The Series 2000 is torsionally flexible. The circumferential flexibility is progressive due to the curved profile of the grooves - 'state-of-the-art' in resilient coupling design.



Light load *Normal load* *Shock load*

Accommodating Shaft Misalignment and End-Float

The Series 2000 will accommodate combinations of misalignments present at set-up or occurring during machine displacement, settlement etc.

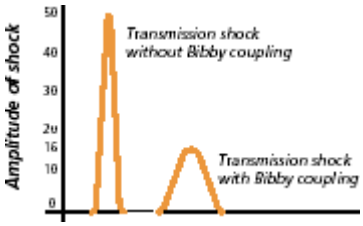


Parallel *Angular* *End-Float*

Limited End-Float kits are available on request.

Effectiveness of Torsional Damping

As the Series 2000 coupling transmits torque, the flexing of the tapered grid spring de-tunes vibrations and cushions shock loads.



This unique charecteristic is due to the torsional flexibility of the coupling being proportionate to the unsuppotred length of each flexible grid rung. since this varies with every variation of torque, a powerful de-tuning action is produced which continuously alters the natural frequency of the system and prevents a build-up of resonance in the system. The resultant reduction in peak loading protects and extends the life of the transmission equipment.

Versatile Design

Both 2000H and 2000V couplings feature identical hubs and grid springs, the different cover styles endowing the units with great versatility - one is horizontally split, the other is vertically split.

All coupling components are designed to be interchangeable with other taper grid couplings.

The stock coupling can be used vertically or horizontally without modification.

Easy Installation and Maintenance

The grid springs are easily installed by hand or with a soft mallet. The cover fasteners can be tightened with standard wrenches. Every Bibby Transmissions' Series 2000 coupling is delivered with detailed installation instructions.

Periodic lubrication of the coupling is required and each cover half is supplied with standard plugs which can be easily removed for re-lubrication. Extended lubrication periods and enhanced coupling life can be achieved by using high performance lubricants referred to in the maintenance instructions.

Selection Examples

1. Nominal Torque (simple selection method)

A 4 cyl. diesel engine driven generator set of 280 kW runs at 1000 rpm. Output and input shafts are identical being 90mm dia x 130mm long. A Bibby type TH, horizontally split, coupling is specified for ease of assembly.

- The service factor from page 2, Table 1 = 1.0: Additional factor (engine) from Table 1A = 1.0: Total = 2.0
- From Table 1A (SF = 2): equivalent: kW = 560
- From Table on page 12, coupling to transmit 560 kW @ 1000 rpm = 2100
- From Table on page 12, allowable speed for 2100T = 2440 rpm Max bore and overall dimensions are satisfactory.

2. Nominal Torque (formula method)

An electric motor of 300 kW is to be coupled to drive a rotary screw compressor at 1000 rpm. Motor shaft is 85mm dia x 110mm long. Compressor shaft 75mm x 100mm long. A Bibby type TV, vertically split, coupling is required.

- From Table 1 service factor = 1.0. Calculate torque:-Nm = Transmitted kW x SF x (9550/rpm) = 300 x 1 x (9550/1000) 2867 Nm.
- From the table on page 13, coupling 2090 has rating in excess of required torque. Max rpm = 4000; Max bore 95mm; bore length 98.4mm make the 2090 selection satisfactory.

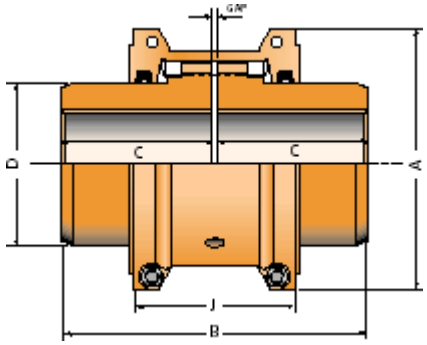
3. Peak Torque (formula method)*

An extruder drive running at 300 rpm has a known peak torque of 11000 Nm. The connected shafts are each 120mm dia x 160mm long. Select a Bibby type TH, horizontally split, coupling to suit the known peak unidirectional torque of 11000 Nm. From the table on page 12, coupling 2120 has torque exceeding calculated peak torque. Coupling max rpm is 2025. Max bore 137mm is greater than shaft diameter. Overall length is satisfactory.

*1. The system peak torque is the maximum load created by the driving or driven equipment.

2. Occasional peak torques of twice the catalogue rating can be accommodated providing they occur less than 1000 times during the life of the coupling.

Series 2000H - Horizontally Split Cover Couplings



Size	Coupling Rating Nm	Max Speed	Min Bore mm	② Max Bore mm	① Cplg Wt. kg	① MR²/ kgm²	Dimensions in mm					
							A	B	C	D	J	Gap
2020	48	4500	13	27	1.8	0.0014	102	98	47.5	39.7	67	3.2
2030	136	4500	13	35	2.4	0.0022	111	98	47.5	49.2	68	3.2
2040	226	4500	13	44	3.2	0.0033	118	105	50.8	57.2	70	3.2
2050	395	4500	13	51	5.2	0.007	138	124	60.3	66.7	79	3.2
2060	621	4350	19	57	7.1	0.012	151	130	63.5	76.2	92	3.2
2070	904	4125	19	68	10.1	0.018	162	156	76.2	87.3	95	3.2
2080	1864	3600	25	83	17.7	0.045	194	181	88.9	104.8	116	3.2
2090	3390	3600	25	95	24.5	0.0787	213	200	98.4	123.8	122	3.2
2100	5706	2440	42	108	41.3	0.18	251	246	120.6	142.1	156	4.8
2110	8474	2250	42	117	53.6	0.27	270	259	127	160.4	163	4.8
2120	12428	2025	60	137	78.7	0.51	308	305	149.2	179.4	192	6.4
2130	18078	1800	66	165	118	0.99	347	330	161.9	217.5	195	6.4
2140	25987	1650	66	184	176	1.85	384	375	184.1	254	201	6.4
2150	37000	1500	108	215	228	3.49	453	372	183	270	272	6.4
2160	51000	1350	120	240	310	5.82	502	402	198	305	278	6.4
2170	67800	1225	135	280	448	10.42	567	438	216	356	307	6.4
2180	94000	1100	150	300	619	18.3	630	484	239	394	321	6.4
2190	124000	1050	150	335	776	26.14	676	524	260	437	325	6.4
2200	169000	900	178	360	1057	43.49	757	565	280	498	356	6.4

1) Coupling weight and MR² with no bore.

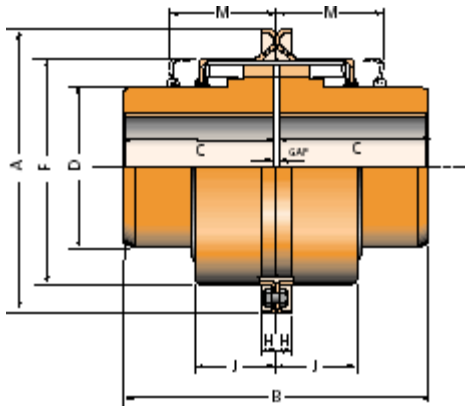
2) Max bores stated above use rectangular parallel keyways to BS 4235 pt 1 1972 or DIN 6885 sht 1 1969

3) Other couplings available are spacer and

half spacer models. Also couplings with disc or drum brakes can be supplied

Bibby Transmissions Taper Grid Resilient Couplings

Series 2000V - Vertically Split Cover Couplings



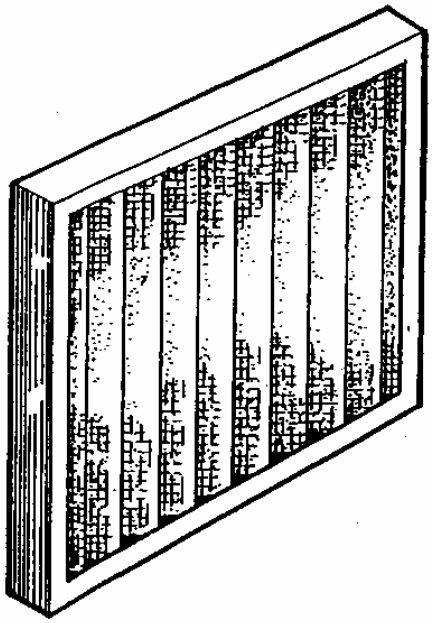
Cplg. Size	Coupling. Rating Nm	Max rpm	① Min Bore mm	② Max Bore mm	① Cplg Wt kg	MR² kgm²	Dimensions in mm								
							A	B	C	D	F	H	J	M	GAP
2020	48	6000	13	27	1.6	0.0011	111	98	47.5	39.7	63	9.5	24.4	48	3.2
2030	136	6000	13	35	2.2	0.0018	121	98	47.5	49.2	72	9.5	25.2	48	3.2
2040	226	6000	13	44	3.0	0.0027	129	105	50.8	57.2	80	9.5	26.0	51	3.2
2050	395	6000	13	51	5.0	0.0063	148	124	60.3	66.7	97	13.0	31.4	61	3.2
2060	621	6000	19	57	6.7	0.010	162	130	63.5	76.2	110	13.0	32.2	64	3.2
2070	904	5500	19	68	9.7	0.016	173	156	76.2	87.3	121	13.0	33.8	67	3.2
2080	1864	4750	25	83	16.6	0.039	200	181	88.9	104.8	149	13.0	44.1	89	3.2
2090	3390	4000	25	95	23.6	0.072	232	200	98.4	123.8	168	13.0	47.3	96	3.2
2100	5706	3250	42	108	39.5	0.172	267	246	120.6	142.1	198	16.0	60.2	121	4.8
2110	8474	3000	42	117	51.9	0.261	286	259	127.0	160.4	216	16.0	63.3	124	4.8
2120	12428	2700	60	137	75.8	0.500	319	305	149.2	179.4	246	16.0	73.8	143	6.4
2130	18078	2400	66	165	115.0	1.080	378	330	161.9	217.5	284	22.0	75.4	147	6.4
2140	25987	2200	66	184	173.0	1.895	416	375	184.1	254.0	322	22.0	78.5	156	6.4

APPENDIX E FILTER INSTRUCTIONS

Bulletin VF/1

Veeform

Extended Surface Panel Filters



WIDE RANGE OF FILTER SIZES

WIDE CHOICE OF FILTER MEDIA

WASHABLE OR DISPOSABLE

CHOICE OF FILTER DEPTH 25 mm to 200 mm

Description

The Rainbow Veeform Filter is designed to provide a high capacity flow rate for standard face area filter cells at the normally acceptable resistance required for air conditioning systems.

The great advantage of this type of construction is the wide variation available in the form of the filter. There is a wide range of filter media and the Vee depth comes in a range of thicknesses - from 25mm to 200mm.

PLEASE NOTE: Special Sizes can be made to order

Notes on Veeform

Extended Surface Panel Filters

The Rainbow Extended Surface VEEFORM filter has the filter media supported on each side by a light, but strong galvanized weldmesh. When this "sandwich" is formed into a series of vees it creates a strong and rigid filtering surface.

The Filter Material, the number of pleats, and the depth of the pleat dictates the resistance, efficiency, and the dust holding capacity of the Veeform Filter.

These filters come in a variety of forms:-

(a) Steel frame with washable material
(b) Light metal frame with non-washable material
(c) Cardboard frame with non-washable material

The great advantage of this type of construction is the wide variation in the form of the filter. Vee depth can range from 25mm to 200mm.

Test results on our HC-40 (100mm depth) using HE media, show a maximum efficiency of 100% with No. 2 Test Dust and 24.5% with No.1 Test Dust.

The variations that are available are too numerous to detail here. However we will make VEEFORM EXTENDED SURFACE PANEL FILTERS to any specifications that are required.

Rainbow FILTERS

THE CLEAN AIR PEOPLE

Rainbow Filters Pty. Ltd.
A.C.N. 004 450 837
42 - 46 Osboldstone Road
Wangaratta. VIC 3677
AUSTRALIA

"*Rainbow*" VEEFORM FILTER

VF/RMM20

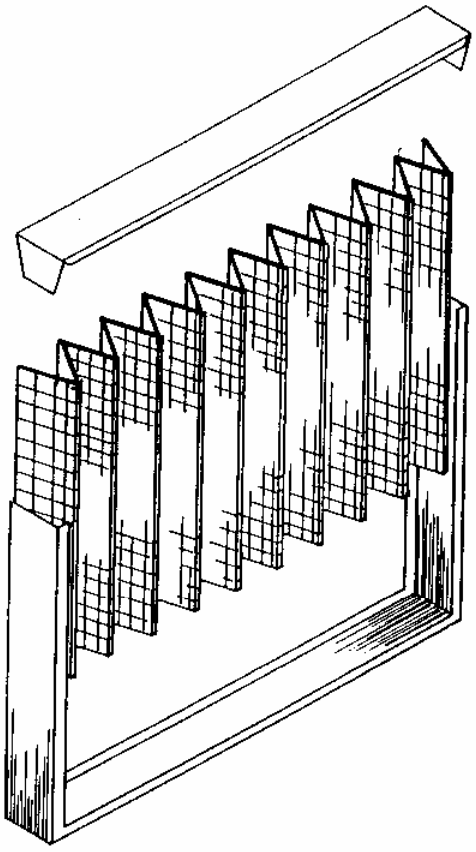
TECHNICAL DATA SHEET

Test Velocity	2.04 m/s
Initial Resistance	66 pa
Average Efficiency (No 4 test dust)	87.7%
Dust Holding Capacity	355 g/sq. metre
Final Resistance	250 pa

FILTER CODE	ACTUAL SIZE	CAPACITY - l/s
EAAW-01	495 x 394 x 50mm	400
EAAW-02	495 x 495 x 50mm	500
EAAW-03	622 x 394 x 50mm	500
EAAW-04	622 x 495 x 50mm	640
EAAW-05	749 x 495 x 50mm	750
✳ EAAW-06	597 x 597 x 50mm	720
EAAW-08	597 x 292 x 50mm	360

Rainbow FILTERS

MAINTENANCE INSTRUCTIONS



RESISTANCE INDICATOR

Where a manometer is installed across the filter bank, the filter should be cleaned when the resistance is double the initial (clean) resistance, or when the resistance reaches 125 pascals.

Where a manometer is not employed, it is recommended that the filters are washed monthly for most general air conditioning applications. More frequent cleaning may be required if the installation is subject to high dust concentration.

WASHING

Remove the complete filter cell from the holding frame and hose with cold water from the clean air side. Shake out the excess moisture and replace the filter in the holding frame. (It is not necessary to remove the crimped media from the filter frame for washing.

REPLACING CRIMPED MEDIA

Remove the filter from the holding frame and remove the top member of the channel surround by drilling rivets (2 per side). Remove the old crimped media and slide new pleated element into position ensuring that the end pleats seal in the side channels.

HOLDING FRAMES

Before replacing the Filter Cell the Holding Frame should be inspected for possible damage to the seal and the universal clips.

VEEFORM VF FILTERS

EXTENDED SURFACE PANEL TYPE

THE CLEAN AIR PEOPLE

Rainbow Filters Pty. Ltd.
A.C.N. 004 450 837
42 - 46 Osboldstone Road
Wangaratta. VIC 3677
AUSTRALIA

RAINBOW MICROMAT MEDIA

R M M 2 0

RAINBOW MICROMAT FILTER MEDIA RMM20 is a washable media that meets the industry requirements for a washable media with a good service life and offers a EU3 rating.

RMM20's dust holding capacity gives a good service life when used in our extended surface filters such as the Maxi Wedge Filter.

This media has a nominal thickness of 23mm and is clearly marked "RAINBOW MICROMAT MEDIA RMM20" on the clean air side. Rainbow Filters carry this material in a variety of roll widths for your convenience.

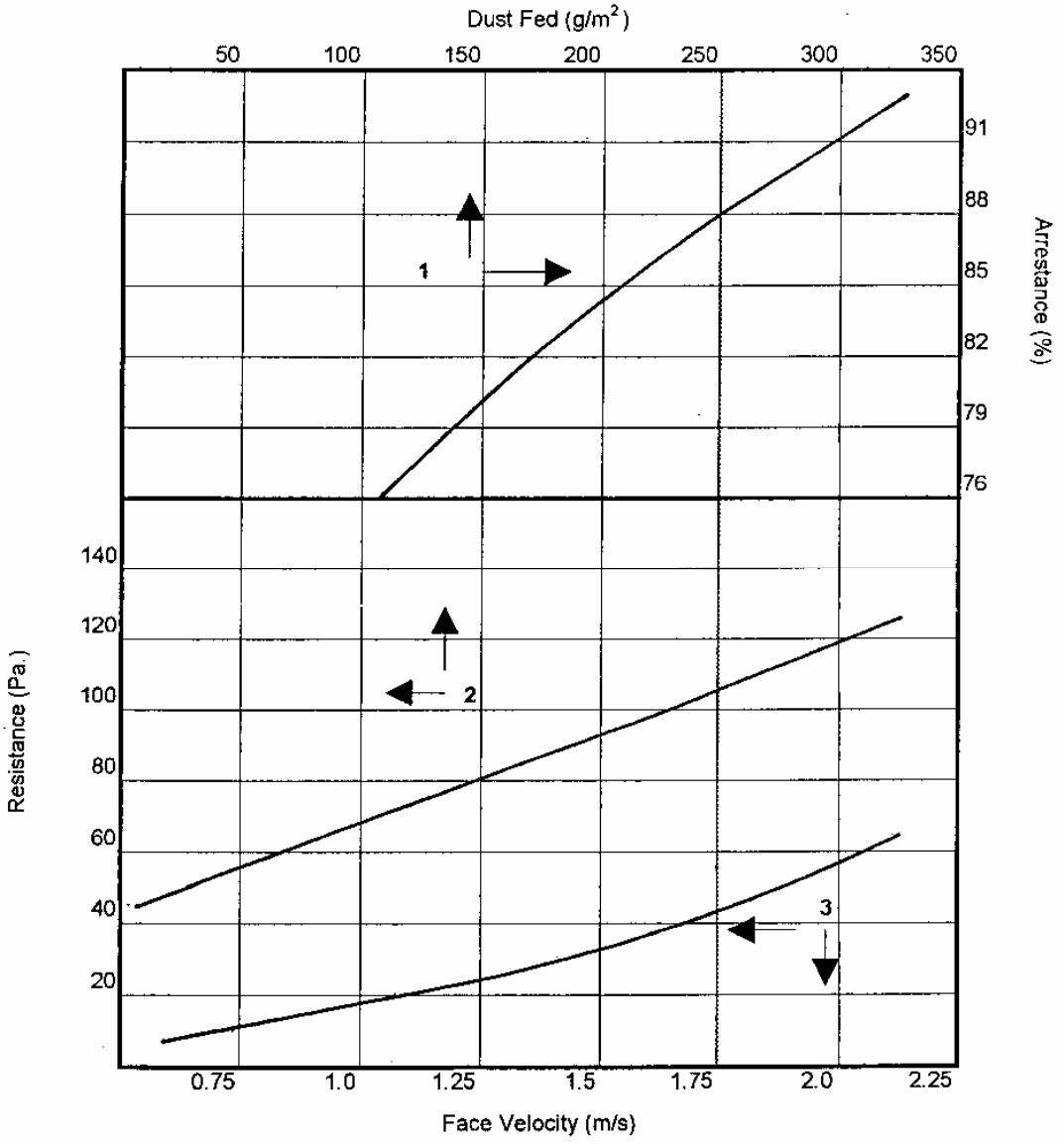
Available roll widths :-

2000mm wide x 20 metres
1220mm wide x 20 metres
1000mm wide x 20 metres
610mm wide x 20 metres
500mm wide x 20 metres
406mm wide x 20 metres
305mm wide x 20 metres

TECHNICAL DATA

Temperature Resistance	100° C Continuous
Fire Resistance	Manufactured with a fire retardent resin.
Initial Resistance	
At rated flow of 1.78 m/s	45 Pa
AS1132 No 4 test dust	
Average Arrestance	84.5 %
Dust Holding No 4 test dust (final pressure drop of 125 Pa)	
Per unit of effective face area	275 g/m^2

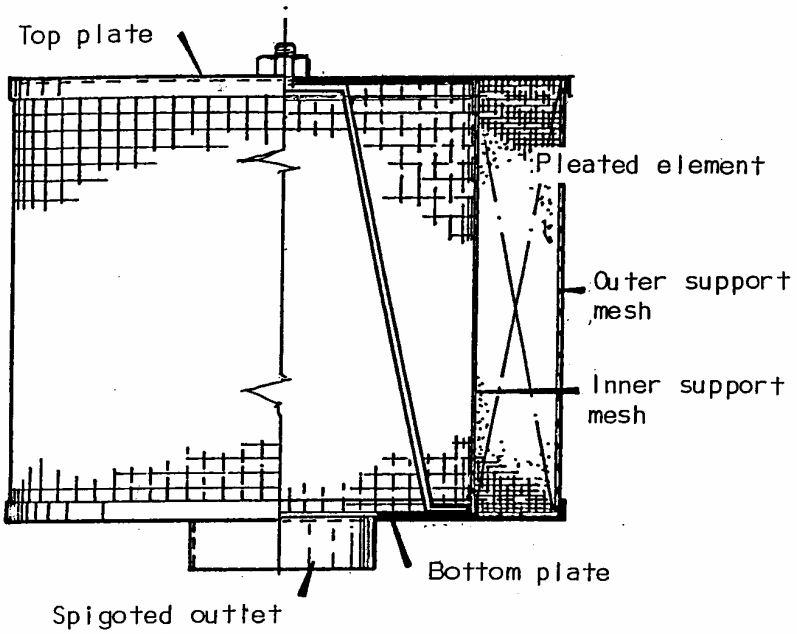
RAINBOW MICROMAT MEDIA
R M M 2 0



Note : Due to our policy of continuous research and development specifications are subject to change without notice.

1. Arrestance versus Dust Fed
2. Pressure Drop versus Dust Fed.
3. Pressure Drop versus Air Velocity.

MAINTENANCE INSTRUCTIONS



RESISTANCE INDICATOR

Where a manometer is installed across the filter bank, the filter should be cleaned when the resistance is double the initial (clean) resistance, or when the resistance reaches 125 pascals.

Where a manometer is not employed, it is recommended that the filters are washed monthly for most general air conditioning applications. More frequent cleaning may be required if the installation is subject to high dust concentration.

WASHING

First remove the TOP PLATE from the Circular Filter Cell then the CRIMPED MEDIA may be removed and hosed with cold water from the clean air side. Shake out the excess moisture and replace the CRIMPED MEDIA in the Circular Filter. (It is necessary to remove the crimped media from the filter for washing).

REPLACING CRIMPED MEDIA

Remove the TOP PLATE from the Circular Filter and remove the old crimped media. Slide the new pleated element into position ensuring that the ends of the pleats seal evenly against the bottom circular plate. Replace the TOP PLATE ensuring that the pleated element seals evenly against the top plate and that the plate is sitting squarely on the filter. It should not be necessary to remove the Circular Filter from its permanent position.

VEEFORM CVF FILTERS

EXTENDED SURFACE CIRCULAR TYPE

APPENDIX F MOTOR MANUAL

Page No

INSTALLATION AND MAINTENANCE INSTRUCTIONS FOR ELECTRIC MOTORS — ENGLISH

INSTRUCCIONES PARA LA INSTALACIÓN Y MANTENIMIENTO DE MOTORES ELÉCTRICOS — ESPAÑOL

BETRIEBS - UND WARTUNGSANLEITUNGEN FÜR ELEKTROMOTOREN — DEUTSCH

INSTRUCTIONS POUR INSTALLATION ET MANUTENTION DE MOTEURS ÉLECTRIQUES — FRANÇAIS

ISTRUZIONI D'USO E MANUTENZIONE PER MOTORI ELETTRICI — ITALIANO

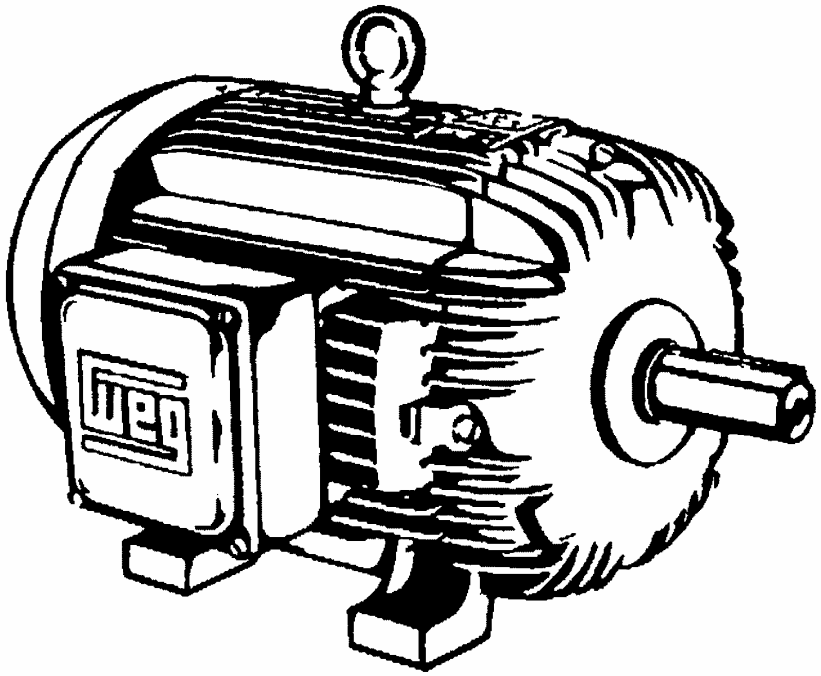
INSTALLATIONS-OG VEDLIGEHOLDELSESVEJLEDNING FOR ELEKTRISKE MOTORER — DANSK

INSTALLATIONS- OCH UNDERHÅLLSINSTRUKTIONER FÖR ELEKTRISKA MOTORER — SVENSKA

ИНСТРУКЦИЯ ПО УСТАНОВКЕ И ТЕХНИЧЕСКОМУ ОБСЛУЖИВАНИЮ ЭЛЕКТРИЧЕСКИХ ДВИГАТЕЛЕЙ — РУССКИЙ

MOTORS AND DRIVERS

CE



0280.1400

READ CAREFULLY THIS MANUAL BEFORE INSTALLING THE MOTOR

RECEIVING CHECK

Check if any damage has occured during transportation.

✓Check nameplate data.

✓Remove shaft locking device (if any) before operating the motor.

✓Turn the shaft with the hand to make sure it is turning freely.

HANDLING AND TRANSPORTATION

1 - General

MOTORS MUST NOT BE LIFTED BY THE SHAFT, BUT BY THE EYEBOLTS

Lifting devices, when supplied, are designed only to support the motor. If the motor has two lifting devices then a double chain must be used to lift it.

Lifting and lowering must be done gently without any shocks, otherwise the bearings can get damaged.

DURING TRANSPORTATION, MOTORS FITTED WITH ROLLER OR ANGULAR CONTACT BEARINGS ARE PROTECTED AGAINST BEARING DAMAGES WITH A SHAFT LOCKING DEVICE.

THIS LOCKING DEVICE MUST BE USED ON ANY FURTHER MOTOR TRANSPORTATION, EVEN WHEN THIS MEANS TO UNCOUPLE THE MOTOR FROM THE DRIVEN MACHINE.

STORAGE

If motors are not immediately installed, they must be stored in dry places, free of dust, vibrations, gases, corrosive smokes, under constant temperature and in normal position free from other objects.

Motor storage temperature must remain between 5°C to 60°C, with relative humidity not

In case the motors are stored for more than two years, the bearings must be replaced or the lubrication grease must be totally removed after cleaning.

Single phase motors when kept in stock for 2 years or more must have their capacitors replaced (if any).

We recommend to turn the shaft (by hands) at least once a month, and to measure the insulation resistance before installing it, in cases of motors stored for more than 6 months or when subject to high humidity areas.

If motor is fitted with space heaters, these should be switched on.

Insulation Resistance Check

Measure the insulation resistance before operating the motor and/or when there is any sign of humidity in the winding.

The resistance measured at 25°C must be:

$$Ri \geq (20 \times U) / (1000 + 2P)\ [M\Omega]$$

(measured with a MEGGER at 500 V d.c.)
where U = voltage (V); P = power (kW).

If the insulation resistance is less than 2 megaohms, the winding must be dried according to the following:

Warm it up inside an oven at a minimum temperature of 80°C increasing 5°C every hour until 105°C, remaining under this temperature for at least one hour.

Check if the stator insulation resistance remains constant within the accepted values. If not, stator must be reimpregnated.

INSTALLATION

1 - Safety

All personnel involved with electrical installations, either handling, lifting, operation or maintenance must be well informed and updated concerning safety standards and principles that govern the work and carefully follow them.

We strongly recommend that these jobs

MAKE SURE THAT ELECTRIC MOTORS ARE SWITCHED OFF BEFORE STARTING ANY MAINTENANCE SERVICE.

Motors must be protected against accidental starts.

When performing any maintenance service, disconnect the motor from the power supply. Make sure all accessories have been switched off and disconnected.

In order to prevent from penetrating dust and/or water into the terminal box, cable glands or threaded pipe in the lead holes must be installed.

Do not change the regulation of the protecting devices to avoid damaging.

2 - Operating Conditions

Electric motors, in general, are designed for operation at an altitude of 1000m above sea level for an ambient temperature between 0°C and 40°C. Any variation is stated on the nameplate.

COMPARE THE CURRENT, VOLTAGE, FREQUENCY, SPEED, OUTPUT AND OTHER VALUES DEMANDED BY THE APPLICATION WITH THE DATA GIVEN ON THE NAMEPLATE.

Motors supplied for hazardous locations must be installed in areas that comply with that specified on the motor nameplate.

KEEP AIR INLET AND OUTLET FREE AND CLEAN. THE AIR BLOWN OUT BY THE MOTOR SHALL NOT ENTER AGAIN. THE DISTANCE BETWEEN THE AIR INLET AND THE WALL MUST BE AROUND ¼ OF THE INLET OPENING DIAMETER.

3 - Foundation

Motors provided with feet must be installed on solid foundations to avoid excessive vibrations.

The purchaser is fully responsible for the foundation.

Metal parts must be painted to avoid corrosion.

The foundation must be uniform and sufficiently tough to support any schock. It must be designed in such a way to stop any vibration originated from resonance.

4 - Drain Holes

Make sure the drains are placed in the lower part of the motor when the mounting configuration differs from that specified on the motor purchase order.

5 - Balancing

WEG MOTORS ARE DYNAMICALLY BALANCED WITH HALF KEY, AT NO LOAD AND UNCOUPLED.

Transmission elements such as pulleys, couplings, etc must be dynamically balanced with half key before installation.
Use always appropriate tools for installation and removal.

6 - Alignment

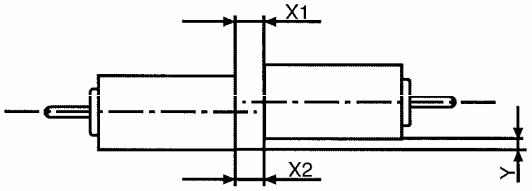
ALIGN THE SHAFT ENDS AND USE FLEXIBLE COUPLING, WHENEVER POSSIBLE.

Ensure that the motor mounting devices do not allow modifications on the alignment and further damages to the bearings.

When assembling a half-coupling, be sure to use suitable equipment and tools to protect the bearings.

Suitable assembly of half-coupling:

Check that clearance **Y** is less than 0.05 mm and that the difference **X1** to **X2** is less than 0.05 mm, as well.



Note: Dimension X1 and X2 must be 3mm minimum

Figure and alignment tolerances

7 - Belt Drive

When using pulley or belt coupling, the following must be observed:

Belts must be tighten just enough to avoid slippage when running, according to the

specifications stated on the belt supplier recommendation.

WARNING:
Excessive tension on the pulleys will damage the bearings and lead to a probable shaft rupture.

8 - Connection

WARNING:

Voltage may be connected at standstill inside the terminal box for heating elements or direct winding heating.

WARNING:

The capacitor on single-phase motors can retain a charge which appears across the motor terminals, even when the motor has reached standstill.

A WRONG CONNECTION CAN BURN THE MOTOR.

Voltage and connection are indicated on the nameplate. The acceptable voltage variation is ±10% ; the acceptable frequency variation is ±5% and the total acceptable variation is ± 10% .

9 - Starting Methods

The motor is rather started through direct starting. In case this is not possible, use compatible methods to the motor load and voltage.

The rotation direction is clockwise if the motor is viewed from DE side and if the phases are connected according to the sequence L1, L2, L3.

To change the rotation direction, interchange two of the connecting leads.

THE CONNECTION TO THE POWER SUPPLY MUST BE DONE BY QUALIFIED PERSONNEL AND WITH FULL ATTENTION TO ASSURE A SAFE AND PERMANENT CONNECTION. AFTER CONNECTING THE MOTOR, CHECK FOR ANY STRANGE BODY INSIDE THE TERMINAL BOX. THE CABLE INLETS NOT IN USE MUST BE CLOSED.

Make sure to use the correct cable dimension, based on the rated current stamped on the motor nameplate.

BEFORE ENERGIZING THE TERMINALS, CHECK IF THE GROUNDING IS MADE ACCORDING TO THE CURRENT STANDARDS. THIS IS ESSENTIAL AGAINST ACCIDENT RISKS.

When the motor is supplied with protective or monitor temperature device such as thermostats, thermistors, termal protector, etc, connect their terminals to the corresponding devices on the control panel.

10 - Start-Up

THE KEY MUST BE FASTENED OR REMOVED BEFORE STARTING THE MOTOR.

a) The motor must start and operate smoothly. In case this does not occur, turn it off and check the connections and the mounting before starting it again.

b) If there is excessive vibration, check if the fastening screws are correctly fastened. Check also if the vibration comes from a neighbour machine. Periodical vibration checks must be done.

c) Run the motor under rated load for a short period of time and compare if the running current is equal to that stamped on the nameplate.

MAINTENANCE

WARNING:
SAFETY CHECK LIST

1 - General Inspection

✓Check the motor periodically.
✓Keep the motor clean and assure free air flow.
✓Check the seals or V Ring and replace them, if required.
✓Check the connections as well as supporting screws.
✓Check the bearings and observe: Any excessive noise, vibration, bearing temperature and grease condition.
✓When a change, under normal conditions, is detected, check the motor and replace the required parts.

ENGLISH

The frequency of the inspections depends on the motor type and on the application conditions.

LUBRICATION

FOLLOW THE REGREASING INTERVALS. THIS IS FUNDAMENTAL FOR PROPER MOTOR OPERATION.

1 - Machines without Grease Nipples

Motors up to frame 200 are normally fitted without grease nipples. In these cases the regreasing shall be done at the preventive maintenance job observing the following aspects:

✓Disassemble carefully the motors.
✓Take all the grease out.
✓Wash the bearing with querosene or diesel.
✓Regrease the bearing immediately.

2 - Machines Fitted with Grease Nipples

It is strongly recommended to grease the machine while running. This allows the grease renewal in the bearing housing. When this is not possible due to turning parts by the grease device (pulleys, bushing, etc) that offer some risk to the physical integrity of the operator, proceed as follows:
✓Clean the area near the grease nipple.
✓Put approximately half of the total grease and run the motor for 1 minute at full speed.
Then turn off the motor and insert the rest of the grease.
✓The injection of all the grease with the motor in standstill can make the grease penetrate into the motor, through the inner seal of the bearing housing.

FOR LUBRICATION USE ONLY MANUAL GREASE GUN.

RELUBRICATION INTERVALS

TABLE 1 - BALL BEARINGS - Series 62/63

Relubrication intervals (running hours – horizontal position)

	II pole		IV pole		VI pole		VIII pole		X pole		XII pole		Grease
						Serie 62							
Bearing	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	(g)
6209	18400	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	9
6211	14200	16500	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	11
6212	12100	14400	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	13
						Serie 63							
Bearing	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	(g)
6309	15700	18100	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	13
6311	11500	13700	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	18
6312	9800	11900	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	21
6314	3600	4500	9700	11600	14200	16400	17300	19700	19700	20000	20000	20000	27
6316	-	-	8500	10400	12800	14900	15900	18700	18700	20000	20000	20000	34
6319	-	-	7000	9000	11000	13000	14000	17400	17400	18600	18600	20000	45
6322	-	-	5100	7200	9200	10800	11800	15100	15100	15500	15500	19300	60

TABLE 2 - ROLLER BEARINGS - Series NU 3

Relubrication intervals (running hours – horizontal position)

	II pole		IV pole		VI pole		VIII pole		X pole		XII pole		Grease
Bearing	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	60Hz	50Hz	(g)
NU 309	9800	13300	20000	20000	20000	20000	20000	20000	20000	20000	20000	20000	13
NU 311	6400	9200	19100	20000	20000	20000	20000	20000	20000	20000	20000	20000	18
NU 312	5100	7600	17200	20000	20000	20000	20000	20000	20000	20000	20000	20000	21
NU 314	1600	2500	7100	8900	11000	13100	15100	16900	16900	19300	19300	20000	27
NU 316	-	-	6000	7600	9500	11600	13800	15500	15500	17800	17800	20000	34
NU 319	-	-	4700	6000	7600	9800	12200	13700	13700	15700	15700	20000	45
NU 322	-	-	3300	4400	5900	7800	10700	11500	11500	13400	13400	17300	60
NU 324	-	-	2400	3500	5000	6600	10000	10200	10200	12100	12100	15000	72

Note:
✓The ZZ bearings from 6201 to 6307 do not require relubrication as its life time is about 20,000 hours.
✓Tables 1 and 2 are intended for the lubrication period under bearing temperature of 70°C (for bearings up to 6312 and NU 312) and temperature of 85°C (for bearings 6314 and NU 314 and larger).
✓For each 15°C of temperature rise, the relubrication period is reduced by half.
✓The relubrication periods given above are for those cases applying Polyrex® EM grease.
✓When motors are used on the vertical position, their relubrication interval is reduced by half if compared to horizontal position motors.

WE RECOMENDED TO USE BALL BEARINGS FOR MOTORS DIRECTLY COUPLED TO THE LOAD.

WARNING:
EXCESS OF GREACE CAN CAUSE BEARNING OVERHEATING RESULTING IN COMPLETE DAMARGE.

Compatibility of Polyrex® EM grease with other types of grease:

Containing polyurea thickener and mineral oil, the Polyrex® EM grease is compatible with other types of grease that contain:
✓Lithium base or complex of lithium or polyurea and highly refined mineral oil.
✓Inhibitor additive against corrosion, rust and anti-oxidant additive.

Notes:
✓Although Polyrex® EM is compatible with types of grease given above, we do not recommended to mix it with any other greases.
✓ If you intend to use a type of grease different than those recommended above , first contact WEG.
✓On applications (with high or low temperatures, speed variation, etc), the type of grease and relubrification interval are given on an additional nameplate attached to the motor.

THE USE OF STANDARD MOTORS IN SPECIFIC AREAS OR SPECIAL APPLICATIONS MUST BE DONE BY CONSULT TO THE GREASE MANUFACTURER OR WEG

DISASSEMBLY AND ASSEMBLY

Disassembly and assembly must be done by qualified personnel using only suitable tools and appropriated methods.

The stator grips must be applied over the side face of the inner ring to be disassembled or over an adjacent part.

It is essential that bearings assembly be done under cleanning conditions to ensure good operation and to avoid damages. New bearings shall only be taken out from their cases when assembling them.

Before installing a new bearing it is required to check the shaft fitting for any sharp edge or strike signals.

For bearing assembly warm their inner parts withsuitable equipment - inductive pocess - or use suitable tools.

SPARE PARTS

When ordering spare parts, please specify the full type designation and product code as stated on the motor nameplate. Please also inform the motor serial number stated on the nameplate.

MOTORS FOR HAZARDOUS LOCATIONS

Besides the recommendations given previously, these ones must be also followed:

THE SPECIFICATION OF THE MOTOR INSTALLATION PLACE IS FOR CUSTOMER'S RESPONSIBILITY, WHO WILL ALSO DETERMINE THE ENVIRONMENT CHARACTERISTICS.

Motors for hazardous locations are manufactured according to specific standards for such environments and they are certified by worldwide certifying entities.

1 - Installation

The complete installation must follow procedures given by the local legislation in effect.

THE INSTALLATION OF HAZARDOUS LOCATION MOTORS MUST BE CARRIED OUT BY SKILLED PEOPLE, AND THE THERMAL PROTECTION MUST BE ALWAYS INSTALLED, EITHER INSIDE OR OUTSIDE THE MOTOR, OPERATING AT THE RATED CURRENT.

2 - Maintenance

Maintenance must be carried out by repair shops authorized by WEG.

Repair shops and people without Weg's authorization who will perform any service on hazardous location motors will be fully responsible for such service as well as for any consequential damage.

ANY ELECTRICAL OR MECHANICAL MODIFICATION MADE ON HAZARDOUS LOCATION MOTORS WILL VOID THE CERTIFICATION.

When performing maintenance, installation or relubrication, follow these instructions:

✓Check if all components are free of edges, knocks or dirt.
✓Make sure all parts are in perfect conditions.
✓Lubricate the surfaces of the endshield fittings with protective oil to make the assembly easier.
✓Use only rubber hammer to fit the parts.
✓Check for correct bolts tightening.
✓Use clearance calibrator for correct T-box fitting (smaller than 0.05mm).

DO NOT REUSE DAMAGED OR WORN PARTS. REPLACE THEM BY NEW ONES SUPPLIED BY THE FACTORY.

MOTORS DRIVEN BY VFD

Applications using VFD´s without filter can affect motor performance as follows:

✓Lower efficiency.
✓Higher vibration.
✓Higher noise level.
✓Higher rated current.
✓ Higher temperature rise.
✓Reduced motor insulation.
✓Reduced bearing life.

1- Standard Motors

✓Voltages lower than 440V do not require filter.
✓Voltages equal or higher than 440V or lower than 575V require filter for motor power supply cables longer than 20 meters.
✓Voltages equal or higher than 575V require filter for any size of power supply cables.

IF SUCH RECOMMENDATIONS ARE NOT FOLLOWED ACCORDINGLY, MOTOR WARRANTY WILL BE VOID.

2- Inverter Duty Motors:

✓Check power supply voltage of the forced cooling set.
✓Filters are not required.

WARRANTY TERMS

Weg warrants its products against defects in workmanship and materials for twelve (12) months from the invoice date issued by the factory, authorized distributor or agent limited to eighteen (18) months from manufacturing date independent of installation date as long as the following items are fulfilled accordingly:

- Proper transportation, handling and storage;
- Correct installation based on the specified ambient conditions and free of corrosive gases;
- Operation under motor capacity limits;
- Observation of the periodical maintenance services;
- Repair and/or replacement effected only by personnel duly authorized in writing by Weg;
- The failed product be available to the supplier and/or repair shop for a required period to detect the cause of the failure and corresponding repair;
- Immediate notice by the purchaser about failures accured and that these are accepted by Weg as manufacturing defects.

This warranty does not include disassembly services at the purchaser facilities, transportation costs with product, tickets, accomodation and meals for technical personnel when requested by the customer.
The warranty service will be only carried out at Weg Authorized Repair Shops or at Weg's facilities.

Components whose useful life, under normal use, is shorter than the warranty period are not covered by these warranty terms.
The repair and/or replacement of parts or components, when effected by Weg and/or any Weg Authorized Repair Shop, will not give warranty extension.

This constitutes Weg's only warranty in connection with this sale and the company will have no obligation or liability whatsoever to people, third parties, other equipment or installations, including without limitation, any claims for consequential damages or labor costs.

MOTORS AND DRIVERS

INSTRUCTIONS FOR HANDLING AND INSTALLING TECO ELECTRIC MOTORS

TECO AUSTRALIA PTY. LTD.
23-25 MURIEL AVENUE,
RYDALMERE N.S.W. 2116, AUSTRALIA
TEL: (02) 684-4277 TLX: AA 74652 FAX: (02) 684 2532

1. – HANDLING AND STORAGE

Motors should be preferably stored in their normal operating positions. They should be stored in surroundings as clean and dry and free from vibration as possible. Motors with roller bearings should be left with the rotor locking arrangement in the locked position.

If motors have been exposed to moisture during long periods of storage then the insulation resistance of the windings against the frame should be checked with the aid of a megger (max. d.c. voltage 500V). If the resistance is less than 1 M ohms at a winding temperature of 75°C then motor should be dried in a warm room or with a heater (winding temperature should not exceed 80°C). In the case of totally enclosed motors, one endshield should be removed during storage to permit air circulation.

2 – INSTALLATION AND OPERATION

When installing the motor the following points should be carefully checked:

- rated voltage and frequency
- ambient temperature does not exceed 45 C
- the location is in the shade (out of the rays of the sun)
- altitude does not exceed 1000 metres above sea level
- correct marking of leeds
- suitable thermal protection is provided with a starter

The use of the motor should conform to the specified degree of protection in accordance with AS1939. The intake and outlet openings as well as the channels between the cooling fins must be kept clean and protected against clogging. Care must be taken to ensure that cooling air can flow in and out unhindered. The space between the air intake area and the nearest wall should be approximately equal to the shaft height of the motor. Foundations must be designed in such a way that vibration is avoided when the motor and the driven machine are running coupled.

Care should be taken to ensure that any condensate drain holes are located at the lowest point of motor casing. Motors provided with a rotor locking arrangement to prevent damage to the bearings in transit must be removed before motors are put into operation. Before mounting the transmission parts, the motor shaft should be cleaned with a solvent.

Secure motor to level surface. Unevenness leads to mechanical deformation of the motor. The motor should be used only with coupling systems which are elastic with respect to centre offset, angular displacement, longitudinal shift and torsional strain. Rigid coupling systems are not permissable.

If direct coupling is employed check centre offset and angular offset with screwed-on test arem and dial guage. The following deviations should not be exceeded:

> Centre offset (radial measurement) 0,03 mm in 2-pole motors. 0,05 mm in motors with more than 2 poles. (The dial shows twice the value of the deviation). Angular offset (axial measurement) 0,10 mm.

Check alignment at normal operating temperature.

With applications involving belt transmission, unnecessary axial forces on the bearings can be avoided by positioning the shafts parallel to each other and keeping the pulleys perfectly aligned. The belt tension should be as just sufficiently stretched to prevent slipping in service. If the pulleys are too small the motor shaft is likely to bend and this must be avoided.

Connection diagrams for three-phase motors with cage rotor or wound rotor as well as for single-phase motors are attached inside the terminal box cover or are supplied with the motor. If the phases L1, L2 and L3 are connected in this order of sequence to the motor terminals U1, V1 and W1, the direction of rotation is clockwise if motor viewed from the drive end. Procedure for reversing direction of rotation: Interchange any two main leads. All motors – apart from a few exceptions – are suitable for operation in both directions. In the case of motors intended for only one direction (with direction-dependent fan), the direction of rotation is indicated by an arrow.

Operation of single phase motors on other than a 50Hz supply is ot recommended. A 20% reduction in speed may prevent operation of the centrifugal switch and the motor will "burn out" due to the starting winding remaining connected to the supply. On the other hand, a 20% increase in speed may cause the centrifugal switch to operate too soon. The centrifugal switch would then disconnect the starting winding before the required speed is reached.

3. - MAINTENANCE, CLEANING AND LUBRICATION

Periodical checking of the contacts of the magnetic starter is recommended, in order to prevent serious problems developing such as oxidation and poor electrical contact.

In dirty locations, TEFC motors should be used for protection against penetration of harmful impurities. However, if a drip-proof (IP22) motor is used, its ventilation system must be cleaned periodically to ensure perfect operation and long life.

Teco motors are factory lubricated with sufficient grease to ensure a long period of operation without attention. Regular lubrication should be carried out according to the maintenance schedule shown in the Table below.

Frames up to 180 are not equipped with grease nipples. This means that greasing can only be carried out during general overhauls when the motor is disassembled. Bearings should be cleaned and regreased with a lithium-based grease which is suitable for operating at temperatures up to 100 C without affecting its lubricating properties. Motors in frames 200L and larger have greasing facilities.

Lubrication should be performed as follows:

- clean the grease nipples with clean cloth
  while the motor is running introduce new grease until all the old grease is purged from the drain holes which are located at the bottom of the bearing housing

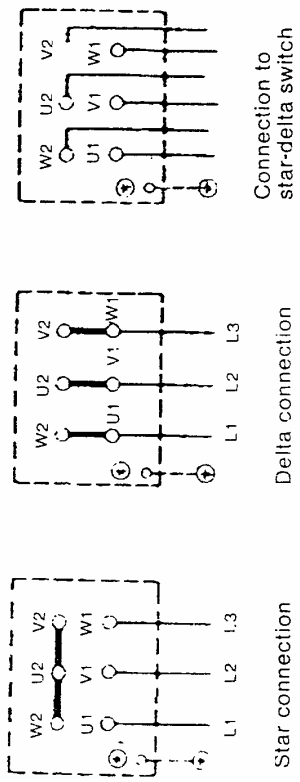
Attention - avoid using too much grease. Excess grease causes more harm to the bearings than too little.

LUBRICATION INTERVALS
(Under normal working conditions)

Frame	Working hours			
	3000 rpm	1500 rpm	1000 rpm	750 rpm
71 - 80 -90 L	8,000	20,000	20,000	20,000
100 L - .112 M	6,000	15,000	20,000	20,000
132 - 180 L	4,500	10,000	16,000	20,000
180 L - 200 L	3,000	8,000	13,000	18,000
225 S/M - 250 M	2,000	6,000	10,000	15,000
280 S/M	1,000	5,000	9,000	14,000
315 S/M	1,000	3,500	8,000	11,000
355 M/L				

Connection Diagrams

Three-phase motors with cage rotor

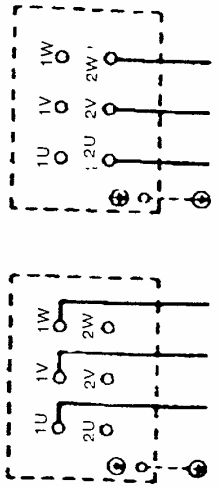


Star connection

Delta connection

Connection to star-delta switch

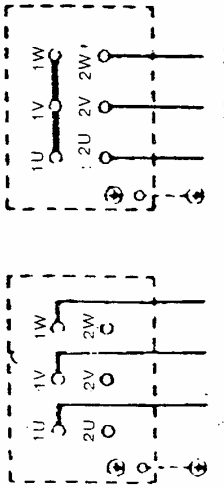
Multi-speed motors with 2 separate windings



high speed

low speed

Multi-speed motors in Dahlander connection (lapped winding)



high speed

low speed

Installation, operation and maintenance

Delivery
Upon receipt the unit should be thoroughly inspected for any damage sustained during transit.
Any equipment damage or shortfall should be immediately advised to your nearest CMG office.

Storage
If the machine is not to be installed immediately, it should be stored in a clean, dry and preferably warm environment. Shafts of stored motors should be rotated occasionally. Specific vibration during storage may lead to "brinelling" of the bearings, therefore motors that are subject to extended storage where vibration exists, should be fitted with bearing locks.

Installation
All motors must be installed in such a manner as to ensure the air intake is not obstructed. Refer to dimension "BL" in the cooling section of this catalogue. Bed plates or slide rails should be firmly fixed to a solid, level foundation to ensure the motor remains rigid and vibration free. Shims or packers (if required) must be of adequate size and placed adjacent to and between base fixings. Protective transport coatings on shafts and/or flanges must be removed prior to connection to the driven load. A light coating of grease to shafts and/or flanges will inhibit corrosion during service and assist removal of pulleys or couplings.

Coupling drive
In fitting couplings or pulleys to the motor shaft, care must be taken to ensure the roller/ball bearings are not damaged. Tapped holes are provided in shaft extensions to assist in the fitment of couplings and/or pulleys. Under no circumstances should couplings and/or pulleys be impact driven onto the shaft. Couplings or pulleys should be independently balanced with a half key.

Alignment
Great care must be taken in aligning the complete machine, since misalignment can cause rapid deterioration of bearings and lead to other mechanical failures due to the stress produced. After final tightening of foundation bolts, machine alignment should be rechecked as bed plates could distort. No end thrust should be applied to the motor without express approval.

Electrical connection
Ensure all electrical connections are solid and continuous. Check motor starter and overloads for correct rating and trip setting. All circuit breakers, HRC fuses or protective devices associated with the motor must be rated to suit motor running current and starting characteristics.

Initial start up
Prior to initial start up, the following steps must be taken:

- Insulation resistance test. On machines up to 600 volt, the minimum value should be 1MΩ.
- Thermistors if fitted, should be checked for continuity with a multimeter and never mega-tested.
- Ensure supply voltage and frequency correspond to the motor nameplate ratings.
- Ensure shaft turns freely before initial start.
- Measure stator resistance and record in Log Book.

Operation
Standard motors are designed for a 415 volt (±5%) 3 phase, 50 Hertz supply. Use of standard motors on other supply systems should be verified with our office prior to installation. All units are S1 rated to AS1359 and associated standards, for operation below 1000 metres at a maximum ambient temperature of 40°C.

For operation in conditions other than that above please refer to your nearest CMG office.

Electric motor starting imposes severe thermal stress on the motor, the frequency of starting should be minimized to ensure optimum machine life.

Number of starts per hour
The number of starts per hour is dependant on the inertia of the driven load and the load torque demand. When high inertia load is applied (flywheel, heavy fan etc) please refer to your nearest CMG office for advice. A guide to generally acceptable starts per hour would be as per table.

For greater number of starts per hour, please contact your nearest CMG office for advice.

	Starts per hour			
Frame	2 pole	4 pole	6 pole	8 pole
71	-	40	-	-
80	20	40	40	-
90	16	30	40	-
100	16	30	40	40
112	16	30	40	40
132	10	20	25	25
160	10	20	25	25
180	8	15	20	20
200	6	12	12	12
225	5	10	10	10
250	4	8	8	8
280	3	6	6	6
315	3	4	4	4

Permitted starting time
In respect to the temperature rise of the motor, starting time (i.e., from rest to operational speed) should not exceed the time indicated in the following table. Motor must be allowed to cool prior to each start.

	Starting	Maximum starting time [sec]			
Frame	method	2 pole	4 pole	6 pole	8 pole
71	D.O.L.	-	26	-	-
80	D.O.L.	15	26	40	-
90	D.O.L.	10	15	25	-
100	D.O.L.	12	13	18	40
112	D.O.L.	10	10	18	35
132	D.O.L.	14	12	12	25
160-355	D.O.L.	15	15	20	20
160-355	star-delta	45	45	60	60

Maintenance instructions

The following maintenance instructions apply to all SGA motors except for hazardous location motors. For **SGAE**, **SGAN** and **SGAD** motors maintenance must be carried out by an authorized service agent. Contact CMG for detailed instructions.

A. Ensure air intake space is unobstructed.
B. On a weekly basis use an air hose to ensure all airways are clear and free of dust.
C. Do not wash the motor down unless it is **IP66** rated.
D. On a quarterly basis-
   i) Check motor terminals for tightness and contact.
   ii) If terminal lug/lugs are discolored, re-terminate.
   iii) Check operation of starting equipment, ensuring all terminations are tight.
   iv) Check mechanical operation of thermal overload.
   v) Check mechanical operation of thermistor relay (if fitted).
   vi) Check operation of space heaters (if fitted).
E. On a six (6) monthly basis, in addition to the items in 'D' -
   i) Check stator resistance (compare to original and enter in log book)
   ii) Check supply voltage at motor terminals.
   iii) Check bearings for noise/overheating.

To obtain maximum service life from your electric motor, it is recommended the following maintenance be implemented and recorded in a plant log book.

F. On an annual basis, in addition to the items in 'D' and 'E'-
   i) Re-grease bearings in line with chart below.
   Note: As indicated in the chart, some bearings may require more frequent grease replacement.
   ii) Strip motor down and clean thoroughly.
   iii) Check bearings for wear/damage - replace as necessary.
   iv) Check all machine bolts for cracks or damage - replace as necessary.
   v) Check all holding bolts for signs of fatigue/damage - replace as necessary.
   vi) After re-assembly, check and record:-
   Full Load Current
   Full Load Voltages
   Full Load Speed
   vii) Ensure cooling fan is operational

G. Ensure plant log book records commissioning data and compare maintenance data with original.

Sealed bearings

The required replacement interval for sealed bearings is generally determined by the grease life which is dependant on operating temperature, operating speed, the limiting speed of the bearing and the type of grease. Under normal operating conditions the following relationship applies:-

$$\log t = 6.54 - 2.6\frac{n}{N} - (0.025 - 0.012\frac{n}{N})T$$

Where:
t = Average grease life (hours)
n = Speed (RPM)
N = Bearing limiting speed with grease lubrication (RPM)
T = Operating temperature (°C)

For further information, please contact your nearest CMG office for advice.

Open (regreasable) bearings

Recommended Grease Replenishment Intervals (Hours)[1)]

Bearing number	Bearing bore [mm]	Qty of grease [g]	3000 r/min		1500 r/min		1000 r/min		750 r/min	
			Ball	Roller	Ball	Roller	Ball	Roller	Ball	Roller
6312/NU312	60	20	3800	1900	10100	5050	16000	8000	20000	10800
6313/NU313	65	25	3400	1700	9400	4700	15100	7500	20000	10300
6314/NU314	70	30	3000	1500	8800	4400	14300	7150	19500	9750
6315/NU315	75	30	2570	1285	8200	4100	13500	6750	18500	9250
6316/NU316	80	35	2200	1100	7600	3800	12800	6400	17700	8850
6317/NU317	85	40	1800	900	7100	3550	12100	6050	16800	8400
6318/NU318	90	45	1650	825	6600	3300	11500	5750	16000	8000
6319/NU319	95	45	1500	750	5700	2850	9000	4500	14600	7300
6322/NU322	110	60	1200	600	4800	2400	8300	4150	13400	6700

[1)] Based on maximum grease service life of 20,000 hours.

It should be noted that for motors fitted with Ball and Roller bearings, the lubrication intervals for both bearings should be based on the roller bearing data.

The re-lubrication intervals recommended are calculated on the basis of normal working conditions.

Note: Air operated grease guns should not be used.

Replenishment of grease media should be by means of a hand held grease gun whilst motor is running with relief plate removed.

Recommended lubricant

Use Lithium based grease such as Shell Alvania R3 unless otherwise specified. (**SGAH**, **SGASS** and **SGAHS** require extra high temperature grease, Magnalube G or equivalent.)