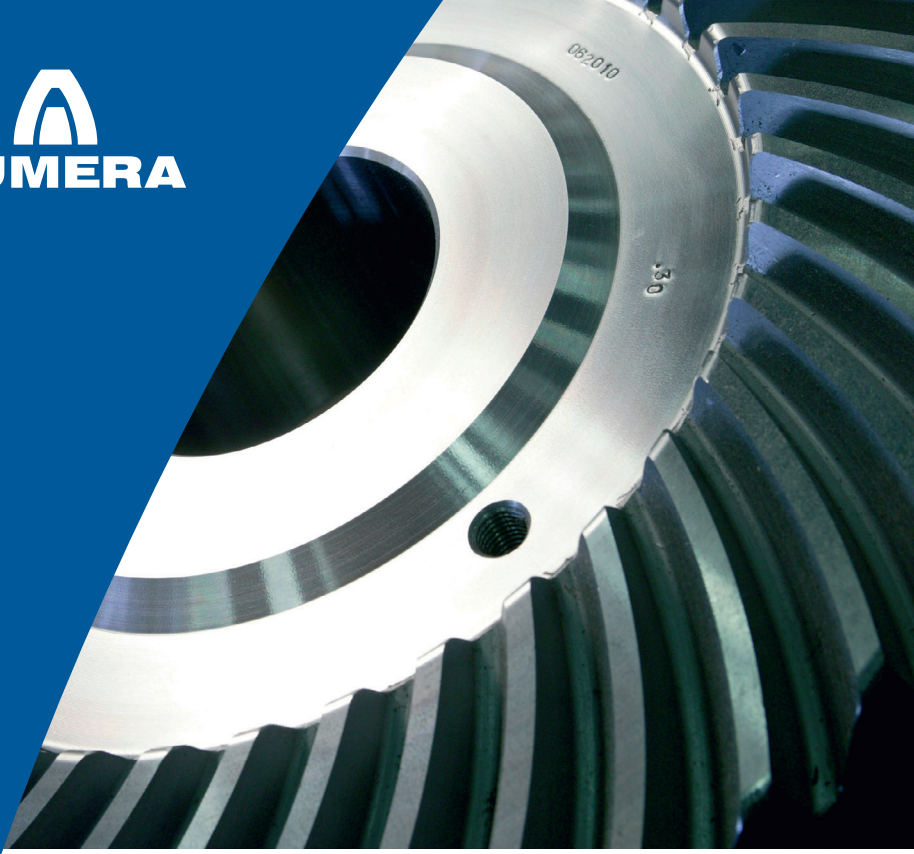
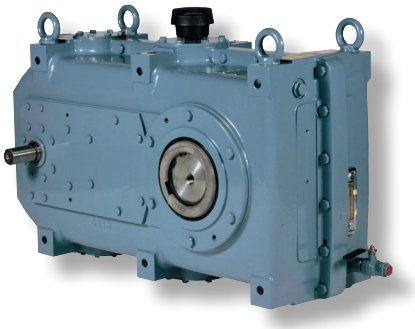
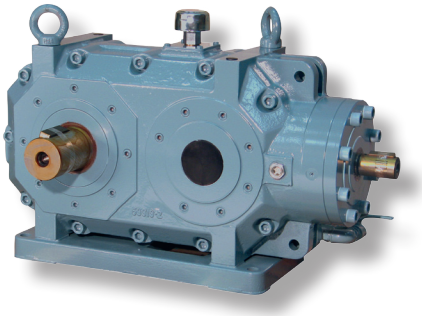
KUMERA



Installation and Maintenance

Helical and Bevel Helical Gearboxes





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Introduction

These are general instructions for persons installing, operating or maintaining helical and bevel helical gearboxes 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 gearboxes described in the instructions are similar to the gearboxes being manufactured at the time of writing.

IMPORTANT
Read carefully before use.
Keep for future reference.

Translation of the original instructions.

Symbols

To be observed during operation and maintenance.

An important issue to be observed during installation, operation, and maintenance.

Contents

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 gearbox must not be installed in a place or used in a way it was not designed for. Gearboxes 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 gearbox. Gearboxes must not be subjected to extra application of load due to installation.

Pay attention to safe operation when installing the gearbox. Protect places dangerous to the operator. Do not make any changes to the structure and guards of our gearboxes. 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 gearbox is in use. Perform any maintenance operations while the gearbox is standing still. When opening inspection covers, make sure that no foreign objects or impurities can enter the gearbox.

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

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

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

READ THE SAFETY INSTRUCTIONS, NO. 6102312

STOP

1.1 Gear noise pressure levels

Table 1 lists the noise level behaviour of helical and bevel helical gearboxes 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 gearbox 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 gearbox. 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 gearboxes

Helical gearboxes		Bevel helical gearboxes	
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 instructions.

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

TABLE 2. Screw tightening torques

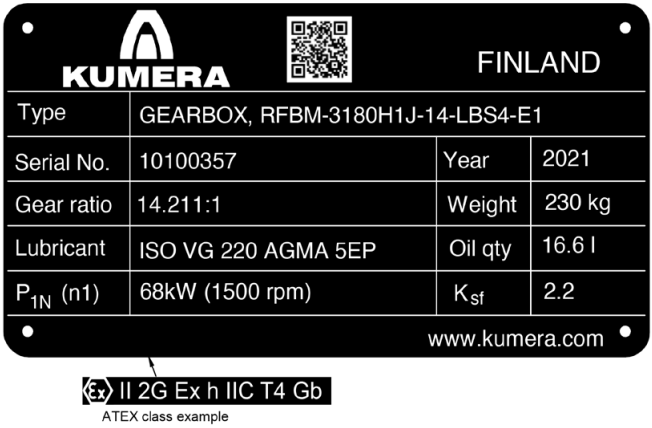
Thread size	Grade 8.8		Grade 10.9		Grade 12.9	
	Dry (Nm)	Greased (Nm)	Dry (Nm)	Greased (Nm)	Dry (Nm)	Greased (Nm)
M 10	49	40	69	59	79	71
M 12	86	69	120	100	136	120
M 16	210	170	295	250	333	265
M 20	410	340	580	490	649	580
M 24	710	590	1000	840	1120	1000
M 30	1450	1200	2000	1700	2210	2000
M 36	2530	2070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

2 Technical Information

2.1 Type plate

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

Example of the gearbox type plate:



Type: Gearbox type (see page 8)

Serial No.: Gearbox serial number

Year: Manufacturing year

Gear ratio: Exact gear ratio

Weight: Weight without oil

Lubricant: Recommended viscosity of lubrication oil

Oil qty: Indicative oil capacity, to be checked using the oil sight glass, the oil level sight glass or the dipstick.

P_{1N} (n1): Nominal power of the gearbox

K_{sf} : Selection factor

ATEX: Note: If the gearbox is ATEX certified, the ATEX mark and class are marked in the bottom left corner.

2.2 Type code

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

Model
L Foot mounted, helical gearbox
T Shaft mounted, helical gearbox
K Foot mounted, bevel gearbox
R Shaft mounted, bevel gearbox
S Mixer gearbox

Range
A F G D E X

Foot
A B C D / L T K R

Motor adapter

Number of reduction stages
1 2 3 4 5

Gearbox 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 the bottom
C Vertical, output horizontal at the top
D Output shaft vertical at the left
E Output shaft vertical at the right

Foot positions
N Underneath
P Above
S On the same side as the output shaft
O On the opposite side from the output shaft

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 the flange of the electric motor

Code of special construction

3 Storage

3.1 Normal protection, 0 to 12 months

THE GEARBOX IS DELIVERED WITHOUT LUBRICANTS! **STOP**

The gearboxes have been treated as follows before delivery:

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

The internal parts of the gearbox are protected by oil that spreads to their surfaces during the test run. Gear oil is used in the test run.

Anti-corrosive agent is also sprayed inside the gearbox. The gearbox 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. Replace the pipe plug with the breather before start-up.

In gearboxes with a labyrinth sealing, the gas can escape, in which case the gearbox is enclosed in airtight plastic that prevents the agent from escaping.

This provides protection for storage for up to 12 months in dry indoor spaces with an even temperature. Store the gearbox on a vibration free base.

THE NORMAL PROTECTION OR LONG-TERM PROTECTION TREATMENT DOES NOT PROTECT THE GEARBOX DURING TRANSPORT BY SEA. **STOP**

3.2 Long-term protection, longer than 12 months

The long-term protection is to be agreed separately when ordering. The long-term storage provides protection to the gearbox in dry indoor spaces with an even temperature. Store the gearbox on a vibration free base.

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

3.2.1 Rust proofing with anti-corrosive agent

Repeat internal rust proofing of the gearbox every 12 months using anti-corrosive agent. You need not remove the anti-corrosive agent during start-up.

During storage, use the gearbox every 12 months manually so that all the shafts rotate at least half a turn. Replace the pipe plug with the breather before start-up.

3.2.2 Rust proofing with oil fill

Alternatively, you can fill the gearbox with oil. In addition to rust proofing, the oil protects the bearings from pitting during transportation. During storage, use the gearbox every 2 months manually so that all the shafts rotate at least half a turn. This spreads the oil onto the gear surfaces.

Before start-up, storage oil is removed, and the gearbox is filled with operating oil using the quantity indicated in the type plate. Replace the pipe plug with the breather before start-up.

3.2.3 Rust proofing with full oil fill

In case it is not possible to operate the gearbox or rotate the shafts during storage, fill the gearbox completely with oil. Change the oil during start-up. Replace the pipe plug with the breather before start-up.

4 Installation and Start-up

THE GEARBOX IS DELIVERED WITHOUT LUBRICANTS! STOP

4.1 Lifting

For lifting, the gearboxes 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°. The lifting eyes must not be used for any other purpose except lifting the gearbox.

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

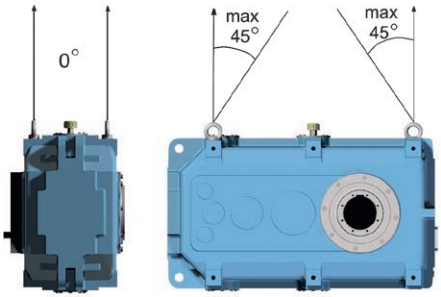


FIGURE 1. Maximum lifting angles of the gearbox

4.2 Gearbox start-up

All gearboxes 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 gearbox at a partial load. During the running-in, monitor the operating sound, running smoothness, temperature, lubrication and oil tightness of the gearbox. 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 gearbox. For gearbox 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.

Stray current shall be prevented from entering the bearings and toothings of the gear unit. In case there is a possibility of stray currents, it is recommended to make necessary stray current measurements during commissioning, in order for the supplier of the whole equipment to be able to take the necessary actions to prevent stray currents.

4.3 Gearbox alignment

The gearbox must be installed to the designed mounting position according to the tolerances of the Figure 2.

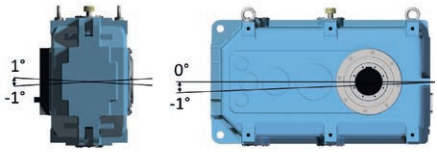


FIGURE 2.

4.4 Installing of a foot-mounted gearbox

A requirement for faultless operation of the gearbox is an even and sturdy foundation. The installation foundation of the gearbox 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 gearboxes 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.

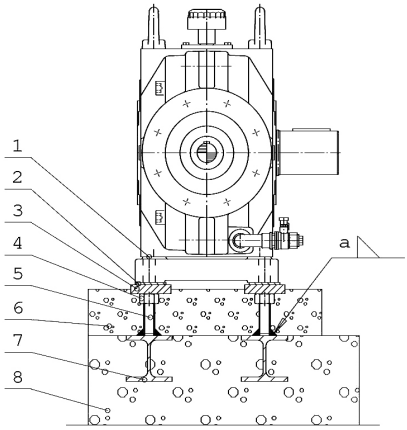


FIGURE 3. Gearbox installed with foundation bolts

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

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

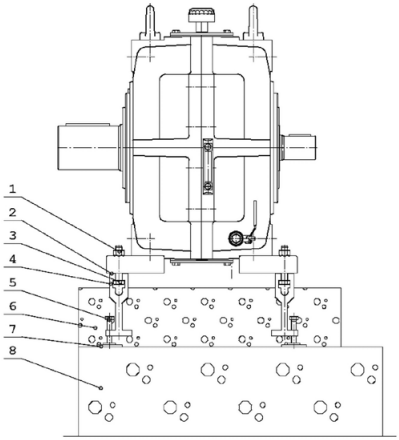


FIGURE 4. Gearbox installed on mounting columns

1. Nut	*5. Adjustment screw*
2. Shim (1…1.5 mm)	*6. Grout*
3. Stud bolt and T-slot nut	*7. Mounting plate*
4. Mounting column	*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 N/mm^2.

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

Grouting is performed after the gearbox has been placed in position. Leave the grouting below the T slot of the mounting column. Its compressive strength must be at least 20 N/mm^2. When the grout is dry, check the alignment of the gearbox. The base must be horizontal and even (max. deviation 0.01 mm/100 mm).

Before installation, check that the oil drain and filling plugs are easily accessible for oil change.

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

STOP

4.5 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.

4.5.1 Measuring radial displacement (∆Kr)

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 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.

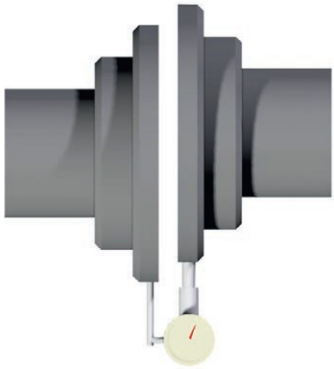


FIGURE 5. Measuring radial displacement

4.5.2 Measuring angular displacement (∆Kw)

Angular displacement is usually measured with a dial gauge. Place the dial gauge on top of one of the coupling halves. Make both 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 6. Measuring angular displacement

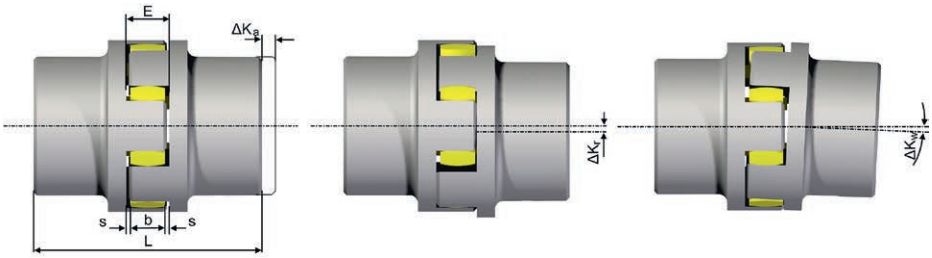


TABLE 3. Installation tolerance of flexible couplings

Coupling size	Dimensions [mm]				Axial offset Δka [mm]	Radial displacement ΔKr [mm]	Angular displacement ΔKw [°]
						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

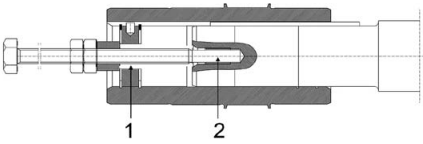
4.6 Installing a shaft-mounted gearbox with a keyway

4.6.1 Installation

To install a shaft-mounted gearbox onto the shaft, drive a screw into the centre hole thread on the shaft end and then tighten the nut on the screw as Figure 7 shows. Before installation, grease should be applied to the shaft to ease future removal.

STOP

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.



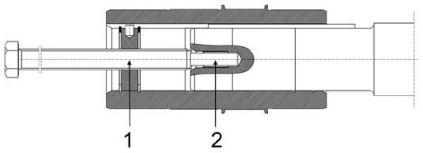
1. Gap
2. Thread

FIGURE 7. Installing a shaft-mounted gearbox onto the driven shaft with a key

4.6.2 Removal

STOP

To remove a shaft-mounted gearbox, use the screw and the thread of the gearbox'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.



1. Thread
2. Unthreaded

FIGURE 8. Removing a shaft-mounted gearbox from the driven shaft with a key

4.6.3 Locking

Lock the shaft-mounted gearbox to the shaft with a screw as shown in Figure 9. Leave a space of approx. 5-10 mm between the shaft-mounted gearbox and the bearing housing of the nearest driven machine.

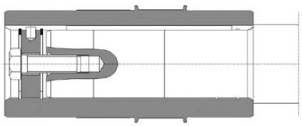
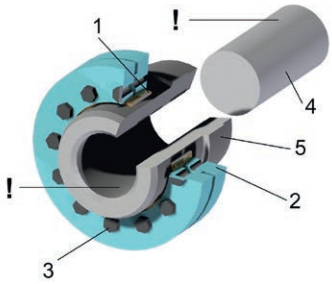


FIGURE 9. Locking the shaft-mounted gearbox

When installing and removing the shaft-mounted gearbox, you can use hydraulic pulling or pushing devices instead of mechanical screws. They provide higher assembly and disassembly force.

4.7 Installing a shaft-mounted gearbox 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 10. Structure of a shrink disc

4.7.1 Installation

1. Remove any spacers that may have been installed between the outer rings for transportation 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 gearbox. To make installation easier, you can grease **the outer surface** of the output shaft of the gearbox 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 gearbox.

6. Tighten all the clamping screws evenly in a circle, as shown in Figure 11.

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

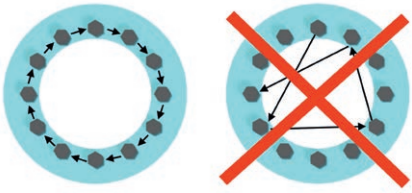


FIGURE 11. Tightening order of shrink disc screws

Tighten the screws equally, maximum ¼ to ½ 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 for SD type shrink discs. The values are for screws greased with MoS_2 grease.

TABLE 4. Tightening torques of shrink disc screws, valid for shrink discs, type SD.

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
M24	840	±42,0
M27	1250	±62,5

4.7.2 Removal

1. Remove the clamping screws evenly, by loosening them in the opposite order to that of tightening. Initially, loosen each clamping screw only ¼ 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 gearbox. Remove any corrosion that has formed between the shafts.

3. Remove the shrink disc from the output shaft of the gearbox.

4.7.3 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).

4.8 Installing a torque arm

In installation, pay attention to the position of the torque arm as shown in Figures 12a or 12b, depending on the type of the torque arm.

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 gearbox 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.

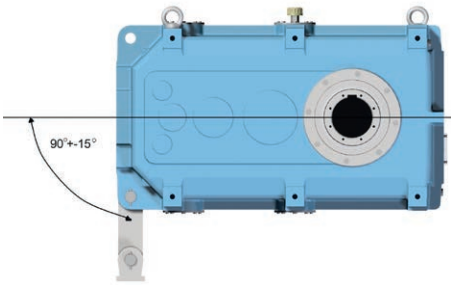


FIGURE 12a. Position of the torque arm

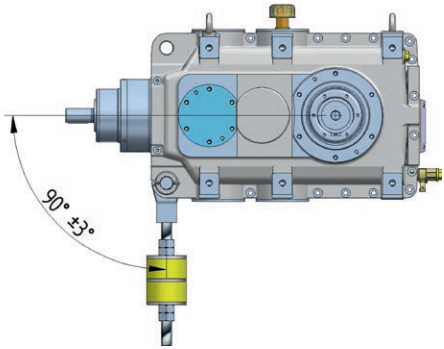


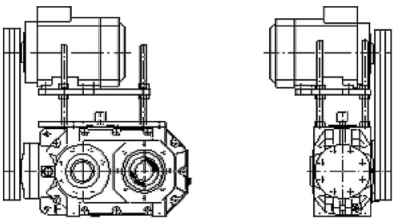
FIGURE 12b. Position of the flexible torque arm

4.9 Installing a motor to the gearbox

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

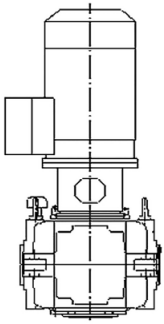
Instructions on the weight ratio of the motor and gearbox:

1. A foot motor on a bracket on a gearbox



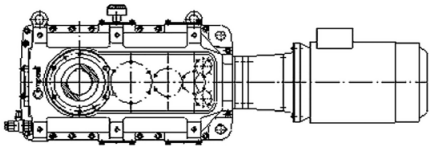
Motor weight ≤ 1.5 x gearbox weight

2. A flange motor vertically on a gearbox



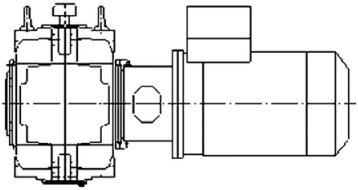
Motor weight ≤ 1.5 x gearbox weight

3. A flange motor at the end of a bevel gearbox



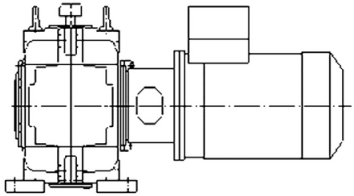
Motor weight ≤ 1.0 x gearbox weight

4. A flange motor connected to the side of a shaft-mounted helical gearbox



Motor weight ≤ 0.4 x gearbox weight

5. A flange motor connected to the side of a foot-mounted helical gearbox



Motor weight ≤ 1.0 x gearbox weight

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

4.10 Installain a V-belt drive

1. Mount the motor to its bracket.

2. Attach the back-plate of the guard to the gearbox and the motor bracket with clamps.

3. Install the belt pulley to the gearbox input shaft with a suitable tool. Alternatively, you can use belt pulleys with conic sleeves. Install the belt pulleys onto the motor and gearbox shafts axially at the same distance. Install the belt pulleys as close as possible to the motor and gearbox 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. Excessively 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.

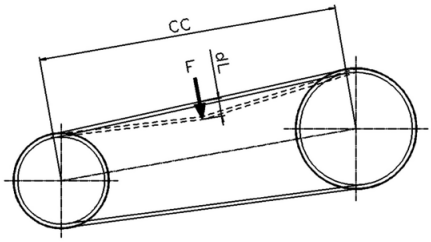


FIGURE 13. Belt force

Example:

1. CC = 1.2 m;
   dL = 10 mm;

   in which case CC x dL
   = 1.2 m x 10 mm/m
   = 12 mm

2. Measure the perpendicular bending force F with a belt tightness gauge.

3. Compare the bending force with 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
	212-250	20-30
SPB	112-150	23-36
	160-200	29-44
	212-280	36-50
	300-400	38-58
SPC	180-236	40-60
	250-355	51-75
	375-530	60-90
XPZ	60-63	8-13
	67-71	9-14
	75-80	10-15
	85-95	11-16
	100-125	13-19
	132-180	16-24
XPA	80-125	18-27
	132-200	22-31
XPB	112-118	24-36
	125-140	27-41
	150-170	30-47
	180-200	36-53
	212-280	38-55
	300-400	41-64
XPC	180-236	50-75
	250-355	65-95
	375-530	80-110

* *calculated with the service factor of a belt drive ~1.5*

** *if the service factor is significantly higher, the correct tightness must be checked*

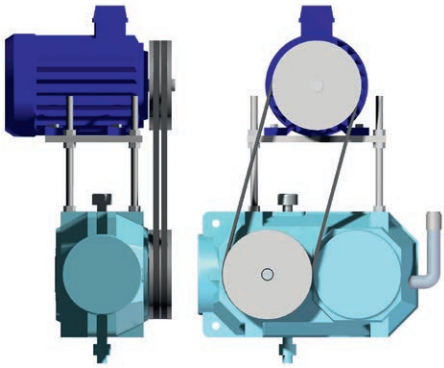


FIGURE 14. A belt drive in a gearbox without a guard

4.11 Installing a tooth-belt drive

The tooth-belt drive pulleys are installed onto the shafts in a manner similar to the V-belt drive, see section 4.10.

Position the tooth belt onto 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 4.10.

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

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

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

4.12 Installing of a chain drive

A chain wheel is normally installed to the slow shaft of the gearbox 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 onto the gearbox 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 ±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 ±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 ±10 mm.

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

4.13 Filling lubrication oil

THE GEARBOX IS DELIVERED WITHOUT LUBRICANTS! **STOP**

1. Before start-up, the gearbox must be filled with oil specified in the type plate of the gearbox or according to the included lubrication recommendation.

2. To check the correct oil level:

   - With the oil sight glass: fill the gearbox with oil up to the middle of the oil sight glass.
   - With the oil level sight glass: fill the gearbox with oil up to between the marks.
   - With the oil plug: add oil to the gearbox until it leaks out of the opened overflow hole.
   - With the dipstick: fill the gearbox with oil up to the area between the dipstick marks.

3. Check the oil level when the gearbox is at a standstill and the oil has cooled. Avoid overfilling when adding oil. Too much oil may cause the gearbox to heat up above the allowed limit.

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

4.14 Installing the breather plug

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

5 Lubrication

THE GEARBOX IS DELIVERED WITHOUT LUBRICANTS! **STOP**

5.1 Lubrication basics

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

5.1.1 Splash lubrication

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

5.1.2 Pressure lubrication

Pressure lubrication is used for gearboxes 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 gearboxes with slower velocities, if required by the gearbox.

5.1.3 Oil bath lubrication

Oil bath lubrication can be used in slow speed gearboxes 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 gearbox.

5.1.4 Grease lubrication

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

5.1.5 Central lubrication

Central lubrication can be used in a gearbox if a centralized lubrication system is available in the environment where the gearbox is used. The piping system for central lubrication must be dimensioned according to the planned oil flow. The drain pipe must be large enough and directed downwards so that the gearbox does not flood. Central lubrication must be active whenever the gearbox is running.

5.2 Oil and grease quantities

An indicative quantity of oil is specified in the gearbox 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 gearbox, 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 gearbox's start-up. **!**

5.3.2 Oil change interval

The gearbox 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 gearbox 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 gearbox.

There are two kinds of impurities: solid and liquid.

Solid impurities are dust entering the gearbox from its surroundings, metal particles caused by wear in the gearbox, 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 gearbox due to processes, washing of the gearbox 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 4 µm, over 6 µm and over 14 µm, the amounts of which are always included in the preceding one.

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

Required cleanliness level ISO 4406
- splash and oil bath lubrication -/19/16
- pressure lubrication -/17/14

5.5 Oil preheating

If the gearbox 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 gearbox. 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

Temperature limits without heating elements			
Oil viscosity class	Splash or bath lubrication		Pressure lubrication
	Mineral oil	Synthetic oil	Mineral and synthetic oil
ISO VG 150	-20 °C	-40 °C	+6 °C
ISO VG 220	-18 °C	-40 °C	+10 °C
ISO VG 320	-15 °C	-35 °C	+15 °C
ISO VG 460	-12 °C	-30 °C	+20 °C

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 gearbox can be arranged as follows:

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

Gearboxes 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 gearboxes 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

Recommended viscosity for lubricant							
Splash or bath lubrication				Pressure lubrication			
Oil sump temperature	*Max. ambient temperature*	Mineral oil	Synthetic oil	Oil sump temperature	*Max. ambient temperature*	Mineral oil	Synthetic oil
< 60 °C	*< 25 °C*	220	220	**< 60 °C**	*< 25 °C*	150	150
61-80 °C	*26-45 °C*	320	320	**61-80 °C**	*26-45 °C*	220	220
81-95 °C	*46-60 °C*	-	460	**81-95 °C**	*46-60 °C*	-	320
					Lubrication unit with additional cooling		
					Lubrication unit without additional cooling		

NOTE. Proper lubrication oil viscosity class is selected by Kumera and marked on gearbox type plate.

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

ISO VG AGMA	150 4 EP	220 5 EP	320 6 EP	460 7 EP
ARAL	Degol BG 150 Plus	Degol BG 220 Plus	Degol BG 320 Plus	Degol BG 460 Plus
BP	Energol GR-XP 150	Energol GR-XP 220	EnergolGR-XP 320	Energol GR-XP 460
CASTROL	Optigear BM 150	Optigear BM 220	Optigear BM 320	Optigear BM 460
FUCHS	Renolin CLP 150	Renolin CLP 220	Renolin CLP 320	Renolin CLP 460
KLÜBER	Klüberoil GEM 1-150 N	Klüberoi IGEM 1-220 N	Klüberoil GEM 1-320 N	Klüberoil GEM 1-460 N
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
LUKOIL	Steelo 150	Steelo 220	Steelo 320	Steelo 460
MOBIL	Mobilgear 600 XP 150	Mobilgear 600 XP 220	Mobilgear 600 XP 320	Mobilgear 600 XP 460
NESTE	Vaihteisto 150 EP	Vaihteisto 220 EP	Vaihteisto 320 EP	Vaihteisto 460 EP
SHELL	Shell Omala S2 G 150	Shell Omala S2 G 220	Shell Omala S2 G 320	Shell Omala S2 G 460
TEBOIL	Pressure Oil 150	Pressure Oil 220	Pressure Oil 320	Pressure Oil 460
TEXACO	Meropa 150	Meropa 220	Meropa 320	Meropa 460
TOTAL	Carter XEP 150	Carter XEP 220	Carter XEP 320	Carter XEP 460
Q8 OILS	Q8 Goya NT 150	Q8 Goya NT 220	Q8 Goya NT 320	Q8 Goya NT 460

Synthetic lubricants

Synthetic lubricants can be used in gearboxes 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 AGMA	150 4 EP	220 5 EP	320 6 EP	460 7 EP
BP	Enersyn HTX-150	Enersyn HTX-220	Enersyn HTX-320	Enersyn HTX-460
CASTROL	Optigear synth X 150	Optigear synth X 220	Optigear synth X 320	Optigear synth X 460
FUCHS	Renolin Unisyn CLP 150	Renolin Unisyn CLP 220	Renolin Unisyn CLP 320	Renolin Unisyn CLP 460
KLÜBER	Klübersynth GEM 4-150 N	Klübersynth GEM 4-220 N	Klübersynth GEM 4-320 N	Klübersynth GEM 4-460 N
NESTE	Vaihteisto S 150 EP	Vaihteisto S 220 EP	Vaihteisto S 320 EP	Vaihteisto S 460 EP
MOBIL	Mobil SHC GEAR 150	Mobil SHC GEAR 220	Mobil SHC GEAR 320	Mobil SHC GEAR 460
SHELL	Omala S4 GX 150	Omala S4 GX 220	Omala S4 GX 320	Omala S4 GX 460
TEBOIL	Sypres 150	Sypres 220	Sypres 320	Sypres 460
TOTAL	Carter SH 150	Carter SH 220	Carter SH 320	Carter SH 460

Lubricant greases	Grease lubricated gearboxes	Grease lubricated bearings
ARAL	Aralub FDP 0	Aralub HL2
BP	Energrease LS EP 0	Energrease LS EP 2
CASTROL	Longtime PD 0	Longtime PD 2
MOBIL	Mobilux EP 0	Mobilux EP 2
SHELL	Alvania Grease GC 00	Alvania Grease RL 2
TEBOIL	Universal CLS	Multipurpose EP

6 Gearbox 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 compound.

6.2 Toothed parts

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

6.3 Bearings

All the shafts of the gearbox 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 gearbox 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.

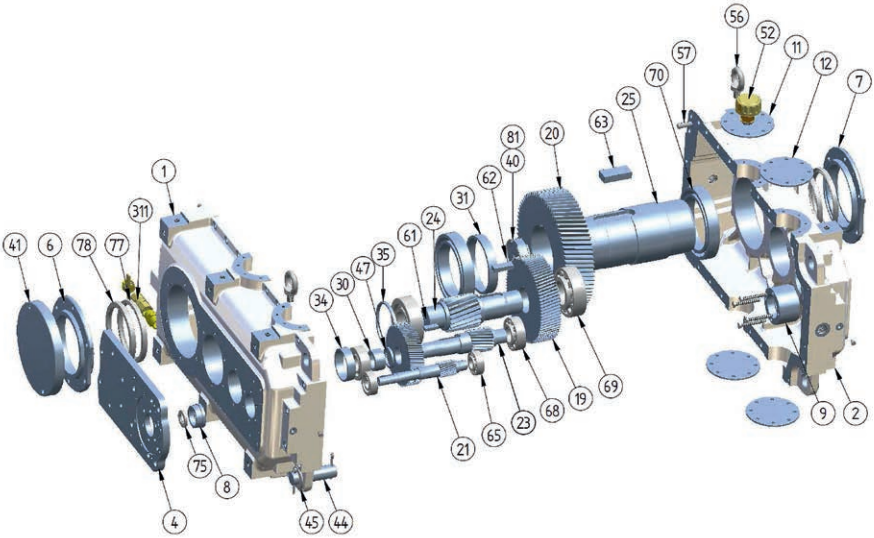


FIGURE 15. A basic diagram of a helical gearbox

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 gearbox. 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 gearboxes as a 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 gearboxes 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 gearboxes
- in single-step bevel and helical gearboxes
- 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.

Lip seals always need lubrication (grease or the gearbox's own oil) to work properly. In constructions with two seals in a row (double seal), the inner seal is lubricated by the oil inside the gearbox and the outer seal is lubricated by the grease inside the dust lip and between both seals. When changing seals, lubricate the inner part of the outer seal before installing the other seal; however, do not fill the inner part of the outer seal completely with grease, but only the edge of the sealing lip.

Kumera's recommended lubricant for seals is Klüber Petamo GHY 133 N.

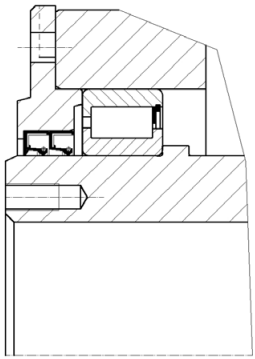


FIGURE 16. Lip sealing

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 gearboxes.

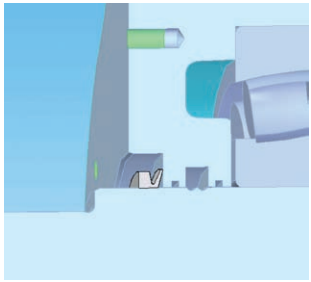


FIGURE 17. Labyrinth seal

6.4.3 Taconite seal

Taconite seals are used in very dusty environments. Add grease periodically to a Taconite seal according to its size; however, at least whenever oil is changed. The seal housing is equipped with a grease nipple for adding grease.

Kumera's recommended lubricant for adding grease is Klüber Petamo GHY 133 N.

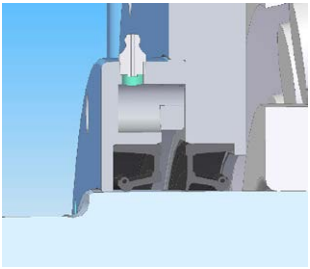


FIGURE 18. Taconite seal

6.4.4 Lip seal and washing cover

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

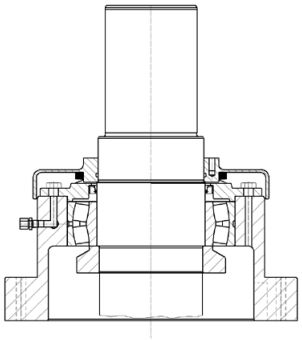


FIGURE 19. Lip seal and washing cover

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.

6.4.6 Dry well and grease-lubrcated bearing

A dry well is used in a vertical-mixer gearbox 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.

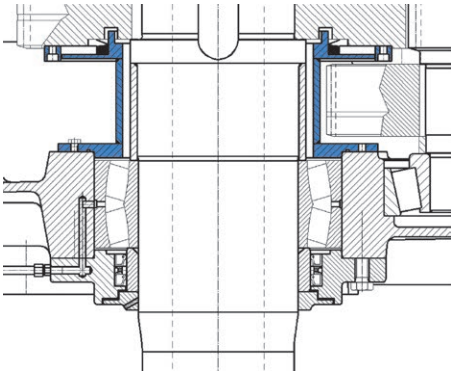


FIGURE 20. Dry well and grease lubrication

The quantity of grease is primarily determined on the basis of the dimension drawing of the gearbox. The tables below can be used as guidelines when estimating grease quantities.

TABLE 7. Grease quantities for grease-lubricated output shaft bearing.

Gearbox size	Post-lubrication amount of grease g / 3 kk
80-140	20
160-200	30
225-280	50
315-400	110
425-530	240
560-670	330
710-900	500

Bearing is pre-filled with grease at the factory.

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 3 months
D < 180 mm	10
D > 180 mm	20

7 Gearbox 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 gearbox 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 gearbox. The customer must check the correct direction of rotation of the electric motor before starting it. An incorrect direction of the motor rotation may break down the backstop. A temporary oversize torque may also break the backstop.

STOP

In case of a shutdown, the reverse torque must not exceed the rated load torque of the gearbox. Figures 22-24 show different backstops.

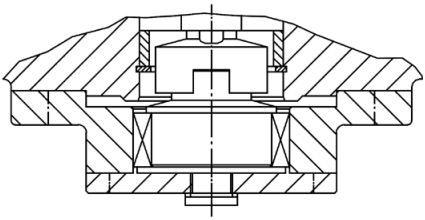


FIGURE 21. Backstop, F series for centre distances <140 mm

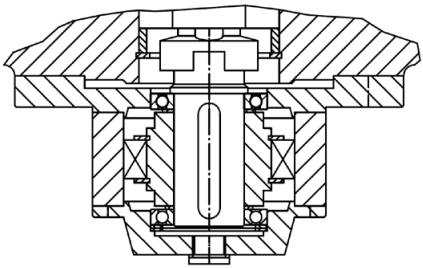


FIGURE 22. Backstop, F series for centre distances 160 mm, 180 mm, 200 mm

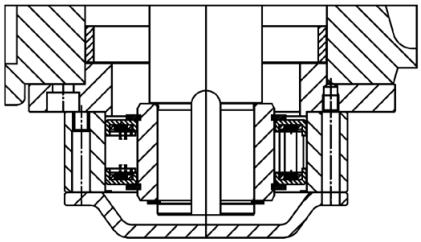


FIGURE 23. Backstop, G and D series

7.2 Lubrication pumps

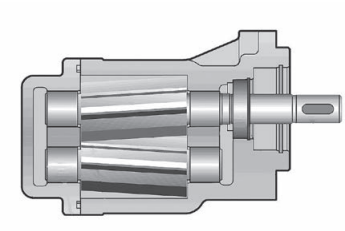


FIGURE 24. Gear pump

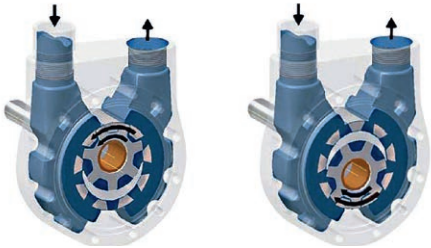


FIGURE 25. Specially designed lubrication pump

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 gearbox, and it can be shut down only after the gearbox has come to a complete stop.

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 gearbox housing and the pump connected to the shaft. When installing the pump, make sure that the oil inlet and outlet of the pump are the right way around.

Deaerating of Lubricating pumps

After a refill or oil-change of the lubricating oil of the gearbox equipped with a shaft-mounted oil pump, one must make sure that the oil circulation starts immediately at the start-up of the unit. This is especially necessary if the oil inlet hole of the pump (suction side) resides above the oil surface inside the gearbox as the air in the pipeline might block the flow to the pump. Therefore the system must be deaerated before start-up.

The pump can be deaerated by filling the pump and pipeline with oil after a refill or oil-change. This is done by opening the hose or pipe fitting from the inlet side (suction) of the pump and by pouring oil into the system and the pump. The unit is then deaerated and ready for service.

Notice!

Deaeration of the lubricating pump is absolutely necessary to avoid breakdown or damage of the gearbox due to a lack of lubricating oil during start-up.

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.

Start the oil circulation 10 minutes before starting the device. This ensures the operation of the pressure lubrication unit and that the bearings and gears receive lubrication even before start-up. If the temperature is below 0 °C, it is recommended to always keep the oil circulation on.

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

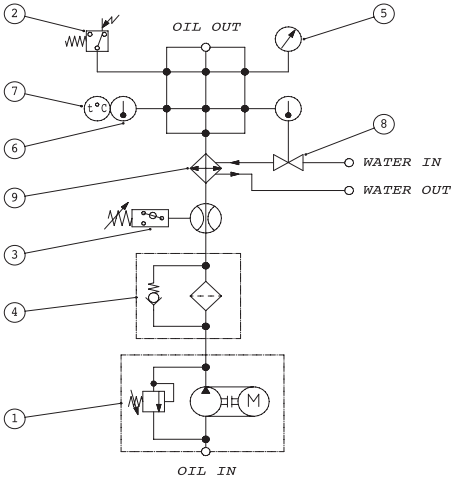


FIGURE 26. Pressure lubrication unit diagram

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 gearbox is not being lubricated as designed.

7.3.2 Pressure switch (part 2)

The pressure switch is used to control the lubrication of the gearbox. 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 gearbox.

7.3.6 Thermometer (part 6)

The thermometer indicates the temperature of the oil entering the gearbox.

7.3.7 Thermo switch (part 7)

A thermo switch is used for monitoring the temperature of the oil entering the gearbox. 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.

Adjustment instructions:

- the thermostatic water valve is delivered fully open, allowing for maximum cooling
- the thermostatic water valve controls the water flow and is intended to keep the oil temperature constant. The adjustment parameter depends on the water temperature and environmental conditions.
- the thermostat must be adjusted so that the gearbox oil temperature is 60-70 °C

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 freshwater environment where the water pH value is higher than 6. If necessary, the cooling water must be pre-treated and filtered (100 µm) before the heat exchanger. The temperature of the cooling water of a water-cooled pressure lubrication system must be +4 to +30 °C. The water flow can be controlled with the thermostat valve. Recommended water pressure 2…8 bar.

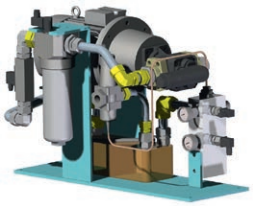


FIGURE 27. Water-cooled pressure lubrication unit

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

7.3.10 Placement of the lubrication unit

- max 0.5 m above the gearbox from the mounting plane
- max 2 m below the gearbox from the mounting plane
- permissible length of the hoses max 3 m

The placement of the lubrication unit according to these instructions unless otherwise agreed.

7.4 Gearbox cooling methods

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

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 gearbox 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 gearbox shaft. The fan and its cover must be cleaned of any dirt during a stoppage or as soon as it gets dirty.

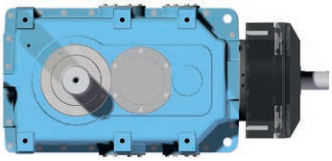


FIGURE 29. Fan in a gearbox

7.4.2 Water cooling coil

The water cooling coil is installed inside the gearbox in the oil sump. The coil is then connected to the water system that circulates water through the coil. If the gearbox has a water cooling coil, the accessories required for cooling or circulating water are not included in the delivery. The temperature of the cooling water must be +4 to +30 °C. The water circulation can be controlled with a thermostat valve, which opens after the oil temperature has reached the desired level.

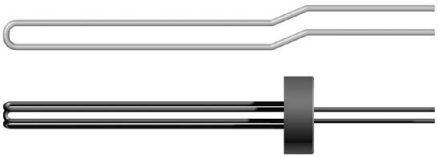


FIGURE 30. Water cooling coils

7.5 Heating the gearbox oil

If the temperature of the gearbox's operating environment is low, the gearbox oil can be heated with a heating element. The maximum allowed surface power of the heating element is 1 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.

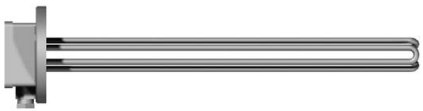


FIGURE 31. Heating element

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 gearbox housing next to the appropriate bearings.

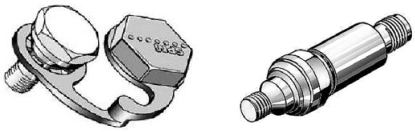


FIGURE 32. Vibration measurement adapter and sensor

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 gearbox oil.

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

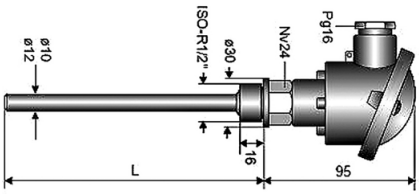


FIGURE 33. Temperature sensor

8 Scheduled Maintenance

Kumera's recommendation for periodic inspections and maintenance of industrial gearboxes according to the table below. Bearing and sealing replacements and renewals of geared parts are recommended to be done by Kumera's specialist.

Recommended maintenance period plan for industrial gearboxes						
Service object	**Every week**	**Every 3 months**	**Annual Maintenance**	**Every 2 years**	**Every 5 years**	**Every 10 years**
Oil level inspection	x					
Temperature measurement	x					
Drive train visual and noise inspection	x					
Vibration measurement		x				
Adding grease (see page 28)		x				
Oil change (Mineral oils)			x			
Air breather change			x			
Oil analysis			x			
Oil filter change			x			
Visual inspection of geared parts			x			
Cleaning of the cooling fan			x			
Drive train inspection (couplings, belt drive)			x			
Oil change (Synthetic oils)				x		
Endoscopy inspection (bearings)				x		
Change of sealings					x	
Change of bearings					x	
Change of backstop and oil pump					x	
Change of geared parts						x

Timely maintenance increases the life of the gearboxes and operational reliability. If abnormalities in the operation of the gearbox are detected, they must be corrected immediately. An internal gear inspection (endoscope inspection) can extend the change intervals for bearings and gearing parts.

The first oil change must be performed after approx. 300 to 500 operating hours after the gearbox's start-up. Oil condition can be examined by oil analysis. Based on the analysis, the oil change interval can be extended if desired.

When opening the inspection covers and SAE flanges of the gearbox, clean the sealing surfaces carefully and apply new sealing compound on the sealing surfaces before closing the covers.

9 Troubleshooting

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

10 Disposal

- Recycle or dispose of packaging material according to applicable national regulations.
- Before disposing of the gearbox after its service life, remove any lubricants from it. Disassemble components of different materials and recycle or dispose of them according to applicable regulations.
- Dispose of the used lubricants in accordance with applicable environmental protection regulations.

Notes

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