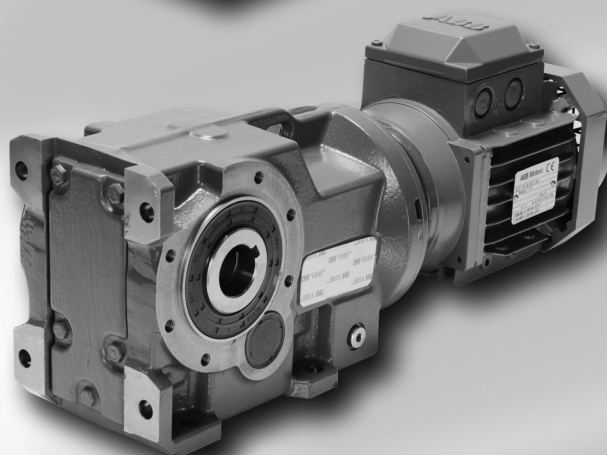
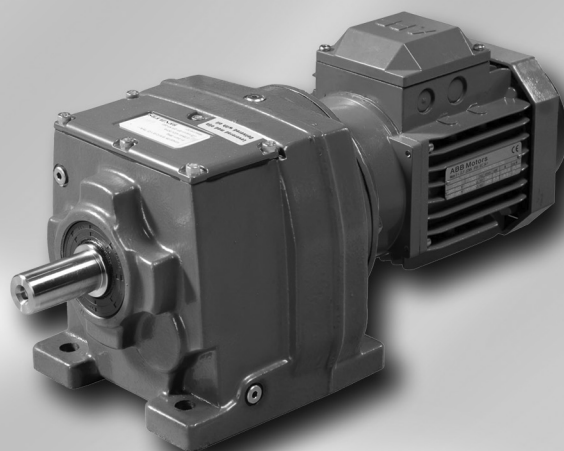


# Series M. C. F. K.

## INSTALLATION & MAINTENANCE

IGM1.00GBA0707



**BENZLERS**

**DAVID BROWN**



## IMPORTANT

### Product Safety Information

**General** - The following information is important in ensuring safety. It **must** be brought to the attention of personnel involved in the selection of M, C, F and K transmission equipment, those responsible for the design of the machinery in which it is to be incorporated and those involved in its installation, use and maintenance.

This equipment will operate safely provided it is selected, installed, used and maintained properly. As with any power transmission equipment **proper precautions must** be taken as indicated in the following paragraphs, to ensure safety.

**Potential Hazards** - these are not necessarily listed in any order of severity as the degree of danger varies in individual circumstances. It is important therefore that the list is studied in its entirety:-

- 1) Fire/Explosion
  - (a) Oil mists and vapour are generated within gear units. It is therefore dangerous to use naked lights in the proximity of gearbox openings.
  - (b) In the event of fire or serious overheating (over 300°C), certain materials (rubber, plastics, etc.) may decompose and produce fumes. Care should be taken to avoid exposure to the fumes, and the remains of burned or overheated plastic/rubber materials should be handled with rubber gloves.
  - (c) If correctly installed and operated the equipment complies to 94/9/EC ATEX 100a as marked on the nameplate. Failure to comply could lead to severe or fatal injury.
- 2) Guards - Rotating shafts and couplings must be guarded to eliminate the possibility of physical contact or entanglement of clothing. It should be of rigid construction and firmly secured.
- 3) Noise - High speed gearboxes and gearbox driven machinery may produce noise levels which are damaging to the hearing with prolonged exposure. Ear defenders should be provided for personnel in these circumstances. Reference should be made to the Department of Employment Code of Practice for reducing exposure of employed persons to noise.
- 4) Lifting - Where provided (on larger units) only the lifting points or eyebolts must be used for lifting operations (see maintenance manual or general arrangement drawing for lifting point positions). Failure to use the lifting points provided may result in personal injury and/or damage to the product or surrounding equipment. Keep clear of raised equipment.
- 5) Lubricants and Lubrication
  - (a) Prolonged contact with lubricants can be detrimental to the skin. The manufacturers instructions must be followed when handling lubricants.
  - (b) The lubrication status of the equipment must be checked before commissioning. Read and carry out all instructions on the lubricant plate and in the installation and maintenance literature. Heed all warning tags. Failure to do so could result in mechanical damage and in extreme cases risk of injury to personnel.
- 6) Electrical Equipment - Observe hazard warnings on electrical equipment and isolate power before working on the gearbox or associated equipment, in order to prevent the machinery being started.
- 7) Installation, Maintenance and Storage
  - (a) In the event that equipment is to be held in storage, for a period exceeding 6 months, prior to installation or commissioning, local application engineering staff must be consulted regarding special preservation requirements. Unless otherwise agreed, equipment must be stored in a building protected from extremes of temperature and humidity to prevent deterioration.  
The rotating components (gears and shafts) must be fumed a few revolutions once a month (to prevent bearings brinelling).
  - (b) External gearbox components may be supplied with preservative materials applied, in the form of a waxed tape overwrap or wax film preservative. Gloves should be worn when removing these materials. The former can be removed manually, the latter using white spirit as a solvent.  
Preservatives applied to the internal parts of the gear units do not require removal prior to operation.
  - (c) Installation must be performed in accordance with the manufacturers instructions and be undertaken by suitably qualified personnel.
  - (d) Before working on a gearbox or associated equipment, ensure that the load has been removed from the system to eliminate the possibility of any movement of the machinery and isolate power supply. Where necessary, provide mechanical means to ensure the machinery cannot move or rotate. Ensure removal of such devices after work is complete.
  - (e) Ensure the proper maintenance of gearboxes in operation. Use only the correct tools and approved spare parts for repair and maintenance. Consult the Maintenance Manual before dismantling or performing maintenance work.
- 8) Hot Surfaces and Lubricants
  - (a) During operation, gear units may become sufficiently hot to cause skin burns. Care must be taken to avoid accidental contact.
  - (b) After extended running the lubricant in gear units and lubrication systems may reach temperatures sufficient to cause burns. Allow equipment to cool before servicing or performing adjustments.
- 9) Selection and Design
  - (a) Where gear units provide a backstop facility, ensure that back-up systems are provided if failure of the backstop device would endanger personnel or result in damage.
  - (b) The driving and driven equipment must be correctly selected to ensure that the complete machinery installation will perform satisfactorily, avoiding system critical speeds, system torsional vibration, etc.
  - (c) The equipment must not be operated in an environment or at speeds, powers, torques or with external loads beyond those for which it was designed.
  - (d) As improvements in design are being made continually the contents of this catalogue are not to be regarded as binding in detail, and drawings and capacities are subject to alterations without notice.

The above guidance is based on the current state of knowledge and our best assessment of the potential hazards in the operation of the gear units.

Any further information or clarification required may be obtained by contacting your local application engineering office.

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## Safety warning Symbols



**Electrical Hazard**  
Could result in death or serious injury



**Danger**  
Could result in serious, slight or minor injuries



**Danger (Touch Hazard)**  
Could result in death or serious injury



**Damaging Situation**  
Could result in damage to gear unit or driven machinery



Important notes on Explosion Protection



**Cleaning**  
Periodic cleaning necessary

## 1. General Information

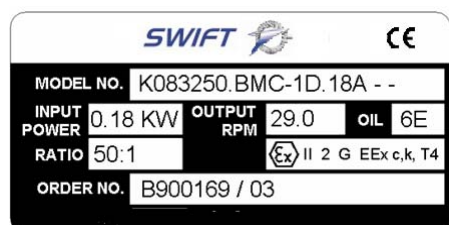
The following instructions will help you achieve a satisfactory installation of your gear unit, ensuring the best possible conditions for a long and trouble free operation.

All units are tested and checked prior to despatch, a great deal of care is taken in packing and shipping arrangements to ensure that the unit arrives at the customer in the approved condition.

## 2. Weather Protection of Unit

All Series M C F & K units are provided with protection against normal weather conditions. Where units are to operate in extreme conditions, or where they are to stand for long periods without running, eg during plant construction, consult our application engineers so that arrangements for adequate protection can be made.

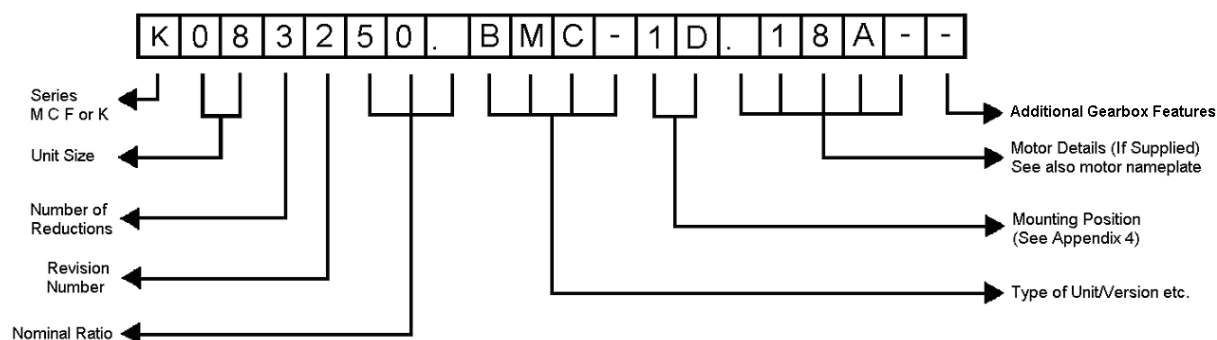
## 3. Reading the Nameplate



### Unit Identification

When requesting further information, or service support quote the following information from the nameplate:

- Unit type (Model No)
- Order Number / Year of Manufacture




### Lubrication Grade

The grade is marked on the nameplate. See Appendix 4 for type and quantity of lubricant.

## 4. Marking



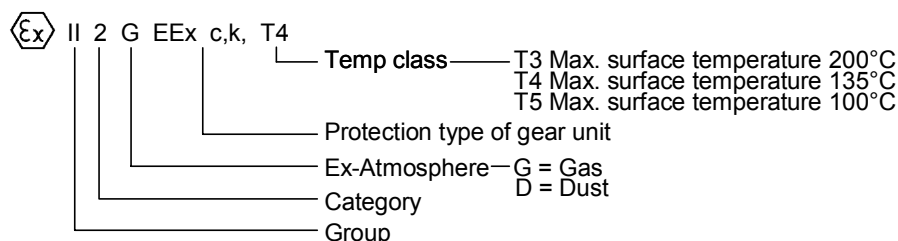
These gear units are intended for use in industrial systems.

Provided they are correctly selected  marked and installed in accordance with these instructions (**gear units only**) they comply with the EU directive 94/9/EC ATEX 100a Group II Cat 2 zones 1 & 21 & Cat 3 zones 2 & 22.





Motors, couplings, or any other equipment fitted to the gear unit must also comply with this directive.

If the gear unit is supplied as a geared motor package it is important to check the nameplates of the **gear unit and the motor** (or any other equipment fitted) corresponds with the classification of the potentially explosive atmosphere in which the unit is to be installed.

### Understanding EU Directive 94/9/EC (ATEX 100a) Markings.



### Examples:

-  II 2 G - (Zone 1) occasional hazardous explosive atmosphere
-  II 3 G - (Zone 2) rare short-term hazardous explosive atmosphere
-  II 2 D - (Zone 21) occasional hazardous explosive atmosphere during normal operation due to presence of combustible dust
-  II 3 D - (Zone 22) short-term hazardous explosive atmosphere due to presence of combustible dust; no hazard during normal operation



## 5. Installation

### 5.1. Safety Warning

#### WARNING!



The customer shall be responsible for the proper use of articles supplied by the company, particularly the rotating shafts between their driving and driven members, and their guarding for safety, and the company shall not be responsible for any injury or damage sustained as a result of the improper use of the articles supplied.

Attention is hereby drawn to the danger of using naked lights in proximity to openings in gearboxes and gear units supplied by the company, and the company shall not be liable for any claim for injury or damage arising from any action in contravention of this warning.

### 5.2. Prior to Installation

- 5.2.1. Check gear unit has not been damaged.
- 5.2.2. Check the gear unit / motor nameplate matches the requirements of the machine the unit is to be installed into.
- 5.2.3. Thoroughly clean the shaft and mounting surfaces that are to be used of anti-corrosion agents using a commercially available solvent. Ensure solvent does not make contact with the oil seals.

### 5.3. Fitting of components to either the unit input or output shaft

The input or output shaft extension diameter tolerance is to ISO tolerance k6 (for shaft diameter ≤ 50mm) and m6 (for shaft diameter > 50mm) and the fitted components should be to ISO tolerance M7 (for bore diameter ≤ 50mm) and K7 (for bore diameter > 50mm).

- 5.3.1. Ensure shaft extensions, bores & keys etc are cleaned.
- 5.3.2. Items (such as gears, sprockets, couplings etc) should not be hammered onto these shafts since this would damage the shaft support bearings.
- 5.3.3. The item should be pushed onto the shaft using a screw jack device fitted into the threaded hole provided in the end of the shaft. See table 1 below.
- 5.3.4. Items being fitted may be heated to 80/100°C to aid assembly further.

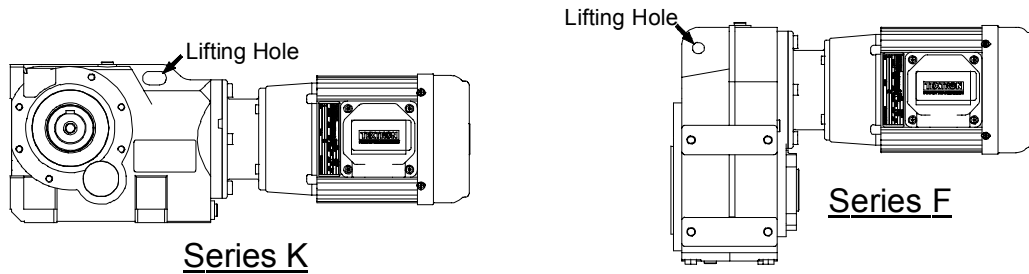


| Shaft Diameter |     | Threaded Hole Details |
|----------------|-----|-----------------------|
| Over           | To  |                       |
| 13             | 16  | M5 x 0.8 12 deep      |
| 16             | 21  | M6 x 1.0 16 deep      |
| 21             | 24  | M8 x 1.25 19 deep     |
| 24             | 30  | M10 x 1.5 22 deep     |
| 30             | 38  | M12 x 1.75 28 deep    |
| 38             | 50  | M16 x 2.0 36 deep     |
| 50             | 85  | M20 x 2.5 42 deep     |
| 85             | 130 | M24 x 3.0 55 deep     |

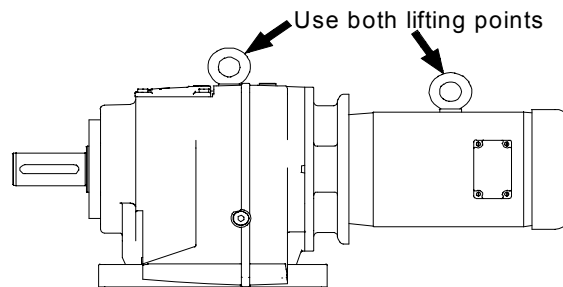
Table 1

#### 5.4. Lifting

Use only lifting points provided.  
Larger Series M & C units are supplied with a lifting eye.  
Series F & K units, have a lifting hole in the gear housing as shown.



On units supplied with a lifting eye on the motor, both the lifting point on the gear unit and motor should be used.





## 5.5. Foot mounted or flange mounted units

- 5.5.1. Ensure the base foundation / flange mounting surface is flat<sup>1</sup>, vibration absorbing and torsionally rigid.
- 5.5.2. The gear unit must be installed in the specified mounting position. The maximum deviation from the designated mounting position is  $\pm 5^\circ$  (unless gear unit is suitably modified and approved for non standard mounting positions).
- 5.5.3. Align unit (see Appendix 1).

**Note:** It is important to ensure when aligning unit on baseplate that all machined mounting points are supported over their full area.  
If steel packings are used, these should be placed either side of the foundation bolt as close as possible.

During final bolting ensure the unit or baseplate is not distorted as this would cause strains in the gear case resulting in errors of alignment of shafts and gearing.

Check all mounting points are fully supported and adjust if necessary by using steel packings.

Torque tighten bolts to torque specified in table 2 below.

- 5.5.4. Secure unit, or baseplate if fitted to a rigid foundation using heavy duty bolts to ISO grade 8.8 minimum

| Set Screw Size | Tightening Torque                        |                    |
|----------------|--|--------------------|
|                | Holding Down Bolts / Output Flange Bolts | Motors to Gearhead |
| M6             | 10 Nm                                    | 10 Nm              |
| M8             | 25 Nm                                    | 18 Nm              |
| M10            | 50 Nm                                    | 37 Nm              |
| M12            | 85 Nm                                    | 64 Nm              |
| M16            | 200 Nm                                   | 150 Nm             |
| M20            | 350 Nm                                   | 260 Nm             |
| M24            | 610 Nm                                   | -                  |
| M30            | 1220 Nm                                  | -                  |
| M36            | 2150 Nm                                  | -                  |

Table 2

- 5.5.5. Recommended fasteners (Basemount units):

| Unit Size | Recommended Fastener Size | Unit Size | Recommended Fastener Size | Unit Size | Recommended Fastener Size |
|-----------|---------------------------|-----------|---------------------------|-----------|---------------------------|
| M01       | M8 x 25L                  | K03       | M10 x 25L                 | C03       | M8 x 20L                  |
| M02       | M8 x 30L                  | K04       | M10 x 30L                 | C04       | M10 x 30L                 |
| M03       | M8 x 30L                  | K05       | M12 x 35L                 | C05       | M10 x 30L                 |
| M04       | M12 x 40L                 | K06       | M12 x 40L                 | C06       | M12 x 40L                 |
| M05       | M12 x 40L                 | K07       | M16 x 50L                 | C07       | M16 x 50L                 |
| M06       | M12 x 40L                 | K08       | M20 x 60L                 | C08       | M20 x 65L                 |
| M07       | M16 x 45L                 | K09       | M24 x 70L                 | C09       | M24 x 75L                 |
| M08       | M16 x 60L                 | K10       | M30 x 80L                 | C10       | M24 x 80L                 |
| M09       | M20 x 70L                 | K12       | M36 x 100L                |           |                           |
| M10       | M24 x 80L                 |           |                           |           |                           |
| M13       | M30 x 90L                 |           |                           |           |                           |
| M14       | M36 x 100L                |           |                           |           |                           |

Table 3

<sup>1</sup> Maximum permissible flatness error for mounting surface is 0.12mm.





## 5.6. Shaft mounted units

- 5.6.1. The gear unit must be installed in the specified mounting position.
- 5.6.2. Assembly of gear unit on to the machine shaft:  
There are four assembly methods dependant on the gear unit type:
- Standard straight bore with keyway. See Appendix 2A.
  - Unit fitted with KIBO® bushes. See Appendix 2B.
  - Unit fitted with shrink disc. See Appendix 2C.
- 5.6.3. Anchor gear unit to a secure point on the structure by means of a torque arm. (See Appendix 2E)



## 5.7. Units for use in a potentially explosive atmosphere

- 5.7.1. If the unit has been damaged in transit do not use. (Remove all transport fixtures and packings prior to start up)
- 5.7.2. Check nameplate of unit corresponds with the sites potentially explosive atmosphere classification.
- 5.7.3. Check ambient temperature falls within lubricant grade recommendations. (See Approved Lubricants p27)
- 5.7.4. Make sure no potentially explosive atmosphere exists during installation.
- 5.7.5. Make sure that gear unit is sufficiently ventilated with no external heat input – cooling air temperature should not exceed 40°C
- 5.7.6. Ensure mounting position corresponds to that marked on the nameplate. (Note! ATEX approval is only valid for mounting position specified on the nameplate.)
- 5.7.7. Check motors, couplings or any other equipment fitted to the gear unit has ATEX approval. Check information listed on nameplates correspond to the environmental conditions of the site.
- 5.7.8. Ensure gearbox is not subjected to any loading greater than those marked on the nameplate.
- 5.7.9. **For units operated with inverter drives**, check motor suitability for use with the inverter. Ensure that the inverter parameters do not exceed those of the motor.
- 5.7.10. **For belt driven units**, check all belts fitted are of sufficient electrical leakage resistance. ( $< 10^9 \Omega$ ).
- 5.7.11. Ensure gear unit and other equipment is electrically grounded (Earthed).
- 5.7.12. Check and adjust guards and covers so that there is no ignition source from sparks that may be thrown by moving parts making contact with guards etc. Ensure coupling guards, covers etc are dust tight or are designed in such a way that a build up of dust deposits cannot form when the unit is used in Zone 21 & Zone 22 classification areas.



## 6. Lubrication

### 6.1. General

- 6.1.1. Series M F & K size 7 and below will be supplied factory filled with a quantity of EP mineral oil (Grade 6E) appropriate to the intended mounting position. However if, as requested, the gear unit is supplied without lubricant then the oil quantity required is obtained from Appendix 4. Gear units size 8 and larger are supplied without lubricant (unless factory filled by request). Recommended lubricants are listed in our Approved Lubricants pages in Appendix 4.
- 6.1.2. Series C size 6 and below are supplied factory filled with synthetic lubricant (Grade 6G). Size 7 and larger are supplied without lubricant.

### Temperature Limitations

The standard lubricant is suitable for operation in ambient temperatures of 0° to 35°C. Outside of this consult Table L1 or Application Engineers.

| (ISO)    | Lubricant   | Ambient Temperature Range                           |             |              |
|----------|---|---|-------------|--------------|
|          |   | -5°C to 20°C (type E)<br>-30°C to 20°C (type G & H) | 0°C to 35°C | 20°C to 50°C |
| CLP (CC) | EP Mineral Oil (type E)                                   | 5E (VG 220)   | 6E (VG 320) | 7E (VG 460)  |
| CLP (HC) | Polyalphaolefin based Synthetic with EP additive (type H) | 5H (VG 220)   | 5H (VG 220) | 6H (VG 320)  |
| CLP (PG) | Polyglycol based Synthetic (type G)                       | 5G (VG 220)   | 6G (VG 320) | 7G (VG 460)  |

Table L1

Note! CLP (CC) & CLP (HC) are the recommended lubricants for Series F K & M.

### 6.2. Ventilator

- 6.2.1. Clean & secure the ventilator (if supplied) in the correct location for the required mounting position. (See Appendix 4)

### 6.3. Oil Level:

#### Units supplied without oil:

- 6.3.1. Fill gear unit with correct type of lubricant until oil escapes from level plug. See Appendix 4

#### Factory filled units:

- 6.3.2. If the unit is fitted with a level plug, (See Appendix 4) check oil level and top up with correct oil type as necessary.

**WARNING** Do not overfill as excess may cause overheating and leakage.

- 6.3.3. Re-fit plugs & tighten to correct torque figure – see notes in maintenance section. Clean away any oil spillage from the surface of the gear unit and driven machinery.





## 7. Motor Connections

### To mains:

- 7.1. Connection of the electric motor to the mains supply should be made by a qualified person. The current rating of the motor will be identified on the motor plate, and correct sizing of the cables to electrical regulations is essential.

### Motor terminal connection:

- 7.2. Circuit diagrams for the correct wiring of the motor terminal box are included as Appendix 3 of this document if the motor is fitted with our 'own brand' motor.  
Alternatively if the motor is supplied separately or if fitted with a motor from a different manufacturer, then this should have appropriate documentation provided with it.



## 8. Starting Up

### 8.1. Prior to starting up

- 8.1.1. Ensure ventilator is fitted (if supplied) see lubrication section 6.2
- 8.1.2. Check oil level, top up if necessary.
- 8.1.3. Ensure all safety devices are in place (ie guards fitted). Check and adjust guards and covers so that there is no ignition source from sparks that may be thrown by moving parts making contact with guards etc. Ensure coupling guards, covers etc are dust tight or are designed in such a way that a build up of dust deposits cannot form when the unit is used in Zone 21 & Zone 22 classification areas.
- 8.1.4. Remove any safety devices fitted to prevent machine rotation.
- 8.1.5. Starting up should only be performed or supervised by suitably qualified personnel.  
Caution: Any deviation from normal operating conditions, (increased temperature, noise, vibrations, power consumption etc) suggest a malfunction, inform maintenance personnel immediately.
- 8.1.6. Units fitted with backstop, ensure motor is correctly wired for free direction of rotation.



## 9. Operation

### 9.1. Noise

The range of product satisfies a noise (sound pressure level) of 85dB(A) or less when measured at 1 metre from the unit surface.  
Measurements taken in accordance with B.S.7676 Pt1 : 1993 (ISO 8579-1 : 1993).



### 9.2. General Safety

Potential hazards which can be encountered during installation, maintenance and operation of drives is covered in greater detail in the product safety page at the front of this booklet.

Advice is also given on sensible precautions which need to be taken to avoid injury or damage.

**PLEASE READ!**



### 9.3. Gear units for use in a potentially explosive atmosphere

After 3 hours of operation check the gear unit surface temperature. This temperature should not exceed 110°C. If temperature exceeds this limit, shut down immediately and contact your local sales office.





# 10. Maintenance

## 10.1. Prior to any maintenance operations

- 10.1.1. De-energise the drive and secure against un-intentional switch on.
- 10.1.2. Wait until the unit has cooled down – Danger of skin burns & pressure build up.



## 10.2. Oil plugs/ventilator

- 10.2.1. Prior to removing plugs, ensure that the unit has cooled sufficiently so that oil will not burn.
- 10.2.2. Remove ventilator plug prior to removing level and/or drain plug. Warning do not stand over ventilator plug whilst removing as pressure build up behind valved ventilator may cause it to eject when removed.
- 10.2.3. Place a container under the oil drain plug to be removed. Note: it is recommended that the oil should be slightly warm, (40-50°C) when drained. (Cooler oil will be more difficult to drain correctly).
- 10.2.4. Top ups or refills should be done through the ventilator position.
- 10.2.5. Remember to refit all plugs and torque tighten to table M1 below.



| Plug Size | Tightening Torque |
|-----------|-------------------|
| M10       | 12Nm              |
| M12       | 20Nm              |
| M14       | 26Nm              |
| M16       | 34Nm              |
| M22       | 65Nm              |

Table M1

- 10.2.6. Clean away any oil spillage.





### 10.3. Lubrication

#### 10.3.1. Periodic inspection.

For Units fitted with level plug or other level indicating device, check the oil level every 3000 hours or 6 months whichever is sooner and if necessary top up with the recommended type of lubricant.

#### 10.3.2. Oil changes.

- Smaller units (supplied without ventilator) are supplied lubricated for life\* except for the following conditions:  
Units that are required to work in explosive atmosphere (94/9/EC Atex 100a Group II category 2 zones 1 & 21 & category 3 zones 2 & 22) should be drained and refilled with correct quantity of lubricant in accordance with the schedule as listed on the tables below. See Appendix 4 for correct oil quantity.
- Larger units (supplied with ventilator) should be drained and refilled with correct quantity of lubricant in accordance with the tables below. See Appendix 4 for correct oil quantity.



Oil Change Period: Series F K & M

| UNIT OPERATING TEMPERATURE °C   | RENEWAL PERIOD          |                           |
|---|-------------------------|---------------------------|
|   | MINERAL OIL             | SYNTHETIC OIL             |
| 75 OR LESS  | 17000 HOURS OR 3 YEARS  | 26000 HOURS OR 3 YEARS    |
| 80  | 12000 HOURS OR 3 YEARS  | 26000 HOURS OR 3 YEARS    |
| 85  | 8500 HOURS OR 3 YEARS   | 21000 HOURS OR 3 YEARS    |
| 90  | 6000 HOURS OR 2 YEARS   | 15000 HOURS OR 3 YEARS    |
| 95  | 4200 HOURS OR 17 MONTHS | 10500 HOURS OR 3 YEARS    |
| 100   | 3000 HOURS OR 12 MONTHS | 7500 HOURS OR 2 1/2 YEARS |
| 105   | 2100 HOURS OR 8 MONTHS  | 6200 HOURS OR 2 YEARS     |
| 110   | 1500 HOURS OR 6 MONTHS  | 2100 HOURS OR 18 MONTHS   |
| NB: INITIAL FILL OF OIL SHOULD BE CHANGED IN A NEW GEAR UNIT AFTER 1000 HOURS OPERATION OR ONE YEAR OR HALF THE ABOVE LIFE WHICHEVER IS THE SOONEST |                         |                           |

Oil Change Period: Series C

| UNIT OPERATING TEMPERATURE °C   | RENEWAL PERIOD          |                           |
|---|-------------------------|---------------------------|
|   | MINERAL OIL             | SYNTHETIC OIL             |
| 65 OR LESS  | 17000 HOURS OR 3 YEARS  | 26000 HOURS OR 3 YEARS    |
| 70  | 12000 HOURS OR 3 YEARS  | 26000 HOURS OR 3 YEARS    |
| 75  | 8500 HOURS OR 3 YEARS   | 22000 HOURS OR 3 YEARS    |
| 80  | 6000 HOURS OR 2 YEARS   | 15000 HOURS OR 3 YEARS    |
| 85  | 4200 HOURS OR 17 MONTHS | 10500 HOURS OR 3 YEARS    |
| 90  | 3000 HOURS OR 12 MONTHS | 7500 HOURS OR 2 1/2 YEARS |
| 95  | 2100 HOURS OR 8 MONTHS  | 6000 HOURS OR 2 YEARS     |
| 100   | 1500 HOURS OR 6 MONTHS  | 4500 HOURS OR 18 MONTHS   |
| NB: INITIAL FILL OF OIL SHOULD BE CHANGED IN A NEW GEAR UNIT AFTER 1000 HOURS OPERATION OR ONE YEAR OR HALF THE ABOVE LIFE WHICHEVER IS THE SOONEST |                         |                           |

\*Mineral oil filled units operating over 70°C should be removed, drained and refilled with the correct quantity of oil after 3 years operation.




#### Warning.

Do not mix Synthetic and Mineral lubricants.

Do not overfill the unit as this can cause leakage and overheating.



### 10.4. Bearings

10.4.1 Bearings should be replaced every 5 years for  marked units.

### 10.5. Grease Lubrication

10.5.1. Where re-greasing points are provided add 2 shots monthly of NLGI 2 grade grease.



### 10.6. Cleaning

10.6.1. With the drive stationary periodically clean any dirt or dust from the gear unit and the electric motor cooling fins and fan guard to aid cooling.



10.6.2. Ensure dust build up does not exceed 5mm (maximum)



## 11. Fault diagnosis

### 11.1. Gear unit problems:

| Symptom   | Possible Causes   | Remedy  |
|---|---|---|
| Output shaft does not rotate, even though the motor is running or the input shaft is rotating.  | Drive between shafts interrupted in the gear unit   | Return the gear unit / geared motor for repair  |
| Unusual, regular running noise  | a) A meshing or grinding sound : damage to bearings<br>b) A knocking sound : irregularity in the gearing  | a) Check oil (See Inspection and Maintenance)<br>b) Contact our Application Engineers   |
| Unusual, irregular running noise  | Foreign matter present in the oil   | a) Check oil (See Inspection and Maintenance)<br>b) Stop the unit, Contact our Application Engineers  |
| Oil leaking <sup>1</sup><br>• from the gear unit cover<br>• from the motor flange<br>• from the gear unit flange<br>• from the output end oilseal | a) Defective gasket on gear unit cover<br>b) Defective gasket<br>c) Gear unit not ventilated  | a) Retighten screws on gear unit cover and observe gear unit. If oil still leaks contact our Application Engineers<br>b) Contact our Application Engineers<br>c) Vent the gear unit (see Appendix 4 - Mounting positions)   |
| Oil leaking from the ventilator   | a) Gear unit over filled with oil<br>b) Gear unit installed in an incorrect mounting position<br>c) Frequent cold starts (oil foaming) and/or high oil level. | a) Correct the oil level (see lubrication section)<br>b) Fit the ventilator in the correct position (see Appendix 4 - Mounting positions) and check oil level (see lubrication)<br>c) Check the oil level (see lubrication) |

1) it is normal for small amounts of oil/grease to leak out of the oil seal during the running in period (24 hours running time)

When contacting our sales office  
Please have the following information available:

- Nameplate data (complete)
- Type and extent of the problem encountered
- The time and the circumstances the problem occurred
- A possible cause

Any further information or clarification required may be obtained by contacting our sales office, please see contact details at the back of this booklet.



## SHAFT ALIGNMENT

Errors of alignment fall into categories of angularity (see figure 1) and eccentricity (see figure 2), or a combination of both.

Errors of angularity should be checked for and corrected before errors of eccentricity

Alignment in accordance with the following procedure will ensure vibration levels meeting those set out in ISO 10816 Part 1.

### Errors of Angularity

If the faces are perfectly true, the angularity can be checked by keeping both shafts stationary and taking measurements with a block gauge and feelers at the four points 1, 2, 3 and 4 as shown in figure 3. The difference between the readings 1 and 3 will give the error of alignment in the vertical plane, over the length of the shaft equal to the diameter of the coupling flanges, and from this the difference in the relative heights of the feet of the motor or other connected machine can be found by proportion. Similarly the difference between the readings 2 and 4 gives the amount of sideways adjustment necessary to correct any errors of alignment in the horizontal plane.

Generally, however, the coupling faces will not be absolutely true and whilst any errors so found could be allowed for in checking angularity by the stationary method an easier method presents itself. This consists in marking the points 1 on both "A" and "B" and rotating both half couplings, keeping the marked points together. By taking measurements each quarter-revolution the errors in the vertical and horizontal planes are again found.

The permitted angularity error is as follows

| TYPE OF COUPLING | ALLOWABLE GAP (G)<br>(mm)   |
|------------------|---|
| Rigid coupling   | $G = 0.0005 D$  |
| All other types  | Please see appropriate installation and maintenance manual for coupling type fitted |

NOTE: D is the diameter (mm) at which the gap is measured.

Figure 1

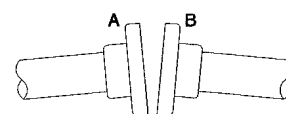


Figure 2

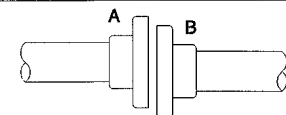


Figure 3

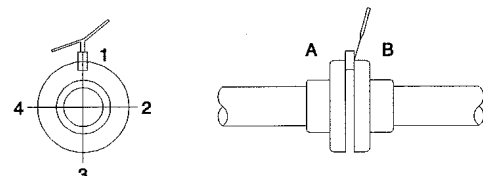


Figure 4

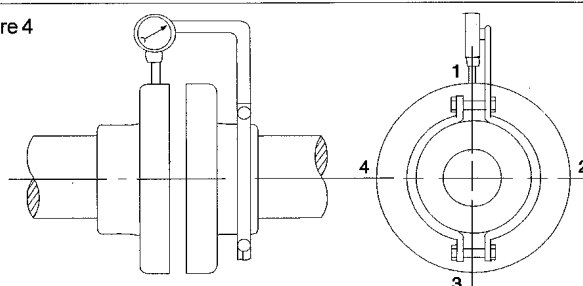
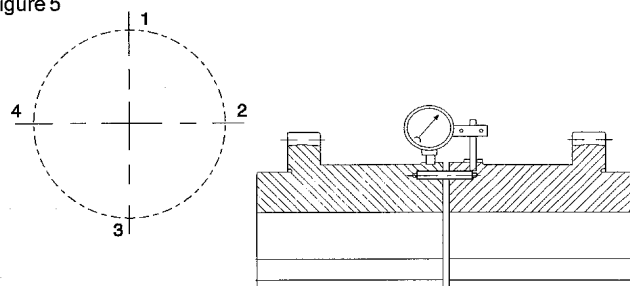


Figure 5



NOTE: Check the alignment after running the unit until it has attained its normal working temperature. Any discrepancies can then be rectified.



## Errors of Eccentricity

The procedure for measuring eccentricity is precisely analogous to that used for angularity. In this case, however, the measurements are taken in a radial direction and the most convenient and accurate means of doing this utilises a dial indicator suitably clamped to one half coupling, and bearing on the hub or flange of the other, as shown in figures 4 and 5 on page 13.

Care must, however, be taken to ensure the support for the dial indicator is sufficiently rigid to prevent the weight of the indicator from causing deflection and, in consequence, inaccurate readings. Extra care should be taken where taper roller bearings are fitted to ensure that alignment is checked with shafts in mid-point position and a final check made with the unit at operating temperature.

| Type of Coupling | Unit Size   | Allowable Eccentricity (mm) |
|------------------|---|-----------------------------|
| Rigid            | SIZE 08 & UNDER   | 0.025                       |
|                  | SIZE 09 & OVER  | 0.035                       |
| All Other types  | Please see appropriate installation and maintenance manual for coupling type fitted |                             |

## **SPECIAL NOTE CONCERNING RIGID COUPLINGS**

In lining up elements involving rigid couplings it is important that no attempt is made to correct errors of alignment or eccentricity greater than those above by tightening of the coupling bolts (This applies when the system is cold or at operating temperature). The result is miss-alignment and the setting up of undue stresses in the shaft, coupling and bearings. This will be revealed by the springing apart of the coupling faces if the bolts are slackened off. A check on the angularity of a pre-assembled job, after bolting down, can be obtained in the case of rigid couplings by slackening off the coupling bolts, when any mis-alignment will cause the coupling faces to spring apart. This check may not, however, reveal any strains due to eccentricity owing to the constant restraint imposed by the spigot.

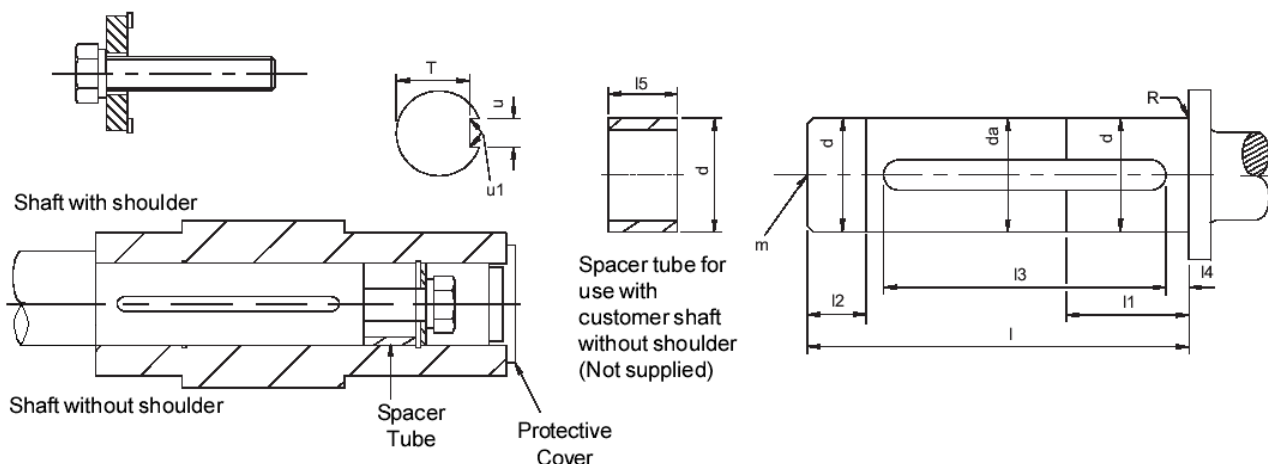
## **SERIES X COUPLINGS**

We produce standard flexible couplings to cover the complete range of gear units, please contact Application Engineering for details.



## Series C, K & F Standard Bore Assembly.

### ASSEMBLY ONTO SHAFT - CUSTOMERS SHAFT DETAIL



| UNIT      | Bore    | d                  | da   | l   | l1  | l2 | l3             | l4 | l5 | m                     | R    | T            | u                 | u1            |
|-----------|---------|--------------------|------|-----|-----|----|----------------|----|----|-----------------------|------|--------------|-------------------|---------------|
| C03       | Std     | 19.993/<br>19.980  | 19.6 | 82  | 30  | 10 | 61.3<br>61.0   | 3  | 22 | M6 x 1.0 16<br>deep   | 0.8R | 16.5<br>16.4 | 6.000/<br>5.970   | 0.16<br>0.25R |
| C04       | Reduced | 24.993/<br>24.980  | 24.6 | 99  | 38  | 13 | 79.3<br>79.0   | 3  | 23 | M10 x 1.5<br>22 deep  | 0.8R | 21.0<br>20.8 | 8.000/<br>7.964   | 0.16<br>0.25R |
|           | Std     | 29.993/<br>29.980  | 29.6 | 99  | 45  | 15 | 79.3<br>79.0   | 3  | 26 | M10 x 1.5<br>22 deep  | 0.8R | 26.0<br>25.8 | 8.000/<br>7.964   | 0.16<br>0.25R |
| C05       | Reduced | 29.993/<br>29.980  | 29.6 | 104 | 45  | 15 | 79.3<br>79.0   | 3  | 23 | M10 x 1.5<br>22 deep  | 0.8R | 26.0<br>25.8 | 8.000/<br>7.964   | 0.16<br>0.25R |
|           | Std     | 34.991/<br>34.975  | 34.6 | 104 | 53  | 18 | 77.3<br>77.0   | 3  | 23 | M12 x 1.75<br>28 deep | 0.8R | 30.0<br>29.8 | 10.000/<br>9.964  | 0.16<br>0.25R |
| C06       | Reduced | 39.991/<br>39.975  | 39.6 | 125 | 60  | 20 | 100.5<br>100.0 | 3  | 31 | M16 x 2<br>36 deep    | 0.8R | 35.0<br>34.8 | 12.000/<br>11.957 | 0.4<br>0.25R  |
|           | Std     | 44.991/<br>44.975  | 44.6 | 125 | 68  | 23 | 101.5<br>101.0 | 3  | 31 | M16 x 2<br>36 deep    | 0.8R | 39.5<br>39.3 | 14.000/<br>13.957 | 0.4<br>0.25R  |
| C07       | Reduced | 49.991/<br>49.975  | 49.6 | 153 | 75  | 25 | 130.5<br>130.0 | 3  | 35 | M16 x 2<br>38 deep    | 1.2R | 44.5<br>44.3 | 14.000/<br>13.957 | 0.4<br>0.25R  |
|           | Std     | 59.990/<br>59.971  | 59.6 | 153 | 90  | 30 | 148.5<br>148.0 | 3  | 38 | M20 x 2.5<br>42 deep  | 1.2R | 53.0<br>52.8 | 18.000/<br>17.957 | 0.4<br>0.25R  |
| C08       | Reduced | 59.990/<br>59.971  | 59.6 | 183 | 91  | 31 | 148.5<br>148.0 | 3  | 37 | M20 x 2.5<br>42 deep  | 1.2R | 53.0<br>52.8 | 18.000/<br>17.957 | 0.4<br>0.25R  |
|           | Std     | 69.990/<br>69.971  | 69.6 | 183 | 105 | 35 | 177.5<br>177.0 | 3  | 37 | M20 x 2.5<br>42 deep  | 1.2R | 62.5<br>62.3 | 20.000/<br>19.948 | 0.6<br>0.4R   |
| C09       | Reduced | 69.990/<br>69.971  | 69.6 | 227 | 105 | 35 | 177.5<br>177.0 | 3  | 58 | M20 x 2.5<br>42 deep  | 1.2R | 62.5<br>62.3 | 20.000/<br>19.948 | 0.6<br>0.4R   |
|           | Std     | 89.988/<br>89.966  | 76.6 | 227 | 135 | 45 | 221.5<br>221.0 | 3  | 58 | M24 x 3.0<br>50 deep  | 1.2R | 81.0<br>80.8 | 25.000/<br>24.948 | 0.6<br>0.4R   |
| C10       | Reduced | 79.990/<br>79.971  | 79.6 | 260 | 120 | 40 | 225.5<br>225.0 | 3  | 53 | M20 x 2.5<br>42 deep  | 1.2R | 71.0<br>70.8 | 22.000/<br>21.946 | 0.6<br>0.4R   |
|           | Std     | 99.988/<br>99.966  | 99.6 | 327 | 150 | 45 | 238.5<br>238.0 | 10 | 46 | M24 x 3.0<br>50 deep  | 0.8R | 90.0<br>89.8 | 28.000/<br>27.948 | 0.6<br>0.4R   |
| F02       | -       | 24.9931/<br>24.980 | 24.6 | 82  | 40  | 13 | 70.3<br>70.0   | 3  | 23 | M10 x 1.5<br>22 deep  | 0.8R | 21.0<br>20.8 | 8.000 /<br>7.964  | 0.16<br>0.25R |
| F03 & K03 | -       | 29.993/<br>29.980  | 29.6 | 82  | 45  | 15 | 70.3<br>70.0   | 3  | 23 | M10 x 1.5<br>22 deep  | 0.8R | 26.0<br>25.8 | 8.000/<br>7.964   | 0.16<br>0.25R |
| F04 & K04 | -       | 34.991/<br>34.975  | 34.6 | 109 | 60  | 20 | 90.5<br>90.0   | 3  | 23 | M12 x 1.75<br>28 deep | 0.8R | 30.0<br>29.8 | 10.000/<br>9.964  | 0.16<br>0.25R |
| F05 & K05 | -       | 39.991/<br>39.975  | 39.6 | 112 | 60  | 20 | 92.5<br>92.0   | 3  | 30 | M16 x 2<br>36 deep    | 0.8R | 35.0<br>34.8 | 12.000/<br>11.957 | 0.4<br>0.25R  |
| F06 & K06 | -       | 39.991/<br>39.975  | 39.6 | 126 | 75  | 25 | 100.5<br>100.0 | 3  | 30 | M16 x 2<br>36 deep    | 0.8R | 35.0<br>34.8 | 12.000/<br>11.957 | 0.4<br>0.25R  |
| F07 & K07 | -       | 44.991/<br>44.975  | 49.6 | 153 | 75  | 25 | 101.5<br>101.0 | 3  | 30 | M16 x 2<br>36 deep    | 0.8R | 44.5<br>44.3 | 14.000/<br>13.957 | 0.4<br>0.25R  |
| F08 & K08 | -       | 59.990/<br>59.971  | 59.6 | 173 | 90  | 30 | 148.5<br>148.0 | 3  | 37 | M20 x 2.5<br>42 deep  | 0.8R | 53.0<br>52.8 | 18.000/<br>17.957 | 0.4<br>0.25R  |
| F09 & K09 | -       | 69.990/<br>69.971  | 69.6 | 232 | 105 | 35 | 161.5<br>161.0 | 3  | 38 | M20 x 2.5<br>42 deep  | 0.8R | 62.5<br>62.3 | 20.000/<br>19.948 | 0.6<br>0.4R   |
| F10 & K10 | -       | 79.990/<br>79.971  | 79.6 | 275 | 120 | 40 | 188.5<br>188.0 | 5  | 37 | M20 x 2.5<br>42 deep  | 0.8R | 71.0<br>70.8 | 22.000/<br>21.946 | 0.6<br>0.4R   |
| K12       | -       | 99.988/<br>99.966  | 99.6 | 327 | 150 | 45 | 238.5<br>238.0 | 10 | 46 | M24 x 3.0<br>50 deep  | 0.8R | 90.0<br>89.8 | 28.000/<br>27.948 | 0.6<br>0.4R   |

See next page for shaft assembly instructions

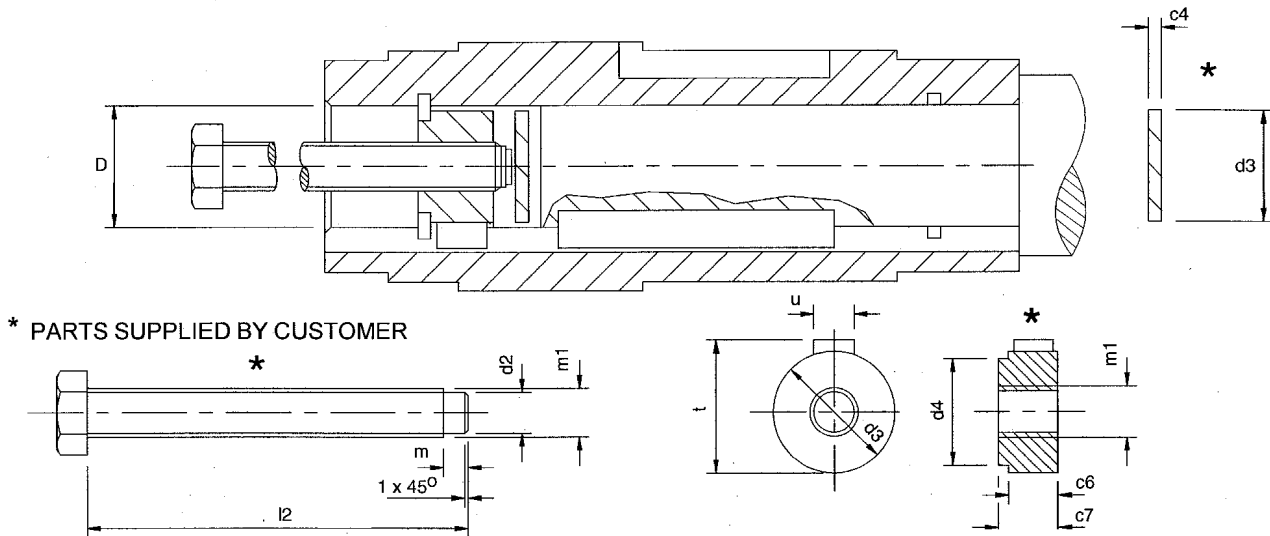
**Shaft Assembly Instructions.**

1. Spray the hollow shaft bore and mating diameter of output shaft with an anti fret compound.
2. Fit the shaft to hollow bore location key in position in the output shaft.
3. Fit the circlip into the output sleeve.
4. Fit the output shaft into the output sleeve. Remember to fit the spacer tube if the output shaft has no shoulder.
5. Secure in place with the washer and bolt, tighten to the values stated in the table below.
6. Fit the protective cover over the open end of the output sleeve.

| Bolt Size | Tightening Torques<br>Nm |
|-----------|--------------------------|
| M10       | 15                       |
| M12       | 20                       |
| M16       | 45                       |
| M20       | 85                       |
| M24       | 200                      |

## Series C, K & F Standard Bore Disassembly.

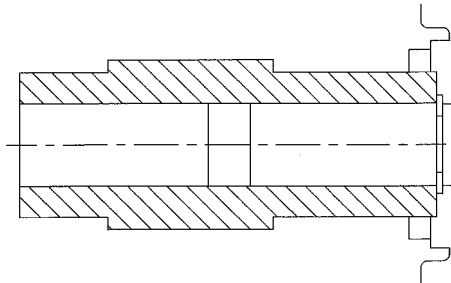
### DISASSEMBLY METHOD FROM SHAFT



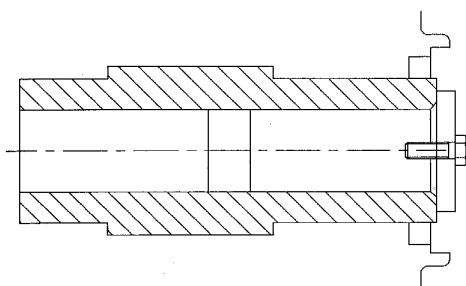
| UNIT      | Bore    | c4 | c6 | c7 | D (H7) | d2 | d3   | d4   | l2  | m | m1         | t    | u  |
|-----------|---------|----|----|----|--------|----|------|------|-----|---|------------|------|----|
| C03       | Std     | 5  | 10 | 12 | 20     | 7  | 19.9 | 11.2 | 120 | 3 | M10 x 1.5  | 22   | 6  |
| C04       | Reduced | 5  | 15 | 17 | 25     | 13 | 24.9 | 16.2 | 23  | 3 | M16 x 2    | 28   | 8  |
|           | Std     | 5  | 15 | 17 | 30     | 13 | 29.9 | 20.8 | 160 | 3 | M16 x 2    | 33   | 8  |
| C05       | Reduced | 5  | 15 | 17 | 30     | 13 | 29.9 | 20.8 | 260 | 3 | M16 x 2    | 33   | 8  |
|           | Std     | 5  | 15 | 17 | 35     | 13 | 34.9 | 25.2 | 160 | 3 | M16 x 2    | 38   | 10 |
| C06       | Reduced | 5  | 20 | 23 | 40     | 20 | 39.9 | 30.9 | 220 | 3 | M24 x 3    | 43   | 12 |
|           | Std     | 5  | 20 | 23 | 45     | 20 | 44.9 | 34.1 | 220 | 3 | M24 x 3    | 49   | 14 |
| C07       | Reduced | 5  | 20 | 23 | 50     | 20 | 49.9 | 39   | 220 | 3 | M24 x 3    | 54   | 14 |
|           | Std     | 8  | 24 | 27 | 60     | 26 | 59.9 | 47.4 | 250 | 5 | M30 x 3.5  | 64   | 18 |
| C08       | Reduced | 8  | 24 | 27 | 60     | 26 | 59.9 | 47.4 | 250 | 5 | M30 x 3.5  | 64   | 18 |
|           | Std     | 8  | 24 | 27 | 70     | 26 | 69.9 | 58.4 | 310 | 5 | M30 x 3.5  | 74.5 | 20 |
| C09       | Reduced | 8  | 24 | 27 | 70     | 26 | 69.9 | 58.4 | 310 | 5 | M30 x 3.5  | 74.5 | 20 |
|           | Std     | 8  | 24 | 27 | 90     | 26 | 89.9 | 75.3 | 360 | 5 | M30 x 3.5  | 95   | 25 |
| C10       | Reduced | 8  | 24 | 27 | 80     | 26 | 79.9 | 65.5 | 360 | 5 | M30 x 3.5  | 85   | 22 |
|           | Std     | 8  | 30 | 34 | 100    | 32 | 99.9 | 84.1 | 420 | 5 | M36 x 4    | 106  | 28 |
| F02       | -       | 5  | 15 | 17 | 25     | 10 | 24.9 | 16   | 120 | 3 | M12 x 17.5 | 28   | 8  |
| F03 & K03 | -       | 5  | 15 | 17 | 30     | 13 | 29.9 | 20.8 | 130 | 3 | M16 x 2    | 33   | 8  |
| F04 & K04 | -       | 5  | 15 | 17 | 35     | 13 | 34.9 | 25.2 | 160 | 3 | M16 x 2    | 38   | 10 |
| F05 & K05 | -       | 5  | 20 | 23 | 40     | 20 | 39.9 | 29.9 | 190 | 3 | M24 x 3    | 43   | 12 |
| F06 & K06 | -       | 5  | 20 | 23 | 40     | 20 | 39.9 | 29.9 | 190 | 3 | M24 x 3    | 43   | 12 |
| F07 & K07 | -       | 5  | 20 | 23 | 50     | 20 | 49.9 | 39   | 220 | 3 | M24 x 3    | 53.5 | 14 |
| F08 & K08 | -       | 8  | 24 | 27 | 60     | 26 | 59.9 | 47.4 | 250 | 5 | M30 x 3.5  | 64   | 18 |
| F09 & K09 | -       | 8  | 24 | 27 | 70     | 26 | 69.9 | 56.4 | 310 | 5 | M30 x 3.5  | 74.5 | 20 |
| F10 & K10 | -       | 8  | 24 | 27 | 80     | 26 | 79.9 | 65.5 | 360 | 5 | M30 x 3.5  | 95   | 25 |
| K12       | -       | 8  | 30 | 34 | 100    | 32 | 99.9 | 84.1 | 420 | 5 | M36 x 4    | 116  | 28 |

## **Series C, K & F Shaft Mount Units.**

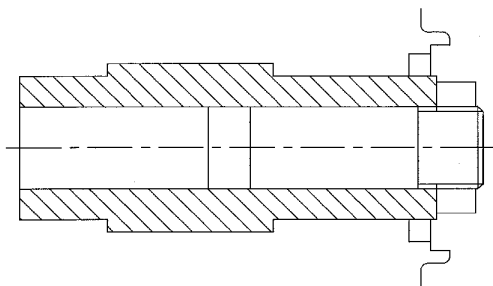
### **Alternative Shaft Fixing Methods.**



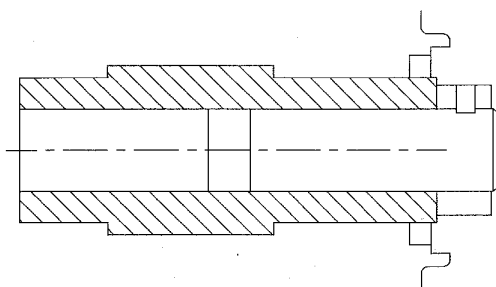
SHAFT MOUNT UNITS RETAINED WITH A CIRCLIP INCLUDING DOUBLE EXTENSION SHAFT



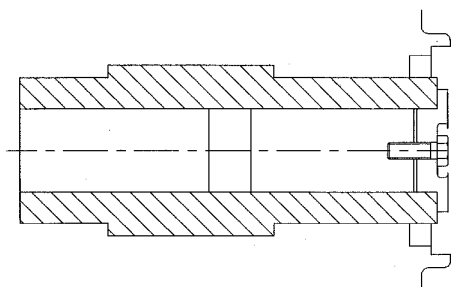
SHAFT MOUNT UNITS RETAINED WITH A BOLT AND PLATE



SHAFT MOUNT UNITS RETAINED WITH A LOCKNUT



SHAFT MOUNT UNITS RETAINED WITH A COLLAR AND GRUBSCREW



SHAFT MOUNT UNITS RETAINED WITH A RECESSED PLATE AND BOLT

## Series F Kibo Bushes.

### Advantages with Kibo taper bushes

- Simple design
- Easy to mount
- Easy to dismount, built in puller
- Tapered bushes assure a safe mounting
- Reduces risk for shearing of key
- Bushings for different bore dimensions are available

The Kibo bush kit comprises of: bushes, locking nuts, end plate, fastening bolt, shaft key and protective cover.

### Mounting

For correct mounting of speed reducer it is important that both bushings get the same squeezing force.

1. Mount the inner bushing with the nut in its outer position. The bushing should be mounted against the shoulder or circlip. The shoulder should not exceed inside diameter of nut.
2. Fit the key in the keyway.
3. Mount the reducer on the machine-shaft and press it against the inner bushing
4. Mount the outer bushing with the nut in it's inner position. Check that the bushing is not squeezed but the nut is in contact with the shaft sleeve.
5. Mount the end plate with its fixing bolt. Tighten the bolt with correct torque. The inner bushing is now locked.
6. Loosen the bolt, so the outer bushing is loose. Turn the nut on the bushing, in it's outer position.
7. Tighten the bolt once again with correct torque. The outer bushing is now locked.

The thicker end plate may be changed to the thinner one in order to gain more space at the hollow shaft end. The thinner end plate

should be tightened with a torque of 25% of the value given in the table below.

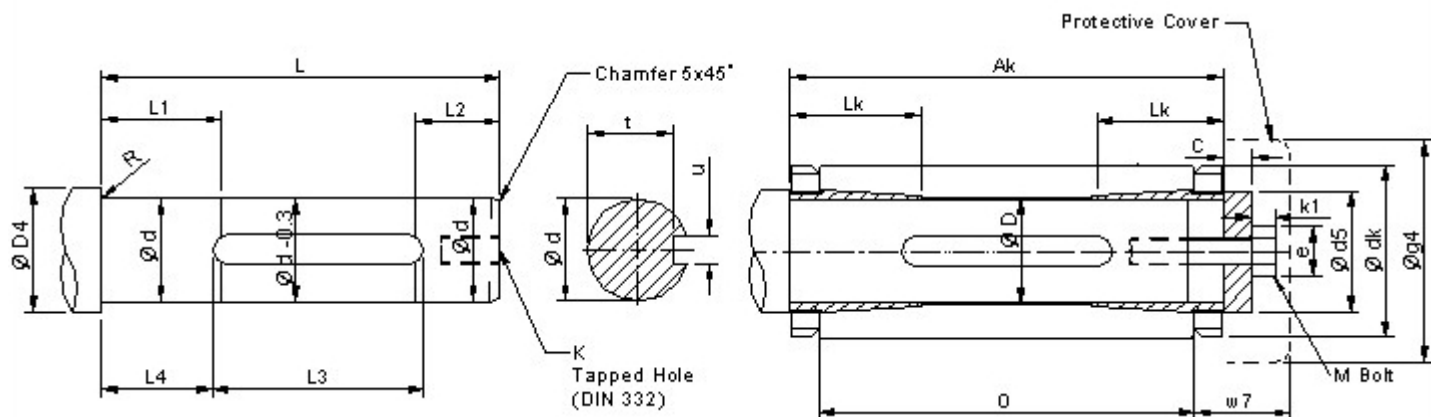
8. Screw the nuts against the hollow shaft by hand, mounting is completed.
9. Fit protective cover.

### Dismounting

- Loosen the bolt and take away the end plate.
- Pull out the outer bushing with the nut, by turning the nut with an adequate tool. Take out the bushing.
- Press the reducer from the inner bushing with the nut, dismounting is completed.

### NOTE:

If reducer is mounted in a corrosive environment, ensure machine shaft bushings and nuts are oiled or greased. Do NOT use grease based on molybdenedisulfide.



## Series F Kibo Bushes Cont.

| Unit Size | Customers Shaft |     |     |          |     |    |    |     |      |         |      |           |
|-----------|-----------------|-----|-----|----------|-----|----|----|-----|------|---------|------|-----------|
|           | φd (h8)         | φd4 |     | K        | l   | l1 | l2 | l3  | l4   | r (max) | t    | u<br>(N9) |
|           |                 | min | max | Din(332) |     |    |    |     |      |         |      |           |
| F04       | 35              | 40  | 42  | M12x28   | 175 | 40 | 36 | 60  | 60   | 1.2     | 30   | 10        |
|           | 30              | 35  |     | M10x22   |     |    |    |     |      |         | 26   | 8         |
|           | 25              | 30  |     |          |     |    |    |     |      |         | 21   | 8         |
| F05       | 40              | 45  | 51  | M16x36   | 198 | 50 | 42 | 77  | 65   | 1.2     | 35   | 12        |
|           | 35              | 40  |     | M12x28   |     |    |    |     |      |         | 30   | 10        |
|           | 30              | 35  |     | M10x22   |     |    |    |     |      |         | 26   | 8         |
| F06       | 40              | 45  | 51  | M16x36   | 225 | 50 | 45 | 77  | 78   | 1.2     | 35   | 12        |
|           | 35              | 40  |     | M12x28   |     |    |    |     |      |         | 30   | 10        |
|           | 30              | 35  |     | M10x22   |     |    |    |     |      |         | 26   | 8         |
| F07       | 50              | 55  | 61  | M16x36   | 258 | 58 | 52 | 79  | 93   | 1.2     | 44.5 | 14        |
|           | 45              | 50  |     |          |     |    |    |     |      |         | 39.5 | 14        |
|           | 40              | 45  |     |          |     |    |    |     |      |         | 35   | 12        |
| F08       | 60              | 66  | 71  | M20x42   | 293 | 61 | 52 | 108 | 97.5 | 1.6     | 53   | 18        |
|           | 55              | 61  |     | M16x36   |     |    |    |     |      |         | 49   | 16        |
|           | 50              | 56  |     |          |     |    |    |     |      |         | 44.5 | 14        |
| F09       | 70              | 76  | 81  | M20x42   | 340 | 70 | 50 | 131 | 75   | 1.6     | 62.5 | 20        |
|           | 65              | 71  |     |          |     |    |    |     |      |         | 58   | 18        |
|           | 60              | 66  |     |          |     |    |    |     |      |         | 53   | 18        |
| F10       | 80              | 89  | 96  | M20x42   | 390 | 70 | 60 | 163 | 104  | 1.6     | 71   | 22        |
|           | 75              | 84  |     |          |     |    |    |     |      |         | 67.5 | 20        |
|           | 70              | 79  |     |          |     |    |    |     |      |         | 62.5 | 20        |
| F11       | 90              | 99  | 101 | M24x50   | 368 | 70 | 73 | 181 | 110  | 2       | 81   | 25        |
|           | 85              | 94  |     |          |     |    |    |     |      |         | 76   | 22        |
|           | 80              | 89  |     |          |     |    |    |     |      |         | 71   | 22        |
| F12       | 100             | 109 | 116 | M24x50   | 428 | 80 | 83 | 200 | 111  | 2.5     | 90   | 28        |
|           | 95              | 104 |     |          |     |    |    |     |      |         | 86   | 25        |
|           | 90              | 99  |     |          |     |    |    |     |      |         | 81   | 25        |

| Unit Size | Customers Shaft |               |                 |     |     |     |      | End Plate |    |     |    |    |                      | Cover |     |
|-----------|-----------------|---------------|-----------------|-----|-----|-----|------|-----------|----|-----|----|----|----------------------|-------|-----|
|           | φD              | KIBO Bush Kit | Column 11 entry | φdk | m1  | Ak  | Lk   | φd5       | C  | φd4 |    |    | Tightening Torque Nm | φg4   | w 7 |
|           |                 |               |                 |     |     |     |      |           |    | M   | e  | k1 |                      |       |     |
| F04       | 35              | C38214-S1     | 1               | 65  | 157 | 180 | 40   | 45        | 10 | M12 | 22 | 8  | 56                   | 81    | 34  |
|           | 30              | C38214-S3     | 2               |     |     |     |      |           |    | M10 | 20 | 7  | 40                   |       |     |
|           | 25              | C38214-S4     | 3               |     |     |     |      |           |    | M10 | 20 | 7  | 40                   |       |     |
| F05       | 40              | C38364-S2     | 1               | 75  | 179 | 207 | 50   | 55        | 12 | M16 | 28 | 10 | 124                  | 85    | 43  |
|           | 35              | C38364-S3     | 2               |     |     |     |      |           |    | M12 | 22 | 8  | 70                   |       |     |
|           | 30              | C38364-S4     | 3               |     |     |     |      |           |    | M10 | 20 | 7  | 40                   |       |     |
| F06       | 40              | C38364-S2     | 1               | 75  | 205 | 233 | 50   | 55        | 12 | M16 | 28 | 10 | 124                  | 85    | 43  |
|           | 35              | C38364-S3     | 2               |     |     |     |      |           |    | M12 | 22 | 8  | 70                   |       |     |
|           | 30              | C38364-S4     | 3               |     |     |     |      |           |    | M10 | 20 | 7  | 40                   |       |     |
| F07       | 50              | C38464-S9     | 1               | 80  | 234 | 265 | 58   | 65        | 14 | M16 | 28 | 10 | 154                  | 122   | 43  |
|           | 45              | C38464-S10    | 2               |     |     |     |      |           |    | M16 | 28 | 10 | 154                  |       |     |
|           | 40              | C38464-S11    | 3               |     |     |     |      |           |    | M16 | 28 | 10 | 154                  |       |     |
| F08       | 60              | C38614-S1     | 1               | 98  | 270 | 303 | 61   | 75        | 16 | M20 | 35 | 13 | 240                  | 147   | 47  |
|           | 55              | C38614-S2     | 2               |     |     |     |      |           |    | M16 | 28 | 10 | 169                  |       |     |
|           | 50              | C38614-S3     | 3               |     |     |     |      |           |    | M16 | 28 | 10 | 169                  |       |     |
| F09       | 70              | C38648-S1     | 1               | 110 | 330 | 369 | 67.5 | 85        | 20 | M20 | 35 | 13 | 290                  | 192   | 90  |
|           | 65              | C38648-S2     | 2               |     |     |     |      |           |    | M20 | 35 | 13 | 290                  |       |     |
|           | 60              | C38648-S3     | 3               |     |     |     |      |           |    | M20 | 35 | 13 | 290                  |       |     |
| F10       | 80              | B93404-S1     | 1               | 130 | 370 | 414 | 53   | 100       | 24 | M20 | 35 | 13 | 274                  | 242   | 90  |
|           | 75              | B93404-S2     | 2               |     |     |     |      |           |    | M20 | 35 | 13 | 274                  |       |     |
|           | 70              | B93404-S3     | 3               |     |     |     |      |           |    | M20 | 35 | 13 | 274                  |       |     |
| F11       | 90              | B91884-S1     | 1               | 140 |     | 390 | 57   | 105       | 26 | M24 | 42 | 15 | 290                  |       |     |
|           | 85              | B91884-S2     | 2               |     |     |     |      |           |    | M24 | 42 | 15 | 290                  |       |     |
|           | 80              | B91884-S3     | 3               |     |     |     |      |           |    | M24 | 42 | 15 | 290                  |       |     |
| F12       | 100             | C38834-S1     | 1               | 155 |     | 450 | 83   | 130       | 7  | M24 | 42 | 15 | 451                  |       |     |
|           | 95              | C38834-S2     | 2               |     |     |     |      |           |    | M24 | 42 | 15 | 451                  |       |     |
|           | 90              | C38834-S3     | 3               |     |     |     |      |           |    | M24 | 42 | 15 | 451                  |       |     |

## Series K Shrink Disc.

The gear unit is fitted with a 'shrink disc' device located on the hollow output shaft to provide a positive outer locking connection between gear unit and driven shaft. The 'shrink disc' is a friction device, without keys, which exerts an external clamping force on the hollow output shaft, thus establishing a mechanical shrink fit between the gear unit hollow shaft and driven shaft. 'Shrink disc' capacities have ample margins in dealing with transmitted torques and external loading imposed on gear units.

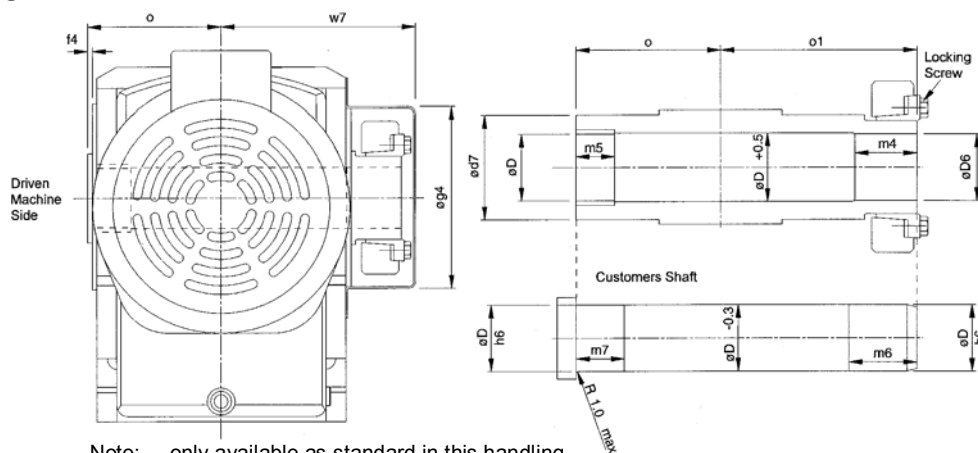
### WORKING PRINCIPLE

The 'shrink disc' consists of a locking collar, a tapered inner ring and locking screws. By tightening the locking screws, the locking collar and tapered inner ring are pulled together, exerting radial forces on the inner ring, thus creating a positive friction connection between hollow shaft and driven shaft.

As the tapered surfaces of locking collar and inner ring are lubricated with Molykote 321R or similar and the taper angle is not self locking, locking collar will not seize on the inner ring and can be released easily when removal is necessary.

When the shrink disc is clamped in position the high contact pressures between tapered surfaces and screw heads and their seatings ensure hermetic sealing and eliminate the possibility of fretting corrosion.

Figure 1



Note: only available as standard in this handling,  
please contact your local sales office for  
opposite handing

| SIZE | D   | D6  | d7  | f4  | g4  | m4 | m5 | m6 | m7 | o   | o1  | w7  | Locking<br>Screws<br>Torque<br>Ta (Nm) |
|------|-----|-----|-----|-----|-----|----|----|----|----|-----|-----|-----|--|
| K03  | 30  | 30  | 50  | 2.5 | 87  | 31 | 20 | 36 | 25 | 60  | 86  | 91  | 29                                     |
| K04  | 35  | 35  | 55  | 2.5 | 107 | 32 | 20 | 37 | 25 | 75  | 102 | 112 | 29                                     |
| K05  | 40  | 40  | 60  | 3   | 107 | 36 | 20 | 41 | 25 | 83  | 112 | 118 | 29                                     |
| K06  | 40  | 40  | 70  | 3.5 | 132 | 38 | 20 | 43 | 25 | 90  | 118 | 130 | 29                                     |
| K07  | 50  | 50  | 80  | 6   | 132 | 36 | 30 | 41 | 35 | 105 | 136 | 152 | 35                                     |
| K08  | 65  | 65  | 90  | 5   | 160 | 41 | 40 | 46 | 45 | 120 | 161 | 175 | 58                                     |
| K09  | 75  | 75  | 100 | 5   | 175 | 55 | 40 | 60 | 55 | 150 | 195 | 210 | 58                                     |
| K10  | 95  | 95  | 120 | 5   | 200 | 65 | 60 | 70 | 65 | 175 | 230 | 245 | 100                                    |
| K12  | 105 | 105 | 140 | 5   | 240 | 85 | 60 | 90 | 75 | 205 | 280 | 295 | 160                                    |

## Shrink Disc Installation & Maintenance.

### SHAFT MOUNTED UNITS USING A SHRINK DISC DEVICE

#### INSTALLATION

'Shrink discs' can be supplied with shaft mounted units. The following procedures should be followed when fitting or removing units from the driven shaft.

- 1 Release locking screws gradually and in succession. Initially a quarter of a turn on each screw will avoid tilting and jamming - do not remove locking bolts completely.
- 2 Remove 'shrink disc' - from gear unit hollow shaft.
- 3 Clean and degrease locating diameters of gear unit hollow shaft, driven shaft and 'shrink disc' locating diameter on hollow shaft extension.
- 4 Draw the gear unit onto the driven shaft (See Figure 3).
- 5 Grease tapered surfaces of outer ring and inner ring with Molykote 321R or similar.
- 6 Fit 'shrink disc' on gear unit hollow shaft to position shown in Figure 1.
- 7 Tighten all locking screws gradually and in succession. Do not tighten in a diametrically opposite sequence. Several passes are required until all screws are tightened until the inner and outer ring faces are in-line and the torque figures  $T_a$  shown in the table on page 17 are achieved.
- 8 Fit protective cover.

Note: When the hollow output shaft is to operate in a vertical position it is essential that the shaft of the driven machine is provided with a shoulder. When the thrust load is not taken by the shoulder on the driven shaft, an end plate, as shown in Figure 3, must be fitted.

It is recommended that customers' shafts at the non-clamped end of the sleeve should be coated with Molykote 321R or equivalent.

#### REMOVAL

- 1 Removal procedure is similar to the reverse of installation.  
Note: Do not remove 'shrink disc' locking screws completely.
- 2 Remove any rust and dirt from gear unit hollow shaft.
- 3 Withdraw gear unit from driven shaft.

Note: 'Shrink disc' should be removed and cleaned thoroughly, and Molykote 321R or similar applied to the tapered surfaces of inner ring and locking collar before re-use.

Note: Protective covers are supplied with all 'shrink discs'. Assembly or removal kits and thrust plates are not provided.



Figure 2

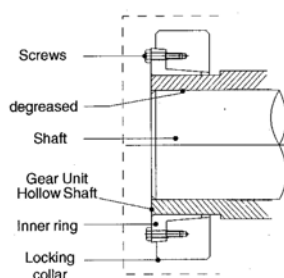
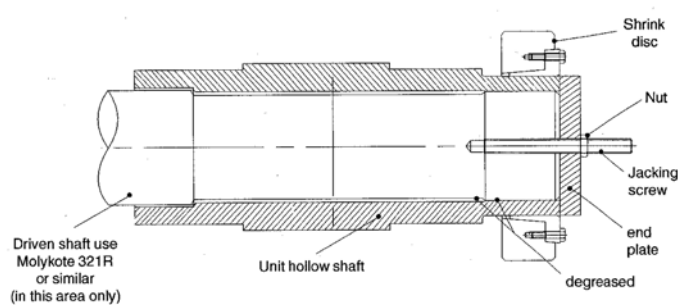


Figure 3 Mounting Gear Unit

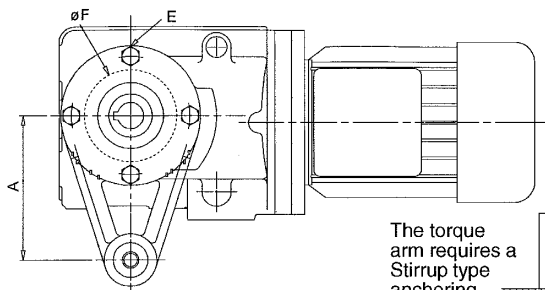




## Series C Torque Bracket Dimensions.



It is recommended that the torque arm is positioned such that the it is fitted on the side of the unit adjacent to the driven machine.

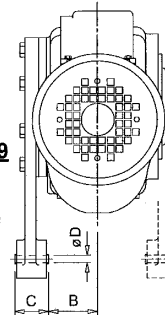


**Column 9  
Entry**

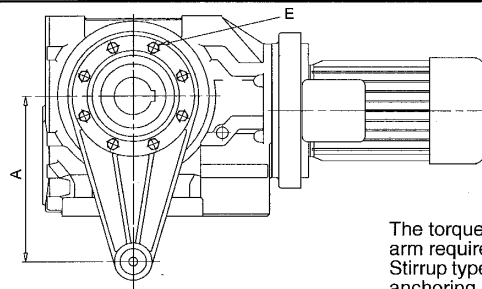
**T** Torque  
arm  
on left

**Column 9  
Entry**

**Q** Torque  
arm  
on right



| SIZE OF<br>UNIT | DIMENSIONS IN MM |      |    |          |                         |                       |
|-----------------|------------------|------|----|----------|-------------------------|-----------------------|
|                 | A                | B    | C  | $\phi D$ | E                       | $\phi F$ (Spigot Dia) |
| C03             | 110              | 47   | 36 | 10.3     | 4 x M8<br>on a 90 pcd   | 69.990 /<br>69.969    |
| C04             | 130              | 52   | 36 | 10.3     | 8 x M8<br>on a 107 pcd  | 84.990 /<br>84.968    |
| C05             | 160              | 52   | 36 | 10.3     | 8 x M8<br>on a 130 pcd  | 104.990 /<br>104.968  |
| C06             | 200              | 71.5 | 44 | 16.5     | 8 x M10<br>on a 155 pcd | 124.990 /<br>124.965  |

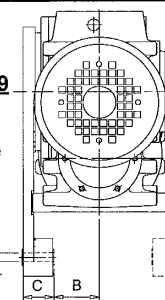


**Column 9  
Entry**

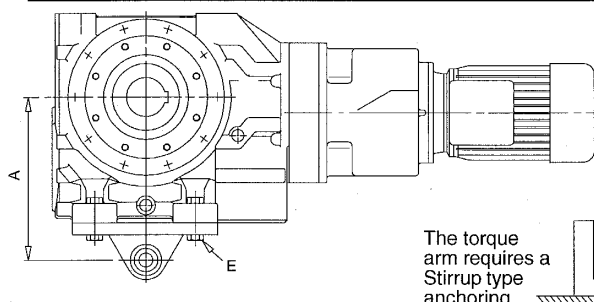
**T** Torque  
arm  
on left

**Column 9  
Entry**

**Q** Torque  
arm  
on right



| SIZE OF<br>UNIT | DIMENSIONS IN MM |      |    |          |                          |  |
|-----------------|------------------|------|----|----------|--------------------------|--|
|                 | A                | B    | C  | $\phi D$ | E                        |  |
| C07             | 250              | 77.5 | 60 | 16.4     | 6 x M12<br>on a 150 pcd  |  |
| C08             | 310              | 85.5 | 60 | 16.4     | 8 x M12<br>on a 195 pcd  |  |
| C09             | 380              | 98   | 80 | 25       | 6 x M16<br>on a 230 pcd  |  |
| C10             | 430              | 137  | 80 | 25       | 10 x M16<br>on a 280 pcd |  |

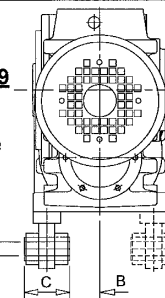


**Column 9  
Entry**

**T** Torque  
arm  
on left

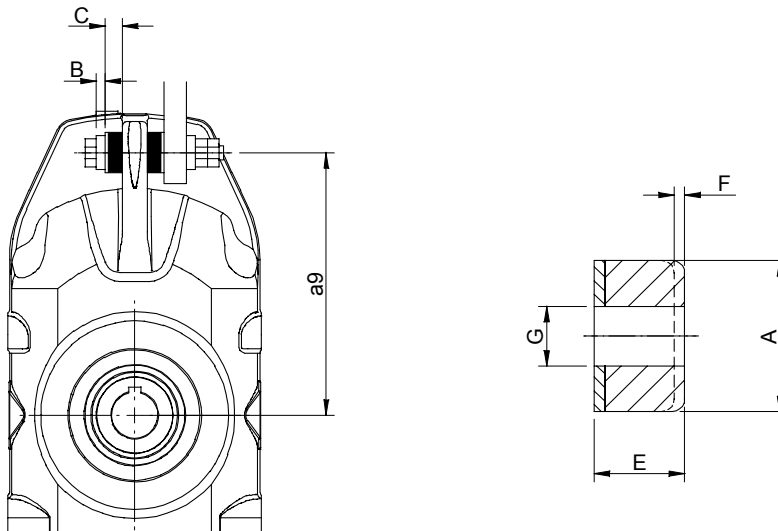
**Column 9  
Entry**

**Q** Torque  
arm  
on right

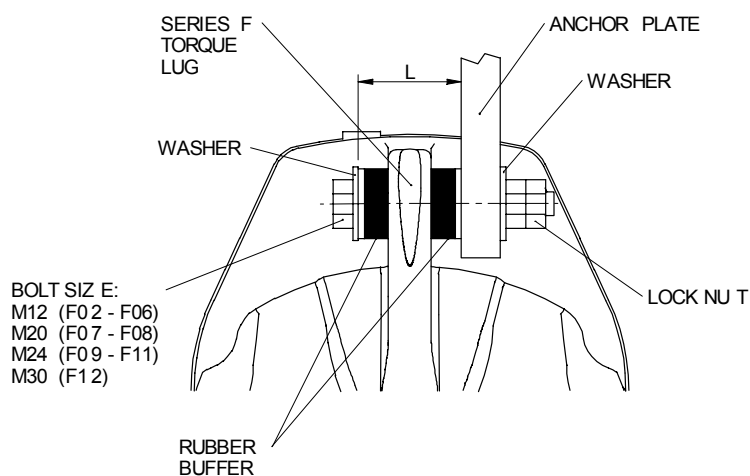


| SIZE OF<br>UNIT | DIMENSIONS IN MM |    |     |          |                              |  |
|-----------------|------------------|----|-----|----------|------------------------------|--|
|                 | A                | B  | C   | $\phi D$ | E                            |  |
| C1040           | 430              | 95 | 110 | 25       | 2 Nuts &<br>M24 x 100L Bolts |  |

## Series F Torque Buffer Dimensions.



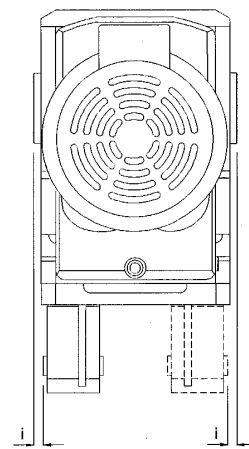
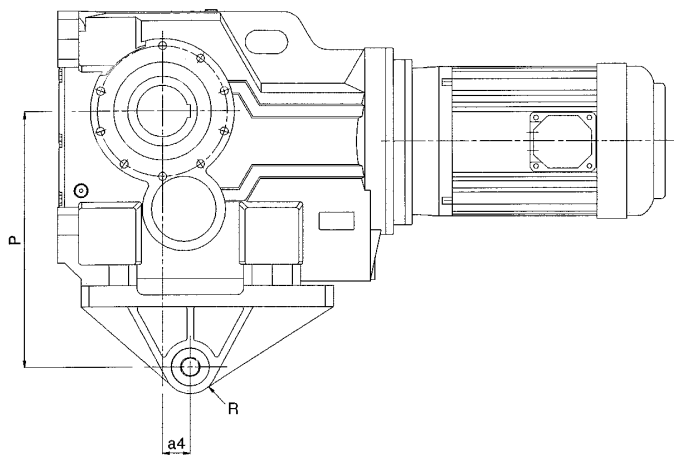
| UNIT SIZE | A   | (min | C    | a9  | E  | F   | G  |
|-----------|-----|------|------|-----|----|-----|----|
| F02       | 40  | 2    | 18.5 | 140 | 20 | 1.5 | 13 |
| F03       | 40  | 2    | 18   | 158 | 20 | 2   | 13 |
| F04       | 40  | 2    | 18   | 170 | 20 | 2   | 13 |
| F05       | 40  | 2    | 18   | 198 | 20 | 2   | 13 |
| F06       | 40  | 2    | 18   | 218 | 20 | 2   | 13 |
| F07       | 62  | 10   | 30   | 278 | 33 | 3   | 23 |
| F08       | 62  | 10   | 29   | 346 | 33 | 4   | 23 |
| F09       | 82  | 12   | 40   | 395 | 44 | 4   | 26 |
| F10       | 82  | 12   | 38   | 485 | 44 | 5   | 26 |
| F11       | 82  | 12   | 38   | 485 | 44 | 6   | 26 |
| F12       | 102 | 12   | 48   | 550 | 54 | 6   | 33 |



| Unit Size | Dim L mm |
|-----------|----------|
| F02       | 52       |
| F03       | 52       |
| F04       | 52       |
| F05       | 52       |
| F06       | 52       |
| F07       | 80       |
| F08       | 84       |
| F09       | 110      |
| F10       | 112      |
| F11       | 116      |
| F12       | 146      |

Notes 1) Tighten bolt to give Dim 'A' this will pre compress the rubber buffers  
2) Torque arm kit comprises two rubber buffers. The customer must supply other components shown.

## Series K Torque Bracket Dimensions.



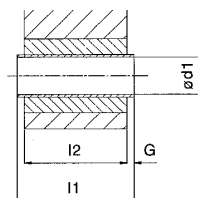
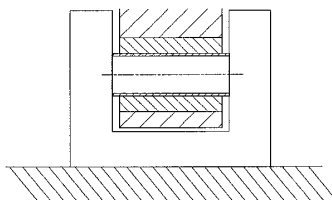
**Column 9 Entry**

**T** Torque bracket  
on left

**Column 9 Entry**

**Q** Torque bracket  
on right

The torque  
arm requires a  
Stirrup type  
anchoring



| SIZE       | a4   | d1*            | G | i  | l1  | l2  | P   | R  |
|------------|------|----------------|---|----|-----|-----|-----|----|
| <b>K03</b> | 23.5 | 10.5<br>10.3   | 2 | 20 | 36  | 32  | 140 | 20 |
| <b>K04</b> | 30   | 10.5<br>10.3   | 2 | 20 | 36  | 32  | 160 | 20 |
| <b>K05</b> | 40   | 16.5<br>16.3   | 2 | 18 | 60  | 56  | 192 | 35 |
| <b>K06</b> | 45   | 16.5<br>16.3   | 2 | 25 | 60  | 56  | 200 | 35 |
| <b>K07</b> | 52.5 | 16.5<br>16.3   | 2 | 25 | 60  | 56  | 250 | 35 |
| <b>K08</b> | 60   | 25.25<br>24.75 | 5 | 30 | 80  | 70  | 300 | 40 |
| <b>K09</b> | 70   | 25.25<br>24.75 | 5 | 40 | 100 | 90  | 350 | 40 |
| <b>K10</b> | 74   | 25.25<br>24.75 | 5 | 45 | 100 | 90  | 450 | 40 |
| <b>K12</b> | 60   | 38.25<br>37.75 | 8 | 10 | 126 | 110 | 550 | 58 |

**NOTES:**

It is recommended that the torque arm is fitted on the side of the unit adjacent to the driven machine.

\* The use of a fitted bolt is recommended.





## Three Phase Induction Motor Installation.

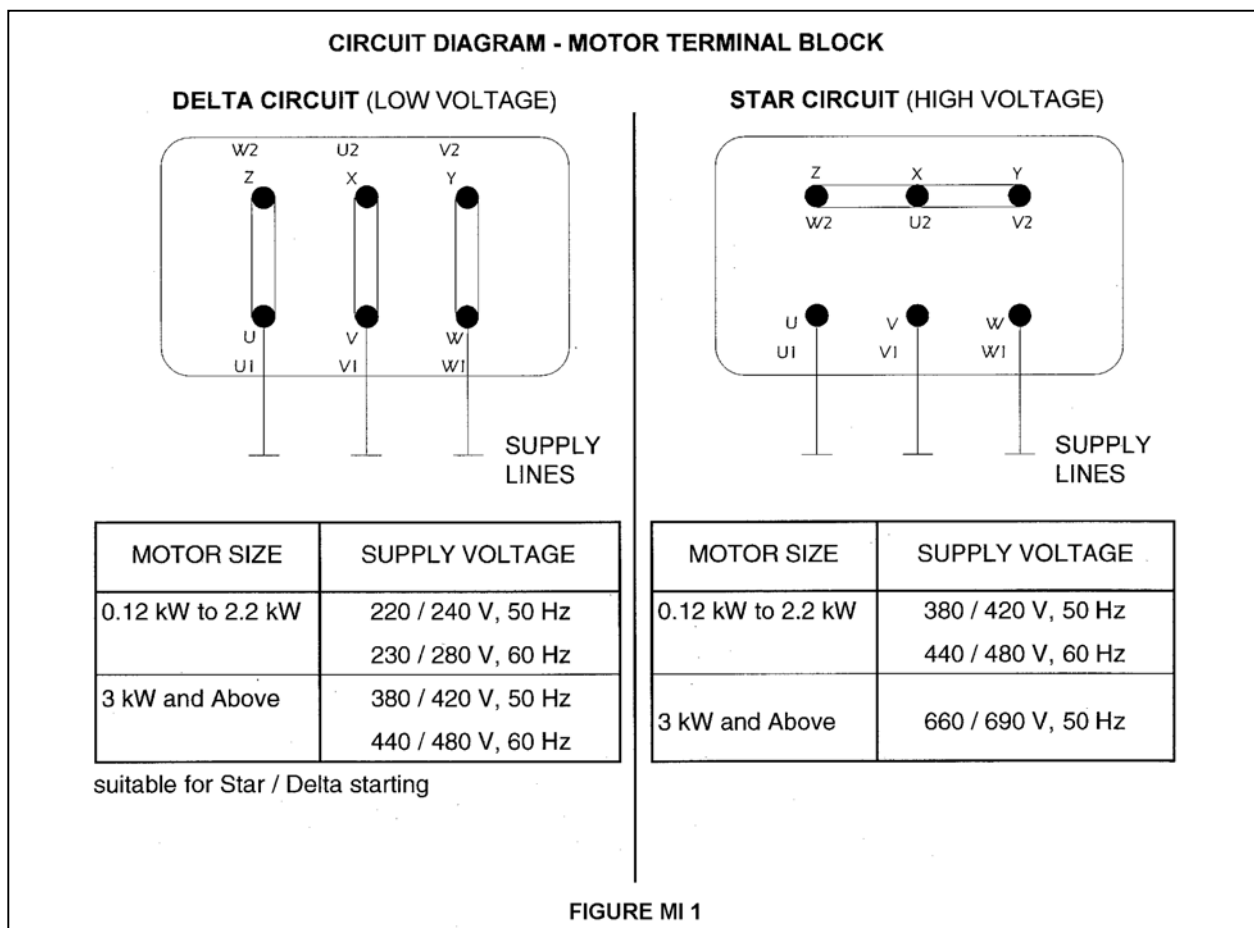
### Connection to Mains Power Supply.



- Connection of the electric motor to the mains supply should be done by a qualified person.
- Connect motor terminals in accordance with the diagram inside the terminal box cover. (Also identified in Figure MI 1 below).

Note: It is important that the mains supply details are checked against the motor nameplate data and that they are connected as indicated on the nameplate. The correct sizing of the cables to electrical regulations is essential.

- To change the direction of rotation of the electric motor, one of the three main line terminals should be changed with the other.
- Connect the earth conductors to the marked earth terminals.



Note: This instruction only applies to our own brand plated motors.

Motors fitted by the customer or requested by the customer from a different manufacturer will have separate documentation provided with it.



## Approved Lubrication.

**Type E** Mineral oil containing industrial EP additives. These have a high load carrying capacity.

| SUPPLIER                                  | LUBRICANT RANGE            | GRADE NUMBERS                |               |            |
|---|----------------------------|------------------------------|---------------|------------|
|   |                            | 5E                           | 6E            | 7E         |
|   |                            | AMBIENT TEMPERATURE RANGE °C |               |            |
|   |                            | -5 TO 20                     | 0 TO 35       | 20 TO 50   |
| Batoyle Freedom Group                     | Remus                      | 220 (-2)                     | 320 (-2)      | 460 (-2)   |
| Boxer Services / Millers Oils             | Indus                      | 220 (-10)                    | 320 (-10)     | 460 (-10)  |
| BP Oil International Limited              | Energol GR-XF              | 220 (-16)                    | 320 (-13)     | 460 (-1)   |
|   | Energol GR-XP              | 220 (-15)                    | 320 (-10)     | 460 (-7)   |
| Caltex                                    | Meropa                     | 220 (-4)                     | 320 (-4)      | 460 (-4)   |
|   | RPM Borate EP Lubricant    | 220 (-7)                     | 320 (-4)      | 460 (-7)   |
| Carl Bechem GmbH                          | Berugear GS BM             | 220 (-20)                    | 320 (-13)     | 460 (-10)  |
|   | Staroil G                  | 220 (-13)                    | 320 (-13)     | 460 (-10)  |
| Castrol International                     | Alpha Max                  | 220 (-19)                    | 320 (-13)     | 460 (-10)  |
|   | Alpha SP                   | 220 (-16)                    | 320 (-16)     | 460 (-1)   |
| Chevron International Oil Company Limited | Gear Comp EP (USA ver)     | 220 (-16)                    | 320 (-13)     | 460 (-10)  |
|   | Gear Comp EP (Eastern ver) | 220 (-13)                    | 320 (-13)     | 460 (-13)  |
|   | Ultra Gear                 | 220 (-10)                    | 320 (-7)      | 460 (-7)   |
| Eko-Elda Abee                             | Eko Gearlub                | 220 (-13)                    | 320 (-10)     | 460 (-1)   |
| Engen Petroleum Limited                   | Gengear                    | 220 (-15)                    | 320 (-12)     | 460 (-3)   |
| Esso/Exxon                                | Spartan EP                 | 220 (-12)                    | 320 (-12)     | 460 (-4)   |
| Fuchs Lubricants                          | Powergear                  |                              | P/Gear (-16)  | M460 (-4)  |
|   | Renogear V                 | 220EP (-13)                  | 320EP (-4)    | 460EP (-4) |
|   | Renogear WE                | 220 (-7)                     | 320 (-4)      | 400 (-4)   |
|   | Renolin CLPF Super         | 6 (-13)                      | 8 (-10)       | 10 (-10)   |
| Klüber Lubrication                        | Klüberoil GEM1             | 220 (-5)                     | 320 (-5)      | 460 (-5)   |
| Kuwait Petroleum International            | Q8 Goya                    | 220 (-16)                    | 320 (-13)     | 460 (-10)  |
| Lubrication Engineers Inc.                | Almasol Vari-Purpose Gear  | 607 (-18)                    | 605 (-13)     | 608 (-10)  |
| Mobil Oil Company Limited                 | Mobil gear 600 series      | 630 (-13)                    | 632 (-13)     | 634 (-1)   |
|   | Mobil gear XMP             | 220 (-19)                    | 320 (-13)     | 460 (-7)   |
| Omega Manufacturing Division              | Omega 690                  |                              | 85w/140 (-15) |            |
| Optimal Ölwerke GmbH                      | Optigear BM                | 220 (-11)                    | 320 (-10)     | 460 (-7)   |
|   | Optigear                   | 220 (-18)                    | 320 (-9)      | 460 (-7)   |
| Pertamina (Indonesia)                     | Masri                      | 220 (-4)                     | 320 (-4)      | 460 (-7)   |
| Petro-Canada                              | Ultima EP                  | 220 (-22)                    | 320 (-16)     | 460 (-10)  |
| Rocol                                     | Sapphire Hi-Torque         | 220 (-13)                    | 320 (-13)     | 460 (-13)  |
| Sasol Oil (Pty) Limited                   | Cobalt                     | 220 (-4)                     | 320 (-1)      | 460 (-4)   |
|   | Hemat                      | 220 (-10)                    | 320 (-7)      | 460 (-4)   |
| Saudi Arabian Lubr. Oil Co.               | Gear Lube EP               | EP220 (-1)                   | EP320 (0)     | EP460 (0)  |
| Shell Oils                                | Omala                      | 220 (-4)                     | 320 (-4)      | 460 (-4)   |
|   | Omala F                    | 220 (-13)                    | 320 (-10)     | 460 (-4)   |
| Texaco Limited                            | Meropa                     | 220 (-16)                    | 320 (-16)     | 460 (-10)  |
|   | Meropa WM                  | 220 (-19)                    | 320 (-16)     | 460 (-11)  |
| Total                                     | Carter EP                  | 220 (-7)                     | 320 (-7)      | 460 (-4)   |
|   | CarterVP/CS                | 220 (-16)                    | 320 (-13)     | 460 (-7)   |
| Tribol GmbH                               | Molub-Alloy Gear Oil       | 90 (-18)                     | 690 (-16)     | 140 (-13)  |
|   | Tribol 1100                | 220 (-20)                    | 320 (-18)     | 460 (-16)  |

### DANGER:

Numbers in brackets indicate the minimum pour point temperature of the specified oil in °C  
**THE UNIT MUST NOT BE RUN BELOW THIS TEMPERATURE.**



## **Approved Lubrication.**

**Type G** Polyglycol based synthetic lubricants with Anti-Wear or EP additives.

These have a medium to high load carrying capacity. (see +)

| SUPPLIER                              | LUBRICANT RANGE                     | GRADE NUMBERS                            |             |             |           |            |
|---------------------------------------|-------------------------------------|--|-------------|-------------|-----------|------------|
|                                       |                                     | 5G                                       | 6G          | 7G          | 8G        | 9G         |
|                                       |                                     | OIL SUPPLIERS CORRESPONDING DESIGNATIONS |             |             |           |            |
| Boxer Services / Millers Oils         | Boxergear W                         | 220 (-31)                                | 320 (-31)   | 460 (-28)   |           |            |
| BP Oil International Limited          | Energyn SG-XP                       | 220 (-31)                                |             | 460 (-34)   | 680 (-28) |            |
| Caltex                                | Synlube CLP                         | 220 (-34)                                | 320 (-31)   | 460 (-28)   | 680 (-31) |            |
| Carl Bechem GmbH                      | Berusynth EP                        | 220 (-25)                                | 320 (-25)   | 460 (-25)   | 680 (-28) | 1000 (-28) |
| Castrol International                 | Alphasyn PG                         | 220 (-34)                                | 320 (-31)   | 460 (-28)   |           |            |
| Esso/Exxon                            | Glycolube                           | 220 (-25)                                | 320 (-25)   | 460 (-23)   |           |            |
| Fuchs Lubricants                      | Renolin PG                          | 220 (-34)                                | 320 (-34)   | 460 (-34)   | 680 (-28) | 1000 (-28) |
| Klüber Lubrication                    | Klübersynth GH6                     | 220 (-25)                                | 320 (-25)   | 460 (-20)   | 680 (-20) | 1000 (-28) |
|                                       | Klübersynth UH1 6                   | 220 (-30)                                | 320 (-25)   | 460 (-25)   |           |            |
| Kuwait Petroleum International        | Q8 Gade                             | 220 (-22)                                | 320 (-22)   | 460 (-22)   |           |            |
| Laporte Performance Chemicals Limited | Berox Industrial Lubricant SW       | 220 (-25)                                | 320 (-25)   | 460 (-23)   | 680 (-20) | 1000 (-28) |
|                                       | Berox SL Range                      | 220 (-40)                                | 320 (-37)   | 460 (-23)   |           |            |
|                                       | Berox Oil Soluble Industrial Lube x | 220 (-23)                                |             |             |           |            |
| Mobil Oil Company Limited             | Glygoyle                            | 30 (-22)                                 | HE320 (-37) | HE460 (-35) |           |            |
| Optimal Ölwerke GmbH                  | Optiflex A +                        | 220 (-28)                                | 320 (-28)   | 460 (-28)   | 680 (-28) | 1000 (-25) |
| Shell Oils                            | Tivela                              | SB (-25)                                 | SC (-25)    | SD (-23)    |           |            |
|                                       | Tivela S                            | 220 (-34)                                | 320 (-34)   | 460 (-34)   |           |            |
| Texaco Limited                        | Synlube CLP                         | 220 (-34)                                | 320 (-31)   | 460 (-10)   | 680 (-31) |            |
| Total                                 | Carter SY                           | 220 (-25)                                | 320 (-28)   | 460 (-22)   |           |            |
| Tribol GmbH                           | Tribol 800                          | 220 (-27)                                | 320 (-25)   | 460 (-25)   | 680 (-25) | 1000 (-23) |

+ NOT SUITABLE FOR APPLICATIONS REQUIRING INDUSTRIAL EP ADDITIVES

x THIS PARTICULAR LUBRICANT IS COMPATIBLE WITH TYPES M, A, E, AND H

**NOTE: TYPE G LUBRICANTS WILL AFFECT CERTAIN GEARCASE PAINTS AND SHRINK CERTAIN SEALS, CONTACT OUR SALES OFFICE BEFORE USE.**

### **DANGER:**

Numbers in brackets indicate the minimum pour point temperature of the specified oil in °C  
**THE UNIT MUST NOT BE RUN BELOW THIS TEMPERATURE.**



## **Approved Lubrication.**

**Type H** Polyalphaolefin based synthetic lubricants with Anti-Wear or EP additives.

These have a medium to high load carrying capacity.

| SUPPLIER                       | LUBRICANT RANGE        | GRADE NUMBERS                |           |
|--------------------------------|------------------------|------------------------------|-----------|
|                                |                        | 5H                           | 6H        |
|                                |                        | AMBIENT TEMPERATURE RANGE °C |           |
|                                |                        | -30 to 35                    | 2 to 50   |
| Batoyle Freedom Group          | Titan                  | 220 (-31)                    | 320 (-28) |
| Boxer Services / Millers Oils  | Silkgear               | 220 (-35)                    | 320 (-35) |
| BP Oil International Limited   | Enersyn EPX            |                              | 320 (-28) |
| Caltex                         | Pinnacle EP            | 220 (-43)                    | 320 (-43) |
| Carl Bechem GmbH               | Berusynth GP           | 220 (-38)                    | 320 (-35) |
| Castrol International          | Alphasyn EP            | 220 (-37)                    | 320 (-31) |
|                                | Alphasyn T             | 220 (-31)                    | 320 (-28) |
| Chevron International Oil Co   | Tegra                  | 220 (-46)                    | 320 (-33) |
| Esso/Exxon                     | Spartan Synthetic EP   | 220 (-46)                    | 320 (-43) |
| Fuchs Lubricants               | Renogear SG            | 220 (-32)                    | 320 (-30) |
|                                | Renolin Unisyn CLP     | 220 (-37)                    | 320 (-34) |
| Klüber Lubrication             | Klübersynth GEM4       | 220 (-30)                    | 320 (-25) |
| Kuwait Petroleum International | Q8 El Greco            | 220 (-22)                    | 320 (-19) |
| Lubrication Engineers Inc.     | Synolec Gear Lubricant | 9920 (-40)                   |           |
| Mobil Oil Company Limited      | Mobilgear SHC          | 220 (-40)                    | 320 (-37) |
|                                | Mobil gear XMP         | 220 (-40)                    | 320 (-33) |
| Optimal Ölwerke GmbH           | Optigear Synthetic A   | 220 (-31)                    | 320 (-31) |
| Petro-Canada                   | Super Gear Fluid       | 220 (-43)                    | 320 (-37) |
| Shell Oils                     | Omala HD               | 220 (-43)                    | 320 (-40) |
| Texaco Limited                 | Pinnacle EP            | 220 (-43)                    | 320 (-43) |
|                                | Pinnacle WM            | 220 (-43)                    | 320 (-40) |
| Total                          | Carter EP/HT           | 220 (-34)                    | 320 (-31) |
| Tribol GmbH                    | Tribol 1510            | 220 (-36)                    | 320 (-33) |

### **DANGER:**

Numbers in brackets indicate the minimum pour point temperature of the specified oil in °C  
**THE UNIT MUST NOT BE RUN BELOW THIS TEMPERATURE.**



## SERIES C LUBRICATION

**C03, C04, C05, & C06 Units**, are supplied factory filled with polyglycol synthetic oil (Grade 6G) appropriate to the intended mounting position. If the unit is supplied without lubricant the unit must be filled with the correct lubricant and quantity as listed below.

**C07, C08, C09, & C10 Units**, require filling with polyglycol synthetic oil (Grade 6G)

Lubricant quantities are approximate fill until oil escapes from the level plug hole, fit ventilator plug (when supplied) in the appropriate position for the required mounting position.

**Primary Units used for Quadruple Reduction**, are supplied factory filled with EP mineral oil (Grade 6E) appropriate to the intended mounting position. If the unit is supplied without lubricant the unit must be filled with the correct lubricant and quantity.

### Lubricant Quantities (Litres)

| DOUBLE REDUCTION & FINAL STAGE QUADRUPLE REDUCTION |   |       |       |       |       |       |       |       |       |       |
|--|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Unit Size  |   | Level | C0321 | C0421 | C0521 | C0621 | C0721 | C0821 | C0921 | C1021 |
| MOUNTING POSITION                                  | 1 | 1     | 0.3   | 0.4   | 0.7   | 1.5   | 4.5   | 7.1   | 17    | 28    |
|  |   | 2     | -     | -     | -     | -     | 3.0   | 5.9   | 11    | 17    |
|  | 2 | All   | 0.5   | 0.7   | 1.0   | 2.3   | 3.5   | 6.2   | 12    | 21    |
|  | 3 | All   | 0.5   | 0.7   | 1.0   | 2.3   | 3.5   | 6.2   | 12    | 21    |
|  | 4 | 1     | 0.7   | 1.0   | 1.4   | 3.1   | 5.1   | 9.5   | 17    | 26    |
|  |   | 2     | -     | -     | -     | -     | 3.0   | 4.8   | 8.3   | 14    |
|  | 5 | All   | 0.6   | 0.9   | 1.4   | 3.0   | 5.6   | 9.6   | 18    | 31    |
|  | 6 | 1     | 0.7   | 1.0   | 1.4   | 3.2   | 7.4   | 12    | 25    | 42    |
|  |   | 2     | -     | -     | -     | -     | 5.1   | 9.5   | 17    | 28    |

| TRIPLE REDUCTION  |   |       |       |       |       |       |       |
|-------------------|---|-------|-------|-------|-------|-------|-------|
| Unit Size         |   | Level | C0331 | C0431 | C0531 | C0631 | C0731 |
| MOUNTING POSITION | 1 | 1     | 0.4   | 0.5   | 0.9   | 2.1   | 4.8   |
|                   |   | 2     | -     | -     | -     | -     | 3.8   |
|                   | 2 | All   | 0.8   | 0.9   | 1.4   | 2.5   | 3.7   |
|                   | 3 | All   | 0.8   | 0.9   | 1.4   | 2.5   | 3.7   |
|                   | 4 | 1     | 1.2   | 1.5   | 2.1   | 4.0   | 5.9   |
|                   |   | 2     | -     | -     | -     | -     | 3.6   |
|                   | 5 | All   | 1.0   | 1.3   | 2.0   | 4.6   | 6.6   |
|                   | 6 | 1     | 1.2   | 1.5   | 1.9   | 4.0   | 9.2   |
|                   |   | 2     | -     | -     | -     | -     | -     |

| QUADRUPLE REDUCTION |   |         |   |         |   |         |   |         |   |         |   |
|---------------------|---|---------|---|---------|---|---------|---|---------|---|---------|---|
| Unit Size           |   | C0341   |   | C0441   |   | C0541   |   | C0641   |   | C0741   |   |
|                     |   | Primary | Secondary   | Primary | Secondary   | Primary | Secondary   | Primary | Secondary   | Primary | Secondary   |
|                     |   | M0122   | C0321   | M0122   | C0421   | M0122   | C0521   | M0322   | C0621   | M0322   | C0721   |
| MOUNTING POSITION   | 1 | 0.5     | See above<br>Double<br>Reduction table<br>for lubricant | 0.5     | See above<br>Double<br>Reduction table<br>for lubricant | 0.5     | See above<br>Double<br>Reduction table<br>for lubricant | 0.8     | See above<br>Double<br>Reduction table<br>for lubricant | 0.8     | See above<br>Double<br>Reduction table<br>for lubricant |
|                     | 2 | 0.5     |   | 0.5     |   | 0.5     |   | 0.8     |   | 0.8     |   |
|                     | 3 | 0.5     |   | 0.5     |   | 0.5     |   | 0.8     |   | 0.8     |   |
|                     | 4 | 0.5     |   | 0.5     |   | 0.5     |   | 0.8     |   | 0.8     |   |
|                     | 5 | 0.7     |   | 0.7     |   | 0.7     |   | 1.1     |   | 1.1     |   |
|                     | 6 | 1.0     |   | 1.0     |   | 1.0     |   | 1.4     |   | 1.4     |   |

| QUADRUPLE REDUCTION..CONT |   |         |   |         |   |         |   |
|---------------------------|---|---------|---|---------|---|---------|---|
| Unit Size                 |   | C0841   |   | C0941   |   | C1041   |   |
|                           |   | Primary | Secondary   | Primary | Secondary   | Primary | Secondary   |
|                           |   | M0522   | C0821   | M0522   | C0921   | M0722   | C1021   |
| MOUNTING POSITION         | 1 | 1.5     | See above<br>Double<br>Reduction table<br>for lubricant | 1.5     | See above<br>Double<br>Reduction table<br>for lubricant | 2.6     | See above<br>Double<br>Reduction table<br>for lubricant |
|                           | 2 | 1.5     |   | 1.5     |   | 2.6     |   |
|                           | 3 | 1.5     |   | 1.5     |   | 2.6     |   |
|                           | 4 | 1.5     |   | 1.5     |   | 2.6     |   |
|                           | 5 | 2.0     |   | 2.0     |   | 3.2     |   |
|                           | 6 | 2.6     |   | 2.6     |   | 4.7     |   |



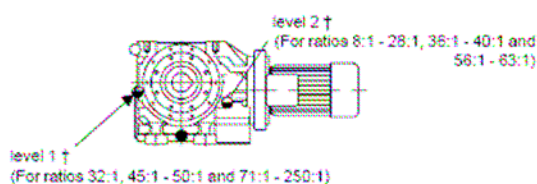


## SERIES C LUBRICATION FILL LEVELS

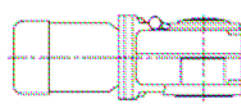
MOUNTING 1 C03, 04, 05, 06 ★



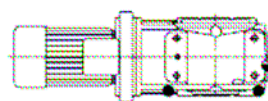
C07, 08, 09, 10



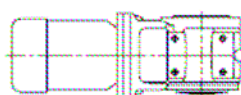
MOUNTING 2 C03, 04, 05, 06 ★



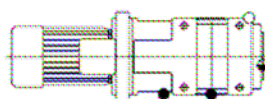
C07, 08, 09, 10



MOUNTING 3 C03, 04, 05, 06 ★



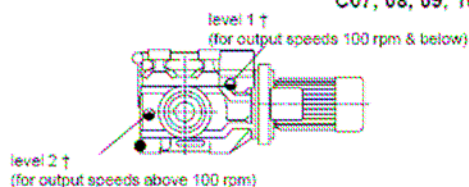
C07, 08, 09, 10



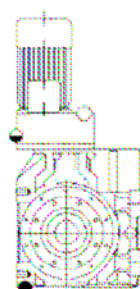
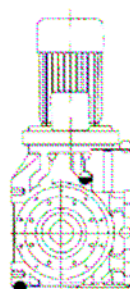
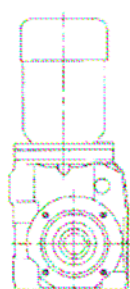
MOUNTING 4 C03, 04, 05, 06 ★



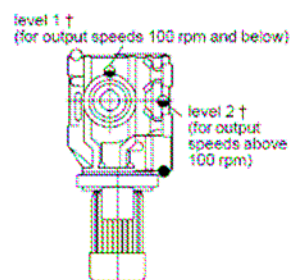
C07, 08, 09, 10



MOUNTING 5 C03, 04, 05, 06 ★ C07, 08, 09, 10 C0731



MOUNTING 6 C03, 04, 05, 06 C07, 08, 09, 10



MOTOR MUST BE FITTED WITH SEAL FOR THIS POSITION

- DRAIN POSITION
- LEVEL POSITION
- VENTILATOR / FILLING POSITION

} C07/08/09/10  
ONLY

★ THESE UNITS ARE NOT FITTED WITH A VENTILATOR  
SIZES C03 AND C04 HAVE TWO TAPPED HOLES FOR FILLING PURPOSES,  
SIZES C05 AND C06 HAVE THREE TAPPED HOLES FOR FILLING PURPOSES

† ASSUMING 1450 RPM INPUT



## SERIES F LUBRICATION

**F02,F03,F04,F05,F06,&F08 Units & Primary Units used for Quintuple Reduction**, are supplied factory filled with EP mineral oil (Grade 6E) appropriate to the intended mounting position. If the unit is supplied without lubricant the unit must be filled with the correct lubricant and quantity as listed below.

**F09,F10,F11, & F12 Units**, require filling with EP mineral oil (Grade 6E)

Lubricant quantities are approximate fill until oil escapes from the level plug hole, fit ventilator plug (when supplied) in the appropriate position for the required mounting position. If the unit is supplied without lubricant the unit must be filled with the correct lubricant and quantity.

### Lubricant Quantities (Litres)

| DOUBLE REDUCTION  |   |       |       |       |       |       |       |       |       |       |       |       |
|-------------------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Unit Size         |   | F0222 | F0322 | F0422 | F0522 | F0622 | F0722 | F0822 | F0921 | F1021 | F1121 | F1221 |
| MOUNTING POSITION | 1 | 0.8   | 1.3   | 1.3   | 2.1   | 3.5   | 6.3   | 10.7  | 19    | 34    | 28    | 47    |
|                   | 2 | 0.4   | 0.8   | 0.8   | 1.4   | 2.3   | 3.5   | 7.1   | 13    | 22    | 17    | 27    |
|                   | 3 | 0.4   | 1.1   | 1.1   | 1.4   | 2.3   | 3.4   | 8.8   | 17    | 28    | 22    | 36    |
|                   | 4 | 0.5   | 0.8   | 0.8   | 1.8   | 3.0   | 5.0   | 4.7   | 15    | 27    | 24    | 40    |
|                   | 5 | 1.1   | 1.2   | 1.2   | 2.8   | 4.5   | 8.0   | 9.7   | 24    | 43    | 34    | 56    |
|                   | 6 | 1.3   | 2.0   | 2.0   | 3.2   | 5.2   | 9.0   | 17.2  | 25    | 43    | 30    | 50    |

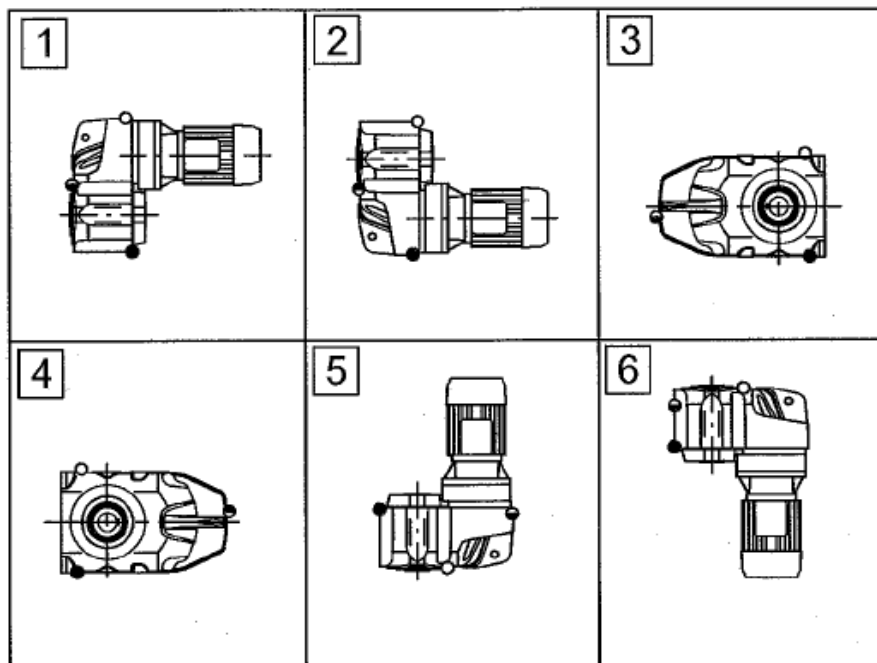
| TRIPLE REDUCTION  |   |       |       |       |       |       |       |       |       |       |       |       |
|-------------------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Unit Size         |   | F0232 | F0332 | F0432 | F0532 | F0632 | F0732 | F0832 | F0931 | F1031 | F1131 | F1231 |
| MOUNTING POSITION | 1 | 0.8   | 1.2   | 1.3   | 2.1   | 3.5   | 6.3   | 10.4  | 19    | 34    | 27    | 45    |
|                   | 2 | 0.4   | 0.8   | 0.8   | 1.4   | 2.3   | 3.5   | 7.3   | 15    | 24    | 16    | 25    |
|                   | 3 | 0.4   | 1.1   | 1.1   | 1.4   | 2.3   | 3.4   | 9.2   | 17    | 28    | 21    | 34    |
|                   | 4 | 0.5   | 0.8   | 0.8   | 1.8   | 3.0   | 5.0   | 5.3   | 16    | 27    | 23    | 38    |
|                   | 5 | 1.1   | 1.2   | 1.2   | 2.8   | 4.5   | 8.0   | 9.7   | 24    | 43    | 33    | 53    |
|                   | 6 | 1.3   | 2.0   | 2.0   | 3.2   | 5.2   | 9.0   | 17.4  | 25    | 43    | 29    | 48    |

| QUADRUPLE REDUCTION |   |         |           |         |           |         |           |         |           |         |           |
|---------------------|---|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|
| Unit Size           |   | F0342   |           | F0442   |           | F0542   |           | F0642   |           | F0742   |           |
|                     |   | Primary | Secondary | Primary | Secondary | Primary | Secondary | Primary | Secondary | Primary | Secondary |
|                     |   | M0122   | F0322     | M0122   | F0422     | M0322   | F0522     | M0322   | F0622     | M0322   | F0722     |
| MOUNTING POSITION   | 1 | 0.5     | 1.3       | 0.5     | 1.3       | 0.8     | 2.1       | 0.8     | 3.5       | 0.8     | 6.3       |
|                     | 2 | 0.5     | 0.8       | 0.5     | 0.8       | 0.8     | 1.4       | 0.8     | 2.3       | 0.8     | 3.5       |
|                     | 3 | 0.5     | 1.1       | 0.5     | 1.1       | 0.8     | 1.4       | 0.8     | 2.3       | 0.8     | 3.4       |
|                     | 4 | 0.5     | 0.8       | 0.5     | 0.8       | 0.8     | 1.8       | 0.8     | 3.0       | 0.8     | 5.0       |
|                     | 5 | 0.7     | 1.2       | 0.7     | 1.2       | 1.1     | 2.8       | 1.1     | 4.5       | 1.1     | 8.0       |
|                     | 6 | 1.0     | 2.0       | 1.0     | 2.0       | 1.4     | 3.2       | 1.4     | 5.2       | 1.4     | 9.0       |

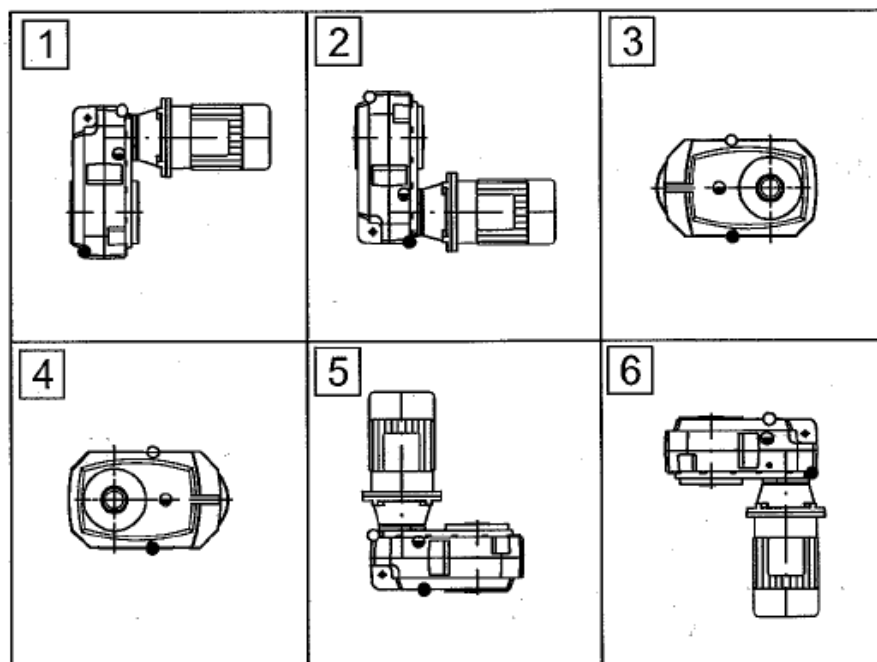
| QUADRUPLE REDUCTION..CONT |   |         |           |         |           |         |           |
|---------------------------|---|---------|-----------|---------|-----------|---------|-----------|
| Unit Size                 |   | F0842   |           | F0941   |           | F1041   |           |
|                           |   | Primary | Secondary | Primary | Secondary | Primary | Secondary |
|                           |   | M0522   | F0822     | M0522   | F0921     | M0722   | F1021     |
| MOUNTING POSITION         | 1 | 1.5     | 11        | 1.5     | 19        | 2.6     | 34        |
|                           | 2 | 1.5     | 7         | 1.5     | 13        | 2.6     | 22        |
|                           | 3 | 1.5     | 9         | 1.5     | 17        | 2.6     | 28        |
|                           | 4 | 1.5     | 5         | 1.5     | 15        | 2.6     | 27        |
|                           | 5 | 2.0     | 10        | 2.0     | 24        | 3.2     | 43        |
|                           | 6 | 2.6     | 17        | 2.6     | 25        | 4.7     | 43        |

## SERIES F PLUG POSITIONS

### F02 - F10



### F11,& F12



- Ventilator / filling position
- Level Position
- Drain Position



## SERIES K LUBRICATION

**K03,K04,K05,K06,& K07 Units & Primary Units used for Quintuple Reduction**, are supplied factory filled with EP mineral oil (Grade 6E) appropriate to the intended mounting position. If the unit is supplied without lubricant the unit must be filled with the correct lubricant and quantity as listed below.

**K08,K09,K10,& K12 Units**, require filling with EP mineral oil (Grade 6E)

Lubricant quantities are approximate fill until oil escapes from the level plug hole, fit ventilator plug (when supplied) in the appropriate position for the required mounting position. If the unit is supplied without lubricant the unit must be filled with the correct lubricant and quantity.

### Lubricant Quantities (Litres)

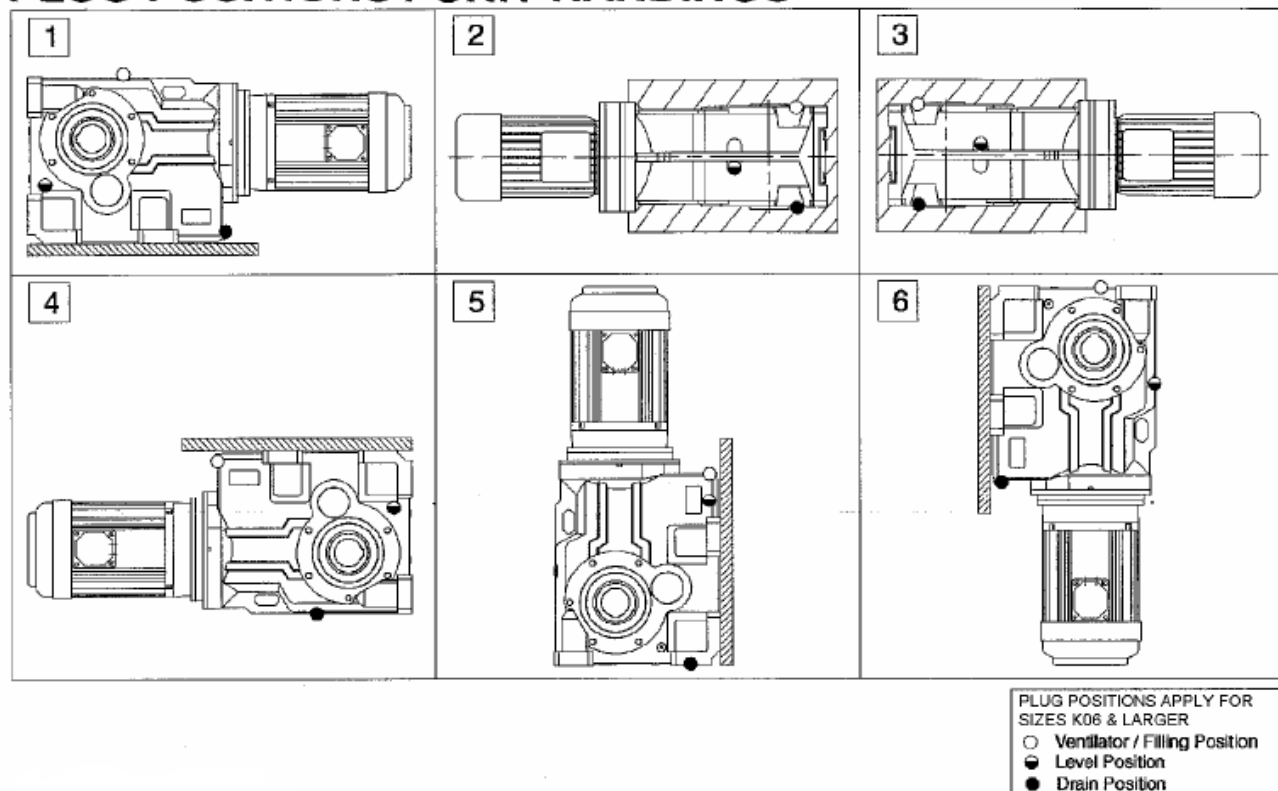
| TRIPLE REDUCTION  |   |       |       |       |       |       |       |       |       |       |
|-------------------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Unit Size         |   | K0332 | K0432 | K0532 | K0632 | K0732 | K0832 | K0931 | K1031 | K1231 |
| MOUNTING POSITION | 1 | 0.5   | 0.7   | 1.1   | 1.5   | 2.7   | 4.4   | 9.3   | 15    | 23    |
|                   | 2 | 0.7   | 0.9   | 1.5   | 1.8   | 3.6   | 3.7   | 8.3   | 15    | 27    |
|                   | 3 | 0.8   | 1.1   | 1.7   | 2.8   | 4.0   | 7.6   | 18    | 28    | 33    |
|                   | 4 | 1.0   | 1.3   | 1.9   | 2.7   | 4.5   | 7.5   | 17    | 30    | 39    |
|                   | 5 | 1.2   | 1.7   | 2.5   | 3.6   | 5.7   | 9.6   | 21    | 34    | 50    |
|                   | 6 | 0.9   | 1.2   | 2.0   | 2.6   | 4.5   | 7.6   | 16    | 25    | 35    |

| QUINTUPLE REDUCTION |   |         |           |         |           |         |           |         |           |         |           |
|---------------------|---|---------|-----------|---------|-----------|---------|-----------|---------|-----------|---------|-----------|
| Unit Size           |   | K0352   |           | K0452   |           | K0552   |           | K0652   |           | K0752   |           |
|                     |   | Primary | Secondary | Primary | Secondary | Primary | Secondary | Primary | Secondary | Primary | Secondary |
|                     |   | M0122   | K0332     | M0122   | K0432     | M0322   | K0532     | M0322   | K0632     | M0322   | K0732     |
| MOUNTING POSITION   | 1 | 0.5     | 0.5       | 0.5     | 0.7       | 0.8     | 1.1       | 0.8     | 1.5       | 0.8     | 2.7       |
|                     | 2 | 0.5     | 0.7       | 0.5     | 0.9       | 0.8     | 1.5       | 0.8     | 1.8       | 0.8     | 2.7       |
|                     | 3 | 0.5     | 0.8       | 0.5     | 1.1       | 0.8     | 1.7       | 0.8     | 2.8       | 0.8     | 2.7       |
|                     | 4 | 0.5     | 1.0       | 0.5     | 1.3       | 0.8     | 1.9       | 0.8     | 2.7       | 0.8     | 2.7       |
|                     | 5 | 0.7     | 1.2       | 0.7     | 1.7       | 1.1     | 2.5       | 1.1     | 3.6       | 1.1     | 5.7       |
|                     | 6 | 1.0     | 0.9       | 1.0     | 1.2       | 1.4     | 2.0       | 1.4     | 2.6       | 1.4     | 4.5       |

| QUINTUPLE REDUCTION..CONT |   |         |           |         |           |         |           |         |           |
|---------------------------|---|---------|-----------|---------|-----------|---------|-----------|---------|-----------|
| Unit Size                 |   | K0852   |           | K0951   |           | K1051   |           | K1251   |           |
|                           |   | Primary | Secondary | Primary | Secondary | Primary | Secondary | Primary | Secondary |
|                           |   | M0522   | K0832     | M0522   | K0931     | M0722   | K1031     | M0722   | K1231     |
| MOUNTING POSITION         | 1 | 1.5     | 4.4       | 1.5     | 9.3       | 2.6     | 15        | 2.6     | 23        |
|                           | 2 | 1.5     | 3.7       | 1.5     | 8.3       | 2.6     | 15        | 2.6     | 27        |
|                           | 3 | 1.5     | 7.6       | 1.5     | 18        | 2.6     | 28        | 2.6     | 33        |
|                           | 4 | 1.5     | 7.5       | 1.5     | 17        | 2.6     | 30        | 2.6     | 39        |
|                           | 5 | 2.0     | 9.6       | 2.0     | 21        | 3.2     | 34        | 3.2     | 50        |
|                           | 6 | 2.6     | 7.6       | 2.6     | 16        | 4.7     | 25        | 4.7     | 35        |



## SERIES K PLUG POSITIONS / UNIT HANDINGS





## SERIES M LUBRICATION

**M01,M02,M03,M04,M05,M06,& M07 Units**, are supplied factory filled with EP mineral oil (Grade 6E) appropriate to the intended mounting position. If the unit is supplied without lubricant the unit must be filled with the correct lubricant and quantity as listed below.

**M08,M09,M10,M13,& M14 Units**, require filling with EP mineral oil (Grade 6E)

Lubricant quantities are approximate fill until oil escapes from the level plug hole, fit ventilator plug (when supplied) in the appropriate position for the required mounting position. If the unit is supplied without lubricant the unit must be filled with the correct lubricant and quantity.

### Lubricant Quantities (Litres)

| SINGLE REDUCTION  |   |       |       |       |       |
|-------------------|---|-------|-------|-------|-------|
| Unit Size         |   | M0512 | M0612 | M0712 | M0812 |
| MOUNTING POSITION | 1 | 0.3   | 0.6   | 1.2   | 2.5   |
|                   | 2 | 0.3   | 0.6   | 1.2   | 2.5   |
|                   | 3 | 0.3   | 0.6   | 1.2   | 2.5   |
|                   | 4 | 0.4   | 0.7   | 1.5   | 3.5   |
|                   | 5 | 0.4   | 0.6   | 1.2   | 2.5   |
|                   | 6 | 0.5   | 1.0   | 2.0   | 4.1   |

| DOUBLE REDUCTION & FINAL STAGE QUADRUPLE OR QUINTUPLE REDUCTION |   |       |       |       |       |       |       |       |       |       |       |       |       |
|---|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Unit Size   |   | M0122 | M0222 | M0322 | M0422 | M0522 | M0622 | M0722 | M0822 | M0921 | M1021 | M1321 | M1421 |
| MOUNTING POSITION   | 1 | 0.5   | 0.8   | 0.8   | 1.5   | 1.5   | 2.0   | 2.6   | 4.2   | 10.5  | 11.0  | 17.0  | 24.0  |
|   | 2 | 0.8   | 1.2   | 1.2   | 1.8   | 1.8   | 2.0   | 2.9   | 6.3   | 12.0  | 22.0  | 31.0  | 49.0  |
|   | 3 | 0.6   | 0.7   | 0.7   | 1.6   | 1.6   | 1.9   | 2.7   | 5.4   | 12.0  | 22.0  | 31.0  | 49.0  |
|   | 4 | 0.8   | 1.2   | 1.2   | 1.8   | 1.8   | 1.7   | 3.0   | 7.3   | 12.0  | 19.0  | 28.0  | 41.0  |
|   | 5 | 0.7   | 1.1   | 1.1   | 2.0   | 2.0   | 2.2   | 3.2   | 6.8   | 16.8  | 32.0  | 47.0  | 72.0  |
|   | 6 | 1.0   | 1.4   | 1.4   | 2.6   | 2.6   | 2.8   | 4.7   | 9.3   | 16.4  | 26.0  | 38.0  | 65.0  |

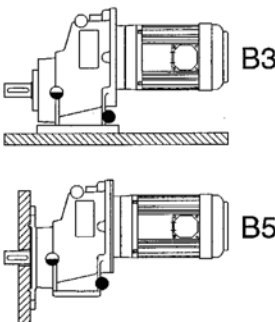
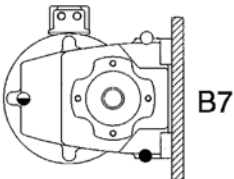
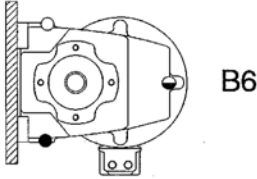
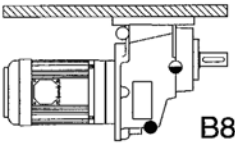
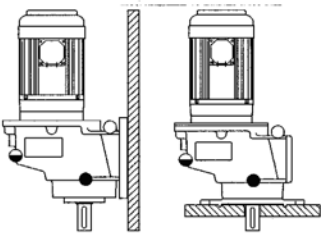
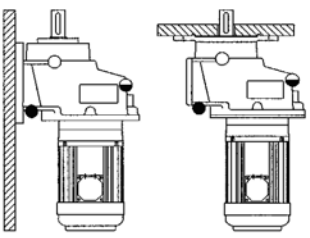
| TRIPLE REDUCTION  |   |       |       |       |       |       |       |       |       |       |       |       |       |
|-------------------|---|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Unit Size         |   | M0132 | M0232 | M0332 | M0432 | M0532 | M0632 | M0732 | M0832 | M0931 | M1031 | M1331 | M1431 |
| MOUNTING POSITION | 1 | 0.6   | 0.8   | 0.8   | 1.6   | 1.6   | 2.1   | 2.7   | 4.4   | 11.5  | 11.0  | 18.0  | 24.5  |
|                   | 2 | 0.9   | 1.3   | 1.3   | 1.9   | 1.9   | 2.1   | 3.0   | 6.5   | 12.0  | 24.0  | 33.0  | 50.0  |
|                   | 3 | 0.7   | 0.7   | 0.7   | 1.7   | 1.7   | 2.0   | 2.8   | 5.6   | 12.0  | 24.0  | 33.0  | 50.0  |
|                   | 4 | 0.9   | 1.2   | 1.2   | 1.9   | 1.9   | 1.8   | 3.1   | 7.5   | 12.0  | 21.0  | 30.0  | 43.0  |
|                   | 5 | 0.7   | 1.1   | 1.1   | 2.1   | 2.1   | 2.3   | 3.3   | 6.8   | 16.8  | 32.0  | 47.0  | 72.0  |
|                   | 6 | 1.1   | 1.6   | 1.6   | 2.7   | 2.7   | 2.9   | 4.8   | 9.7   | 16.5  | 28.0  | 40.0  | 67.0  |

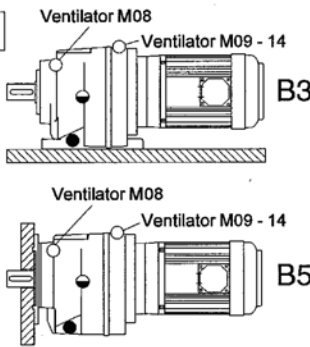
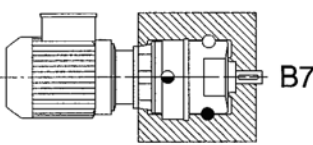
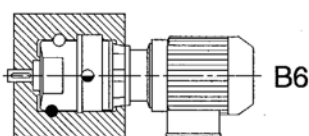
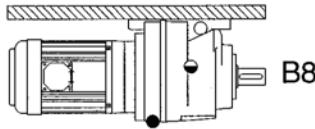
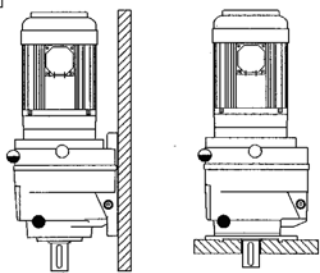
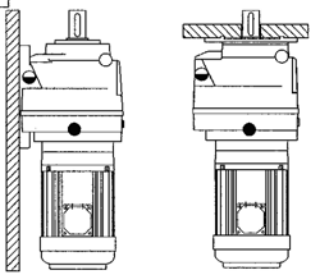
| PRIMARY STAGE QUADRUPLE REDUCTION (Quantities obtained from above double and triple sizes indicated) |       |       |       |       |       |       |       |       |       |       |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Unit Size  | M0342 | M0442 | M0542 | M0642 | M0742 | M0842 | M0941 | M1041 | M1341 | M1441 |
| PRIMARY UNIT   | M0122 | M0322 | M0322 | M0322 | M0322 | M0522 | M0522 | M0722 | M0722 | M0722 |
| SECONDARY UNIT   | M0322 | M0422 | M0522 | M0622 | M0722 | M0822 | M0921 | M1021 | M1321 | M1421 |

| PRIMARY STAGE QUINTUPLE REDUCTION (Quantities obtained from above double and triple sizes indicated) |       |       |       |       |       |       |       |       |       |       |
|--|-------|-------|-------|-------|-------|-------|-------|-------|-------|-------|
| Unit Size  | M0352 | M0452 | M0552 | M0652 | M0752 | M0852 | M0951 | M1051 | M1351 | M1451 |
| PRIMARY UNIT   | M0132 | M0332 | M0332 | M0332 | M0332 | M0532 | M0532 | M0732 | M0732 | M0732 |
| SECONDARY UNIT   | M0322 | M0422 | M0522 | M0622 | M0722 | M0822 | M0921 | M1021 | M1321 | M1421 |



## SERIES M PLUG POSITIONS

| Single Reduction Units   |  |  |
|--|--|--|
| <div>1</div> <div></div>  | <div>2</div> <div></div>  | <div>3</div> <div></div>  |
| <div>4</div> <div></div> | <div>5</div> <div></div> | <div>6</div> <div></div> |

| Double, Triple, Qudruple and Quintuple Reduction Units  |   |   |
|---|---|---|
| <div>1</div> <div></div> | <div>2</div> <div></div> | <div>3</div> <div></div> |
| <div>4</div> <div></div> | <div>5</div> <div></div> | <div>6</div> <div></div> |

○ Ventilator / Filling Position

● Level Position

● Drain Position

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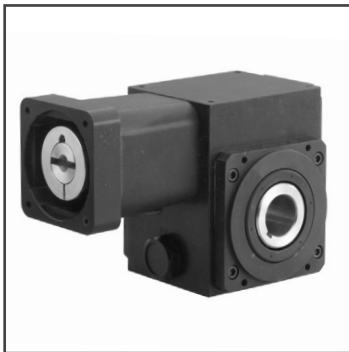
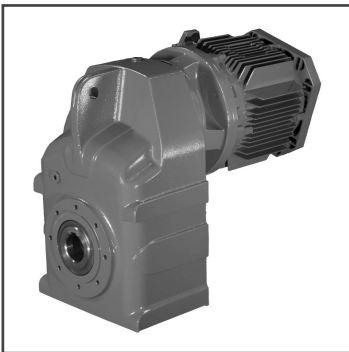
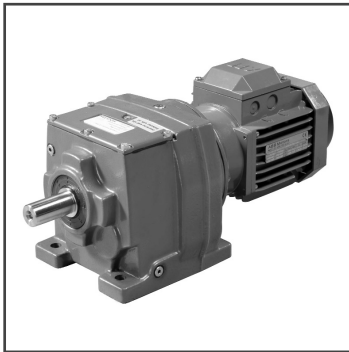
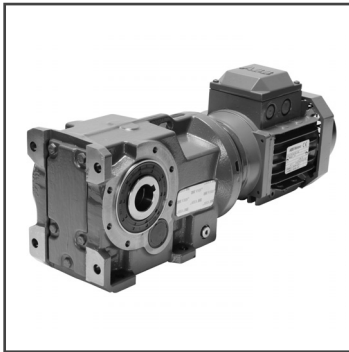
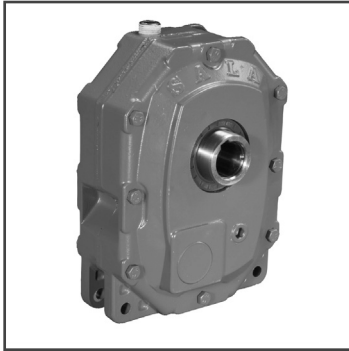
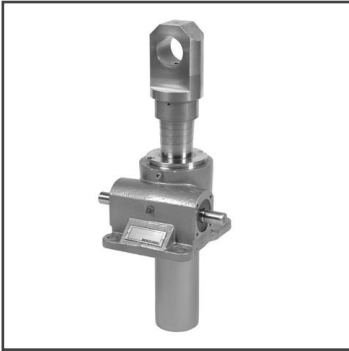
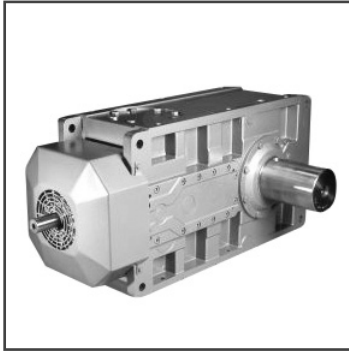
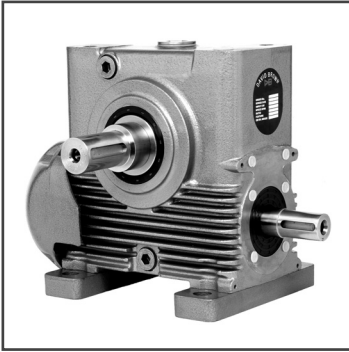
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