benzlers

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Series E

Installation & Maintenance Manual

radicon

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IE-1.00GBA0816

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 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 arid 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 with 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 manufacturer's 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 turned 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 manufacturer's 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 bums. 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, and 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.

Safety warning Symbols

Electrical Hazard
Could result in death or serious injury

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

Important notes on Explosion Protection

Danger
Could result in serious, slight or minor injuries

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

Cleaning
Periodic cleaning necessary

1. General Information

1.1. Declaration of Conformity

We hereby declare that our products have been designed in accordance with the following Directives and Standards:

- The Machinery Directive 2006/42/EC
- EN ISO 12100:2010 Safety of Machinery. General principles for design. Risk assessment and risk reduction.
- Conformity with other harmonised standards, tests, and specifications, (In as much as they apply to our products)

1.2. Declaration of Incorporation According to Machinery Directive 2006/42/EC Annex IIB

This product must not be put into service until the machinery into which it is to be incorporated has been declared in conformity with the provisions of the machinery directive 2006/42/EC.

The equipment shall only be loaded within the framework of our recommendations, and installed and operated in accordance with our installation and maintenance instructions.

We hereby draw attention to the dangers of improper use of this equipment and particularly warns users against operating with inadequate guarding of rotating parts and the use of naked lights in close proximity to the equipment.

We will provide upon a reasoned request from national authorities, any relevant information on our products.

1.3. Warranty Conditions

We warrant our products to be free of defects for a period of 12 months from the date the product is installed to a maximum of 18 months from the date shipment.

The warranty will only be valid if the product is loaded within the framework of our recommendations, and installed and operated in accordance with our installation and maintenance instructions.

The warranty is limited to the repair or replacement of the defective product or part which is returned to our factory after notification of failure.

We shall be liable only for the repair and replacement of the product and shall not be liable to any consequential damages resulting from a defective or non-conforming product.

1.4. Scope

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

Industrial gear units are often supplied modified to suit specific customer requirements, or are supplied as part of a drive package. These instructions shall be supplementary to any information contained on a certified arrangement drawing and any separate instructions for equipment fitted to the gear unit.

2. Handling

2.1. Packaging of the gear unit will be determined dependant on the unit size and method of shipment.

2.2. Care must be taken to handle the product in the correct manner appropriate to the method of packaging.

2.3. Larger products may be supplied without any packaging and must be lifted in accordance with details given in section 5

3. External Protection

3.1. All our industrial gear units are provided with adequate protection against normal operating conditions for a period of up to 6 months. Units should be stored in a clean and dry sheltered space prior to installation

3.2. Special arrangements should be made if units are to operate in extreme climatic conditions, or when they are to stored or be left standing for long periods without running, (e.g. during plant construction) Please consult our application engineers so that adequate protection can be arranged.

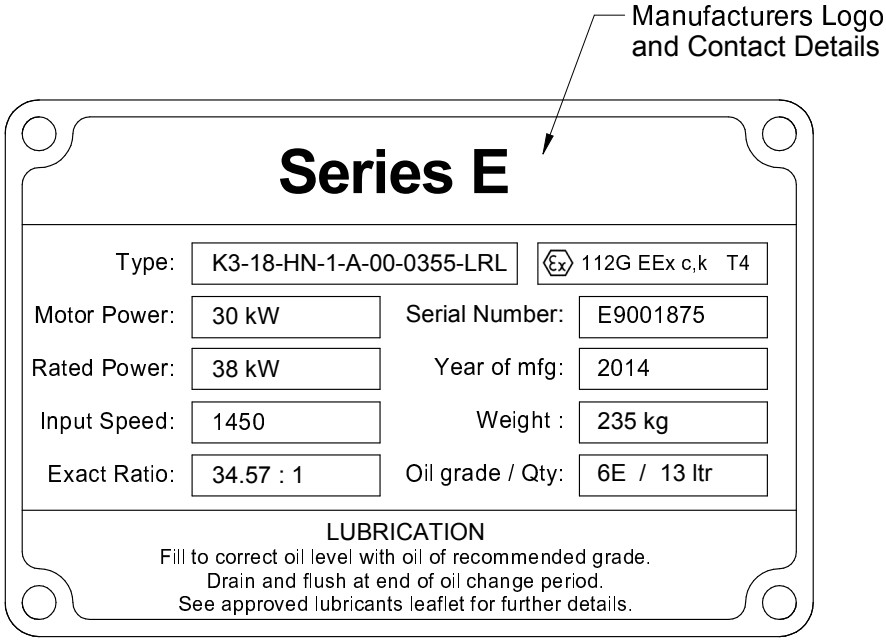
4. Reading the Nameplate

4.1. Unit Identification

The nameplate contains the manufacturers contact details and a unique serial number

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

- Type (Model No)
- The Serial Number
- Year of Manufacture



4.2. Unit Details

The exact gear ratio, together with the selected power and speed details are marked on the nameplate.
N.B. Output Speed = Input Speed / Exact Ratio

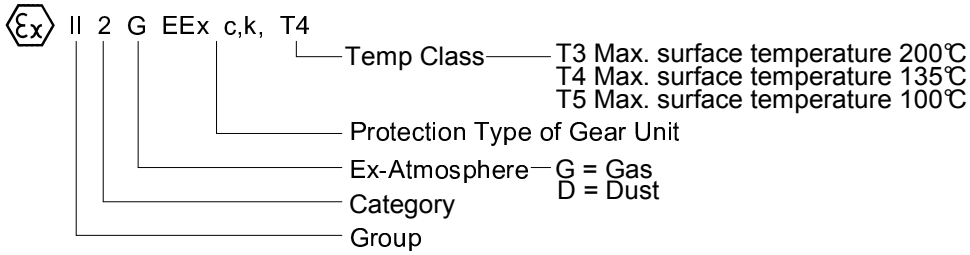
4.3. Lubricant Details

The Lubrication grade and approximate quantity is marked on the nameplate.
See Appendix 2 for Recommended Lubricants

4.4. The Ex Marking

Units marked with this symbol are intended for use in industrial systems.
Provided the units are correctly selected and are installed in accordance with these instructions (gear units only) they will comply with the EU directive 94/9/EC ATEX 100a for Group II Cat 2 zones 1 & 21 or 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 the EU Directive 94/9/EC (ATEX 100a) markings:



Examples:

Ex II 2 G - (Zone 1) Occasional hazardous explosive atmosphere

Ex II 3 G - (Zone 2) Rare short-term hazardous explosive atmosphere

Ex II 2 D - (Zone 21) Occasional hazardous explosive atmosphere during normal operation due to presence of combustible dust

Ex II 3 D - (Zone 22) Rare short-term hazardous explosive atmosphere due to presence of combustible dust; no hazard during normal operation

5. Installation

5.1. General Information

WARNING!

CAUTION

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.

WARNING: All Series E units are despatched without oil, on installing the unit fill with recommended lubricant to correct level. In accordance with the details in section 6

5.2. Prior to Installation

CAUTION

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 gearbox mounting surfaces and shafts to be free of paint & anti-corrosion agents using a commercially available solvent, ensure the solvent does not make contact with the oil seals.

5.2.4. Do not use files or abrasive papers to remove paint or anti-corrosion coatings

5.3. Fitting of Components to either the Unit Input or Output Shaft

STOP

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).

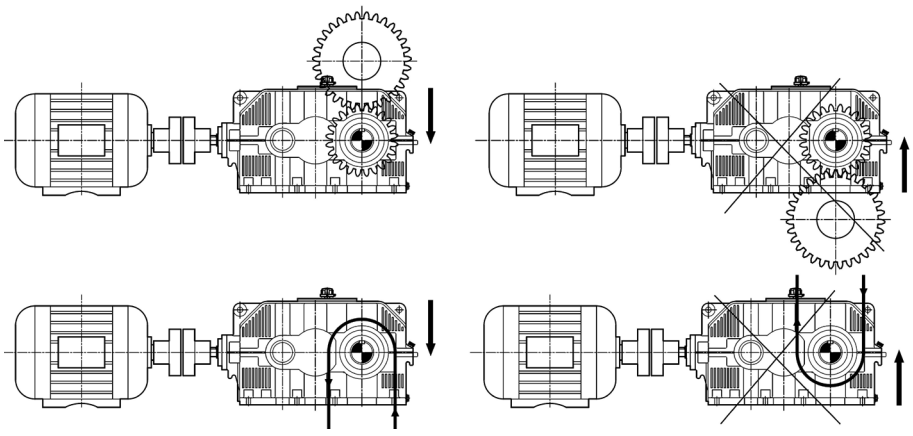
5.3.1. Ensure shaft extensions, bores & keys etc are cleaned.

5.3.2. Items (such as gears, sprockets, couplings etc) should not be hammered onto these shafts since this could damage the gearbox shaft and supporting 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.

5.3.4. Items being fitted may be heated to 80/100°C to aid assembly further.

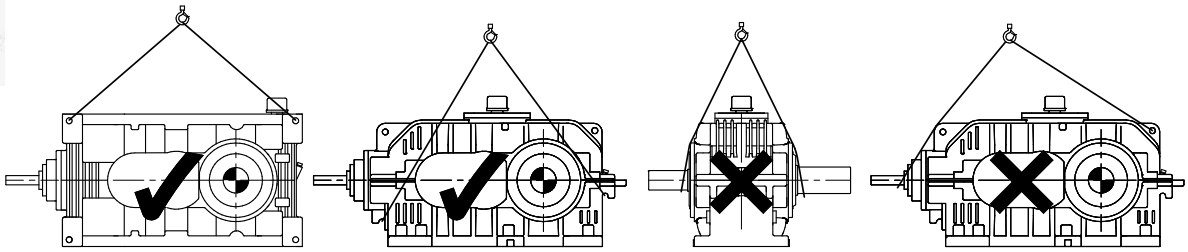
5.3.5. Overhung pinions and sprockets should be located as close to the gear unit as possible, and should be (wherever possible) assembled so that the radial reaction forces are in a downward direction.



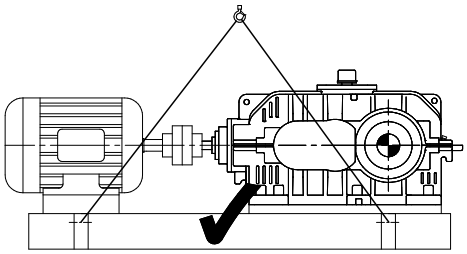
5.4. Lifting

CAUTION

Gearbox Only Use the lifting points identified below, do not use the gearbox shafts.



Gearbox, Motor and Baseplate Assembly – Use the lifting points located on the baseplate



CAUTION

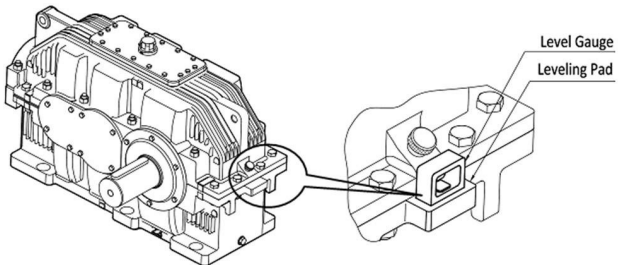
Note: Failure to use these lifting points could result in personal injury / or damage to the product and surrounding equipment.

5.5. Installing foot mounted units

STOP

5.5.1. Ensure the base foundation mounting surface is flat[1], vibration absorbing and torsionaly rigid.
Note: Units to be mounted on baseplates should if possible be mounted on the same bedplate as the prime mover. *[1] Maximum permissible flatness error for mounting surface is 0.12mm*.

5.5.2. The gear unit must be installed in the specified mounting position and on a level surface to insure correct lubrication. Levelling surfaces are provided on the gear unit housing to aid installation.
The maximum deviation from the horizontal is ± 1.5° (unless the gear unit is suitably modified and approved for a non-standard mounting position).



5.5.3. Align unit (see Appendix 4).

Note: It is important to ensure when aligning unit on baseplate that all machined mounting points are supported over their full area.
If steel packing's 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 packing's.

Torque tighten bolts to torque specified in Table 1.

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

Table 1

Set Screw Size	Tightening Torque
M8	25 Nm
M10	50 Nm
M12	85 Nm
M14	135 Nm
M16	200 Nm
M20	350 Nm

Set Screw Size	Tightening Torque
M24	610 Nm
M27	1000 Nm
M30	1220 Nm
M33	1900 Nm
M36	2150 Nm
M42	3460 Nm

5.6. Installing Shaft Mounted Units

The following procedure is recommended for Hollow shaft or Rigid coupled gear units.

5.6.1. Clean the driven machine shaft and gear unit bore, or rigid coupling facings

5.6.2. Assemble the gear unit into position on the driven machine shaft.

5.6.3. The assembly method will vary dependant on output shaft design - follow the procedures as detailed in Appendix 4
Note! The gearbox should be located as close as possible to the bearing of the driven machine.

5.6.4. Secure the unit onto the driven machine shaft - follow the procedures as detailed in Appendix 4

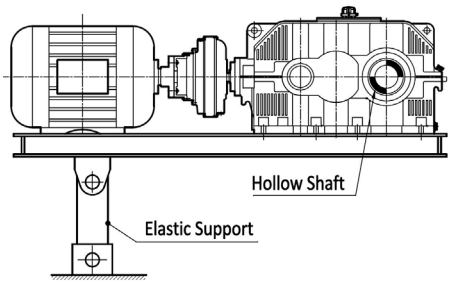
5.6.5. Fit a torque reaction arm to the gear unit or baseplate (as indicated on the assembly drawing) and anchor the torque reaction arm to a secure point.
Unless specified otherwise, the torque reaction arm will be supplied by the client.
The length of the torque arm is variable dependant on the site conditions.

5.6.6. When used as traverse drives with high inertia loads, e.g. crane drives (slewing, long travel and cross travel) or bogie drives and high inertia load roller table drives, it is recommended that the units should be fitted with a shock absorbing torque reaction arm.
Consult our application engineers for details.

5.6.7. Check the gearbox is installed in the correct mounting position and is mounted level
Levelling surfaces are provided on the gear unit housing to aid installation, the maximum deviation from the horizontal is ± 1.5° (unless the gear unit is suitably modified and approved for a non-standard mounting position).

5.6.8. If necessary adjust the position of the torque arm anchor point so that the gearbox operates in the level position.

5.6.9. Gear units supplied assembled to a swing baseplate will have a unique torque reaction point – consult the specific assembly drawing for details.



5.7. Preparation for Starting Up

5.7.1. Fit guards in accordance with the factory acts.

5.7.2. Check motor wiring for correct direction of rotation, this is important when a backstop device is fitted.

5.7.3. Fill gear unit with oil as detailed in section 6.

5.8. Units for use in a Potentially Explosive Atmosphere (ATEX)

5.8.1. If the unit has been damaged in transit do not use.
(Remove all transport fixtures and packing's prior to start up)

5.8.2. Check the unit nameplate data matches with the sites potentially explosive atmosphere classification.

5.8.3. Check ambient temperature falls within lubricant grade recommendations.
(See Approved Lubricants in Appendix 2)

5.8.4. Make sure no potentially explosive atmosphere exists during installation.

5.8.5. Make sure that gear unit is sufficiently ventilated with no external heat input – cooling air temperature should not exceed 40°C

5.8.6. Ensure mounting position corresponds to that marked on the nameplate.
(Note! ATEX approval is only valid for mounting position specified on the nameplate.)

5.8.7. 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.

5.8.8. Ensure gearbox is not subjected to any loading greater than those marked on the nameplate.

5.8.9. 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.

5.8.10. Belt driven units - Check all belts fitted are of sufficient electrical leakage resistance. (< 10^9 Ω).

5.8.11. Ensure the gear unit and other equipment is electrically grounded (earthed).

5.8.12. Check and adjust all guards and covers so that there is no ignition source from sparks that may be thrown by moving parts making contact with guards etc.

5.8.13. Ex group II cat 2D (Zone 21) & Ex group II cat 3D (Zone 22)
Ensure coupling guards, covers etc. are dust tight, or are designed in such a way that any build-up of dust deposits cannot form.

6. Lubrication

6.1. General Information

6.1.1. All Series E units are despatched without oil (a warning label is attached), and therefore must be filled by the client.

6.1.2. The grade and type of oil will be stamped on the nameplate, in the format: 6E or 5H etc...

6.1.3. Only use new clean oil.

6.2. Temperature Limitations

6.2.1. Check lubricant grade (stamped on nameplate) is suitable for the operating ambient temperature range. Consult Table L1.

Table L1

(ISO)	Lubricant	Ambient Temperature Range		
		-5°C to 20°C (type E) / -30°C to 20°C (type 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)

6.3. Ventilator

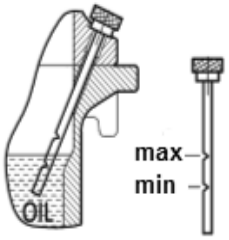
CAUTION

6.3.1. Clean & secure the ventilator in the correct location for the required mounting position.

6.4. Oil Level

6.4.1. The approximate quantity of oil required is given in Table 1 Appendix 2

6.4.2. The unit should be filled via the inspection cover or ventilator position to the level marked on the dipstick or any other level indicator fitted (sight glass etc.)



6.4.3. Where possible run the unit without load for a short time to circulate the lubricant thoroughly, then stop the unit and re-check the oil level after allowing the unit to stand for 10 minutes, if necessary top up to the correct mark on the dipstick or any other level indicator fitted.

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

CAUTION

6.4.4. Check and re-fit all plugs & ventilator

6.4.5. Clean away any oil spillage from the surface of the gear unit and surrounding equipment.

6.5. Approved Lubricants

6.5.1. Oils
See Appendix 2 Tables 2 and 3 for lubricants approved for use in the gear unit.

6.5.2. Greases
See Appendix 2 Table 3 for greases approved for use in the gear unit.

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. Motor terminal connection should be made in accordance with appropriate documentation supplied by the motor manufacturer.

8. Starting

8.1. Prior To Starting Up

8.1.1. Ensure ventilator is fitted see lubrication section 6.3

8.1.2. Check oil level, top up if necessary.

8.1.3. Ensure all safety guards are in place, 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.

8.1.4. Ex group II cat 2D (Zone 21) & Ex group II cat 3D (Zone 22)
Ensure coupling guards, covers etc are dust tight or are designed in such a way that a build up of dust deposits cannot form.

8.1.5. Remove any safety devices fitted to prevent machine rotation.

8.1.6. Units fitted with backstop, ensure motor is correctly wired for free direction of rotation.

8.1.7. Units fitted with a cooling coil must be connected to a suitable cooling water supply – see Appendix 1

8.1.8. Units utilising a forced lubrication system must be suitably connected to the lubrication system and operated in accordance with specific instructions provided separately to this publication.

8.2. Starting Up

8.2.1. Starting up should only be performed or supervised by suitably qualified personnel.

8.2.2. Units fitted with backstop, ensure the motor is correctly wired for free direction of rotation.

8.2.3. Units fitted with cooling coil or force lubrication system, check that water supply or lubrication system is turned on at start up.

8.2.4. The initial starting should be done with minimum driven machine load (empty condition).

8.2.5. The machine loading should be gradually increased over time to its full operating load.

8.2.6. Check the gear unit surface temperature, (the expected temperature under full loading should not exceed 110°C) also visually check the gear unit for oil leakage.
Note! It is normal during Initial start up that a small amount of oil or grease could discharge via the seals or ventilator. This should be cleaned away when the machine is shut down.

Caution! Any deviation from normal operating conditions, (sudden increases in temperature, noise, vibrations, power consumption etc.) suggests a malfunction, shut down immediately and inform our application engineers.

8.2.7. Initial Starting Up Procedure for Gear Units Operating in a Potentially Explosive Atmosphere

During initial running in it is important to measure the gear unit maximum surface temperature when run under maximum load conditions, and after a minimum of 3 hours operation. The maximum surface temperature must **not** exceed 110°C for temperature class's T3 & T4 or 80°C for class T5. If these temperaturea are exceeded, shut down immediately and contact our application engineers.

9. Operation

9.1. Noise

The range of un-cooled or water cooled Series E product satisfies a noise (sound pressure level) of 85 dB(A) or less when measured at 1 metre from the unit surface.
Fan cooled units may exceed this level.
Measurements taken in accordance with BS.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!

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

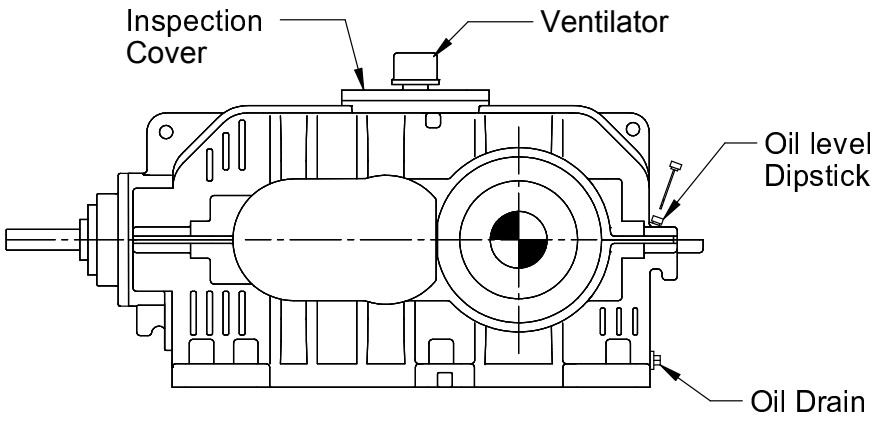
10.2.1. Prior to removing any plugs, ensure that the unit has cooled sufficiently so that oil will not burn.

10.2.2. 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).

10.2.3. Top ups or refills should be done through the inspection cover or ventilator position, remember to re-fit any plugs.

10.2.4. Clean and secure the ventilator.

10.2.5. Clean away any oil spillage from the surface of the gear unit and surrounding equipment.



10.3. Lubrication

10.3.1. Periodic Inspection.

Units are fitted with a dipstick 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.

10.3.2.1. On all sizes regular oil changes are essential and the following factors should be used to determine the frequency at which these are carried out.

a. The operating oil temperature.
b. The type of oil.
c. The operating environment – humidity, dust, etc.
d. The operating conditions – shock, loading, etc.

10.3.2.2. At elevated temperatures the effective life of the oil is very much reduced. This is most pronounced with oils containing fatty or EP additives. To prevent damage to the gear unit due to lubricant breakdown the oil should be renewed as detailed in Table M2.

Table M2

Unit Operating Temperature °C	Renewal Period	
	Mineral Oil CLP(CC) Type E	Synthetic Oil CLP(HC) Type H
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 2.5 YEARS
105	2100 HOURS OR 8 MONTHS	6200 HOURS OR 2 YEARS
110	1500 HOURS OR 6 MONTHS	5200 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.		

Note:
Figures quoted are for oil temperatures when the unit has attained normal running temperature when operating under load. These figures are based on normal running but where conditions are particularly severe it may be necessary to change the oil more frequently.
If the lubricant type is to be changed then the unit must be flushed out prior to re-filling.

Warning
Do not mix synthetic and mineral lubricants.
Do not overfill the unit as this can cause leakage and overheating.

10.3.3. For units installed in a potentially explosive atmosphere (ATEX) it is essential to ensure that the oil is changed on or before the renewal period specified in Table M2.

10.4. Bearings

10.4.1. Bearings should be checked after 5 years operation and replaced (if necessary)

10.5. Grease Lubrication

10.5.1. On certain units the output bearings are grease lubricated, these should bearings should be fully re-greased at 3000 hour intervals (unless otherwise instructed)

10.5.2. Where re-greasing points are provided, it is recommended that 2 shots (6 grams) are added monthly, See Appendix 4 for approved greases

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. For Ex (ATEX) applications, ensure any build-up of dirt or dust does not exceed 5mm (maximum)

11. Fault diagnosis

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 b) A knocking sound : irregularity in gearing	a) Check oil (See Maintenance) b) Contact our Application Engineers or your local Sales Office
Unusual, irregular running noise	Foreign matter present in the oil	a) Check oil (See Maintenance) b) Stop the unit, contact our Application Engineers or your local Sales Office
Oil leaking [1] • from gear unit cover • from motor flange • from gear unit flange • from output end oil seal	a) Defective gasket on gear unit cover b) Defective gasket c) Gear unit not ventilated	a) Retighten screws on gear unit cover and observe gear unit. If still oil leaks contact our Application Engineers or your local Sales Office. b) Contact our Application Engineers or your local Sales Office. c) Vent the gear unit.
Oil leaking from the ventilator	a) Gear unit over filled with oil b) Gear unit installed in an incorrect mounting position c) Frequent cold starts (oil foaming) and/ or high oil level	a) Correct the oil level (See Lubrication) b) Correct the mounting position and check oil level (See Lubrication) c) Check the oil level (See Lubrication)

* 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.

Cooling Coil

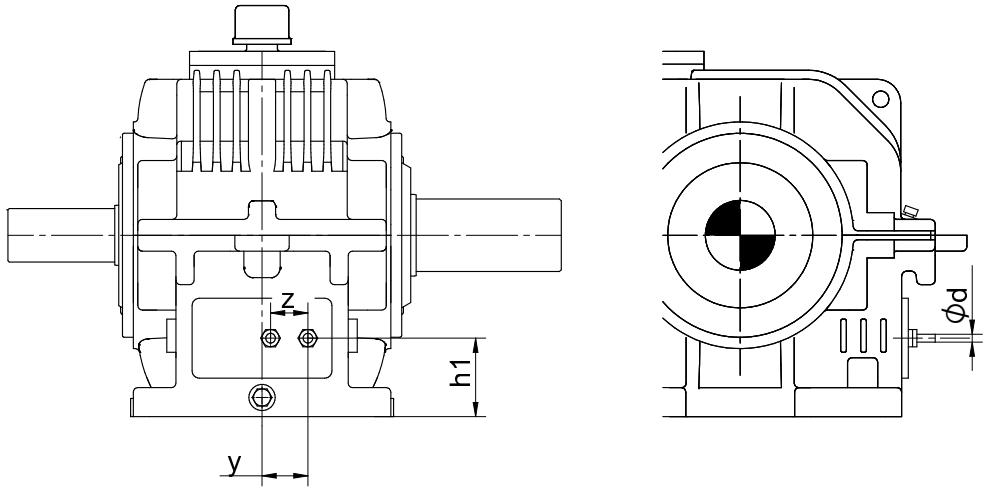
Provision for a water supply to be made by the client, the inlet and outlet should be connected to the water pipes via a suitable straight coupling.

Cooling coils are suitable for fresh, brackish or sea water with flow in either direction, the water flow rate should be controlled by a valve.

For best performance, the water supply should be at 10°C / 12°C temperature, with a flow rate of 5 litres / minute; the water pressure should not exceed 8 bar.

CAUTION

Cooling water must be drained from the coil if the unit is to stand idle for prolonged periods in freezing conditions.



Size	H1 / S1			
	d	h1	y	z
11	dimensions on request			
13				
15				
17				
18				
20				
21				
22				
23				
24				
25				
26				

Size	H2 / S2, H3 / S3, H4 / S4			
	B2 / K2, B3 / K3, B4 / K4 / K4			
	d	h1	y	z
11	dimensions on request			
13				
14				
15				
16				
17	3/8”	75	40	32
18	3/8”	88	40	68
19	3/8”	88	40	68
20	3/8”	88	40	68
21	3/8”	110	40	80
22	3/8”	110	40	80
23	3/8”	110	40	80
24	1/2”	125	60	113
25	1/2”	125	60	113
26	1/2”	125	60	113

Series E units are despatched without oil (a warning label is attached), The lubricant type / grade and approximate quantity is marked on the nameplate.
Approved lubricants can be found from Tables 2 or 3. The lubricant change period is stated in Section 10.3
The gear unit should be filled to the level marked on the dipstick or any other level indicator fitted (sight glass, etc.).

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

Where possible run the unit without load for a short time to circulate the lubricant thoroughly, stop the unit and re-check the oil level after allowing the unit to stand for 10 minutes, and if necessary top up to the correct mark on the dipstick or any other level indicator fitted (sight glass etc.).

For grease lubricated bearings or seals, a list of approved greases is given in Table 3.

Table 1: Approximate Lubricant Quantity (litres)

Unit - Size	11	13	14	15	16	17	18	19	20	21	22	23	24	25	26
H1 / S1	2.5	3.5	-	7.5	-	11	17	-	28	40	54	67	115	130	165
H2 / S2	-	-	3	4	5	6	10	13	16	24	33	46	65	90	120
H3 / S3	-	-	-	6	9	10	12	16	25	32	43	61	85	120	170
H4 / S4	-	-	-	-	-	-	15	21	25	32	43	61	85	120	170
B2 / K2	2.5	3.5	-	6	-	11	16	-	27	39	52	65	115	130	165
B3 / K3	-	-	4.5	5.5	8.5	11	15	21	30	37	50	70	95	130	185
B4 / K4	-	-	-	-	-	11	15	21	30	37	50	70	95	130	185

Table 2: Approved Lubricants Type E

ISO: CLP-CC - Mineral oil's containing industrial EP additives

Supplier	Lubricant Type	5E	6E	7E
		Ambient Temperature Range		
		-5 to 20°C	0 to 35°C	20 to 50°C
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)
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)
Optimal Ölwerke GmbH	Optigear BM	220 (-11)	320 (-10)	460 (-7)
	Optigear	220 (-18)	320 (-9)	460 (-7)
Petro-Canada	Ultima EP	220 (-22)	320 (-16)	460 (-10)
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)
	Carter XEP	220 (-16)	320 (-13)	460 (-7)

Numbers in brackets indicate the minimum pour point temperature of the specified oil in °C
The gear unit must not be run below this temperature.

Table 3: Approved Lubricants Type H

ISO: CLP-HC - Polyalphaolefin based synthetic lubricants with anti-wear or EP additives.

Supplier	Lubricant Type	5H	6H
		Ambient Temperature Range	
		-30 to 35°C	20 to 50°C
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)

Numbers in brackets indicate the minimum pour point temperature of the specified oil in °C
The gear unit must not be run below this temperature.

Table 4: Approved Bearing Greases

NLGI grade 2 grease's, suitable for operating in ambient temperature range of -20°C to 50°C
For use outside this range consult our Application Engineers.

Supplier	Lubricant Range
BP Oil International Limited	Energrease LS-EP
Caltex	Multifak EP
Castrol International	LMX Grease
	Spheerol AP
	Spheerol EPL
Fuchs Lubricants	Renolit EP
Klüber Lubrication	Klüberlub BE 41-542
Mobil Oil Company Limited	Mobilgrease XHP
	Mobilith SHC
Omega Manufacturing Division	Omega 85
Optimol Ölwerke GmbH	Longtime PD
Shell Oils	Albida RL
	Alvania EP B
	Nerita HV
Texaco Limited	Multifak All Purpose EP

Shaft Alignment

Errors of alignment fall into categories of angularity (see Fig 1) and eccentricity (see Fig 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.

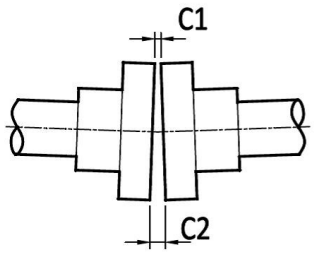


Fig 1

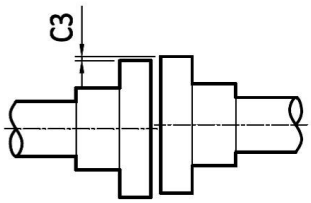


Fig 2

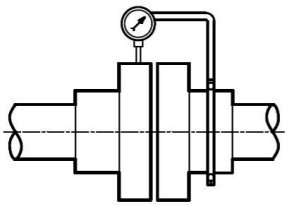


Fig 3

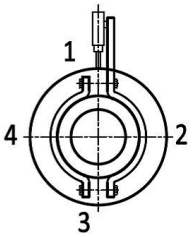


Fig 4

Errors of Angularity

The angularity can be checked by keeping both shafts stationary and taking measurements with a block gauge and feelers at four equal points around the circumference of the coupling hubs as shown in Figure 1. The difference between the vertical plane reading's (C1 and C2) will give the error of alignment over a length equal to the diameter of the coupling flange, Similarly, the difference between the readings on the horizontal plane gives the amount of sideways adjustment.

A simpler method of checking angularity is by marking adjacent points on the coupling hubs and rotating both together keeping the marks in line, by taking gap measurements each quarter-revolution the errors in the vertical and horizontal planes can be found.

NOTE: The alignment should be re-checked after running the unit until it has attained its normal working temperature. Any discrepancies should be rectified.

The permitted angularity error is as follows:

Type of Coupling	Allowable Difference in Gap (G) (mm)	NOTE: D is the diameter (mm) at which the gap is measured.
Rigid Coupling	G = 0.0005 D	
All other types	G = 0.001 D	

Errors of Eccentricity

The procedure for measuring eccentricity (C3 fig 2) is done by using a dial indicator suitably clamped to one half coupling hub, and bearing onto the hub or flange of the other hub, as shown in Figures 3 and 4.

Care must 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.

The permitted eccentricity error (in addition to that of angularity) is as follows:

Coupling	Output Shaft	Input Shaft
	Max Eccentricity (mm)	Max Eccentricity (mm)
Rigid	0.05	0.08
All other types	Consult the appropriate installation and maintenance instructions for coupling type and size fitted	

Special note concerning the alignment of rigid couplings

When lining up shafts fitted with rigid couplings it is important that no attempt is made to force the coupling hubs together by tightening up the coupling bolts, this will induce undue stresses in the shaft, coupling and bearings. This malpractice can be revealed by the springing apart of the coupling faces as the bolts are slackened off.

We produce a range of flexible couplings; please consult our Application Engineers for details

Assembly of Shaft Mounted Gear Unit with Key Connection

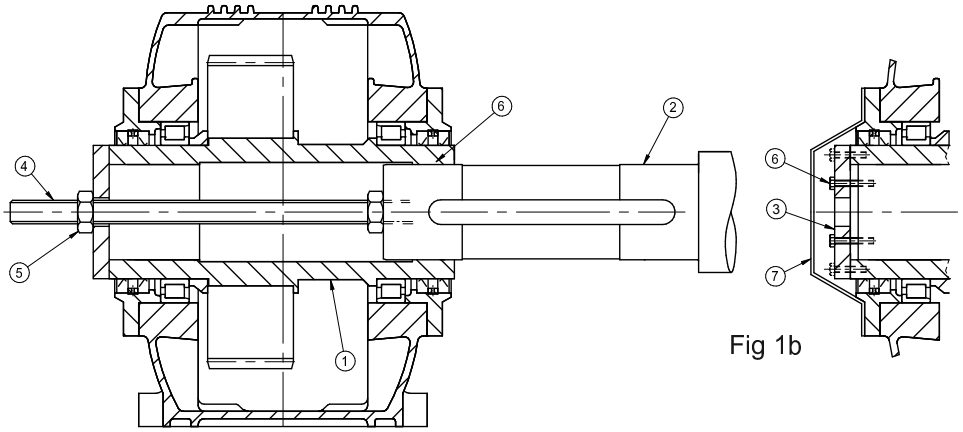
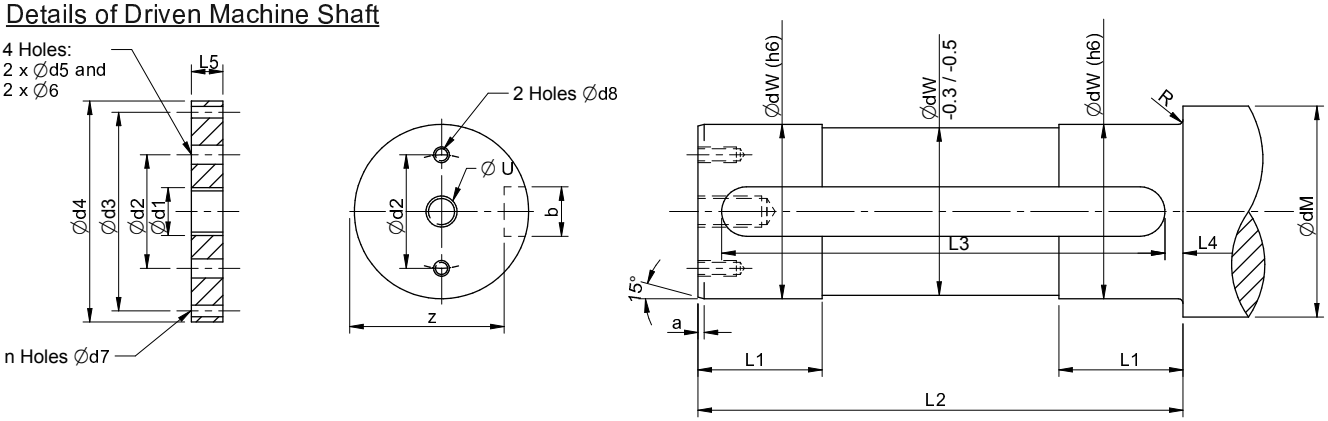


Fig 1a Fig 1b

- Clean and degrease the gear unit shaft bore (1) and the driven machine shaft (2)
- Assemble the key into the driven machine shaft keyway and spray a suitable anti-fretting lubricant to both gear unit bore and the driven machine shaft.
- Secure the assembly spindle/screw (4) into the driven machine shaft, secure the end plate (3) to the gear unit shaft.
- Accurately align the gear unit and draw it onto the driven machine shaft as shown (Fig 1a) ensure the gear unit is drawn fully into position and up to the shoulder on the driven machine shaft, remove the spindle and nut.
- Locate the assembly axially by securing the end plate to the gear unit and to the driven machine shaft, using screws(6), fit the protective cover (7) as shown (Fig 1b)

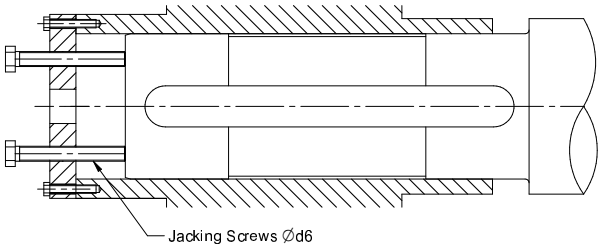
Details of Driven Machine Shaft



Size	Driven Machine Shaft													End Plate								
	dw	dM	d2	d8	L1	L2	L3	L4	z	b	a	R	U	d1	d2	d3	d4	d5	d6	d7	n	L5
11	35	55	-	-	35	207	10	187	30.0	10	3	2.5	M10	12	-	-	45	-	-	-	-	
13	50	70	35	M8x16	50	227	15	197	44.5	14	3	2.5	M16	14	35	60	69.5	9	M8	5.5	4	8
14	55	75	40	M8x16	55	237	15	207	49.0	16	4	2.5	M20	22	40	67.5	79	9	M10	6.6	4	8
15	60	80	45	M10x20	60	267	20	227	53.0	18	4	2.5	M20	22	45	72.5	89	11	M10	6.6	6	8
16	70	90	50	M10x20	70	287	20	247	62.5	20	4	2.5	M20	22	50	85	99	11	M10	6.6	6	8
17	75	95	55	M10x20	75	297	20	257	67.5	20	5	4	M20	22	55	90	109	11	M10	6.6	6	10
18	90	110	65	M10x20	90	337	20	297	81.0	25	5	4	M24	26	65	110	129	11	M10	9	4	10
19	105	125	70	M12x25	105	357	25	307	95.0	28	5	4	M24	26	70	120	139	14	M12	9	4	10
20	110	135	75	M12x25	115	377	25	327	100.0	28	5	4	M24	26	75	125	159	14	M12	11	4	12
21	120	150	80	M12x25	130	437	25	387	109.0	32	6	6	M24	26	80	140	169	14	M12	11	4	12

Disassembly from Machine Shaft

- Re-fit the end plate, and assemble the jacking screws.
- Support the gear unit and extract the driven machine shaft.



Shaft Mounted Gear Unit with Shrink Disc Connection

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 (See Figure 4).

As the tapered surfaces of locking collar and inner ring are lubricated with a ‘dry film lubricant spray’ (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 ensure hermetic sealing and eliminate the possibility of fretting corrosion.

A ‘shrink disc’ device is 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.

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 (See Figure 4).
As the tapered surfaces of locking collar and inner ring are lubricated with a ‘dry film lubricant spray’ (Molykote 321R or similar) and the taper angle is not self-locking, the 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 ensure hermetic sealing and eliminate the possibility of fretting corrosion.

If the hollow output shaft is to operate in a vertical position it is essential that the gear unit is located against a shoulder or thrust plate on the driven machine shaft.

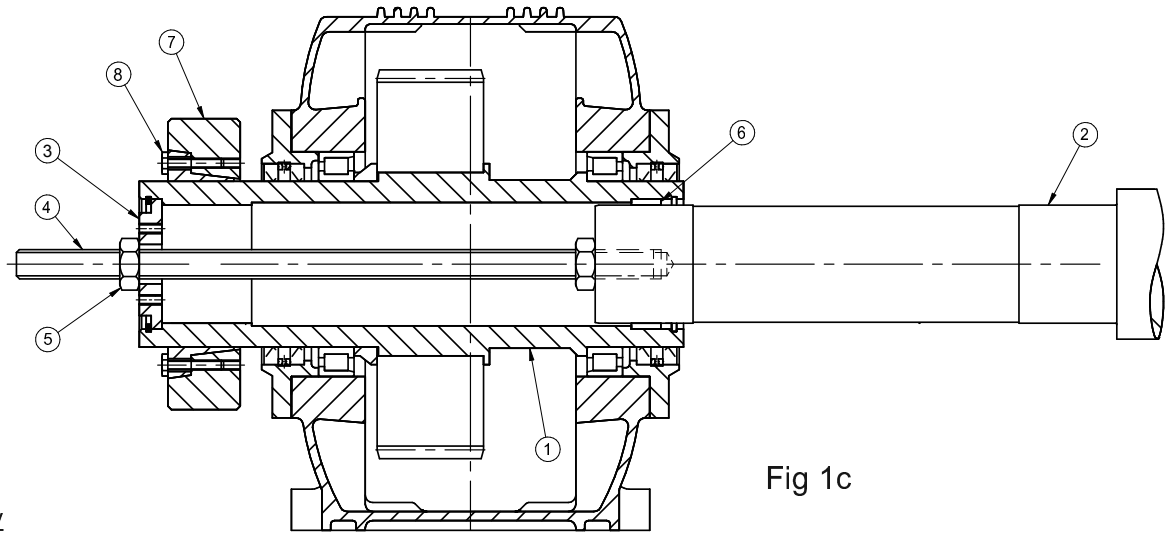


Fig 1c

Assembly

- Clean and degrease the locating diameters of the gear unit hollow shaft bore(1), the driven machine shaft (2) and the shrink disk locating surface
- Apply a ‘dry film lubricant spray’ (Molykote 321R or similar) to the tapered surfaces of the shrink disc (7) and to the non-clamped end of the driven shaft.
- Ensure driven shaft and shrink disk locating surfaces at the clamped end, are degreased, clean and dry.
- Check that the anti-fretting guide bush (6) is correctly located in the gear unit hollow shaft bore.
- If the design requires the shrink disc device to be located adjacent to the driven machine, then the shrink disc assembly should be loosely mounted in position on the gear unit shaft prior to mounting the gear unit on to the driven machine shaft.
- Secure the assembly spindle/screw/nut (4 & 5) into the driven machine shaft, secure the end plate (3) to the gear unit shaft.
- Accurately align the gear unit and draw it onto the driven machine shaft as shown (Fig 1c) ensure the gear unit is drawn fully into position, remove the spindle and nut.
- Fit the shrink disc device in position on the gear unit hollow shaft, tighten all locking screws (8) gradually and in succession (do not tighten in a diametrically opposite sequence) several passes are required until all screws are tightened to achieve the torque figure Ma (Fig 1d)
- Fit the protective cover.

Removal

Removal procedure is similar to the reverse of installation.

- Remove any rust and dirt from the assembly.
- Loosen off the locking screws in succession, but do not completely remove.
- Remove the shrink disc and withdraw the unit from the driven shaft
- If the shrink disc is to be re-used it should be dismantled and cleaned thoroughly, a 'dry film lubricant spray' (Molykote 321R or similar) applied to the tapered surfaces of inner ring and locking collar before re-use.

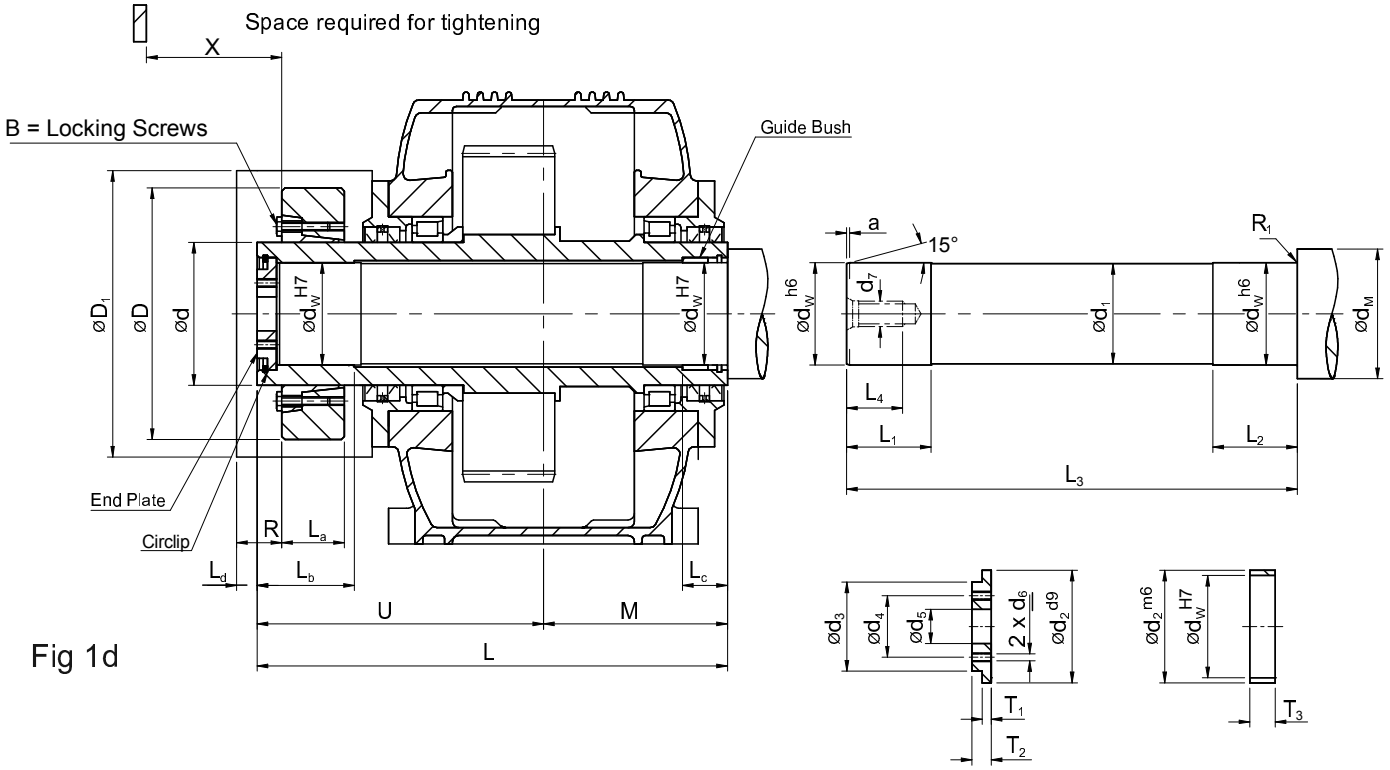


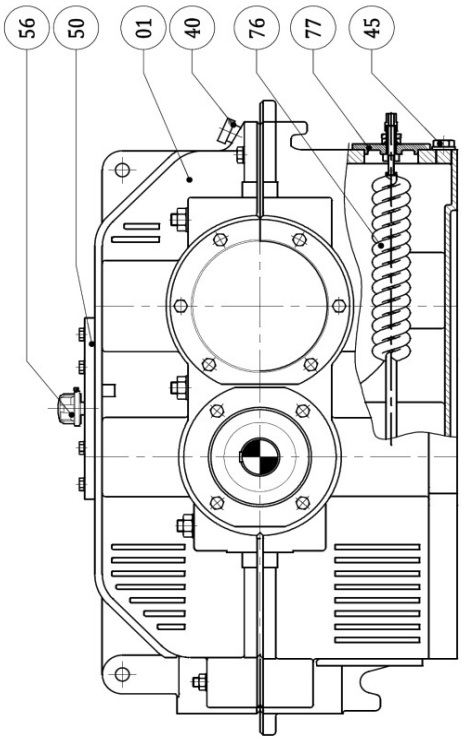
Fig 1d

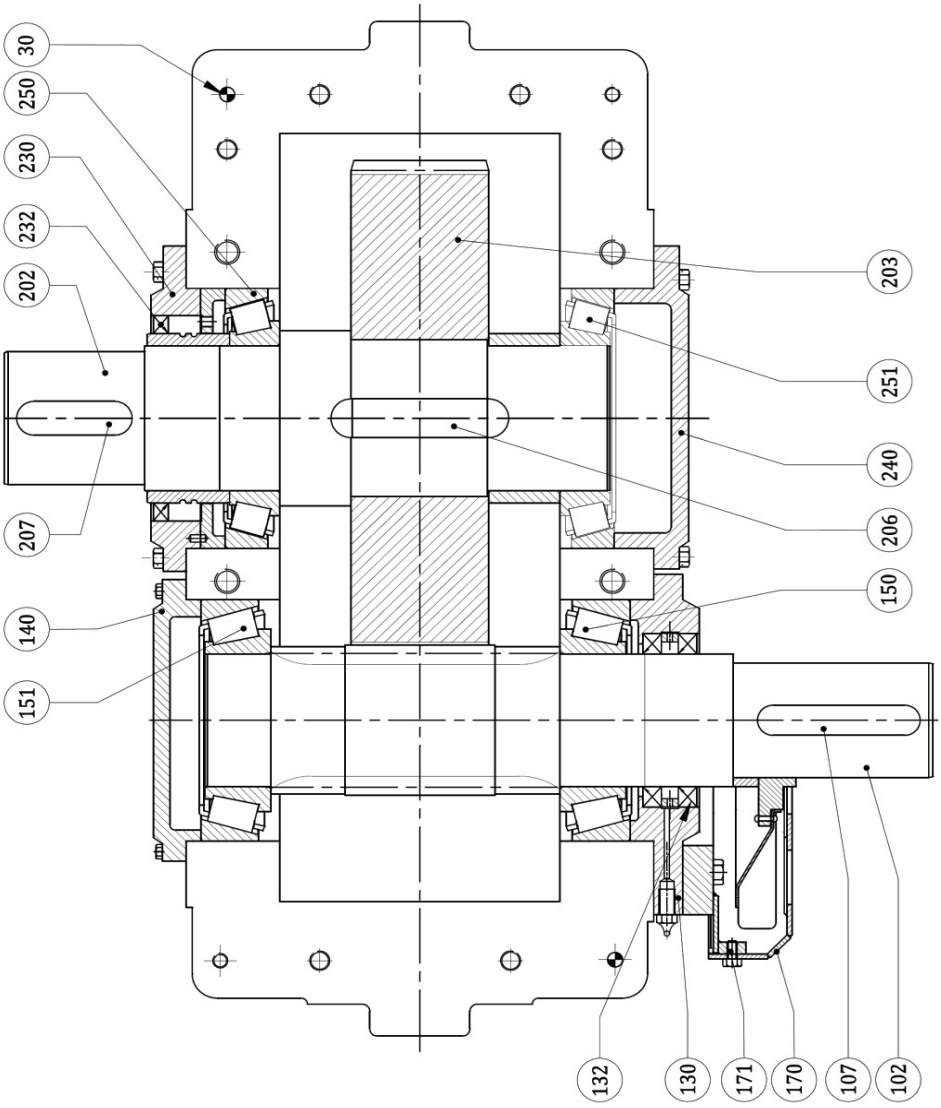
Size	Hollow Shaft							Shrink Disc									
	dw	L	Lb	Lc	U	Ms	R	Type	D	d	D1	La	Ld	Mt (Nm)	B	Mt (Nm)	Mass (kg)
14	60	300	50	30	180	120	17	80 - 60	141	80	160	31	20	3190	M10	58	2.3
15	65	330	55	35	195	135	17	90 - 65	155	90	185	38	20	5400	M10	58	3.2
16	75	360	65	40	215	145	20	100 - 75	170	100	200	43.5	20	7200	M10	58	4.3
17	80	380	80	41	230	150	26	110 - 80	185	110	220	49	20	10000	M12	100	5.8
18	95	430	85	44	260	170	27	125 - 95	215	125	290	53.5	20	16500	M12	100	8.7
19	105	460	95	49	280	180	32	140 - 105	230	140	320	58	20	22100	M14	160	10.3
20	115	485	100	49	295	190	33	155 - 115	263	155	350	63	20	29500	M14	160	15.2
21	125	555	120	68	335	220	35	165 - 125	290	165	380	68	25	41200	M16	240	21.5
22	140	600	135	68	370	230	35	180 - 140	320	180	410	85.5	25	64000	M16	240	32.7
23	160	680	155	73	420	260	37	220 - 160	370	220	480	105	25	103000	M20	470	53
24	180	755	160	83	460	295	38	240 - 180	405	240	530	109	25	140000	M20	470	66
25	200	795	180	88	490	305	46	260 - 200	430	260	550	120	25	184000	M20	470	82
26	220	895	190	103	550	345	48	280 - 220	460	280	570	135	25	240000	M20	470	103

Size	Driven Machine Shaft										End Plate							Guide Bush			
	DW	d1	dm	R1	L1	L2	L3	L4	d7	a	d2	d3	d4	d5	d6	T1	T2	dw	d2	T3	Circlip
14	60	59.5	80	1.5	45	65	286	42	M20	4	70	50	35	22	M6	5	13	60	70	17	70 x 2.5
15	65	64.5	85	1.5	50	70	316	42	M20	4	75	55	40	22	M8	5	13	65	75	22	75 x 2.5
16	75	74.5	95	1.5	55	75	342	42	M20	4	85	65	45	22	M8	7	17	75	85	23	80 x 3
17	80	79.5	100	1.6	70	90	362	42	M20	5	90	70	50	22	M8	7	17	80	90	24	90 x 3
18	95	94.5	120	1.6	70	90	408	50	M24	5	105	80	55	26	M10	8	20	95	105	24	105 x 4
19	105	104.5	130	1.6	80	100	438	50	M24	5	120	90	60	26	M10	8	20	105	120	29	120 x 4
20	115	114.5	140	1.6	85	105	463	50	M24	5	130	100	65	26	M10	8	20	115	130	29	130 x 4
21	125	124.5	160	2.5	85	110	530	50	M24	6	140	105	65	26	M12	10	23	125	140	45	140 x 4
22	140	139.5	170	2.5	105	130	575	60	M30	6	155	115	75	33	M12	10	23	140	155	45	155 x 4
23	160	159.5	190	2.5	130	155	655	60	M30	6	175	120	80	33	M12	10	23	160	175	50	175 x 4
24	180	179.5	210	2.5	130	160	725	60	M30	6	195	125	85	33	M16	12	28	180	195	55	195 x 4
25	200	199.5	240	4.0	150	180	765	60	M30	8	220	140	95	33	M16	12	28	200	220	60	220 x 5
26	220	219.5	260	4.0	165	195	865	80	M36	8	240	160	110	39	M20	12	28	220	240	75	240 x 5

H1 / S1 Gear Units

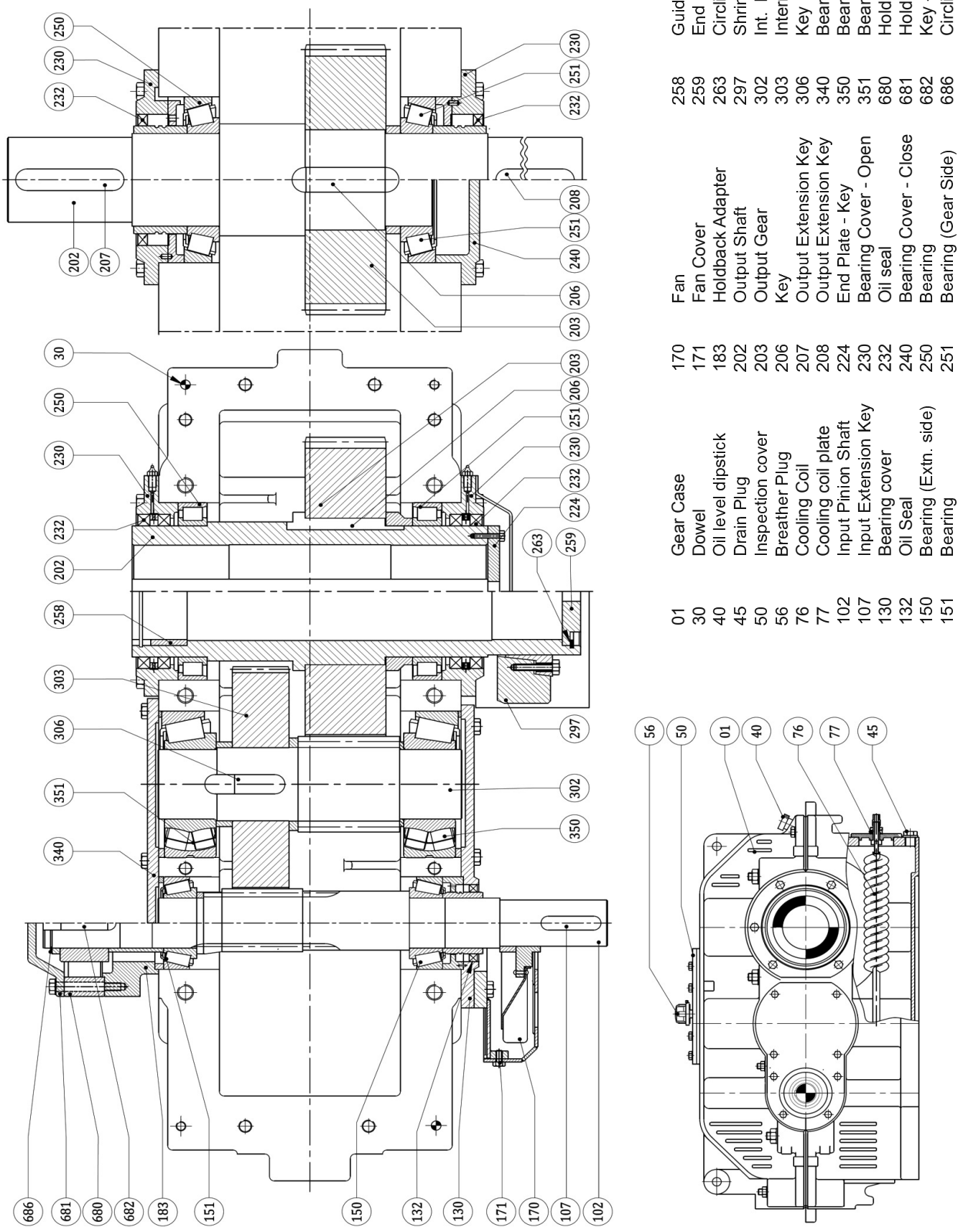
01	Gear Case
30	Dowel
40	Oil level dipstick
45	Drain Plug
50	Inspection cover
56	Breather Plug
76	Cooling Coil
77	Cooling coil plate
102	Input Pinion Shaft
107	Input Extension Key
130	Bearing cover
132	Oil Seal
140	Bearing cover
150	Bearing (Extn. side)
151	Bearing
170	Fan
171	Fan Cover
202	Output Shaft
203	Output Gear
206	Key
207	Output Extension Key
230	Bearing Cover - Open
232	Oil seal
240	Bearing Cover - Close
250	Bearing (Extn. side)
251	Bearing





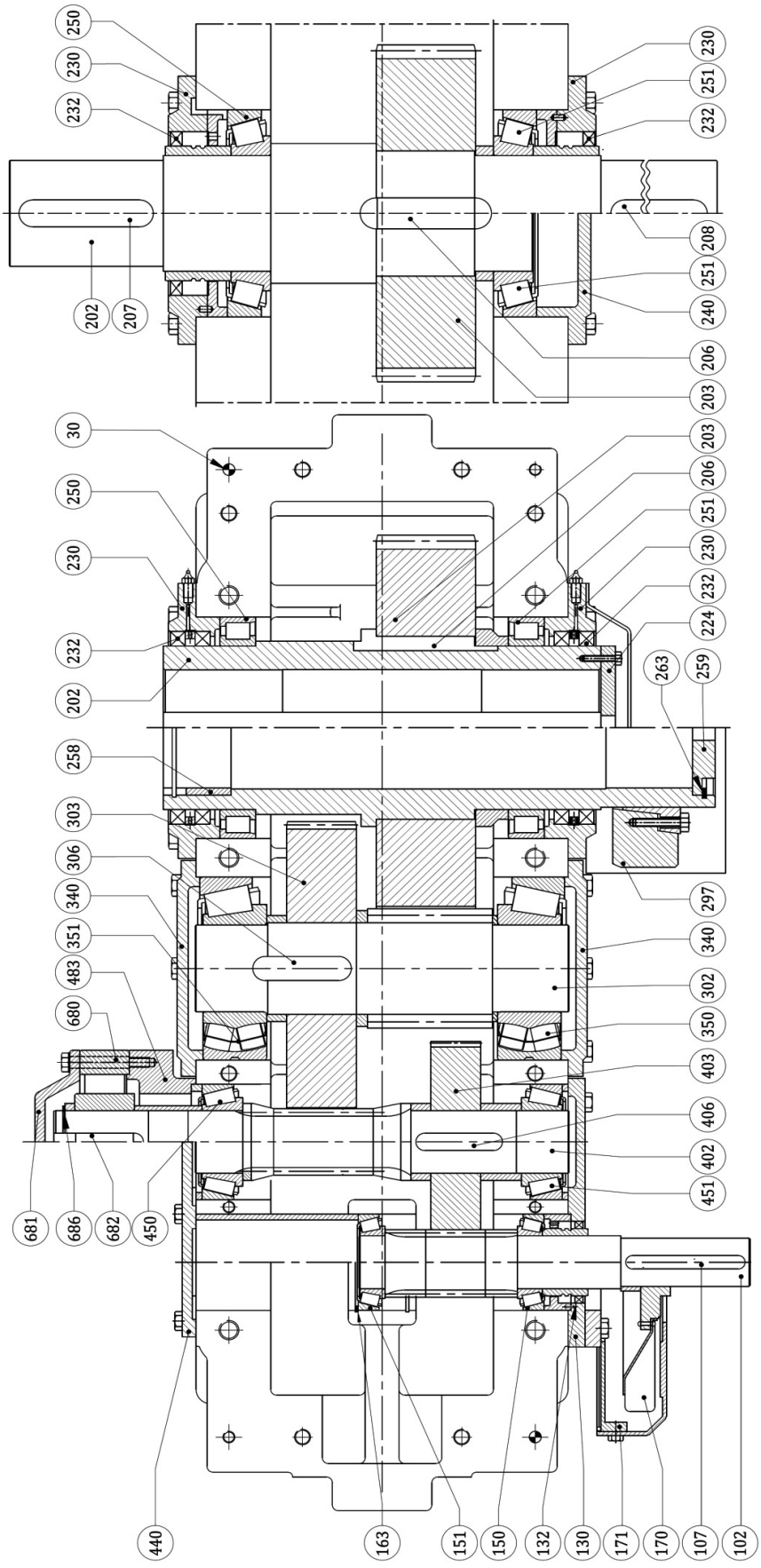
H3 / S3 Gear Units

H2 / S2 Gear Units

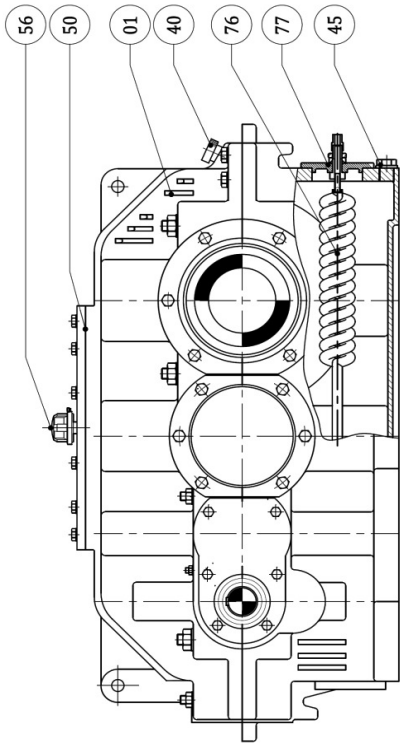


258 Guide Bush
259 End Plate - SD
263 Circlip

H3 / S3 Gear Units

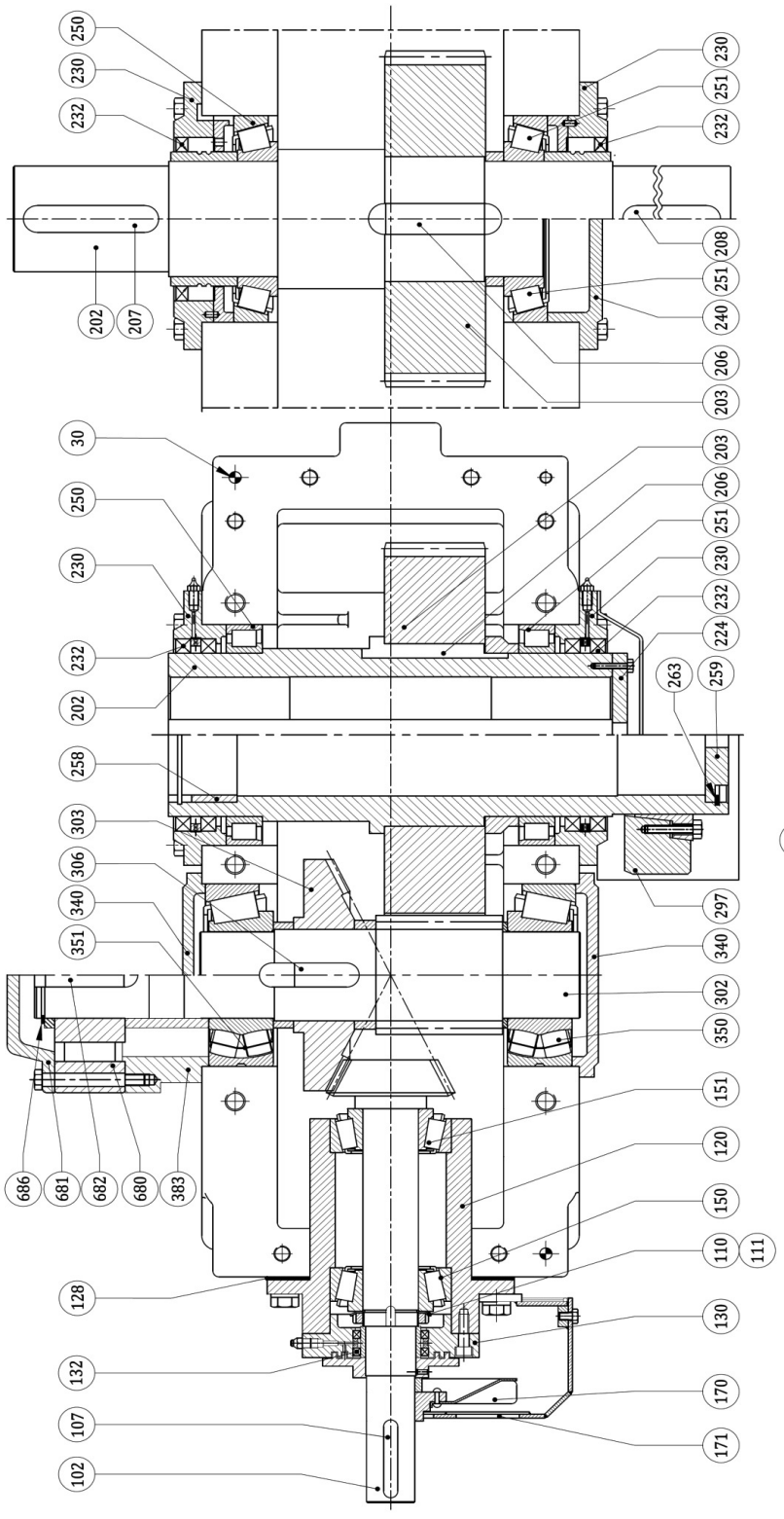


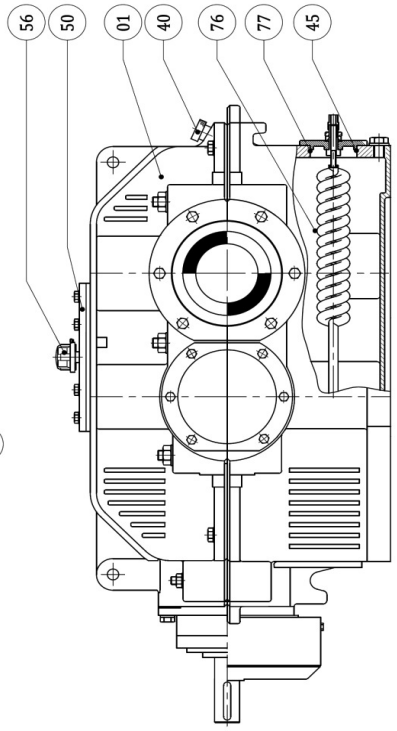
01	Gear Case	202	Output Shaft	302	Int. Pinion Shaft
30	Dowel	203	Output Gear	303	Intermediate Gear
40	Oil level dipstick	206	Key	306	Key
45	Drain Plug	207	Output Extension Key	340	Bearing Cover
50	Inspection cover	208	Output Extension Key	350	Bearing
56	Breather Plug	224	End Plate - Key	351	Bearing (Gear Side)
76	Cooling Coil	230	Bearing Cover - Open	402	Int. Pinion Shaft
77	Cooling coil plate	232	Oil seal	403	Intermediate Gear
102	Input Pinion Shaft	240	Bearing Cover - Close	406	Key
107	Input Extension Key	250	Bearing	440	Bearing Cover
130	Bearing cover	251	Bearing (Gear Side)	450	Bearing
132	Oil Seal	258	Guide Bush	451	Bearing (Gear Side)
150	Bearing (Extn. side)	259	End Plate - SD	483	Holdback Adapter
151	Bearing	263	Circlip	680	Holdback
163	Circlip	297	Shrink Disc	681	Holdback Cover
170	Fan			682	Key - Holdback
171	Fan Cover			686	Circlip



B2/ K2 GEAR UNITS

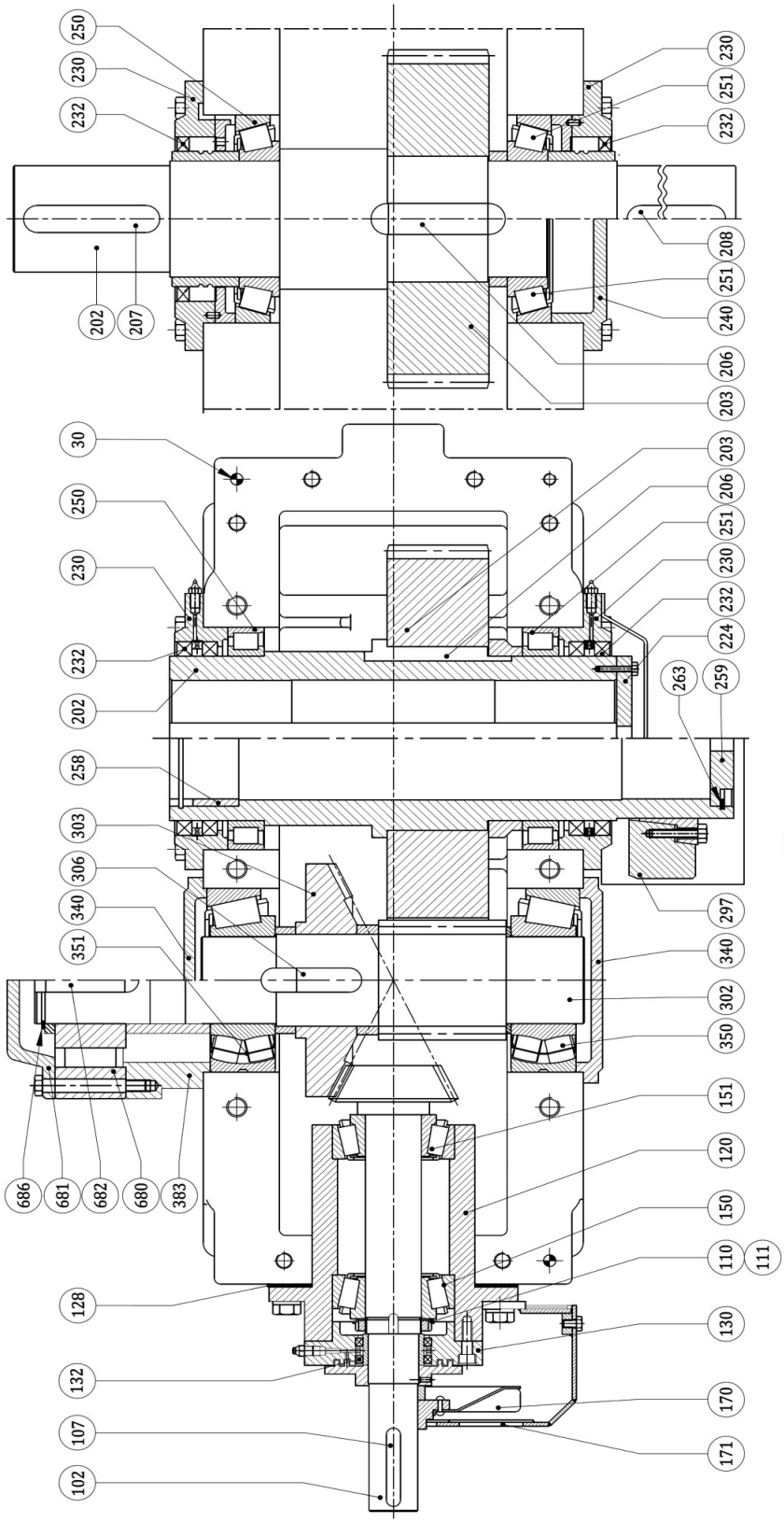
H4 / S4 Gear Units



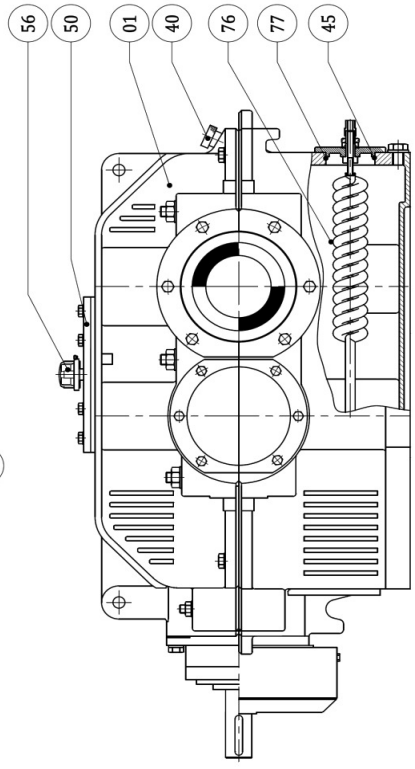


01	Gear Case
30	Dowel
40	Oil level dipstick
45	Drain Plug
50	Inspection cover
56	Breather Plug
76	Cooling Coil
77	Cooling coil plate
102	Input Pinion Shaft
107	Input Extension Key
130	Bearing cover
132	Oil Seal
150	Bearing (Extn. side)
151	Bearing
163	Circlip
170	Fan
171	Fan Cover
202	Output Shaft
203	Output Gear
206	Key
207	Output Extension Key
208	Output Extension Key
224	End Plate - Key
230	Bearing Cover - Open
232	Oil seal
240	Bearing Cover - Close
250	Bearing
251	Bearing (Gear Side)
258	Guide Bush
259	End Plate - SD
263	Circlip
297	Shrink Disc
302	Int. Pinion Shaft
303	Intermediate Gear
306	Key
340	Bearing Cover
350	Bearing
351	Bearing (Gear Side)
183	Holdback Adapter
680	Holdback
681	Holdback Cover
682	Key - Holdback
686	Circlip

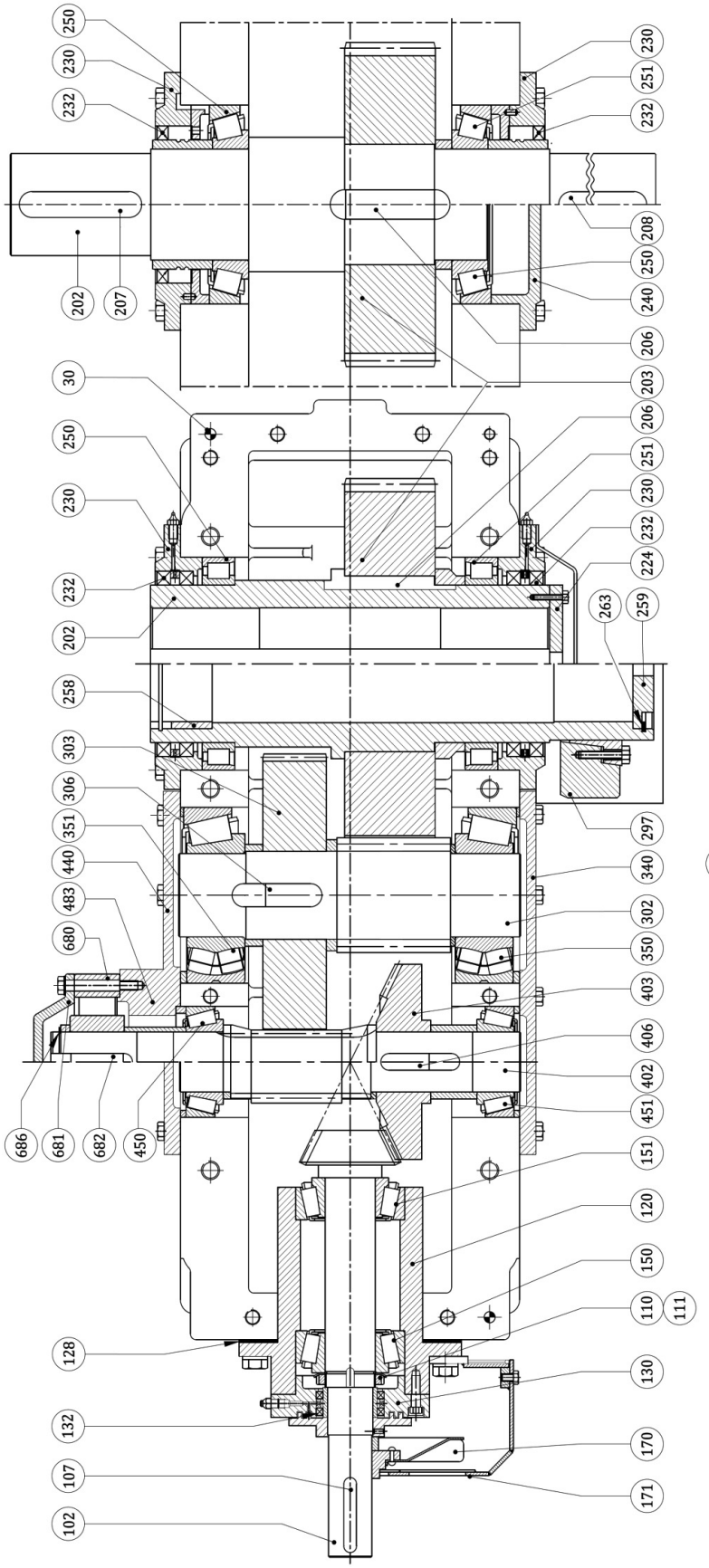
B2 / K2 Gear Units



01	Gear Case	150	Bearing (Extn. side)	258	Guide Bush
30	Dowel	151	Bearing	259	End Plate - SD
40	Oil level dipstick	170	Fan	263	Circlip
45	Drain Plug	171	Fan Cover	297	Shrink Disc
50	Inspection cover	202	Output Shaft	302	Int. Pinion Shaft
56	Breather Plug	203	Output Gear	303	Intermediate Gear
76	Cooling Coil	206	Key	306	Key
77	Cooling coil plate	207	Output Extension Key	340	Bearing Cover
102	Input Pinion Shaft	208	Output Extension Key	350	Bearing
107	Input Extension Key	224	End Plate - Key	351	Bearing (Gear Side)
110	Locknut	230	Bearing Cover - Open	183	Holdback Adapter
111	Lock Washer	232	Oil seal	680	Holdback
120	Flanged Bush	240	Bearing Cover - Close	681	Holdback Cover
128	Adjusting Shim	250	Bearing	682	Key - Holdback
130	Bearing cover	251	Bearing (Gear Side)	686	Circlip
132	Oil Seal				

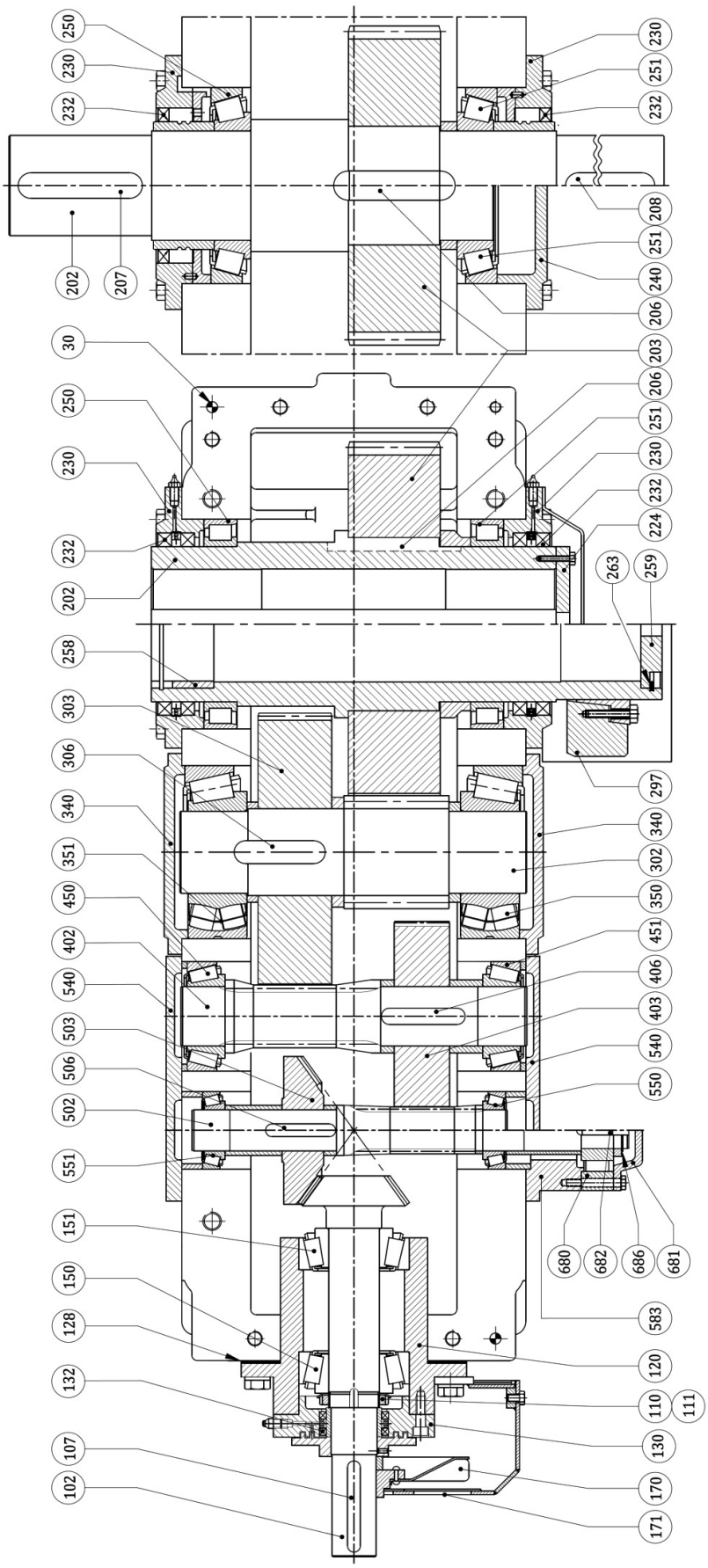


B3 / K3 Gear Units

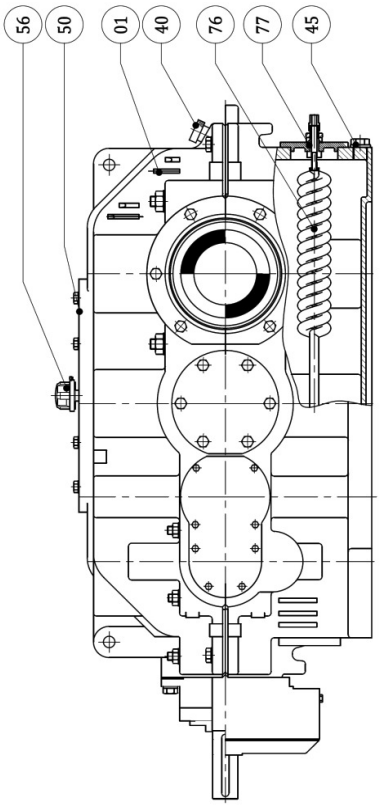


01	Gear Case	170	Fan	302	Int. Pinion Shaft
30	Dowel	171	Fan Cover	303	Intermediate Gear
40	Oil level dipstick	202	Output Shaft	306	Key
45	Drain Plug	203	Output Gear	340	Bearing Cover
50	Inspection cover	206	Key	350	Bearing
56	Breather Plug	207	Output Extension Key	351	Bearing (Gear Side)
76	Cooling Coil	208	Output Extension Key	402	Int. Pinion Shaft
77	Cooling coil plate	224	End Plate - Key	403	Intermediate Gear
102	Input Pinion Shaft	230	Bearing Cover - Open	406	Key
107	Input Extension Key	232	Oil seal	440	Bearing Cover
110	Locknut	240	Bearing Cover - Close	450	Bearing
111	Lock Washer	250	Bearing	451	Bearing (Gear Side)
120	Flanged Bush	251	Bearing (Gear Side)	483	Holdback Adapter
128	Adjusting Shim	258	Guide Bush	680	Holdback
130	Bearing cover	259	End Plate - SD	681	Holdback Cover
132	Oil Seal	263	Circlip	682	Key - Holdback
150	Bearing (Extn. side)	297	Shrink Disc	686	Circlip
151	Bearing				

B4 / K4 Gear Units



01	Gear Case	171	Fan Cover	340	Bearing Cover
30	Dowel	202	Output Shaft	350	Bearing
40	Oil level dipstick	203	Output Gear	351	Bearing (Gear Side)
45	Drain Plug	206	Key	402	Int. Pinion Shaft
50	Inspection cover	207	Output Extension Key	403	Intermediate Gear
56	Breather Plug	208	Output Extension Key	406	Key
76	Cooling Coil	224	End Plate - Key	450	Bearing
77	Cooling coil plate	230	Bearing Cover - Open	451	Bearing (Gear Side)
102	Input Pinion Shaft	232	Oil seal	502	Int. Pinion Shaft
107	Input Extension Key	240	Bearing Cover - Close	503	Intermediate Gear
110	Locknut	250	Bearing	506	Key
111	Lock Washer	251	Bearing (Gear Side)	540	Bearing Cover
120	Flanged Bush	258	Guide Bush	550	Bearing
128	Adjusting Shim	259	End Plate - SD	551	Bearing (Gear Side)
130	Bearing cover	263	Circlip	583	Holdback Adapter
132	Oil Seal	297	Shrink Disc	680	Holdback
150	Bearing (Extn. side)	302	Int. Pinion Shaft	681	Holdback Cover
151	Bearing	303	Intermediate Gear	682	Key - Holdback
170	Fan	306	Key	686	Circlip



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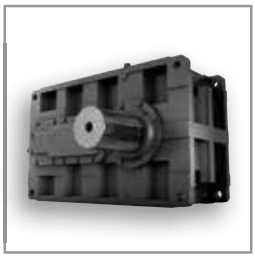



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