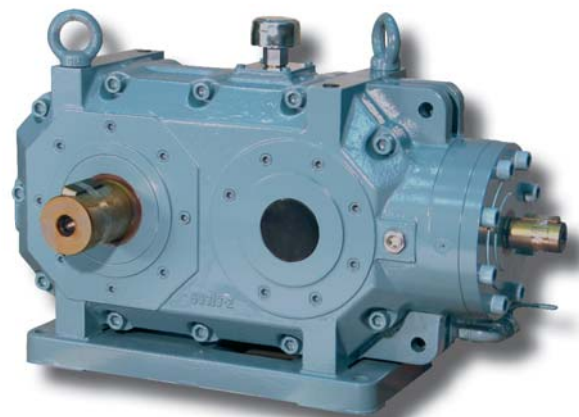


## **Installation and Maintenance** Helical and Bevel Helical Gear Units







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## Introduction

These are general instructions for persons installing, operating or maintaining helical and bevel helical gear units made by Kumera Drives Oy. They should read and understand the contents of these instructions. **Kumera Drives Oy is not liable for any damages caused by not following these instructions.**

The gear units described in the instructions are similar to the gear units being manufactured at time of writing.

## Symbols

To be observed during operation and maintenance.



Important issue to be observed during installation, operation and maintenance.



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## 1 Safety

In order to prevent any damages, transportation, unpacking, installation and setup shall be performed by professional personnel in accordance with the instructions of Kumera Drives Oy.

A gear unit must not be installed in a place or used in a way it was not designed for. Gear units are delivered to the customer in accordance with the information supplied to Kumera Drives Oy, and this information must not be deviated from when installing the gear unit. Gear units must not be subjected to extra application of load due to installation.

Consider safe operation when installing the gear unit. Protect places dangerous to the operator. Do not make any changes to the structure and guards of our gear units. Kumera Drives Oy is not liable for structural changes or changes to the guards made by another party.

Do not remove the safety devices while the gear unit is in use. Perform any maintenance operations while the gear unit is standing still. When opening inspection covers, make sure that no foreign objects or impurities can enter the gear unit.

Helical and bevel helical gear units may generate noise pressure levels in excess of the permissible noise pressure level, depending on the output power level of the gear unit. Persons working near the gear unit must use the appropriate protection.

The gear units may warm up to the extent that their surface becomes hot. Avoid touching the gear surface during operation.

The gear unit was packed at the Kumera Drives Oy factory according to the terms of delivery, in such a way that it withstands normal transportation.

When lifting the gear unit, use its lifting eyes. See the machine plate for the weight of the gear. The gear lifting eyes are only for lifting the gear unit, not for accessories such as an electric motor. Do not use the shafts when lifting. Report any damage during transport to Kumera Drives Oy immediately.

## 1.1 Gear noise pressure levels

Table 1 lists the noise level behaviour of helical and bevel helical gear units in accordance with the power class of the gear. The table values are calculated and indicative, and they can be used for comparison with the noise level of the gear unit during operation.

According to the ISO 4871 standard, the emission sound pressure level is to be measured at a distance of 1 metre from the outer surface of the gear unit. Noise level variations due to accessories are not taken into account in the table.

One fan increases the noise level by approx. 3 dB(A). Major deviations from the values must be examined in order to establish the cause of the unusually loud noise.

TABLE 1. Output power / emission sound pressure levels of helical and bevel helical gear units.

Helical gear units		Bevel helical gear units	
Unit output (kW)	Noise level (dBA)	Unit output (kW)	Noise level (dBA)
5	54	5	56
10	58	10	60
20	61	20	63
40	65	40	67
60	67	60	69
80	69	80	71
100	70	100	72
150	72	150	74
200	74	200	76
250	75	250	77
300	76	300	78
400	77	400	79
500	79	500	81
700	80	700	82
900	82	900	84
1200	83	1200	85
1500	84	1500	86
2000	86		
2500	87		
3000	88		
3500	89		
4000	90		
4500	90		
5000	91		

## **1.2 Screw tightening torques**

All the screw connections mentioned in the instructions must be tightened according to Table 2, unless otherwise mentioned in the installation instruction.

We recommend to grease the screws before installation. The table provides values for dry and greased (friction coefficient 0.10) screws.

TABLE 2. Screw tightening torques.


Thread size	Grade 8.8		Grade 10.9		Grade 12.9	
	Dry (Nm)	Greased (Nm)	Dry (Nm)	Greased (Nm)	Dry (Nm)	Greased (Nm)
M 10	49	40	69	59	79	71
M 12	86	69	120	100	136	120
M 16	210	170	295	250	333	265
M 20	410	340	580	490	649	580
M 24	710	590	1000	840	1120	1000
M 30	1450	1200	2000	1700	2210	2000
M 36	2530	2070	3560	2990	3850	3500

## 2 Technical Information

### 2.1 Type plate

A type plate is installed during packing onto all the gear units supplied by us. The plate contains the required identification information and lubrication recommendations of the gear unit.

Example of the gear unit type plate:

 <b>KUMERA</b> FINLAND			
<b>Type</b>		<b>RFBM-3180 H1J</b> <b>LBS 4 E1</b>	
<b>i</b>	56/1	308	<b>kg</b>
<b>EP Oil</b>	ISO VG 220 AGMA 5EP	16,6	<b>L</b>
<b>No.</b>	D311124/06 1.01/ 1		

<b>Type:</b>	Gear unit type (see page 10)
<b>i:</b>	Nominal gear ratio
<b>kg:</b>	Weight without oil
<b>EP Oil:</b>	Recommended viscosity of lubrication oil
<b>L:</b>	Indicative oil capacity, to be checked using the oil sight glass or dipstick
<b>No. :</b>	Gear unit serial number

## 2.2 Type code

R F B M – 3 180 H1 J – 56 – L B S 4 – 42F300 – E1

### **Model**

L Foot mounted, helical gear unit  
T Shaft mounted, helical gear unit  
K Foot mounted, bevel gear unit  
R Shaft mounted, bevel gear unit  
S Mixer gear unit

### **Range**

A E F G D H

### **Foot**

A B C D

### **Motor adapter**

### **Number of reduction stages**

1 2 3 4 5

### **Gear unit size**

### **Output shaft, options**

H1 Hollow shaft, normal  
H2 Hollow shaft, stepped  
H3 Hollow shaft, shrink disc

### **Additional equipment**

J Backstop  
T Fan  
V Water cooling coil  
Z Pressure lubrication unit  
P Lubrication oil pump  
K Centralized lubrication system

### **Ratio**

### **Shaft arrangement**

L Output shaft to the left  
R Output shaft to the right  
V Input and output shaft to the left  
H Input and output shaft to the right

### **Mounting positions**

A Horizontal  
B Vertical, output horizontal at bottom  
C Vertical, output horizontal at top  
D Output shaft vertical at left  
E Output shaft vertical at right

### **Foot positions**

N Underneath  
P Above  
S To the left  
O To the right

### **Rotation directions of shafts**

1 Output shaft clockwise  
2 Output shaft counter-clockwise  
3 Output shaft clockwise, input shaft clockwise  
4 Output shaft counter-clockwise, input shaft clockwise  
5 Output shaft clockwise, input shaft counter-clockwise  
6 Output shaft counter-clockwise, input shaft counter-clockwise

### **IEC code for flange of the electric motor**

### **Code of special construction**

## 3 Storage

### 3.1 Normal protection

The gear units have been treated as follows before delivery:

The internal parts of the gear unit are protected by oil that spreads to their surfaces during the test run. Gear oil is used in the test run. The breather plug is in place.

**THE GEAR UNIT IS DELIVERED  
WITHOUT OIL!**

**STOP**

The shaft ends and other machined surfaces outside the gear units are treated with an anti-corrosive agent. Remove the anti-corrosive agent with solvent before start-up.

This treatment protects the gear unit during short-term indoor storage. Short-term indoor storage refers to a period of less than two (2) months.

The normal protection treatment does not protect the gear unit during transport by sea.

### 3.2 Long-term protection

For long-term storage, special anticorrosion protection is applied to the gear units. The long-term protection is to be agreed separately when ordering.

#### **3.2.1. Storage period of 2 to 12 months**

Anti-corrosive agent is sprayed inside the gear unit. The gear unit is made airtight by replacing the breather plug with a pipe plug. The effect of the agent is based on slow evaporation and accumulation on the metal surfaces. An invisible layer is formed on the metal surfaces and prevents corrosion by passivating the metal.

This provides protection for storage for up to 12 months in dry indoor spaces with an even temperature.

In gear units with labyrinth sealing, the gas can escape, in which case the gear unit is enclosed in airtight plastic that prevents the agent from escaping. The external shaft ends and other machined surfaces are treated with an anti-corrosive agent that must be removed before start-up.

#### **3.2.2. Storage period longer than 12 months**

Repeat rust proofing of the gear unit every 12 months using a protective agent. You need not remove the protective agent during start-up.

Alternatively, you can fill the gear unit with oil.

When filling the gear unit with oil, use the quantity indicated in the type plate. At the same time, replace the breather with a pipe plug. In addition to rust proofing, the oil protects the bearings from pitting during transport. During storage, use the gear unit e.g. by hand so that all the shafts rotate at least half a turn. This spreads the oil onto the gear surfaces. Replace the pipe plug with the breather before start-up.

In case it is not possible to operate the gear unit or rotate the shafts during storage, fill the gear unit completely with oil. Change the oil during start-up.

This provides protection for long-term storage in dry indoor spaces with an even temperature.

## 4 Installation and Start-up

**THE GEAR UNIT IS DELIVERED  
WITHOUT OIL!**

**STOP**

### 4.1 Gear unit start-up

All gear units are test-run prior to delivery from the factory. However, the test run does not correspond to actual load conditions: for this reason, you should at first operate the gear unit at a partial load. During the running-in, monitor the operating sound, running smoothness, temperature, lubrication and oil tightness of the gear unit. If you notice something abnormal during running-in, detect and eliminate the cause of the problem before the final start-up.

During operation, pay attention to the operating sound, warm-up, vibration and oil circulation.

Overheating, for example, is often caused by an excessive amount of oil in the gear unit. For gear unit operation, the recommended maximum temperature is +90°C. In higher temperatures, use special lubricants and/or additional cooling. The oil change interval is shorter in high temperatures.

### 4.2 Installing of a foot-mounted gear unit

A requirement for faultless operation of the gear unit is an even and sturdy foundation. The installation foundation of the gear unit must be designed to withstand unit loads without distorting.

Distortion of the foundation during operation may cause distortion of the gear housing and incorrect tooth contact. This may result in breakdown of the teeth, bearings or housing.

The foundation must not resonate as a result of gear running, and any resonance caused by nearby equipment must not be allowed to affect the foundation.

Small gear units with mounting feet can be mounted directly onto a concrete foundation with foundation bolts. Use shims between the concrete foundation and the bedplate when using foundation bolts. When the grout of the foundation bolts is dry, check that the foundation is straight. Correct any faults with shims. Then, tighten the foundation bolts.

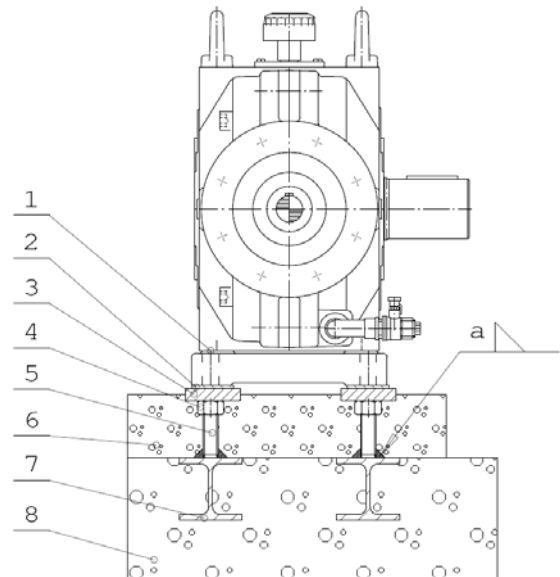


FIGURE 1. Gear unit installed with foundation bolts.

1. Nut
2. Shim (1...1.5 mm)
3. Steel plate
4. Nut
5. Foundation bolt
6. Grout of foundation bolts
7. Beam
8. Foundation

For mounting large gear units (shaft distance >250 mm), we recommend either mounting columns made of cast iron or steel, or machined steel foundations.

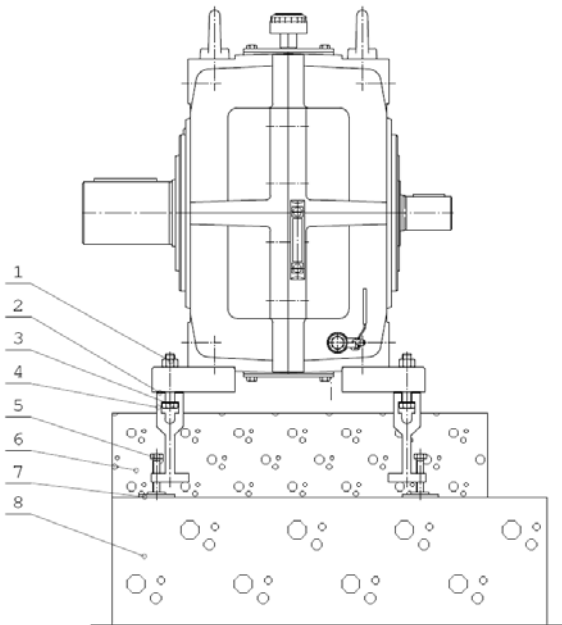


FIGURE 2. Gear unit installed on mounting columns.

1. Nut
2. Shim (1...1.5 mm)
3. Stud bolt and T-slot nut
4. Mounting column
5. Adjustment screw
6. Grout
7. Mounting plate
8. Foundation

The mounting screws and nuts must be tightened to the correct torque without exceeding the maximum values determined by the screw grade. The required torque depends on the diameter, number and grade of the bolts. The minimum tensile strength of the bolts, mounting columns and beams is  $350 \text{ N/mm}^2$ .

The foundation must be reinforced so that its strength is at least the same as that of the gear unit mounting screws. It acts also as the dowel-bar reinforcement for grouting.

Grouting is performed after the gear unit has been placed in position. Leave the grouting below the T slot of the mounting column. Its compressive strength must be at least  $20 \text{ N/mm}^2$ .

When the grout is dry, check the alignment of the gear unit. The base must be horizontal and even (max. deviation  $0.01 \text{ mm}/100 \text{ mm}$ ).

Check before installation that the oil drain and filling plugs are easily accessible for oil change.

Do not weld the gear unit, its housing or any part! When performing other welding, do not attach the earthing cable to the gear unit or its parts. **STOP**

### 4.3 Lifting

For lifting, the gear units have been provided with one or several lifting eyes. Lifting must be done simultaneously and symmetrically by all lifting eyes. The load suspension angle shall not exceed  $45^\circ$ . The lifting eyes must not be used for any other purpose except lifting the gear unit. **!**

Do not use the shafts for lifting the gear unit. If the shaft and its bearings are subjected to even a slight load in the wrong direction, the shaft bearings may be damaged.

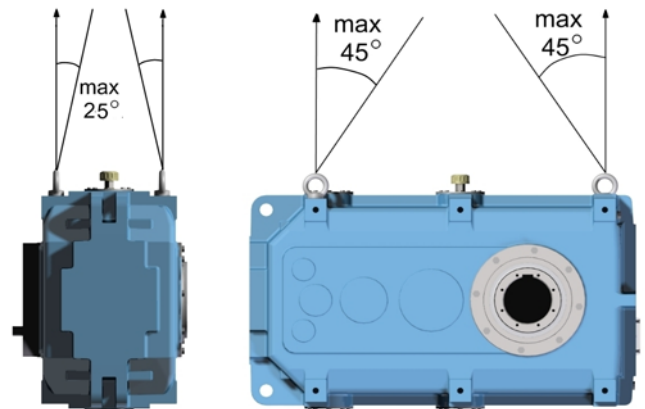


FIGURE 3. Maximum lifting angles of the gear unit

## 4.4 Mounting a coupling

To mount a coupling onto the shaft, heat the coupling halves to approximately +100°C or draw them onto the shaft using the tapped holes at the ends of the shafts.

### 4.4.1 Measuring radial displacement ( $\Delta K_r$ )

You can measure the radial displacement with a dial gauge or another appropriate device. Place the dial gauge on top of one of the coupling halves. Make both of the halves rotate together while checking that the tip of the dial gauge does not move on the measuring surface (top of the coupling half). Divide the variance indicated by the dial gauge to acquire the value of radial displacement.

The installation tolerances of flexible couplings are specified in Table 3 on the next page. For other couplings, follow the manufacturer's instructions.

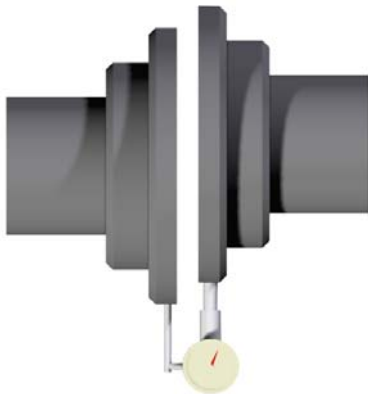


FIGURE 4. Measuring radial displacement.

### 4.4.2 Measuring angular displacement ( $\Delta K_w$ )

Angular displacement is usually measured with a dial gauge. Place the dial gauge on top of one of the coupling halves. Make both of the halves rotate together while checking that the tip of the dial gauge does not move on the measuring surface (top of the coupling half). The installation tolerances of flexible couplings are specified in Table 3 on the next page. For other couplings, follow the manufacturer's instructions.

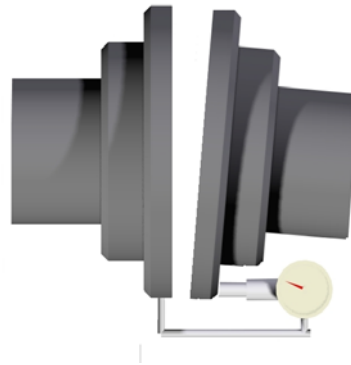


FIGURE 5. Measuring angular displacement.

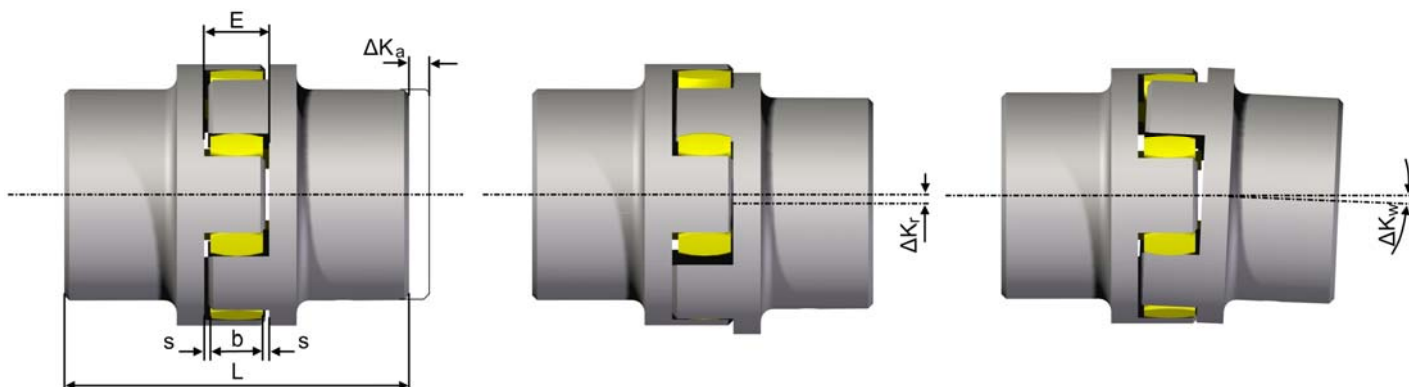


TABLE 3 Installation tolerances of flexible couplings.

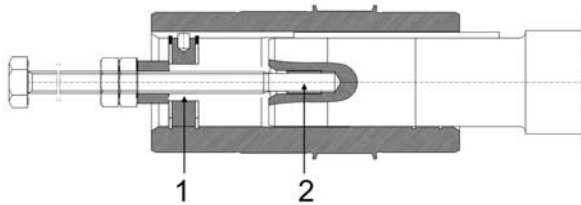
Coupling size	Dimensions [mm]				Axial offset $\Delta k_a$ [mm]	Radial displacement $\Delta K_r$ [mm]	Angular displacement $\Delta K_w$ [°]
						Speed of rotation [rpm]	
	L	E	b	s		1500	1500
14	35	13	10	1.5	1.0	0.16	1.2
15	28	8	6	1.0	1.0	0.16	1.2
19	66	16	12	2.0	1.2	0.20	1.2
21	78	18	14	2.0	1.4	0.22	0.9
28	90	20	15	2.5	1.5	0.25	0.9
38	114	24	18	3.0	1.8	0.28	1.0
42	126	26	20	3.0	2.0	0.32	1.0
48	140	28	21	3.5	2.1	0.36	1.1
55	160	30	22	4.0	2.2	0.38	1.1
65	185	35	26	4.5	2.6	0.42	1.2
75	210	40	30	5.0	3.0	0.48	1.2
90	245	45	34	5.5	3.4	0.50	1.2
100	270	50	38	6.0	3.8	0.52	1.2
110	295	55	42	6.5	4.2	0.55	1.3
125	340	60	46	7.0	4.6	0.60	1.3

## 4.5 Installing of a shaft-mounted gear unit with a keyway

### 4.5.1 Installation

To install a shaft-mounted gear unit onto the shaft, drive a screw into the centre hole thread in the shaft end and then tighten the nut on the screw as Figure 6 shows. Before installation, grease should be applied to the shaft to facilitate future removal.

The screw diameter must be smaller than the diameter of the tapped hole of the thrust plate and equivalent to the diameter of the tapped hole of the shaft end. **STOP**

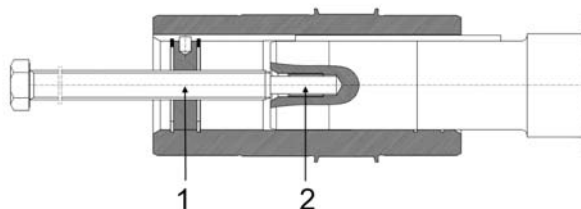


1. Gap
2. Thread

FIGURE 6. Installing of a shaft-mounted gear unit onto the driven shaft with a key.

### 4.5.2 Removal

To remove a shaft-mounted gear unit, use the screw and the thread of the gear unit's thrust plate. The thread corresponds to the thread of the thrust plate hole, and the end is unthreaded. Do not damage the shaft end thread. **STOP**



1. Thread
2. Unthreaded

FIGURE 7. Removing of a shaft-mounted gear unit from the driven shaft with a key.

### 4.5.3 Locking

Lock the shaft-mounted gear unit to the shaft with a screw as shown in Figure 8. Leave a space of approx. 5-10 mm between the shaft-mounted gear unit and the bearing housing of the nearest driven machine.

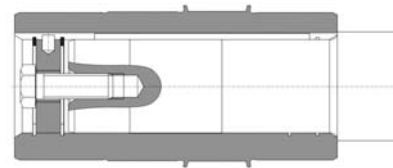
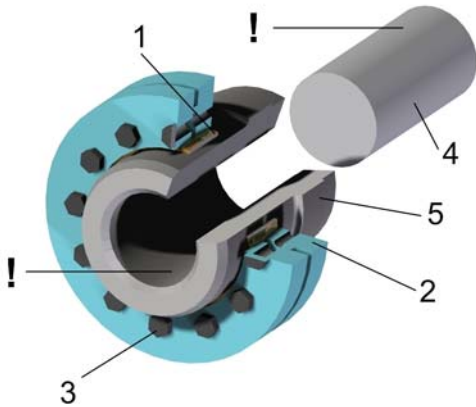


FIGURE 8. Locking the shaft-mounted gear unit.

When installing and removing the shaft-mounted gear unit, you can use hydraulic pulling or pushing devices instead of mechanical screws. They provide higher assembling and disassembling force.

## 4.6 Installing of a shaft-mounted gear unit with a shrink disc

Shrink discs are delivered ready for installation. Do not disassemble them before they have been tightened for the first time.



1. Inner ring
  2. Outer ring
  3. Screw
  4. Shaft
  5. Output shaft
- ! **GREASE-FREE**

FIGURE 9. Structure of shrink disc.

### 4.6.1 Installation

1. Remove any spacers that may have been installed between the outer rings for transport reasons.
2. Tighten the three clamping screws so that you can still rotate the inner ring. The three tightened screws must form the tips of an equilateral triangle. Measure the gap between the outer rings at different points to ensure that the outer rings are parallel.
3. Push the shrink disc onto the output shaft of the gear unit. To make installation easier, you can grease the **outer surface** of the output shaft of the gear unit at the place where the shrink disc is located.
4. Use solvent to remove grease from the **inner surface** of the output shaft and the **shaft** of the driven machine that will be installed to it.

5. Install the shaft of the driven machine inside the output shaft on the gear unit.
6. Tighten all the clamping screws evenly in a circle, as shown in Figure 10.

Do not tighten the clamping screws before the output shaft of the gear unit has been installed!

**STOP**

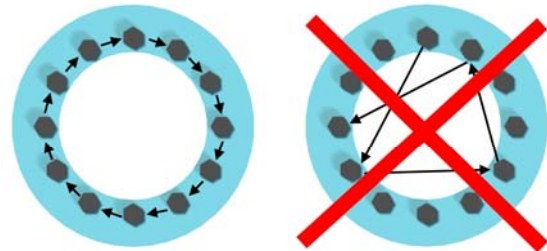


FIGURE 10. Tightening order of shrink disc screws.

Tighten the screws equally, maximum  $\frac{1}{4}$  to  $\frac{1}{2}$  turns at a time, until their tightening torques are the same. You must tighten the screws in several rounds. **The outer rings must remain parallel.**

Check the tightening torques with a torque wrench. See Table 4 for the correct screw tightening torques.

The values are for screws greased with MoS<sub>2</sub> grease.

TABLE 4. Tightening torques of shrink disc screws.

Screws (grade 10.9)	Tightening torque (Nm)	Tolerance +5% (Nm)
M5	4	+0.2
M6	12	+0.6
M8	30	+1.5
M10	59	+3.0
M12	100	+5.0
M16	250	+12.5
M20	490	+25.0

#### 4.6.2 Removal

1. Remove the clamping screws evenly, by loosening them in the opposite order to that of tightening. Initially, loosen each clamping screw only  $\frac{1}{4}$  of a round. In this way, you can avoid distortion of the outer ring. Never unscrew the clamping screws.
2. Remove the shaft of the driven machine from the output shaft of the gear unit. Remove any corrosion that has formed between the shafts.
3. Remove the shrink disc from the output shaft of the gear unit.

#### 4.6.3 Cleaning and lubrication

You need not detach the removed shrink discs from each other or lubricate them again before tightening them again. However, clean and lubricate dirty shrink discs. Grease the clamping screws with multi-purpose grease and replace damaged seal rings. When replacing the inner ring, the bevel surfaces must be greased (e.g. MoS2).

#### 4.7 Installing a torque arm

When installing, pay attention to the position of the torque arm as shown in Figure 11. The torque arm must always be equipped with two joints that allow movement of the point of support due to thermal expansion. If there is eccentricity at the end of the driven machine's shaft, the torque arm must be equipped with two ball joints.

The torque arm can take compression or tensile load. With compression load, the arm rod must be designed to be sufficiently strong so that there is no buckling. We recommend installing the gear unit so that compression load is applied to the arm rod. With compression load, the support reaction caused by torque lessens the load of the shaft end and bearing of the driven machine.

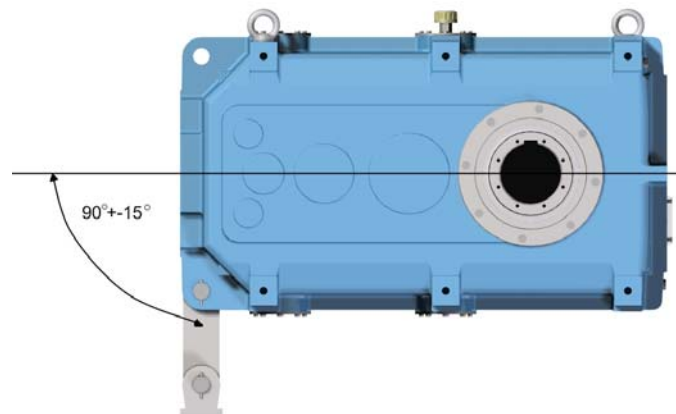



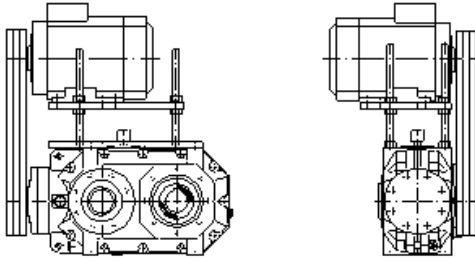
FIGURE 11. Position of the torque arm.

## **4.8 Installing of a motor to the gear unit**

In flange mountings, the installation space between the gear unit shaft and the motor shaft must be at least 3 mm.  There must be a gap between the shaft ends.

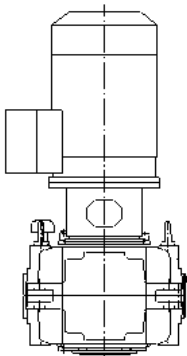
Instructions on the weight ratio of the motor and gear unit:

1. Foot motor on a bracket on the shaft-mounted helical gear unit



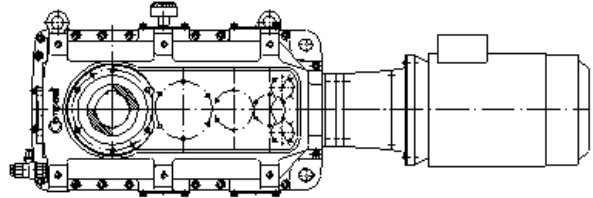
**Motor weight  $\leq 1.5$  x gear unit weight**

2. Flange motor vertically on the gear unit



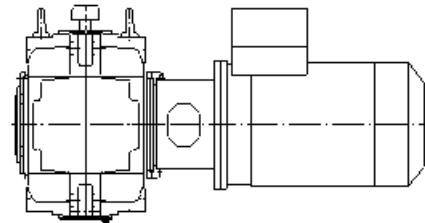
**Motor weight  $\leq 1.5$  x gear unit weight**

3. Flange motor at the end of the shaft-mounted bevel gear unit



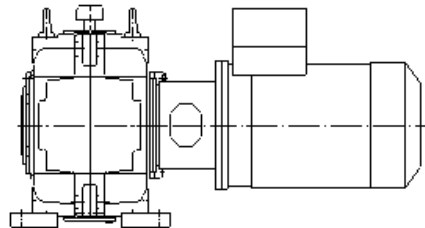
**Motor weight  $\leq 1.0$  x gear unit weight**

4. Flange motor connected to the side of the helical shaft-mounted gear unit



**Motor weight  $\leq 0.4$  x gear unit weight**

5. Flange motor connected to the side of the foot-mounted helical gear unit



**Motor weight  $\leq 1.0$  x gear unit weight**

The limits can be exceeded only by the permission of Kumera Drives Oy after a more specific review of each case.

## 4.9 Installing of a V-belt drive

1. Mount the motor to its bracket.
2. Attach the back-plate of the guard with clamps to the gear unit and the motor bracket.
3. Install the belt pulley to the gear unit input shaft with a suitable tool. Alternatively, you can use belt pulleys with conic sleeves. Install the belt pulleys on the motor and gear unit shafts axially at the same distance. Install the belt pulleys as close as possible to the motor and gear unit bearings. The shafts must be installed parallel to each other. The maximum permitted angle error of the belt pulleys is 0.5 degrees.
4. Install the V-belts onto the pulleys and tighten them with the adjustment screws of the motor bracket. Tighten the belts according to Table 5. When checking the belt tightness, measure the length of the belt span and the perpendicular bending force that causes the belt to bend 10 mm (dL) for each 1,000 mm of the belt span (CC).

Do not over tighten the belts. Overly tight belts increase the load on the shaft ends and considerably shorten the lifetime of the bearings.

5. Tighten the mounting screws of the back plate of the guard and attach the guard cover with a hexagon screw.

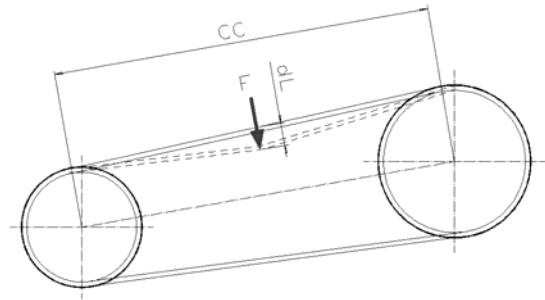


FIGURE 12. Belt force.

Example:

1.  $CC = 1.2 \text{ m};$   
 $dL = 10 \text{ mm};$

$$\begin{aligned} &\text{in which case } CC \times dL \\ &= 1.2 \text{ m} \times 10 \text{ mm/m} \\ &= 12 \text{ mm} \end{aligned}$$

2. Measure the perpendicular bending force  $F$  with a belt tightness gauge.
3. Compare the bending force to the values in Table 5. The belt bending force should be within the indicated range.

TABLE 5. V-belt tightness.

Belt profile	Ø of smaller pulley (mm)	Force needed to bend the belt 1 mm/100 mm (N)
SPZ	56-71	7-8
	75-80	9-13
	85-95	10-15
	100-125	12-17
	132-180	13-19
SPA	80-95	12-16
	100-125	14-21
	132-200	19-28
SPB	212-250	20-30
	112-150	23-36
	160-200	29-44
	212-280	36-50
SPC	300-400	38-58
	180-236	40-60
	250-355	51-75
XPZ	375-530	60-90
	60-63	8-13
	67-71	9-14
	75-80	10-15
	85-95	11-16
XPA	100-125	13-19
	132-180	16-24
	80-125	18-27
XPB	132-200	22-31
	112-118	24-36
	125-140	27-41
	150-170	30-47
	180-200	36-53
XPC	212-280	38-55
	300-400	41-64
	180-236	50-75
XPC	250-355	65-95
	375-530	80-110

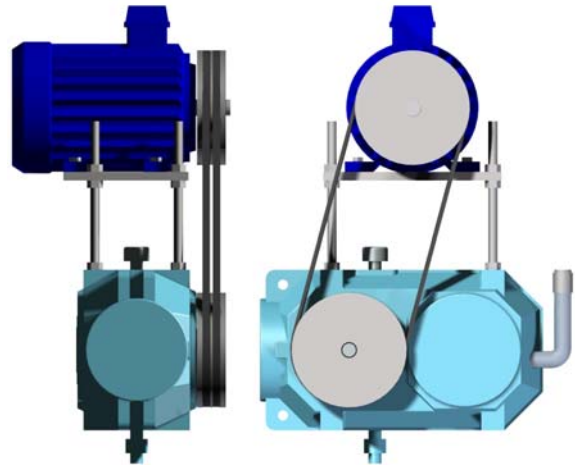


FIGURE 13. Belt drive in a gear unit without a guard.

#### 4.10 Installing of a tooth-belt drive

The tooth-belt drive pulleys are installed to the shafts in a manner similar to the V-belt drive, see section 4.9.

Position the tooth belt to the belt pulleys slack. Tighten the belt to the correct tightness with the adjustment screws of the motor bracket. According to the formula, the tightness of the tooth-belt depends on the power to be transferred as well as the peripheral velocity. Perform other steps as in section 4.9.

Pretension force: 
$$\text{min.: } F = \frac{25 \times P}{v} (N)$$

$$\text{max.: } F = \frac{50 \times P}{v} (N)$$

in which

P = power to be transferred, kW  
V = belt velocity, m/s

#### **4.11 Installing of a chain drive**

A chain wheel is normally installed to the slow shaft of the gear unit by heating it to a temperature of +80 - +120°C. Small chain wheels can be installed with a suitable pulling tool, using the threaded centre holes of the shaft ends.

Install the chain wheels on the gear unit and driven machine shafts axially at the same distance. Install the chain as close as possible to the bearings, so that the bending moment at the shaft ends remains as low as possible. This also minimizes the bearing loads.

Install the shafts parallel to each other in order to balance the load on the chain and chain wheels. The maximum angular and parallel misalignment error is  $\pm 1/300$ . The allowed angle error between the shafts depends on the distance between the shafts.

At a distance of less than 1 metre, the allowed error is  $\pm 1$  mm. At 1-10 m, the error is calculated with the formula (distance between shafts [mm])/1,000. At a distance of more than 10 metres, the allowed error is  $\pm 10$  mm.

When selecting chain drives, make sure that the allowed loads of the gear unit shaft ends are not exceeded.

#### **4.12 Filling lubrication oil**

***THE GEAR UNIT IS DELIVERED  
WITHOUT OIL!***

**STOP**

1. Before start-up, the gear unit must be filled with oil specified in the type plate of the gear unit or according to the included lubrication recommendation.
2. To check the correct oil level:
  - With the oil sight glass: fill the gear unit with oil up to the middle of the oil sight glass.
  - With the oil level sight glass: fill the gear unit with oil up to between the marks.
  - With the oil plug: add oil to the gear unit until it leaks out of the opened overflow hole.
  - With the dipstick: fill the gear unit with oil up to the area between the dipstick marks.
3. Check the oil level when the gear unit is at a standstill and the oil has cooled. Avoid overfilling when adding oil. Too much oil may cause the gear unit to heat up above the allowed limit.

For more information on lubrication and lubricating oils, see Chapter 5.

#### **4.13 Installing of the breather plug**

Before starting up the gear unit, make sure that the breather plug is in place and operational.

## 5 Lubrication

**THE GEAR UNIT IS DELIVERED  
WITHOUT OIL!**

**STOP**

### 5.1 Lubrication basics

Depending on the gear unit and operating conditions, four different lubrication methods are used.

#### **5.1.1. Splash lubrication**

Splash lubrication is used for gear units with peripheral velocities of is 2-14 m/s. In this case, it is essential to ensure that the amount of oil in the gear unit is correct. Too low an amount causes insufficient lubrication of the gear unit, and too high an amount may cause the gear unit to overheat over the allowed limit.

#### **5.1.2 Pressure lubrication**

Pressure lubrication is used for gear units with peripheral velocities higher than 14 m/s. Utmost care should be taken to ensure a continuous flow of oil onto the mesh point of the gear. Pressure lubrication can also be used for gear units with slower velocities, if required by the gear unit.

#### **5.1.3 Oil bath lubrication**

Oil bath lubrication can be used in slow speed gear units with peripheral velocities slower than 4 m/s. This method provides efficient lubrication of the bearings and gears. Due to the low peripheral velocity, no harmful warming of the lubricant occurs in the gear unit.

#### **5.1.4 Grease lubrication**

Grease lubrication is used in gear units with peripheral velocities slower than 5 m/s. Grease lubrication is especially suitable for gear units in occasional operation undergoing frequent starts. The grease remains on the tooth surface and in the bearings during stoppages.

### 5.2 Oil and grease quantities

An indicative quantity of oil is specified in the gear unit type plate.

The amount is always indicative. Check the exact amount of oil with an oil sight glass, oil level sight glass, oil level plug or dipstick



In a grease-lubricated gear unit, the amount of grease is specified in the type plate.

### 5.3 Oil change

#### **5.3.1 First oil change**

The first oil change must be performed after approx. 300 to 500 operating hours after the gear unit's start-up.



#### **5.3.2 Oil change interval**

The gear unit oil must be changed every 12 months when using mineral oil, and every 24 months when using synthetic oil. In grease lubrication, the change must be performed approx. every 8,000 operating hours. In special cases and when using special oils, please discuss the change intervals with a representative of the oil company or our factory.

The breather plug must be replaced when the oil is changed. A clogged breather plug generates pressure that causes oil leaks in the seals. If the system has a filter, it must always be replaced when the oil is changed.

#### **5.3.3. Bearing lubrication**

If the gear unit is equipped with grease nipples to lubricate the bearings, add approx. 10-20 g of new bearing grease into each bearing nipple every 6 months.

## **5.4 Cleanliness of oil**

The cleanliness of oil is crucial for the service life of the bearings and gears of the gear unit.

There are two kinds of impurities: solid and liquid.

Solid impurities are dust entering the gear unit from its surroundings, metal particles caused by wear in the gear unit, carbon from possible overheating and dirt caused by external factors in the lubrication system (e.g. a container used for oil change).

Liquid impurities are water and chemicals that have ended up in the gear unit due to processes, washing of the gear unit or condensation.

The mechanical cleanliness of oil is determined by the standard ISO 4406. The standard divides the oil cleanliness grade into three parts. The cleanliness grade of a 100 ml oil sample is calculated in three parts: particles over 2 µm, over 5 µm and over 15 µm, the amounts of which are always included in the preceding one.

The customer is responsible for the cleanliness of the oil. At long oil change intervals, inspect the cleanliness of the oil with an oil sample in order to ensure proper lubrication.

## **5.5 Oil preheating**

If the gear unit is installed in a cold environment and is equipped with pressure lubrication, oil preheating is often required. The oil is heated with a heating element installed in the oil sump of the gear unit. A separate thermostat is installed for controlling the heating element.

In splash lubrication, heating is required only if the temperature falls below the pour point of the oil.

In pressure lubrication, heating is required if the temperature falls below the following values:

TABLE 6. Oil heating.

ISO class	Temperature °C
VG 320	15
VG 220	10
VG 150	6

Set the upper limit of the thermostat so that it switches heating off at a temperature that is approx. +10°C higher than the above temperature.

## **5.6 Oil cooling**

Oil cooling may be required due to, for example, a high ambient temperature. When the oil temperature exceeds +80°C, oil cooling is necessary. With synthetic oil, temperatures up to +90°C can be allowed. At high temperatures, ensure the heat resistance of the sealing material and sufficient clearance of the bearings.

**Cooling of a gear unit can be arranged as follows:**

- Install a fan to the input shaft of the gear unit. Also several fans can be used.
- Install a water cooling coil in the oil sump.

**Gear units with pressure lubrication can be cooled as follows:**

- Install a water-cooled heat exchanger into the oil circulating system.
- Install an air-cooled heat exchanger into the oil circulating system.

For more details, see section 7.3.

## **5.7 Synthetic lubricants**

Synthetic lubricants can be used in gear units that are operating in very low or high temperatures and when the oil change interval should be extended. When using other than the synthetic lubricants specified below, check the suitability of the sealing materials.

## **5.8 Breather plug**

The breather plug is supplied detached. Install it when filling with oil. The breather plug must be replaced when the oil is changed.

A clogged air filter generates pressure that causes oil leaks in the seals.

## 5.9 Recommended lubricants

### Lubrication groups

Ambient temperature °C	Ambient temperature °F	Lubrication method	ISO VG	AGMA
-30 ... +5	-22 ... +41	Pressure lubrication	68	2 EP
		Splash lubrication	150	4 EP
		Oil bath lubrication	150	4 EP
-5 ... +25	+23 ... +77	Pressure lubrication	150	4 EP
		Splash lubrication	220	5 EP
		Oil bath lubrication	220	5 EP
+15 ... +45	+68 ... +113	Pressure lubrication	150	4 EP
		Splash lubrication	320	6 EP
		Oil bath lubrication	320	6 EP
+35 ... +60	+104 ... +140	Pressure lubrication	220	5 EP
		Splash lubrication	460	7 EP
		Oil bath lubrication	460	7 EP

### Mineral oils DIN 51517-CLP, EP (extreme pressure) oil

ISO VG	68	150	220	320	460
AGMA	2 EP	4 EP	5 EP	6 EP	7 EP
MOBIL		Mobilgear XMP 150	Mobilgear XMP 220	Mobilgear XMP 320	Mobilgear XMP 460
ESSO	Spartan EP 68	Spartan EP 150	Spartan EP 220	Spartan EP 320	Spartan EP 460
SHELL	Shell Omalaoil 68	Shell Omalaoil 150	Shell Omalaoil 220	Shell Omalaoil 320	Shell Omalaoil 460
LE		604 Almasol Vari-Purpose Gear Lub	607 Almasol Vari-Purpose Gear Lub	605 Almasol Vari-Purpose Gear Lub	608 Almasol Vari-Purpose Gear Lub
BP	Energol GR-XP 68	Energol GR-XP 150	Energol GR-XP 220	Energol GR-XP 320	Energol GR-XP 460
TEXACO	Meropa 68	Meropa 150	Meropa 220	Meropa 320	Meropa 460
CASTROL	Optigear BM 68	Optigear BM 150	Optigear BM 220	Optigear BM 320	Optigear BM 460
NESTE	Vaihteisto 68 EP	Vaihteisto 150 EP	Vaihteisto 220 EP	Vaihteisto 320 EP	Vaihteisto 460 EP
KLÜBER	Klüberoil GEM 1-68 N	Klüberoil GEM 1-150 N	Klüberoil GEM 1-220 N	Klüberoil GEM 1-320 N	Klüberoil GEM 1-460 N
ARAL		Degol BG 150 Plus	Degol BG 220 Plus	Degol BG 320 Plus	Degol BG 460 Plus

### Synthetic lubricants

Synthetic lubricants can be used in gear units that are operating in very low or high temperatures or when the oil change period should be longer than usual.

The viscosity of synthetic oil must be the same as that of the mineral oil otherwise used in the same conditions. When using other than the synthetic lubricants specified below, check the suitability of the sealing materials.

### Synthetic oils DIN 51517-CLP, EP (extreme pressure) oil

ISO VG	68	150	220	320	460
AGMA	2 EP	4 EP	5 EP	6 EP	7 EP
MOBIL		Mobilgear SHC XMP 150	Mobilgear SHC XMP 220	Mobilgear SHC XMP 320	Mobilgear SHC XMP 460
SHELL		Omala HD 150	Omala HD 220	Omala HD 320	Omala HD 460
BP		Energyn HTX-150	Energyn HTX-220	Energyn HTX-320	Energyn HTX-460
NESTE	Vaihteisto S 68 EP	Vaihteisto S 150 EP	Vaihteisto S 220 EP	Vaihteisto S 320 EP	Vaihteisto S 460 EP
KLÜBER	Klübersynth GEM 4-68 N	Klübersynth GEM 4-150 N	Klübersynth GEM 4-220 N	Klübersynth GEM 4-320 N	Klübersynth GEM 4-460 N
CASTROL		Optigear synth X 150	Optigear synth X 220	Optigear synth X 320	Optigear synth X 460

Lubricant greases	Grease-lubricated gear units	Grease-lubricated bearings
MOBIL	Mobilux EP 0	Mobilux EP 2
ESSO	Fibrax 370 EP	Beacon 2
SHELL	Alvania Grease GC 00	Alvania Grease RL 2
ARAL	Aralub FDP 0	Aralub HL2
BP	Energrease LS EP 0	Energrease LS EP 2
CASTROL	Longtime PD 0	Longtime PD 2

## 6 Gear Unit Design

### 6.1 Housing

The housings are made of grey cast iron. If necessary, nodular cast iron or a welded steel structure is used. The division planes of the housings are sealed with elastic mass.

### 6.2 Toothed parts

The helical teeth are case-hardened and ground, and calculated according to the standard ISO 6336. Bevel gears are case-hardened and lapped, and calculated according to the standard AGMA 2003-B97.

### 6.3 Bearings

All the shafts of the gear unit are equipped with roller bearings. The bearings are self-lubricated, pressure-lubricated or splash-lubricated.

With splash lubrication, it is important to ensure that the oil level of the gear unit is correct. If necessary, you can monitor the condition of the bearings with vibration measuring adapters that can be used for measuring vibrations or for listening to bearing sounds.

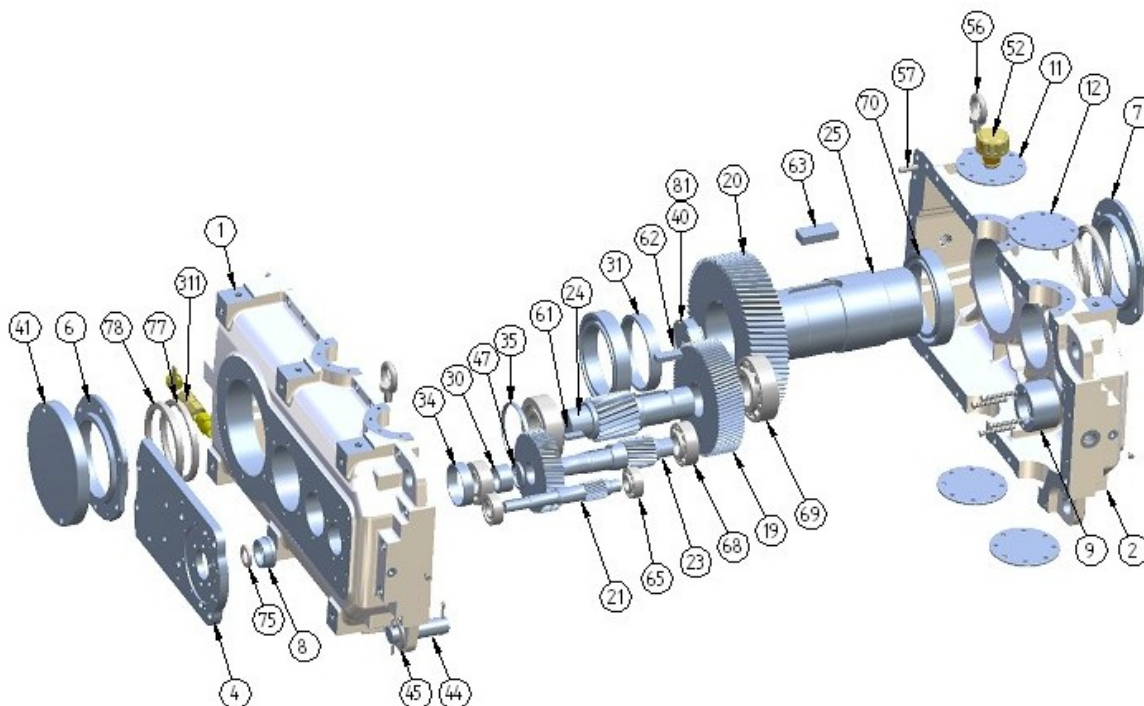


Figure 14. Basic diagram of a helical gear unit.

1 Housing half I	12 Inspection cover	31 Distance ring	52 Breather plug	69 Bearing
2 Housing half II	19 Gear	34 Distance ring	56 Eye bolt	70 Bearing
4 Bearing cover	20 Gear	35 Distance ring	57 Helical pin	75 Shaft oil seal
6 Bearing cover	21 Input shaft	40 Counter plate	61 Rectangular key	77 Shaft oil seal
7 Bearing cover	23 Intermediate shaft	41 Cover	62 Rectangular key	78 Shaft oil seal
8 Sealing housing	24 Intermediate shaft	44 Pin	63 Rectangular key	81 Snap ring
9 Bearing housing	25 Output shaft	45 Washer	65 Bearing	311 Ball valve
11 Inspection cover	30 Distance ring	47 Distance ring	68 Bearing	

## 6.4 Sealing

Ensure that the oil seals of the shafts are in good condition in order to prevent impurities from entering the bearing housing and lubricant. At the same time, this prevents lubricant from leaking from the gear unit. Try to prevent dirt from entering the seal. The shaft seals do not tolerate pressure washing.



### 6.4.1 Lip sealing

Lip sealing is used in the gear units as standard and in applications where there are no special requirements for sealing.

Lip sealing may consist of one or several seals. The outermost lip seal always has a dust lip.

The lip seals of the gear units are made of Viton (FPM) or nitrile rubber (NBR).

VITON sealing material is often used in the following cases:

- If the shaft diameter is 100 mm or less
- On the high speed shaft of gear units
- In single-step bevel and helical gear units
- If the ambient temperature exceeds +50°C
- If the operating temperature of the gear unit exceeds +60°C
- If the peripheral velocity of the shaft exceeds the velocity allowed for nitrile rubber

Note that the frost resistance of a VITON seal is -40°C and the maximum allowed peripheral velocity is 15 m/s.

In lip seals, where the above-mentioned VITON properties are not needed, nitrile rubber seals (NBR) are used.

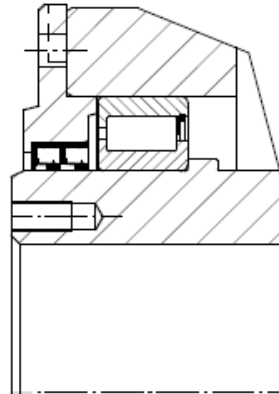


FIGURE 15. Lip sealing.

### 6.4.2 Labyrinth seal

In good conditions, a labyrinth seal with no wearing surfaces can be used on the shafts of high speed single-stage gear units.

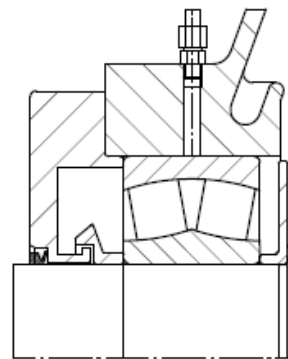


FIGURE 16. Labyrinth seal

### 6.4.3 Taconite seal

Taconite seals are used in very dusty environments. Add periodically grease to a Taconite seal according to its size. The seal housing is equipped with a grease nipple for adding grease.

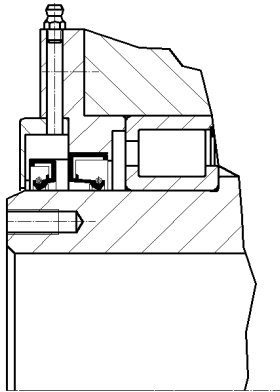


FIGURE 17. Taconite seal

### 6.4.5 V-ring

The V-ring is usually used together with other sealing types to prevent fine dust from entering the actual seal.

### 6.4.4 Lip seal and washing cover

A washing cover is used if the gear unit must tolerate powerful pressure washing. It prevents water and dirt from entering the seals.

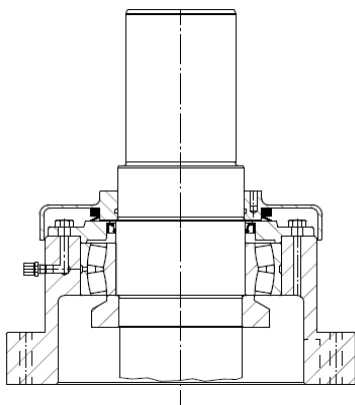


FIGURE 18. Lip seal and washing cover.

### 6.4.6 Dry well and grease-lubricated bearing

A dry well is used in a vertical-mixer gear unit operating in an application, where no oil is allowed to leak through a seal into the process.

The bearings and shaft seals in a dry well are grease lubricated.

A dry well can be equipped with a control pipe for checking, whether oil has entered the well.

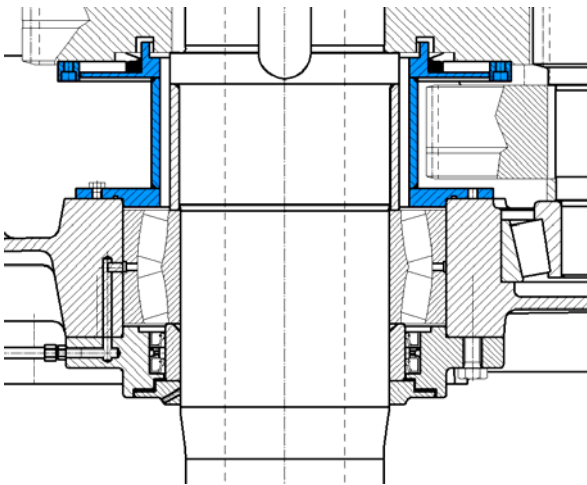


FIGURE 19. Dry well and grease lubrication.

TABLE 7. Grease amounts for G series mixer gear units

Gear unit size	Post-lubrication, amount of grease, g	First fill, amount of grease, g
G-225	50	100
G-250	60	120
G-280	70	140
G-315	90	180
G-355	110	210
G-400	140	270
G-450	180	360

Bearing is pre-filled with grease at the factory.

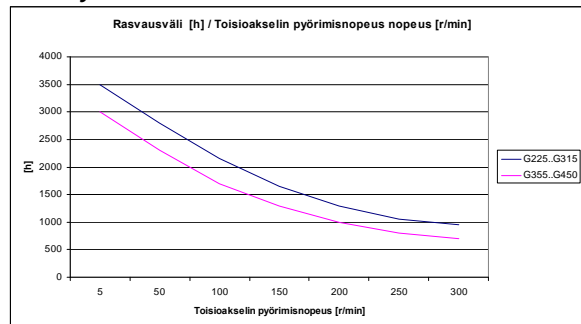


Figure 20. Greasing interval depends on the rotation speed of the output shaft.

Seals lubricated separately with grease must be lubricated according to Table 8.

TABLE 8. Seal lubrication.

Seal size, D = outer diameter	Amount of grease, g per 6 months
D < 180 mm	20
D > 180 mm	40

## 7 Gear Unit Accessories

### 7.1 Backstop

The purpose of a backstop is to prevent the driven machine from unexpectedly or unintentionally running backwards. A backstop allows the gear unit to rotate only in one direction.

Backstops are installed by Kumera Drives Oy. The required direction of rotation of the output shaft must be informed while ordering the gear unit. The customer must check the correct direction of rotation of the electric motor before starting it. Incorrect direction of the motor rotation may break down the backstop. A temporary oversize torque may also break the backstop.

In case of a shutdown, the reverse torque must not exceed the rated load torque of the gear unit. Figures 21-23 show different backstops.

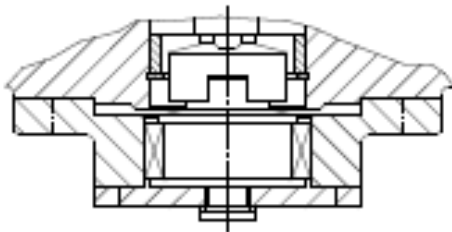


FIGURE 21. Backstop, F series for centre distances <math>< 140\text{ mm}</math>.

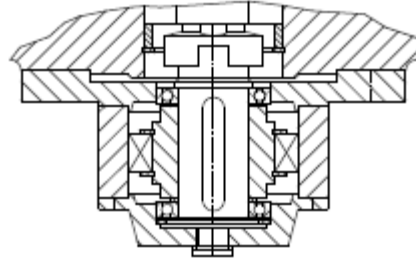


FIGURE 22. Backstop, F series for centre distances 160 mm, 180 mm, 200 mm.

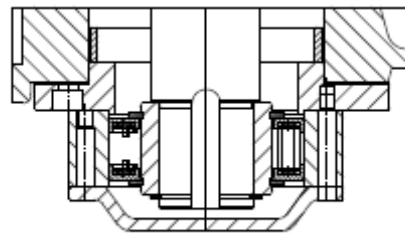


FIGURE 23. Backstop, G and D series.

## 7.2 Lubrication pumps

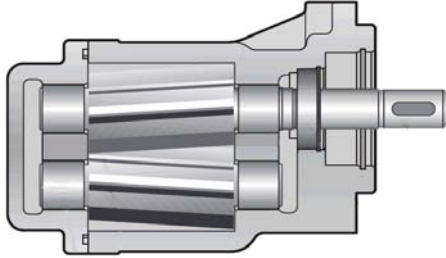


FIGURE 24. Gear pump.

A gear pump is used in lubrication units driven by electric motors. The pumps are available in several sizes. The correct pump model depends on the cooling demand and the required circulation amount of oil.

The pump with an electric motor must always be started before the gear unit, and it can be shut down only after the gear unit has come to a complete stop.

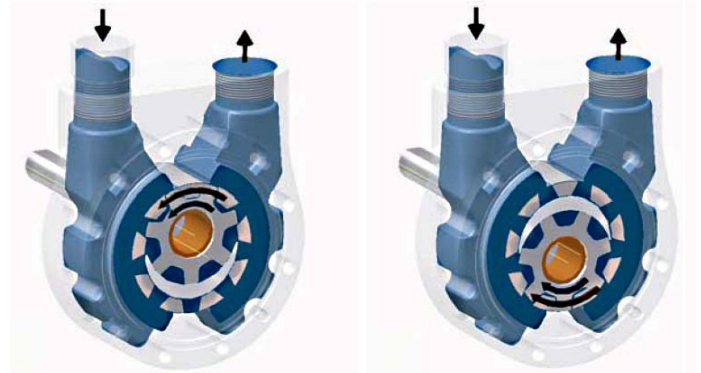


FIGURE 25. Specially designed lubrication pump.

A specially designed gear pump is used in a shaft-driven lubrication system. Its pumping direction stays the same regardless of the direction of rotation. The flange of the pump is mounted to the gear unit housing and the pump connected to the shaft. When installing the pump, make sure that oil inlet and outlet of the pump are the right way around.

## 7.3 Pressure lubrication unit

Before starting up a pressure lubrication unit, connect the measuring sensors to the control system. The cause of an alarm must be determined immediately.

An example of the lubrication diagram of a pressure lubrication unit:

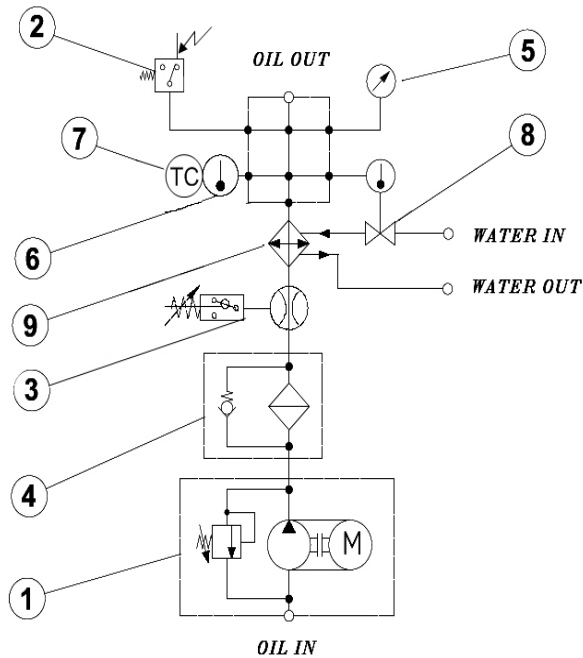


FIGURE 26. Pressure lubrication unit diagram.

### 7.3.1 Pump unit (part 1)

The lubrication pump has a built-in safety valve that protects the system from excessive pressure increase in case of a malfunction. The opening pressure is 8 bar. If the safety valve is continuously open, the gear unit is not being lubricated as designed.

### 7.3.2 Pressure switch (part 2)

The pressure switch is used to control the lubrication of the gear unit. The set point of the pressure switch has been set at the factory to 0.3-0.5 bar. If the pressure drops below the set point, immediately stop the unit and repair the lubrication malfunction.

### 7.3.3 Flow switch (part 3)

A flow switch can be used instead of a pressure switch. Both can be used, if required. If the oil flow drops below the set point, immediately stop the unit and repair the lubrication malfunction.

### 7.3.4 Oil filter (part 4)

The oil filter removes any impurities from the oil. The filter is equipped with a by-pass valve that opens at a pressure difference of 2.5 bar. The oil is not filtered after the by-pass valve has opened.

If the visual clogging indicator of the oil filter shows red, the filter must be replaced. The oil filter can also be equipped with an electronic clogging indicator. The filter element must be replaced in connection with an oil change at least once a year.

### 7.3.5 Pressure gauge (part 5)

The pressure gauge indicates the pressure of the oil entering the gear unit.

### 7.3.6 Thermometer (part 6)

The thermometer indicates the temperature of the oil entering the gear unit.

### 7.3.6 Thermo switch (part 7)

A thermo switch is used for monitoring the temperature of the oil entering the gear unit. If the temperature exceeds the allowed limit, the control system gives an alarm.

### 7.3.8 Thermostatic water valve (part 8)

If the pressure lubrication unit has a water-cooled cooling unit, the water flow is controlled with a thermostat valve. The valve opens when the oil temperature exceeds the preset temperature.

### 7.3.9 Heat exchanger (part 9)

If necessary, the pressure lubrication unit can be equipped with a heat exchanger that cools the lubricant. The heat exchanger can be cooled with water or air.

#### **Water-cooled pressure lubrication unit**

The unit components are designed for a fresh-water environment where the water pH value is higher than 6. If necessary, the cooling water must be pre-treated and filtered (100  $\mu\text{m}$ ) before the heat exchanger. The temperature of the cooling water of a water-cooled pressure lubrication system must be +4 to +40°C. The water flow can be controlled with the thermostat valve.

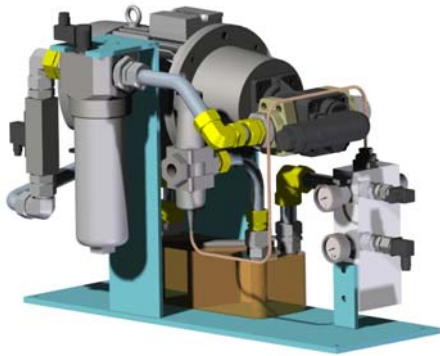


FIGURE 27. Water-cooled pressure lubrication unit.

#### **Air-cooled pressure lubrication unit**

The ambient temperature range of an air-cooled pressure lubrication unit is -10 to +40°C.



FIGURE 28. Air-cooled pressure lubrication unit.

## 7.4 Gear unit cooling methods

Depending on the conditions, the gear unit may warm up so much that separate cooling of the gear unit is necessary. Three different cooling solutions are used for improving the thermal output of the gear unit.

An oil cooler connected to the pressure lubrication unit was discussed in the previous chapter. Alternatively, a fan or a water cooling coil can be used. The cooling solutions are selected according to the operating conditions of the unit and the required cooling performance.

### 7.4.1 Fan

If the operating conditions of the gear unit are dust-free with good ventilation, a fan or several fans can be used for cooling the unit. The fan is installed permanently to the gear unit shaft. The fan and its cover must be cleaned of any dirt during a stoppage or as soon as it gets dirty.

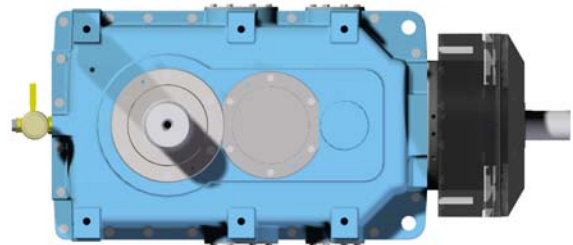


FIGURE 29. Fan in a gear unit.

### 7.4.2 Water cooling coil

The water cooling coil is installed inside the gear unit in the oil sump. The coil is then connected to the water system that circulates water through the coil. If the gear unit has a water cooling coil, the accessories required for cooling or circulating water are not included in the delivery. The water circulation can be controlled with a thermostat valve that opens after the oil temperature has reached the desired level.

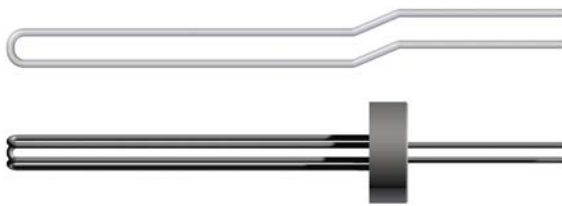


FIGURE 30. Water cooling coils.

### 7.5 Heating the gear unit oil

If the temperature of the gear unit's operating environment is low, the gear unit oil can be heated with a heating element. The maximum allowed surface power of the heating element is  $1 \text{ W/cm}^2$ .

Voltage ranges 230/400 V or 400/690 V

When using a heating element, make sure that it is completely immersed in oil!

The heating element can be controlled with a thermostat or, if the load current of the element exceeds the nominal current of the thermostat, with a separate contactor control.



FIGURE 31. Heating element

### 7.6 Vibration measurement adapter

Vibration measurement adapters can be installed for monitoring the condition of the bearings. The adapters can be installed in the gear unit housing next to the appropriate bearings.

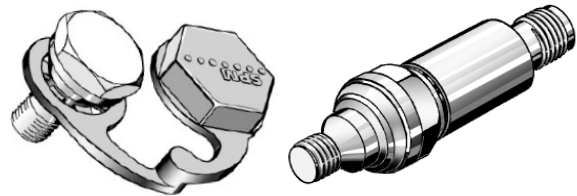


FIGURE 32. Vibration measurement adapter and sensor.

When measuring the vibration measurement level, first remove the adapter cap and make sure that the adapter is clean and properly tightened. Then connect the vibration measurement sensor to the adapter.

### 7.7 Temperature sensor PT-100

A PT-100-type temperature sensor can be used for measuring the temperature of the gear unit oil.

Output signal 2...20 mA (2-pole)  
Protection class IP65 (standard)

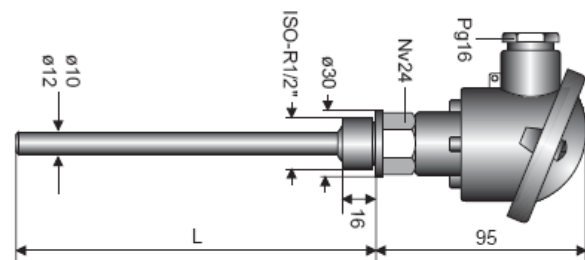



FIGURE 33. Temperature sensor.

## 8 Scheduled Maintenance

During an annual maintenance stop, the following maintenance and inspection procedures should be performed on the gear unit for determining its condition. In addition to the annual inspection, the gear unit's operating sound, temperature and any leaks should be monitored daily. Any abnormalities must be corrected immediately.

### ***Annual maintenance operations:***

#### **1. Oil change and inspection**

- Oil must be changed every year (mineral oil) or every two years (synthetic oil).
- When changing the oil, check its condition to see whether the change interval is suitable for the application.
- The condition of the oil can be checked visually and based on the smell. Deteriorated oil has become dark and smells pungent.
- The condition of the oil can also be determined with a laboratory test, based on which a suitable change interval can be determined.
- When opening the inspection covers of the gear unit, clean the sealing surfaces carefully and spread new sealing compound on the sealing surfaces before closing the covers. 

#### **2. Replacing the breather plug**

- The breather plug must be replaced when the oil is changed.

#### **3. Inspecting the teeth**

- Visually via the inspection cover

#### **4. Inspecting possible leakages and lubrication equipment**

- Inspect the shaft seals
- Check the tightness of the joint surfaces and, if required, the tightness of the screws and pipe connections
- Inspect the oil tightness of the pump
- Inspect the tightness of the oil cooler
- Replace the oil filter

#### **5. Cleaning the fan**

- If the gear unit has a fan, it must be cleaned.

## 9 Troubleshooting

<b>Problem</b>	<b>Possible cause(s)</b>	<b>Prevention/correction</b>
<b>Damaged seals</b>	<i>Normal wear</i> <i>Wear due to dust</i> <i>Hardening due to heat</i>	Grind the sealing surface and improve lubrication Replace the dust lip seals Replace the Viton seals
<b>Damaged bearings</b>	<i>Insufficient lubrication</i> <i>Wear due to impurities</i>	Improve lubrication, increase the amount of oil or its viscosity Improve filtering and/or shorten the oil change intervals
<b>Broken shaft</b>	<i>Fatigue breakdown due to external load</i>	Check the alignment of the couplings Check the tightness of the belt drive
<b>Fretting in connections</b>	<i>Overload, alternating stress, trembling, vibration</i>	Select a tighter fit for connections
<b>Damaged tooth surfaces</b>	<i>Pitting (Overload)</i> <i>Scuffing (Overload)</i> <i>Scratching</i> <i>Broken tooth (Overload)</i>	Upgrade the lubricant Use a higher viscosity lubricant Filter the lubricant oil Repair installation errors