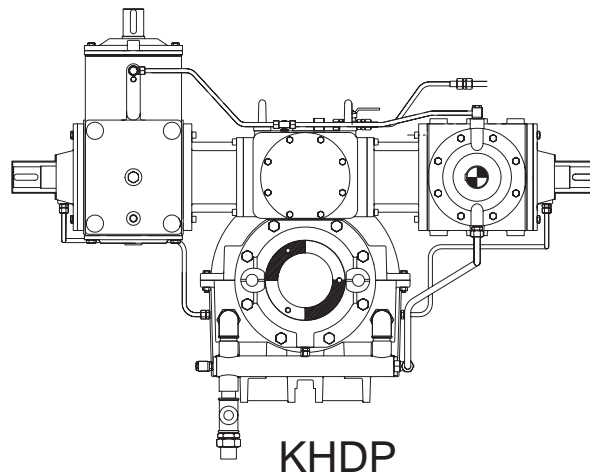
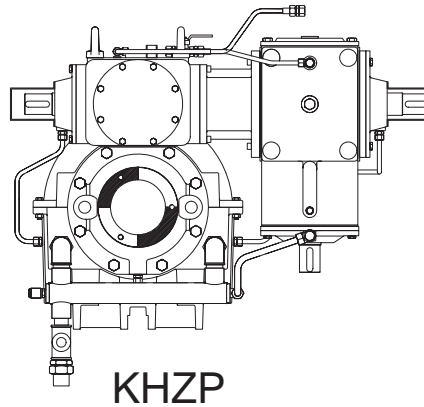
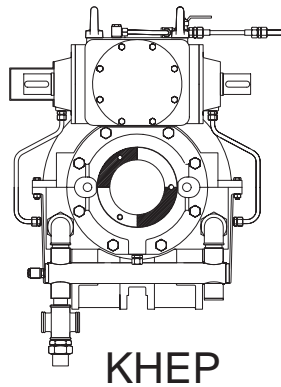


# Operating Instructions

## BA 5816 EN 05.03

Dry-cylinder gear units of types  
KHEP, KHZP and KHDP  
for paper machine drives  
Size 300



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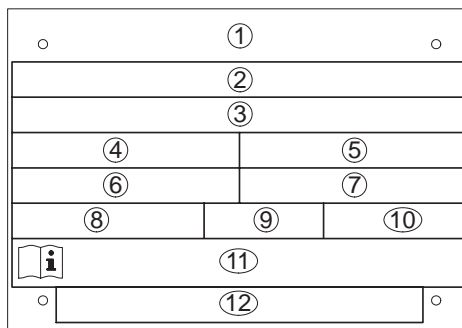
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## 1. Technical data

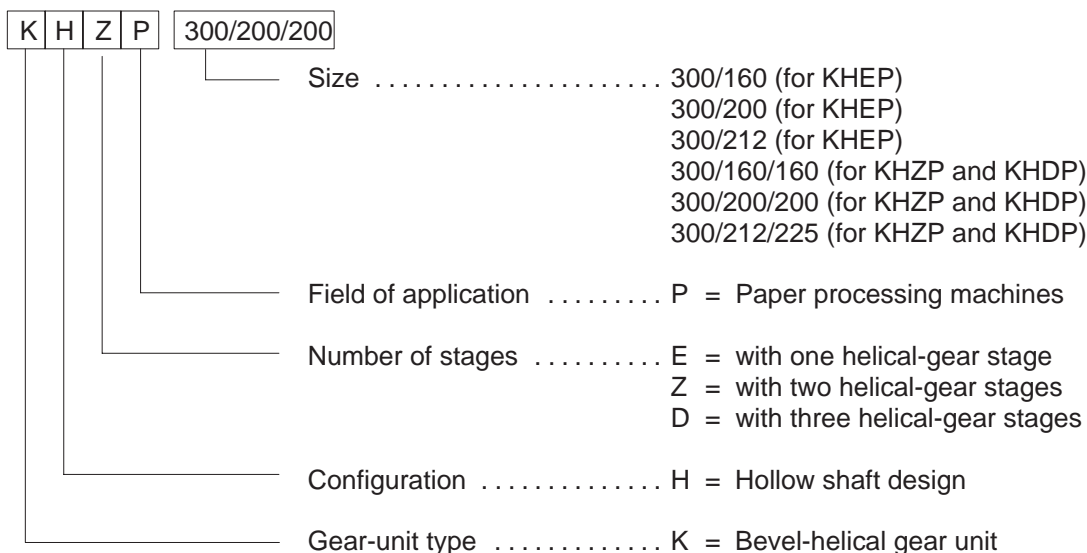
### 1.1 General technical data

The most important technical data are shown on the rating plate. These data and the contractual agreements between FLENDER and the customer for the gear unit determine the limits of its correct use.



- |  |   |
|--|---|
| ① Company logo and production location | ⑦ Speed $n_2$                                     |
| ② Special information                  | ⑧ Type of oil                                     |
| ③ Order no. - item - serial no.        | ⑨ Viscosity of oil in VG class                    |
| ④ Type / Size *)                       | ⑩ Quantity of oil in litres for main gear housing |
| ⑤ Power rating P-RDC / P-NRL in kW     | ⑪ Operating instructions number                   |
| ⑥ Speed $n_1$                          | ⑫ Special information                             |

e.g. \*)



Data on weights and measuring-surface sound levels are given in sections 1.1.1 and 1.1.2.

For further technical data, please refer to the drawings in the gear-unit documentation and the separately enclosed gear-unit table.

## 1.1.1 Weights

| Type        | Approx. weight (kg) for size |         |         |             |             |             |
|-------------|------------------------------|---------|---------|-------------|-------------|-------------|
|             | 300/160                      | 300/200 | 300/212 | 300/160/160 | 300/200/200 | 300/212/225 |
| <b>KHEP</b> | 560                          |         |         | –           | –           | –           |
| <b>KHZP</b> | –                            | –       | –       | 700         | 730         | 800         |
| <b>KHDP</b> | –                            | –       | –       | 900         | 970         | 1110        |

Table 1.1: Weights (approx. values only)

**Note:** All weights are for gear unit without oil filling or attachments. For the exact weights, refer to the drawings in the gear-unit documentation.

## 1.1.2 Measuring-surface sound level

The gear unit has a calculated max. measuring-surface sound-pressure level  $L_{pA}$  of  $87 + 2$  dB(A) at a distance of 1 metre at a max. output of 150 kW

The measurement is carried out to DIN 45635 Parts 1 and 23, using the sound-intensity method.

The workplace of the operating personnel is defined as the area on the measuring-surface at a distance of 1 metre in the vicinity of which persons may be present.

The sound-pressure level applies for the warmed-up gear unit at input speed  $n_1$  and input power P-NRL indicated on the rating plate.

The measuring-surface sound-pressure level includes attached lubrication units (if applicable). With outgoing and incoming pipes, the interfaces are the flanges.

If repeat measurements on site do not produce conclusive results with regard to measuring technology, the measurement obtained on the FLENDER test bench will apply.

## 2. General notes

### 2.1 Introduction

These Operating Instructions (BA) are an integral part of the gear unit supplied and must be kept in its vicinity for reference at all times.

**Caution!**

**All persons involved in the installation, operation, maintenance and repair of the gear unit must have read and understood these Operating Instructions and must comply with them. We accept no responsibility for damage or disruption caused by disregard of these Instructions.**

These operating instructions apply to "**Dry-Cylinder Gear Units**". The gear unit has been developed specifically for operation as a dry-cylinder gear unit for paper machine drives.

The gear unit is designed only for the application described in section 1, "Technical data". Other operating conditions must be contractually agreed.

The gear unit described in these Instructions reflects the state of technical development at the time these Instructions went to print.

In the interest of technical progress we reserve the right to make changes to the individual assemblies and accessories which we regard as necessary to preserve their essential characteristics and improve their efficiency and safety.

### 2.2 Copyright

The copyright to these Operating Instructions is held by **FLENDER AG**.

These Operating Instructions must not be wholly or partly reproduced for competitive purposes, used in any unauthorised way or made available to third parties without our agreement.

Technical enquiries should be addressed to the following works

A. FRIEDR. FLENDER AG

D-46393 Bocholt

Tel.: 02871/92-0

Fax: 02871/92-2596

or to one of our customer-service addresses. A list of our customer-service addresses is given in section 11, "Spare parts, customer-service addresses".

## 3. Safety notes

### 3.1 Proper use

- The gear unit has been manufactured in accordance with the state of the art and is delivered in a condition for safe and reliable use. Any changes on the part of the user are not permitted. This applies equally to safety features designed to prevent accidental contact.
- The gear unit must be used and operated strictly in accordance with the conditions laid down in the contract governing performance and supply agreed by FLENDER and the customer.

### 3.2 Obligations of the user

- The operator must ensure that all persons involved in installation, operation, maintenance and repair have read and understood these Operating Instructions and comply with them at all times in order to:

- avoid injury or damage,
- ensure the safety and reliability of the unit,

and

- avoid disruptions and environmental damage through incorrect use.
- During transport, assembly, installation, dismantling, operation and maintenance of the unit, the relevant safety and environmental regulations must be complied with at all times.
- The gear unit should be operated, maintained or repaired by authorised, trained and qualified personnel.
- The gear unit must not be cleaned using high-pressure cleaning equipment.
- All work must be carried out with great care and with due regard to safety.
- All work on the gear unit must be carried out only when it is not in operation. The drive unit must be secured against being switched on accidentally (e.g. by locking the key switch or removing the fuses from the power supply). A notice should be attached to the start switch stating clearly that work is in progress.
- No welding work should be done on the gear unit. The gear unit must not be used as an earthing point for welding operations. Toothed parts and bearings may be irreparably damaged by welding.
- If any changes are noticed during operation (e.g. overheating or unusual noises), the drive assembly must be switched off immediately.
- Rotating drive components such as couplings, gearwheels, belt drives etc. must be protected against accidental contact.
- If the gear unit is intended for installation in plant or machinery, the manufacturer of such plant or machinery must ensure that the contents of these Instructions are incorporated in his own instructions.
- Notices attached to the gear unit, e.g. rating plate, direction arrows etc. must always be observed. They must be kept free from dirt and paint at all times. Missing plates must be replaced.
- Screws which have been damaged during assembly or disassembly work must be replaced with new ones of the same strength class and type.
- All spare parts must be obtained from FLENDER.

## 3.3 Environmental protection

- When changing oil, the used oil must be collected in suitable containers. Any spillage of oil must be removed immediately.
- Preservative agent should be stored separately from used oil.
- Used oil, preservative agent, oil-binding agents and oil-soaked cloths must be disposed of in accordance with environmental legislation.

## 3.4 Special dangers

- Depending on operating conditions, the surface of the gear unit may heat up considerably.  
**Danger of burns!**
- When changing oil, take care to prevent scalding by hot oil.

## 3.5 Warnings and symbols used in these Instructions



This symbol indicates safety measures which must be observed to avoid **personal injury**.

**Caution!**

This symbol indicates safety measures which must be observed to avoid **damage to the gear unit**.

**Note:** This symbol indicates general **operating instructions** which are of particular importance.

## 4. Handling and storage

**Note:** Observe the "Safety instructions" in section 3.

### 4.1 Scope of supply

The products supplied are listed in the despatch papers. Check immediately on receipt to ensure that all the products listed have actually been delivered. Parts damaged during transport or missing parts must be reported in writing immediately to FLENDER AG.

**Caution!**

**If damage has occurred, the gear unit must not be put into operation.**

### 4.2 Handling

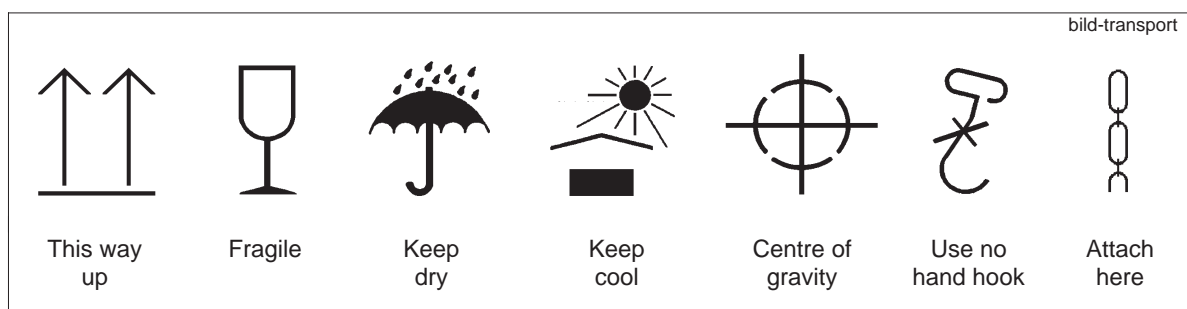


**When handling FLENDER products, use only lifting and handling equipment of sufficient load-bearing capacity!**  
**Observe the notes regarding load distribution on the packaging.**

**Note:** The gear unit is delivered in the fully assembled condition.

Different forms of packaging may be used, depending on the size of the unit and method of transport. Unless otherwise agreed, the packaging complies with the **HPE Packaging Guidelines**.

The symbols marked on the packaging must be observed at all times. These have the following meanings:





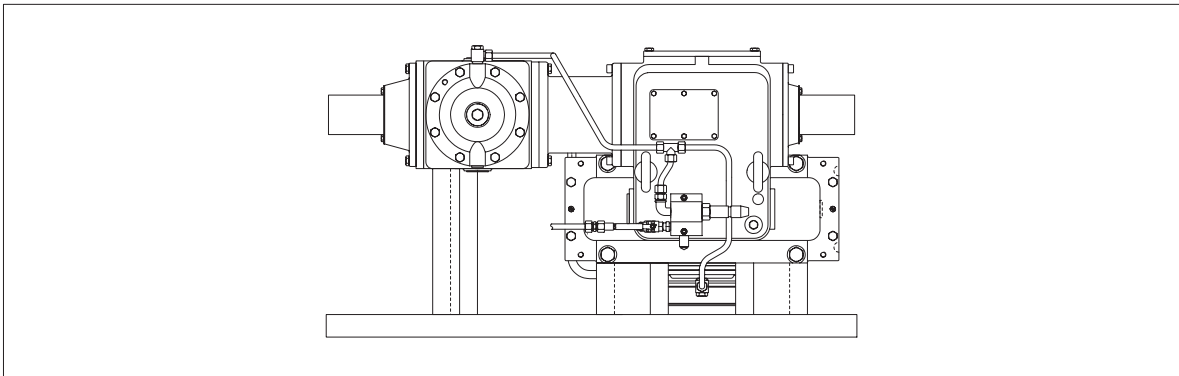
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**Caution!**

The gear unit must always be transported with due care to avoid danger to persons and the gear unit. If, for example, the free shaft ends are knocked, this may damage the gear unit.

**Note:**

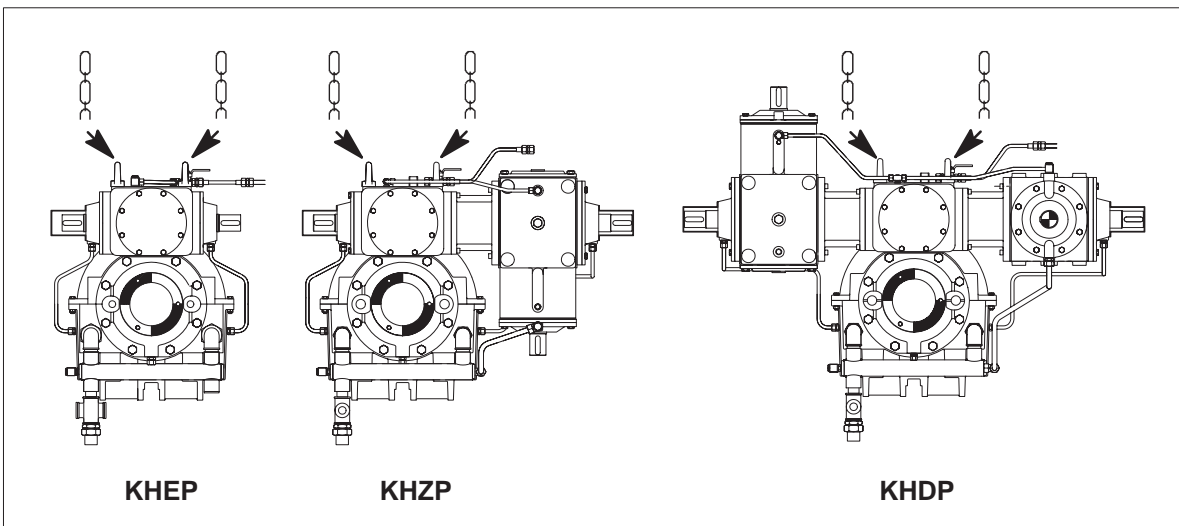
The gear units must be transported with suitable equipment only. Never transport the gear unit with an oil filling.

**Caution!**

The gear unit must only be handled in the position shown in the illustration above.

**Caution!**

Use only the 2 eye bolts provided to transport the gear unit. Do not use the front threads at the shaft ends to attach eye bolts for transport.



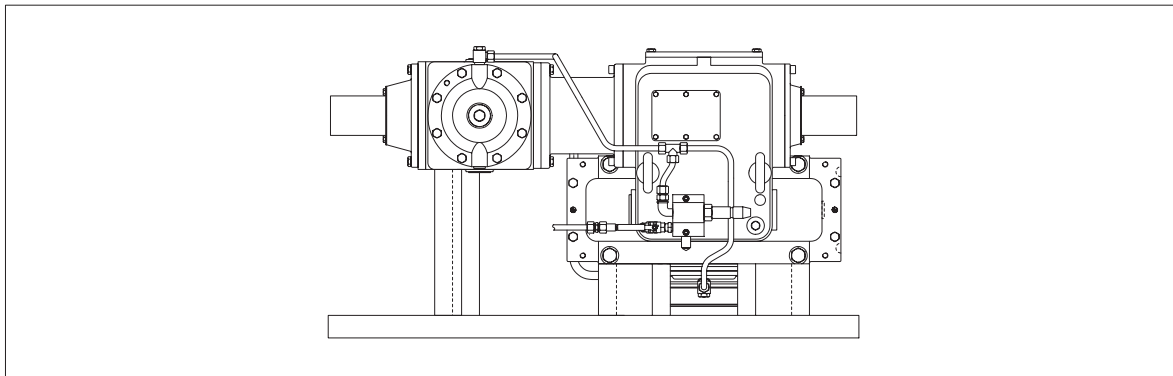
For a detailed view of the gear unit, refer to the drawings in the gear-unit documentation.

## 4.2.1 Storing the gear units

The gear unit must be stored in the position of use in a sheltered place. It must be placed on a vibration-free wooden base and covered over.



**Do not stack gear units on top of one another.**



**Caution!**

The gear unit must only be stored in the position shown in the illustration above.

**Caution!**

If the gear unit is being stored out of doors, it must be particularly carefully covered, and care must be taken that neither moisture nor foreign material can collect on the unit.

## 4.3 Standard corrosion protection

The gear unit is provided with an internal preservative agent; the free shaft end is painted for protection.

The properties of the outer paint coat are as follows: Resistant to acids, weak alkalis, solvents, atmospheric action, temperatures up to 120 °C (temporarily up to 140 °C) and to tropical conditions.

**Note:** Unless otherwise contractually agreed, the internal preservation is guaranteed for 6 months, and the preservation of the free shaft ends for 24 months, provided that storage is in dry, frostfree sheds. The period of validity of the guarantee starts on the date of delivery of the gear unit.

For longer periods of storage (> 6 months) we advise regular checking and, if necessary, renewal of the internal and external preservation (see section 7, "Start-up").

## 5. Technical description

**Note:** Observe the "Safety instructions" in section 3.

### 5.1 General description

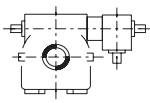
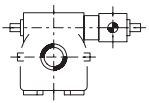
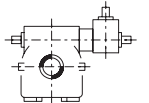
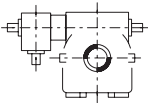
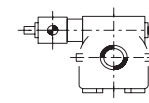
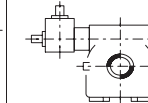
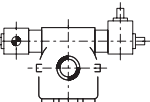
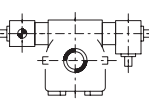
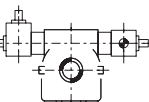
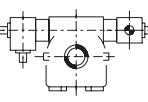
The gear unit is supplied as a two-stage bevel-helical gear unit. It is designed for installation in the horizontal position. It can be operated in both directions of rotation.

The gear unit is characterised by a low noise level. This is achieved by bevel and helical gears with a high contact ratio and special sound-damping housings.

The good temperature characteristics of the gear unit are due to its high degree of efficiency, its large housing surface area and the non-contacting shaft seals (labyrinth seals).

**Note:** The gear unit must be supplied with oil by a separate oil supply system.

A number of shaft configurations (types and rotation directions) are possible. These are shown in the following table as solid shafts:

| Type | Configuration   |   |   |  |  |  |
|------|---|---|---|--|--|--|
|      | A   | B   | C   | D  | E  | F  |
| KHEP |   |   |   |  |  |  |
| KHZP |   |   |   |   |  |  |
| KHDP |  |  |  |  |  |  |




### 5.2 Housing

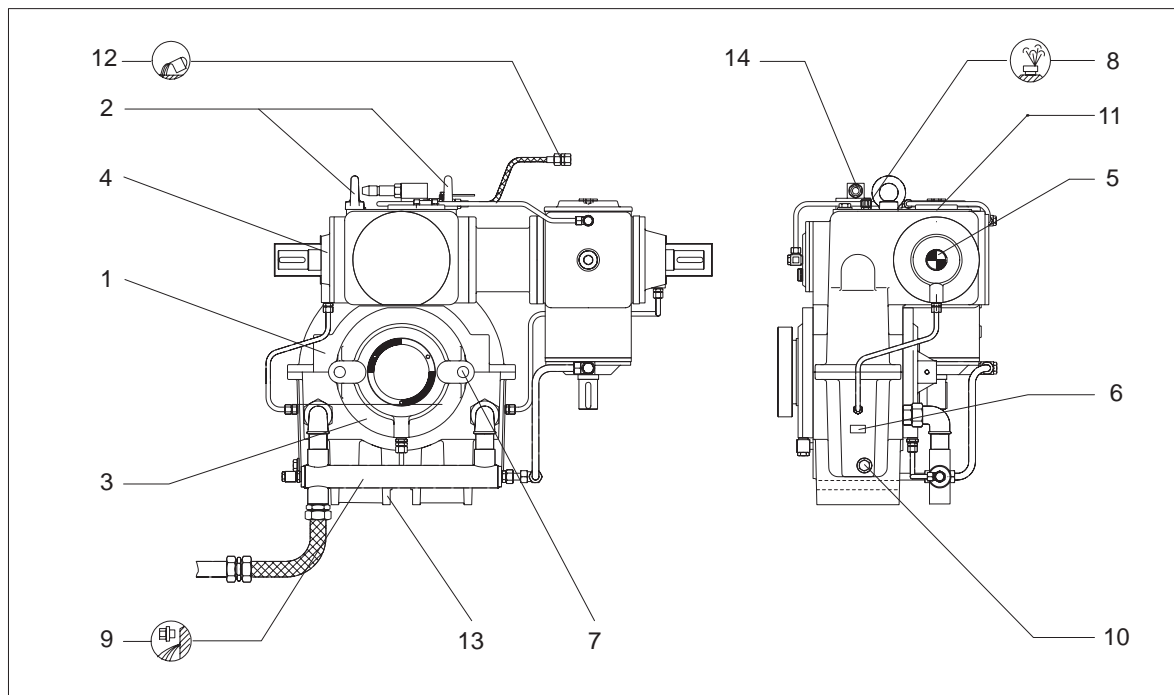
The gear unit housing is made of cast iron and in two parts. The housing is rigid in design and due to its form has excellent noise and temperature characteristics. If required, the housing can also be of steel.

The housing is fitted with adequately dimensioned eye bolts and inspection covers.

The individual oil feed lines must be monitored with pressure monitors to be provided by the customer. A breather screw is provided to ventilate the housing.

Colour codes for breather, oil drainage and symbolic representation:

|            |        |   |
|------------|--------|---|
| Breather:  | yellow |  |
| Oil inlet: | yellow |  |
| Oil drain: | white  |  |



|   |                       |    |   |
|---|-----------------------|----|---|
| 1 | Housing               | 8  | Housing ventilation                     |
| 2 | Eye bolts             | 9  | pressureless oil return                 |
| 3 | Flange cover          | 10 | Oil drain plug                          |
| 4 | Cover                 | 11 | Inspection cover                        |
| 5 | Shaft seals           | 12 | pressurised oil feed                    |
| 6 | Rating plate          | 13 | Support surface for torque reaction arm |
| 7 | Steam head connection | 14 | Oil flow limiter                        |

For a detailed view of the gear unit, refer to the drawings in the gear-unit documentation (the illustration shows a KHZP).

### 5.3 Toothed components

The toothed components of the gear unit are case-hardened. The helical gear teeth are ground, the bevel-helical gear teeth lapped. The high quality of the teeth leads to a significant noise reduction and ensures safe and reliable running.

The gear wheels are joined to the shafts by interference fits and parallel keys. These types of joints transmit with adequate reliability the torques generated.

### 5.4 Lubrication

For the horizontal mounting position the teeth and rolling bearings are adequately supplied with oil by pressure circulation from a separate oil supply system.

#### **Caution!**

**The oil feed line must be monitored with a separate pressure monitor to be provided by the customer.**

### 5.5 Shaft bearings

All shafts are mounted on rolling bearings.

## 5.6 Shaft seals

Labyrinth seals at the shaft outlets prevent oil from escaping from or dirt from entering the gear unit.

Labyrinth seals are non-contacting and avoid wear to the shaft. They therefore require no maintenance and ensure favourable temperature characteristics.

## 5.7 Cooling

The gear units are cooled by a separate oil supply system.

**Note:** The equipment manufacturer's operating instructions should be observed for operation of the oil supply system.

## 5.8 Couplings, cardan shafts

As a rule, cardan shafts or all-steel couplings should be provided for the gear-unit drive.

### Caution!

**Couplings and cardan shafts with peripheral velocities of up to 30 m/s on the outer diameter must be statically balanced. Couplings with peripheral velocities over 30 m/s must be dynamically balanced.**

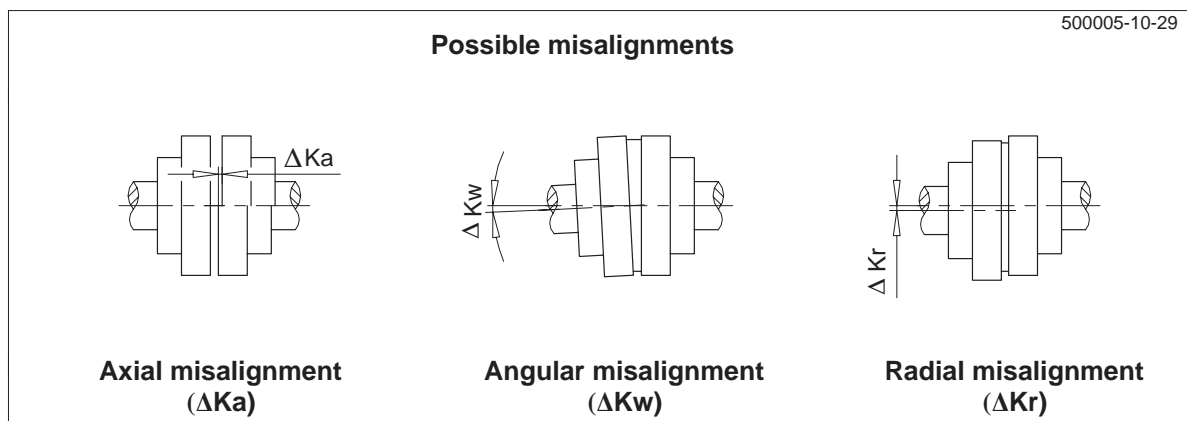
The specific Operating Instructions must be observed for the operation of the couplings or cardan shafts.

### Caution!

**When installing the drives, make absolutely certain that the individual components are accurately aligned in relation to each other. Inadmissibly large errors in the alignment of the shaft ends to be connected due to angular and axial misalignments result in premature wear and material damage.**

**Note:** The smaller the radial and angular misalignment between coupling parts on the shaft ends to be connected, the longer the service life and the higher the reliability of the equipment and the quieter the operation.

Misalignments of the coupling parts in relation to each other can be caused by inaccurate alignment during assembly, but also by actual operation of the equipment (expansion due to heat, shaft deflection, insufficiently rigid machine frames, etc.).



Alignment has to be done in two axial planes arranged perpendicular to each other. This can be done by means of a ruler (radial misalignment) and feeler gauge (angular misalignment). The aligning accuracy can be increased by using a dial gauge or, optically, by using a laser.

### Caution!

**The maximum permissible misalignments must under no circumstances be exceeded during operation.**

**For the exact values, please see operating instructions for the coupling.**

**Angular and radial misalignments may occur at the same time. The sum of both misalignments must not exceed the maximum permissible value of the angular or radial misalignment.**

## 6. Assembly

**Note:** Observe the "Safety instructions" in section 3.

### 6.1 General information on installation

Assembly and installation work must be done with great care by trained and qualified personnel. The manufacturer cannot be held liable for damage caused by incorrect assembly and installation.

During the planning phase sufficient space must be allowed around the gear unit for later care and maintenance work.

Adequate lifting equipment must be available before beginning the installation and assembly work.

**Caution!**

**No welding work must be done on the drive. The drives must not be used as an earthing point for welding operations. Toothed parts and bearings may be irreparably damaged by welding.**

**Caution!**

**All the fastening points provided by the design of the unit must be used. Screws which have been damaged during assembly or disassembly work must be replaced with new ones of the same strength class and type.**

**Note:** For dimensions, space requirement, arrangement of the supply connections (on gear units with oil cooling), refer to the drawings in the gear-unit documentation.

### 6.2 Support bracket

The support bracket must be vertical and level in the area of the torque reaction arm.

It must be designed in such a way that no resonance vibrations are set up and that no vibrations can be transmitted from adjacent foundations. Steel structures on which the unit is to be mounted must be rigid. They must be designed according to the weight and torque, taking into account the forces acting on the gear unit.

### 6.3 Description of installation work

- Remove the anti-corrosion paint on the shafts with suitable cleaning agent such as benzine.



**Ensure adequate ventilation. Do not smoke!  
Danger of explosion.**

- Pull drive unit onto shaft end and secure.  
If this is to be heated for mounting, refer to the dimensioned drawings in the coupling documentation for the required joining temperatures.

Unless otherwise specified, the components may be heated inductively, with a burner or in a furnace.



**Take precautions to avoid burns from hot components!**

**Caution!**

**Use heat shields to protect against radiant heat.**

**Caution!**

**The coupling components must be fitted with the aid of suitable equipment to avoid damaging the shaft bearings through axial joining forces. Always use suitable lifting equipment.**

The components must be pushed smartly onto the shaft up to the position specified in the order-specific dimensioned drawing.

**Caution!**

**Fit the coupling with the aid of suitable fitting equipment. Never use force or knock the couplings into position, as this may damage the gearwheels, rolling bearings, locking rings, etc.**

**Note:** Gear units whose weight requires the use of lifting gear must be attached as shown in section 4 "Transport, handling and storage".

The unit on the input side must be precisely aligned with the gear-unit shaft, using:

- rulers
- spirit level
- dial gauge
- feeler gauge, etc.

Only then should the gear unit be fastened and the alignment checked once again.

**Note:** The accuracy of shaft axis alignment is an important factor in determining the life span of shafts, bearings and couplings. If possible, the deviation should be zero. For amongst others the special requirements for the couplings, refer to the specific operating instructions.

**Caution!** Non-observance can cause shaft rupture, resulting in serious injury.

## 6.4 Shaft-mounted gear unit with hollow shaft and parallel key

### 6.4.1 Assembly

- Remove the preservative agent from the hollow shaft and the machine shaft with a suitable cleaning agent (such as benzine).



**Ensure adequate ventilation. Do not smoke!  
Danger of explosion.**

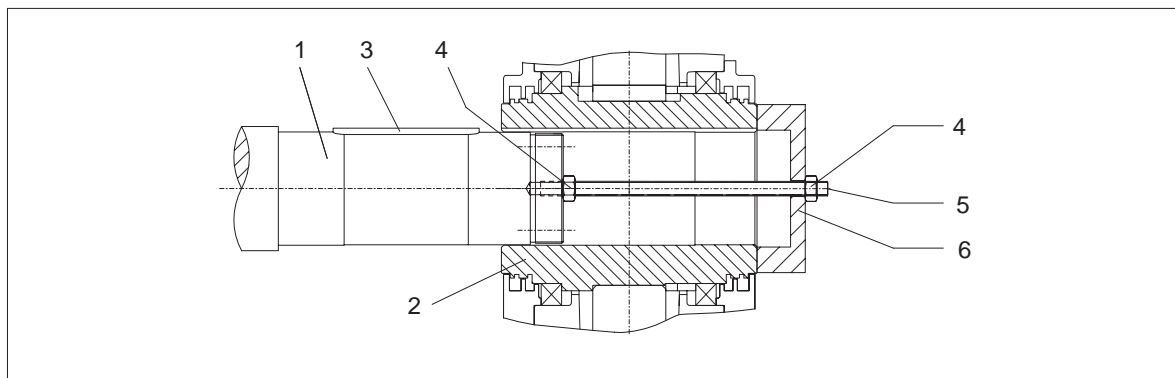
- Check the hollow and machine shafts to ensure that seats and edges are not damaged. If necessary, rework the parts with a suitable tool and clean them again.

Coat with a suitable lubricant (e.g. Calypsol grease type H 443 HD88) to prevent frictional corrosion of the contact surfaces.

#### 6.4.1.1 Fitting

- Fit the gear unit by means of nut and threaded spindle. The counterforce is provided by the hollow shaft.

**Caution!** The hollow shaft must be exactly aligned with the machine shaft to avoid canting.



1 Machine shaft  
4 Nut

2 Hollow shaft  
5 Threaded spindle

3 Parallel key  
6 End plate

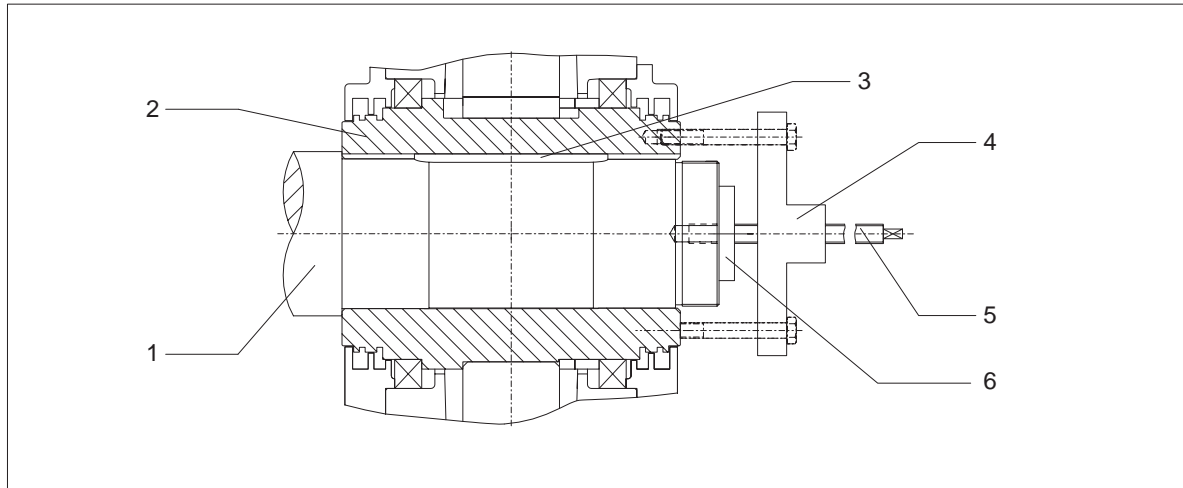
Instead of the nut and threaded spindle shown in the diagram, other types of equipment such as a hydraulic lifting equipment (type Lucas) may be used.

## 6.4.1.2 Axial fastening

Depending on configuration, secure the hollow shaft axially on the machine shaft (e.g. with retaining ring, end plate, set screw etc.).

## 6.4.2 Dismantling

- Remove the axial fastening device from the hollow shaft.
- Depending on the facilities available on site, the gear unit can be forced off the shaft, using forcing screws in an end plate, a central threaded spindle or preferably a Lucas hydraulic lifting unit.



- |   |               |   |                        |
|---|---------------|---|------------------------|
| 1 | Machine shaft | 4 | Hydraulic lifting unit |
| 2 | Hollow shaft  | 5 | Threaded spindle       |
| 3 | Parallel key  | 6 | Plate for forcing out  |

**Caution!** Avoid canting when pulling the unit off.

## 6.5 Shaft-mounting gear unit with hollow shaft and shrink disk

### 6.5.1 Assembly

- Remove the preservative agent from the hollow shaft and the machine shaft with a suitable cleaning agent (such as benzine).



**Ensure adequate ventilation. Do not smoke!  
Danger of explosion!**

- Check the hollow and machine shafts to ensure that seats and edges are not damaged. If necessary, rework the parts with a suitable tool and clean them again.

**Caution!** The bore of the hollow shaft and the machine shaft must be absolutely free of grease in the area of the shrink disk seat. This is essential for safe and reliable torque transmission. Do not use contaminated solvents or dirty cloths for removing grease.

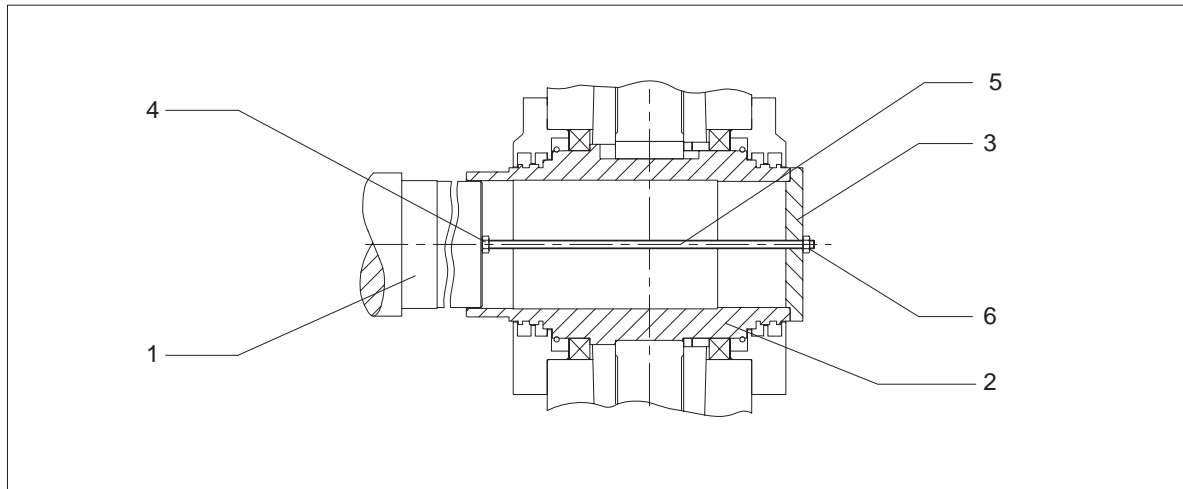


## 6.5.1.1 Fitting

- Fit the gear unit by means of nut and threaded spindle. The counterforce is provided by the hollow shaft.

**Caution!**

The hollow shaft must be exactly aligned with the machine shaft to avoid canting.



1 Machine shaft  
4 Nut

2 Hollow shaft  
5 Threaded spindle

3 End plate  
6 Nut

**Caution!**

The hollow shaft must be exactly aligned with the machine shaft to avoid canting.

Instead of the nut and threaded spindle shown in the diagram, other types of equipment such as a hydraulic lifting equipment (type Lucas) may be used.

## 6.5.1.2 Axial fastening

If the shrink disk is fitted according to instructions (see item 6.5.2.1), the gear unit is fixed securely in the axial direction. Additional fastening is not required.

## 6.5.2 Shrink disk, type HSD

### 6.5.2.1 Assembly of shrink disk

The shrink disk is delivered ready for installation.

**Caution!**

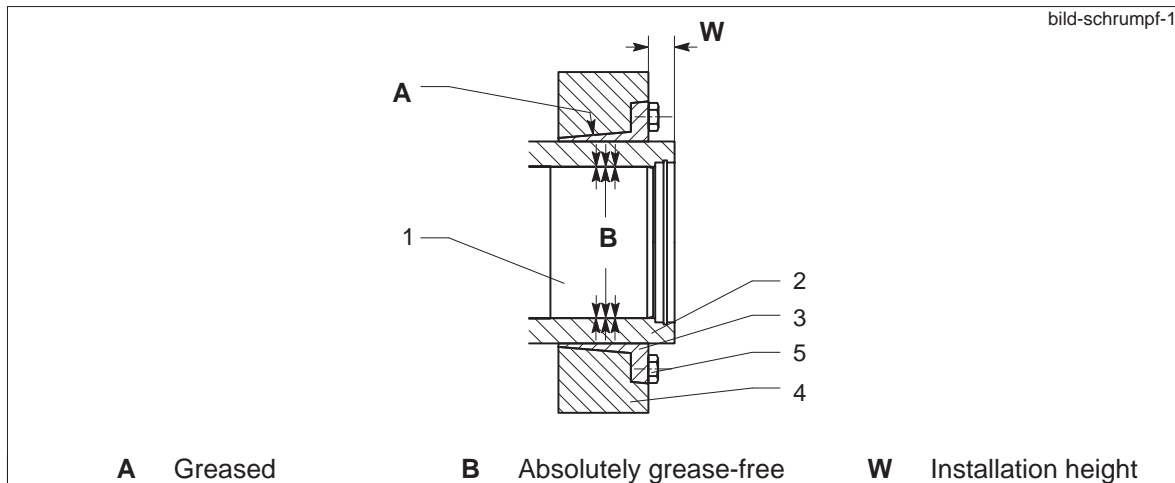
It must not be dismantled before tensioning for the first time.

**Caution!**

The bore of the hollow shaft and the machine shaft must be absolutely free of grease in the area of the shrink disk seat. This is essential for safe and reliable torque transmission. Do not use contaminated solvents or dirty cloths for removing grease.

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- 1 Machine shaft
- 2 Hollow shaft
- 3 Inner ring
- 4 Outer ring
- 5 Tensioning bolt

- Mounting the shaft or fitting the hub onto the shaft

For the exact installation height (W) of the shrink disk, refer to the dimensioned drawing (see section 1, "Technical data")

**Note:** The outer surface of the hollow shaft may be greased in the area of the shrink disk seat.

**Caution!** Do not tighten the tensioning bolts until the machine shaft is installed.

The tensioning bolts must be tightened one after the other, in rotation and in several passes to the tightening torque shown on the shrink disk.

Tighten the tensioning bolts until the lateral surfaces of the inner and outer rings are aligned.

**Note:** This allows the tension condition to be checked visually. For safety the tensioning bolts must then be tightened in 2 further passes.

**Caution!** To avoid overloading the individual bolts, the maximum tensioning torque (see table 6.3) must never be exceeded. The alignment of the front surfaces has priority. If alignment cannot be achieved by tightening, consult FLENDER.

| Tensioning-bolt thread | Max. tensioning torque per bolt (with $\mu = 0.1$ ) |                           |
|------------------------|---|---------------------------|
|                        | Strength class 10.9<br>Nm                           | Strength class 12.9<br>Nm |
| M 6                    | 12  | 14.5                      |
| M 8                    | 29  | 35                        |
| M 10                   | 58  | 70                        |
| M 12                   | 100   | 121                       |
| M 14                   | 160   | 193                       |
| M 16                   | 240   | 295                       |
| M 20                   | 470   | 570                       |
| M 24                   | 820   | 980                       |
| M 27                   | 1210  | 1450                      |

Table 6.3: Maximum torques for tensioning bolts

**Caution!** For safety reasons, a protective cover should be mounted above the shrink disk.

## 6.5.2.2 Demounting and remounting the shrink disk

Disassemble the protective cover.

The loosening process is similar to that of tightening.

To enable the stored energy of the outer ring during disassembly to be lowered slowly via the bolts to be loosened, the bolts must be loosened evenly and in sequence. Initially only by a quarter turn.

**Caution!** Under no circumstances must the bolts be unscrewed one after the other.

If after loosening all the bolts approx. one turn the outer ring does not come free of the inner ring of its own accord, the outer ring can be detensioned with the forcing threads by screwing some of the adjacent fastening bolts into the them. The now loosening outer ring is braced against the remaining bolts. This operation must be carried out until the outer ring releases of its own accord.

Remove shaft or slip hub off the shaft. Rust deposits which may have formed on the shaft must be removed from the hub before performing this operation.

Pull the shrink disk off the hollow shaft.

## 6.5.2.3 Cleaning and greasing the shrink disk

Shrink disks do not have to be dismantled and re-greased before being re-installed.

The shrink disk should only be dismantled and cleaned if it is dirty.

Observe the "Safety instructions" in section 3.

**Caution!** Following cleaning, only the inner sliding surfaces of the shrink disk should be re-greased.

Use a solid lubricant with a high MoS<sub>2</sub>-based molybdenum disulphide content and with a coefficient of friction of  $\mu = 0.04$  according to the following table.

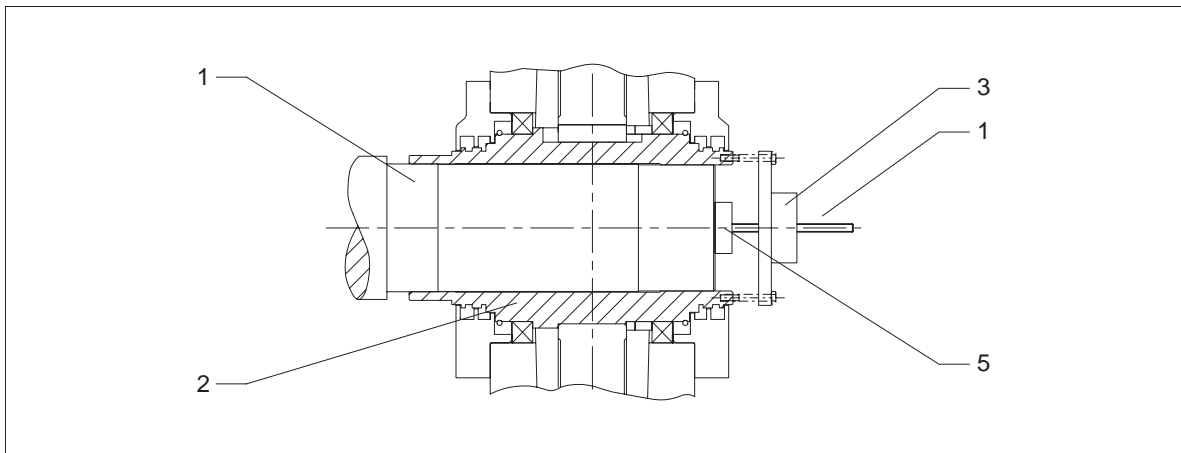
| Lubricant                          | Form           | Manufacturer       |
|------------------------------------|----------------|--------------------|
| Molykote 321 R (lubricating paint) | Spray          | DOW Corning        |
| Molykote Spray (powder spray)      | Spray          | DOW Corning        |
| Molykote G Rapid                   | Spray or Paste | DOW Corning        |
| Aemasol MO 19 P                    | Spray or Paste | A. C. Matthes      |
| Unimoly P 5                        | Powder         | Klüber Lubrication |

Table 6.4: Lubricants for shrink disk after cleaning

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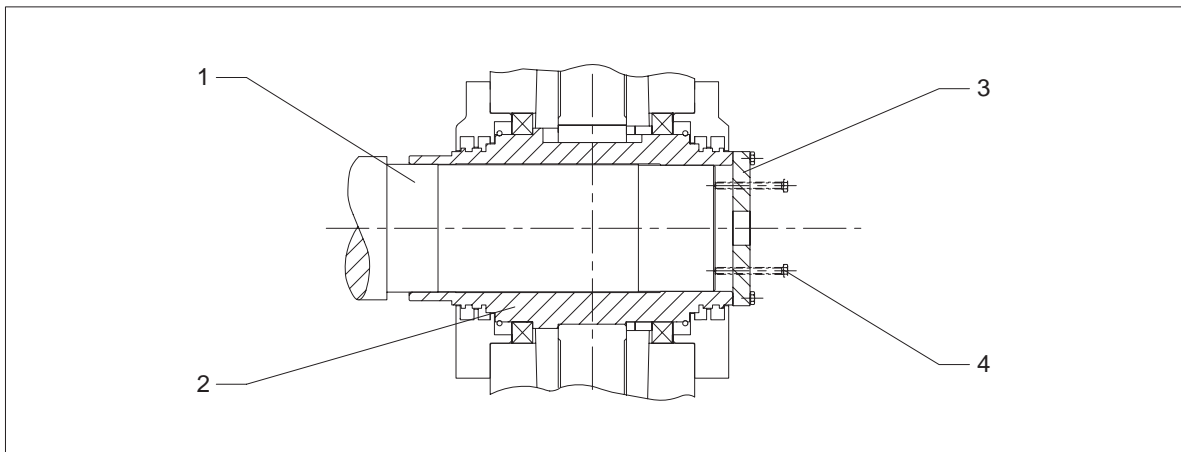
## 6.5.3 Dismantling

- Depending on the facilities available on site, the gear unit can be forced off the shaft, using forcing screws in an end plate, a central threaded spindle or preferably a Lucas hydraulic lifting unit.



- 1 Machine shaft
- 2 Hollow shaft
- 3 Hydraulic lifting unit

- 4 Threaded spindle
- 5 Plate for forcing out



- 1 Machine shaft
- 2 Hollow shaft

- 3 End plate
- 4 Forcing screws

### Caution!

**Avoid canting when pulling the unit off.**

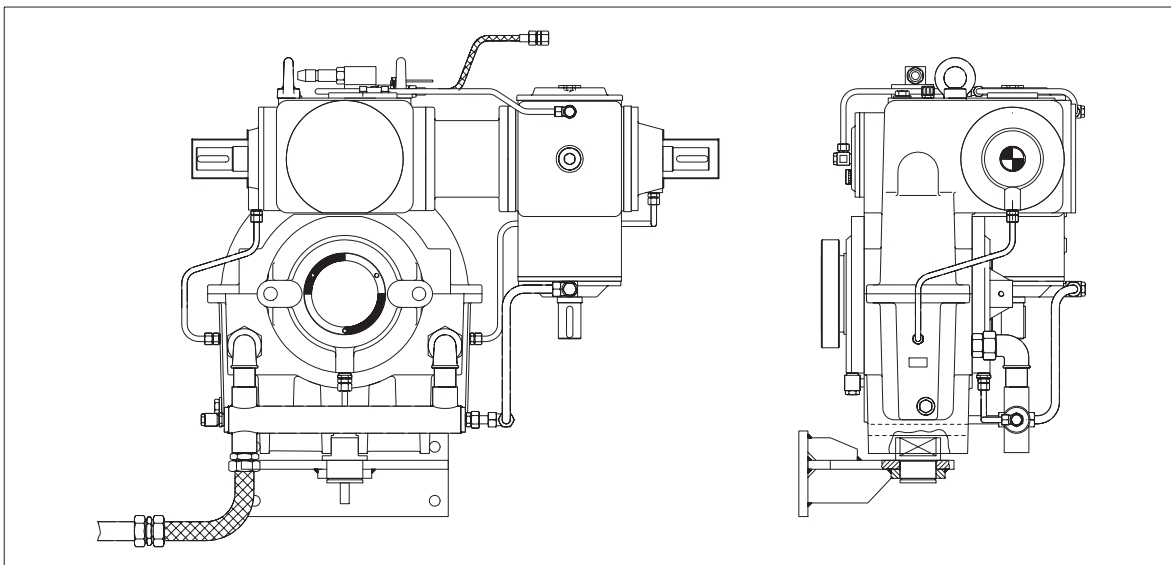
### Note:

When using forcing screws or threaded spindles, the head of the thread pressing against the driven machine should be rounded and well greased to reduce the risk of seizing at this point.

## 6.6 Mounting the torque arm for gear housing

### 6.6.1 Attaching the torque arm

**Caution!** The torque arm must be mounted stress-free on the machine side



- The gear unit is mounted direct on the machine journal and secured against torsion with the torque reaction arm (the illustration shows a KHZP).

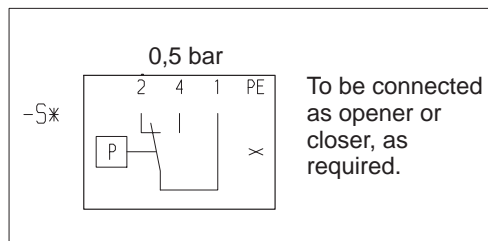
## 6.7 Gear unit with oil lubrication system

- Remove blank flanges and/or plugs on the pressure and suction lines of the gear unit and of the oil-supply unit.
- Install connection pipes between oil-supply unit and gear unit and connect.

**Caution!** Prior to start-up the oil flow limiter and the pressure monitor must always be connected so as to be operative.

For the operation and maintenance of the pressure monitor, the Operating manuals specified in the order-specific appendix must be observed. For technical data, refer to the order-specific equipment list.

**Note:** The installation of the oil supply system, including cooling water in- and outflow, and the electrical installation of the monitoring equipment must be carried out in accordance with separate operating instructions.



## 6.8 Final work

- After installation of the gear unit check all screw connections for tight fit.
- In addition, after tightening the fixings a check must be made to see that the alignment has not changed.
- Rotating parts must be checked for correct seating. Contact with rotating parts is not permitted.

## 7. Start-up

**Note:** Observe the "Safety instructions" in section 3.

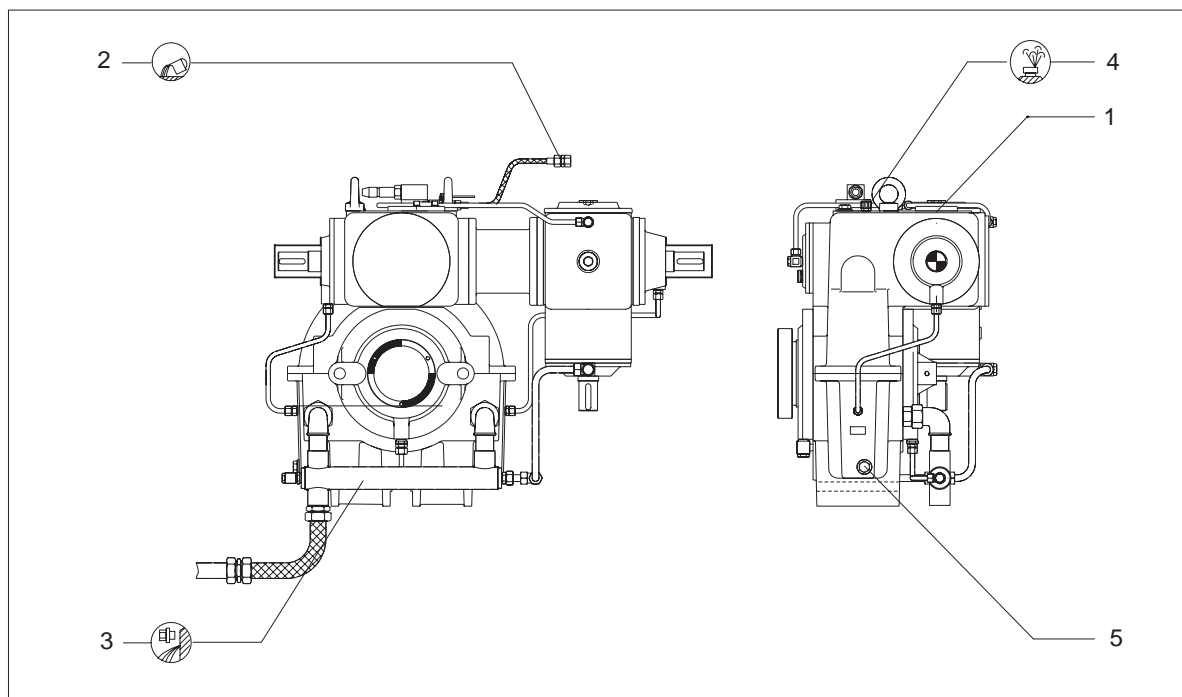
### 7.1 Procedure before start-up

#### 7.1.1 Removal of preservative agent

- Unscrew oil drain plug and drain off the remaining preservative or running-in oil from the housing into a suitable receptacle and dispose of it in accordance with regulations.

**Caution!** Remove any oil spillage immediately with an oil-binding agent.

- Replace the oil drain plug
- Connect oil feed and return to the oil supply unit.



- 1 Inspection cover  
2 pressurised oil feed  
3 pressureless oil return

- 4 Venting screw  
5 Oil drain plug

For a detailed view of the gear unit, refer to the drawings in the gear-unit documentation.

**Caution!** Before start-up replace the yellow plastic screw plug with the venting screw provided by the customer (see also notice on gear unit).

#### 7.1.2 Charging with lubricant

**Note:** The gear unit is supplied with lubricant by the separate oil supply system.

**Note:** For the correct type of oil (of various brands) to be used, refer to the BA 7300 EN operating instructions supplied separately. Information on the type, quantity and viscosity of the oil is given on the rating plate on the gear unit.

**Caution!** Remove any oil spillage immediately with an oil-binding agent.

## 7.2 Start-up

### Gear unit with oil supply system:

- Fully open the shutoff valves in the oil supply and drain line of the oil-supply unit.

**Caution!**

**The gear unit must be operated only together with the oil supply system. For this the oil supply system must be switched on approx. 2 minutes before starting up the gear unit.**

**Note:**

The start-up can begin, when the oil pressure is higher than 1.5 bar. When using an oil flow limiter the oil pressure upstream the oil flow limiter must be > 7.0 bar.

## 7.3 Removal from service

- To take the gear unit out of service, first switch off the drive unit.



**Secure the drive unit to prevent it from being started up unintentionally. Attach a warning notice to the start switch.**

- During longer periods of disuse, start the unit up briefly at intervals of approx. 3 weeks. If the gear unit is to remain out of service for longer than six months, it must be treated with preservative agent (see item 7.3.1).

### 7.3.1 Interior preservation during longer disuse

#### 7.3.1.1 Interior protection with preservative agent

Before longer periods of storage gear units with forced lubrication systems, oil circulation cooling or non-contacting shaft seals should be filled with preservative agent and run without load.

| Duration of protection   | Preservative agent     | Special measures   |
|--|------------------------|--|
| up to 6 months   | Castrol Alpha SP 220 S | None   |
| up to 24 months  |                        | Close gear unit, replace breather screw or air filter with a yellow plug screw, (replace the original parts before start-up) |
| For storage periods longer than 24 months, renew the preservative agent.<br>For storage periods over 36 months, FLENDER should be consulted. |                        |  |

Table 7.1: Preservation procedure when using mineral oil or PAO-based synthetic oil

| Duration of protection   | Preservative agent                           | Special measures   |
|--|--|--|
| up to 6 months   | Special anti-corrosion oil<br>TRIBOL 1390 1) | None   |
| up to 36 months  |  | Close gear unit, replace breather screw or air filter with a yellow plug screw, (replace the original parts before start-up) |
| For storage periods over 36 months, FLENDER should be consulted. |  |  |

Table 7.2: Preservation procedure when using PG-based synthetic oil

- 1) Resistant to tropical conditions and sea water. Max. ambient temperature 50 °C

## 7.3.1.2 Interior preservation procedure

- Switch the gear unit off and drain the oil as described in section 10, "Maintenance and repair".
- Pour in preservative according to table 7.1 or 7.2 through the vent hole or the opening in the inspection cover so that the helical gears submerge.
- Close the venting hole or the opening in the inspection cover.
- Start the gear unit and allow it to idle for a short time.
- Unscrew the oil drain plug and allow the preservative to drain into a suitable container and dispose of it according to regulation.



**There is a risk of scalding from the hot preservative agent draining from the gear unit. Wear protective gloves to avoid scalding.**

- Replace the oil drain plug.

**Caution!**

**Before re-starting the gear unit replace the screw plug with the breather screw or air filter.  
See also item 7.1.1.**

## 7.3.2 Exterior preservation

| Duration of protection | Preservative agent | Layer thickness | Remarks  |
|------------------------|--------------------|-----------------|--|
| up to <b>24</b> months | Tectyl 846 K19     | approx. 50 µm   | Long-term wax-based preservative agent, resistant to sea water and tropical conditions (soluble with CH compounds) |

Table 7.3: External preservation of shaft ends and other bright machined surfaces

### 7.3.2.1 Exterior preservation procedure

- Clean the surfaces
- Apply preservative agent



## 8. Operation

**Note:** Observe the "Safety instructions" in section 3.

### 8.1 General operating data

During operation the unit must be monitored for:

- excessive operating temperature (If mineral oil is used, the gear unit is suitable for a temperature of 80 °C in continuous operation. The maximum short-term operating temperature is 90 °C. See also section 10.)
  - changes in gear noise
  - possible oil leakage at the housing and shaft seals
- and
- correct oil level (see also section 7 "Start-up").

#### **Caution!**

**If any irregularities are noticed during operation or if the pressure monitor in the oil-cooling system (if installed) triggers the alarm, switch the drive unit off at once. Determine the cause of the fault, using the table in section 9. This table contains a list of possible faults, their causes and suggested remedies. If the cause cannot be identified or the unit repaired with the facilities available, you are advised to contact one of our customer-service offices for specialist assistance (see section 11.).**

## 9. Faults, causes and remedy

**Note:** Observe the "Safety instructions" in section 3.

### 9.1 General information on faults and malfunctions

**Note:** Faults and malfunctions occurring during the guarantee period and requiring repair work on the gear unit must be carried out only by FLENDER Customer Service. In the case of faults and malfunctions occurring after the guarantee period and whose cause cannot be precisely identified, we advise our customers to contact our customer service.

#### **Caution!**

**FLENDER will not be bound by the terms of the guarantee or otherwise be responsible in cases of improper use of the gear unit, modifications carried out without FLENDER's agreement or use of spare parts not supplied by FLENDER.**



**To remedy faults and malfunctions, the gear unit must always be taken out of service. Secure the drive unit to prevent it from being started up unintentionally. Attach a warning notice to the start switch.**

## 9.2 Possible faults

| Malfunctions                               | Causes   | Remedy  |
|--|--|---|
| Changes in gear noise                      | Damage to gear teeth   | Contact Customer Service.<br>Check all toothed components and replace any damaged parts.  |
|  | Excessive bearing play   | Contact Customer Service.<br>Adjust bearing play.   |
|  | Bearing defective  | Contact Customer Service.<br>Replace defective bearings.  |
| Increased temperature at bearing points    | Oil flow in gear unit housing too low  | Check separate oil supply system and, if necessary, top up oil<br>Check oil pressure in oil feed line, refer also to item 7.2.        |
|  | Oil too old  | Check date of last oil change and, if necessary, change oil.<br>See section 10 or operator information for separate oil supply system |
|  | Bearing defective  | Contact Customer Service.<br>Check and, if necessary, replace bearings.   |
| Operating temperature too high             | Oil level in housing too high  | Check oil return  |
|  | Oil too old  | Check date of last oil change and, if necessary, change oil.<br>See section 10 or operator information for separate oil supply system |
|  | Oil badly contaminated   | Change oil.<br>See section 10 or operator information for separate oil supply system  |
|  | Coolant flow too low<br>Coolant temperature too high<br>Oil flow through oil-cooler too low due to:<br>very dirty oil filter | See operator information for separate oil supply system   |
| Loud noises in area of gear-unit fastening | Fastening has worked loose   | Tighten bolts / nuts to prescribed torque.<br>Replace damaged bolts / nuts.   |
| Oil leakage from gear unit                 | Inadequate sealing of housing covers or joints   | Check and, if necessary, replace seals.<br>Seal joints  |
| Fault in oil supply system                 |  | See operator information for separate oil supply system   |

Table 9.1: Faults, causes and remedies

## 10. Maintenance and repair

**Note:** Observe the "Safety instructions" in section 3.

### 10.1 General notes on maintenance

**Note:** Maintenance and repair work must be done with care by trained and qualified personnel only.

**Caution!**

The periods indicated in table 10.1 depend on the conditions under which the gear unit is operated. Only average periods can therefore be stated here. These refer to:

|                              |                                 |
|------------------------------|---------------------------------|
| a daily operating time of    | <b>24 hours</b>                 |
| a duty factor of             | <b>100 %</b>                    |
| an input-drive speed of      | <b>1500 1/min</b>               |
| a maximum oil temperature of | <b>90 °C (mineral oil only)</b> |

**Note:** Under different operating conditions the periods indicated below must be adjusted accordingly.

| Measures                                      | Periods  | Remarks         |
|---|--|-----------------|
| Check oil temperature                         | daily  |                 |
| Check for unusual gear-unit noise             | daily  |                 |
| Check gear unit for leaks                     | monthly  |                 |
| Test oil for water content                    | after approx. 400 operating hours<br>once per year at least                  | see Item 10.2.1 |
| First oil change after start-up               | see section 10.2.2 or<br>operator information for separate oil supply system |                 |
| Subsequent oil changes                        |  |                 |
| Clean the venting screw                       | every 3 months   | see Item 10.2.3 |
| Clean gear-unit housing                       | every 5000 operating hours   | see Item 10.2.4 |
| Check tightness of fastening bolts            | after 1 month,<br>then every 5000 operating hours                            | see Item 10.2.5 |
| Carry out complete inspection<br>of gear unit | approx. 2 years  | see Item 10.2.6 |

Table 10.1: Maintenance and repair work

## 10.2 Description of maintenance and repair work

### 10.2.1 Test water-content of oil

For detailed information on testing the oil for water-content apply to the lubricant manufacturer.

### 10.2.2 Changing the oil

**Note:** Please observe the notes in the operator information for the separate oil supply system.

**Note:** Drain the oil while it is still warm, i.e. immediately after shutting down the machinery.

**Caution!**

**When changing the oil, always re-fill the gear unit with the same type of oil. Never mix different types of oil or oils made by different manufacturers. Never mix synthetic oils with mineral-based oils or with other synthetic oils. When changing from mineral-based oil to synthetic oil or from one type of synthetic oil to another, flush the gear unit well with the new type of oil beforehand.**

When changing the oil, the housing must be flushed with oil to remove sludge, metal particles and oil residue. Use the same type of oil as is used for normal operation. High-viscosity oils must be heated beforehand. Ensure that all residues have been removed before filling with fresh oil.

- Stop the gear unit by switching off the drive assembly



**Secure the drive unit to prevent it from being started up unintentionally. Attach a warning notice to the start switch.**

**Note:** For the correct type of oil (of various brands) to be used, refer to the BA 7300 EN operating instructions supplied separately. Information on the type, quantity and viscosity of the oil is given on the rating plate on the gear unit.

### 10.2.3 Cleaning the venting screw

If a layer of dust has built up, the breather screw must be cleaned, whether or not the minimum period of 3 months has expired. To do this, the breather screw must be unscrewed, cleaned with benzine or similar agent and dried. It can also be cleaned by blowing out with compressed air.

**Caution!**

**Foreign bodies must be prevented from entering the gear unit.**

### 10.2.4 Cleaning the gear unit

- Stop the gear unit by switching off the drive assembly



**Secure the drive unit to prevent it from being started up unintentionally. Attach a warning notice to the start switch.**

- Remove any corrosion.

**Caution!**

**The gear unit must not be cleaned with high-pressure cleaning equipment.**

## 10.2.5 Check tightness of fastening bolts

- Stop the gear unit by switching off the drive assembly



**Secure the drive unit to prevent it from being started up unintentionally. Attach a warning notice to the start switch.**

- Fully open the shutoff valves in the oil inlet and outlet line of the oil supply system.
- Check tightness of all fastening bolts with a torque wrench

| Thread size | Strength class | Tightening torque<br>(with $\mu = 0.20$ ) |
|-------------|----------------|---|
| M 10        | 8.8            | 60 Nm                                     |
| M 12        | 8.8            | 105 Nm                                    |
| M 16        | 8.8            | 255 Nm                                    |
| M 20        | 8.8            | 500 Nm                                    |
| M 24        | 8.8            | 870 Nm                                    |
| M 30        | 8.8            | 1750 Nm                                   |
| M 36        | 8.8            | 3050 Nm                                   |
| M 42        | 8.8            | 4950 Nm                                   |
| M 48        | 8.8            | 7400 Nm                                   |
| M 56        | 8.8            | 11700 Nm                                  |

Table 10.2: Tightening torques

**Note:** Damaged bolts must be replaced with new bolts of the same type and strength class.

- Tightening torques for fastening bolts of other strength classes are, if necessary, documented on the dimensioned drawing.

## 10.2.6 General inspection of gear unit

The general inspection of the gear unit must be carried out by the FLENDER Customer Service, as our engineers have the experience and training necessary to identify any components requiring replacement.

## 10.3 Lubricants

The oil selected for use in the gear unit must be of the viscosity (VG class) indicated on the nameplate. The viscosity class applies for the contractually agreed operating conditions.

FLENDER must be consulted for any change in operating conditions.

**Note:** For the correct type of oil (of various brands) to be used, refer to the BA 7300 EN operating instructions supplied separately.

We are familiar with the composition of these lubricants and, as far as we are currently aware, they possess the properties with regard to load-bearing capacity, corrosion resistance, resistance to grey staining and compatibility with seals and internal paint coats which are necessary for the type of gear unit concerned.

We therefore advise our customers to select one of the lubricants listed in the BA 7300 EN instructions, taking into account the VG class specified on the rating plate.

**Note:** To avoid misunderstandings, we should like to point out that this recommendation is in no way intended as a guarantee of the quality of the lubricant supplied. Each lubricant manufacturer is responsible for the quality of his own product.

If for an important reason of your own you do not wish to follow our recommendation, you assume responsibility for the technical suitability of the lubricant used.

## 11. Spare parts, customer-service addresses

### 11.1 Stocking spare parts

By stocking the most important spare and wearing parts on site you can ensure that the gear unit is ready for use at any time.

To order spare parts, refer to the spare-parts list.

For further information refer to the spare-parts drawing stated in the list.

We guarantee only the original spare parts supplied by us.

#### Caution!

**Please note that spare parts and accessories not supplied by us have not been tested or approved by us. The installation and/or use of such products may therefore impair essential characteristics of the gear unit, thereby posing an active or passive risk to safety. FLENDER will assume no liability or guarantee for damage caused by spare parts and accessories not supplied by FLENDER.**

Please note that certain components often have special production and supply specifications and that we supply you with spare parts which comply fully with the current state of technical development as well as current legislation.

When ordering spare parts, always state the following:

| Order no. / Item | Type / Size | Part no. | Quantity |
|------------------|-------------|----------|----------|
|------------------|-------------|----------|----------|

### 11.2 Spare-part and customer service addresses

When ordering spare parts or the services of our specialist engineers, apply first to FLENDER AG.

#### FLENDER Germany

##### A. FRIEDR. FLENDER AG

46393 Bocholt - Tel.: (0 28 71) 92-0 - Fax: (0 28 71) 92 25 96  
E-mail: [contact@flender.com](mailto:contact@flender.com) • [www.flender.com](http://www.flender.com)  
Shipping address: Alfred - Flender - Strasse 77 - 46395 Bocholt

##### A. FRIEDR. FLENDER AG - Kupplungswerk Mussum

Industriepark Bocholt - Schlavenhorst 100 - 46395 Bocholt - Tel.: (0 28 71) 92 28 68 - Fax: (0 28 71) 92 25 79  
E-mail: [couplings@flender.com](mailto:couplings@flender.com) • [www.flender.com](http://www.flender.com)

##### A. FRIEDR. FLENDER AG - Werk Friedrichsfeld

Am Industriepark 2 - 46562 Voerde - Tel.: (0 28 71) 92-0 - Fax: (0 28 71) 92 25 96  
E-mail: [contact@flender.com](mailto:contact@flender.com) • [www.flender.com](http://www.flender.com)

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## 12. Declaration by the manufacturer

### Declaration by the manufacturer

in accordance with EC Engineering Guideline 98/37/EC, Appendix II B

We hereby declare that the

Dry-cylinder gear units of types  
KHEP, KHZP and KHDP  
for paper machine drives  
Size 300

described in these Operating Instructions are intended for incorporation in a machine, and that it is prohibited to put them into service before verifying that the machine into which they are incorporated complies with the EC Guidelines (original edition 98/37/EC including any subsequent amendments thereto).

This Manufacturer's Declaration takes into account all the unified standards (inasmuch as they apply to our products) published by the European Commission in the Official Journal of the European Community.



Bocholt, 2003-05-15

\_\_\_\_\_  
Signature (Head Engineering IDE)