K R F S series Helical Gear Units User Manual

Contents

1 Important Notes

Safety and warning instructions

Please follow the safety and warning instructions in this specification!

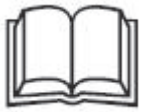
Electrical hazard
Possible consequences: Severe or fatal injuries.

Hazard
Possible consequences: Severe or fatal injuries.

Hazardous situation
Possible consequences: Slight or minor injuries.

Harmful situation
Possible consequences: Damage to the drive and the environment.

Tips and useful information.



You must adhere to the operating instructions to ensure:

. Trouble-free operation

. Fulfillment of any rights to claim under guarantee

Consequently, read the operating instructions before you start working with the gear unit!

The operating instructions contain important information about servicing. Therefore, keep the operating instructions close to the gear unit.

. Adjust the lubricant fill volume and position of the breather valve

accordingly in the event of a change of mounting position (see Sec. "Lubricants" and "Mounting Positions").

. Follow the instructions in Sec. "Mechanical installation" / "Installing the gear unit"!

Waste disposal

Please follow the latest instructions: Dispose of the following materials in accordance with the regulations in force:

. Steel scrap:

. Housing parts

. Gears

. Shafts

. Anti-friction bearing

. Gray-cast iron (if there is no special collection)

. Parts of the worm gears are made of non-ferrous metals. Dispose of the worm gears as appropriate.

. Collect waste oil and dispose of it correctly.

2 Safety Notes

Preface

The following safety notes are primarily concerned with the use of gear units. If using gear motors, please also refer to the safety notes for motors in the relevant operating instructions.

Please also consider the supplementary safety notes in the individual sections of these operating instructions.

Brief Introduction

During and after operation, gear motors, gear units and motors have:

. Electrical parts

. Moving parts

. Hot surfaces

Only qualified staffs may carry out the following works:

. Transportation

. Putting into storage

. Installation / assembly

. Connection

. Start up

. Maintenance

. Recondition

The following information and documents must be observed during these processes:

. Relevant operating instructions and wiring diagrams

. Warning and safety signs on the gear unit / gear motor

. System-specific regulations and requirements

. National / regional regulations governing safety and the prevention of accidents

Serious injuries and property damage may result from:

. Improper use

. Incorrect installation or operation

. Unauthorized removal of necessary protection covers or the housing

Designated use

Gear motors / gear units from FLK are intended for industrial systems. They correspond to the applicable standards and regulations.

Technical data and information about the permitted conditions can be found on the nameplate and in the documentation.

It is essential that you follow all the instructions!

Transportation

Inspect the shipment for any damage that may have occurred in transit as soon as you receive the delivery. Inform the shipping company immediately. It may be that you are not permitted to start up the drive due to the damage.

Tighten installed eye bolts. The eye bolts are only designed for the weight of the gear motor / gear unit. Do not attach any additional loads.

The installed lifting eye bolts comply with DIN 580. The loads and regulations specified in this standard must always be observed. If two eye bolts are available, use both of them for transport. In this case, the tension force vector of the slings must not exceed a 45° angle in accordance with DIN 580.

Use suitable, sufficiently rated handling equipment if necessary. Remove any transportation fixtures prior to start up.

Extended storage of gear units

Gear units of the "extended storage" type have:

. An oil fill suitable for the mounting position so the unit is ready to run (mineral oil CLP and synthetic oil CLP HC). You should still check the oil

level before start up (see Sec. "Inspection / Maintenance" / "Inspection and maintenance of the gear unit").

Comply with the storage conditions specified in the following table for extended storage:

Climate zone	Packaging[1)]	Storage location	Storage time
Temperate (Europe, USA, Canada, China and Russia, excluding tropical zones)	Packed in containers, with desiccant and moisture indicator sealed in the plastic wrap.	With roof, protected against rain and snow, no shock loads.	Up to three years with regular checks on the packaging and moisture indicator (relative atmospheric humidity < 50 %).
	Open	With roof, enclosed at constant temperature and atmospheric humidity (5 °C < ϑ < 60 °C, < 50 % relative atmospheric humidity). No sudden temperature fluctuations and controlled ventilation with filter (free from dirt and dust). No aggressive vapors and no shock loads.	Two years or more given regular inspections. Check for cleanliness and mechanical damage as part of the inspection. Check corrosion protection.
Tropical (Asia, Africa, Central and South America, Australia, New Zealand excluding temperate zones)	Packed in containers, with desiccant and moisture indicator sealed in the plastic wrap. Protected against insect damage and mildew by chemical treatment.	With roof, protected against rain, no shock loads.	Up to three years with regular checks on the packaging and moisture indicator (relative atmospheric humidity < 50 %).
	Open	With roof, enclosed at constant temperature and atmospheric humidity (5 °C < ϑ < 60 °C, < 50 % relative atmospheric humidity). No sudden temperature fluctuations and controlled ventilation with filter (free from dirt and dust). No aggressive vapors and no shock loads. Protection against insect damage.	Two years or more given regular inspections. Check for cleanliness and mechanical damage as part of the inspection. Check corrosion protection.

1) Packaging must be performed by an experienced company using the packaging materials that have been expressly specified for the particular application.

Installation / assembly

Observe the instructions in the sections "Installation" and "Assembly/Removal"!

Start up / operation

Check that the direction of rotation is correct in decoupled status. Listen out for unusual grinding noises as the shaft rotates.

Secure the shaft keys for test mode without drive components. Do not render monitoring and protection equipment inoperative even for test mode.

Switch off the gear motor if in doubt whenever changes occur in relation to normal operation (e.g. increased temperature, noise, vibration). Determine the cause; contact F L K if necessary.

Inspection / maintenance

Follow the instructions in the section "Inspection and Maintenance"!

3 Gear Unit Structure

The following figures are block diagrams. Their purpose is

only to make it easier to assign components to the spare parts lists. Discrepancies may occur depending on the gear unit size and version!

3.1 Basic structure of helical gear units

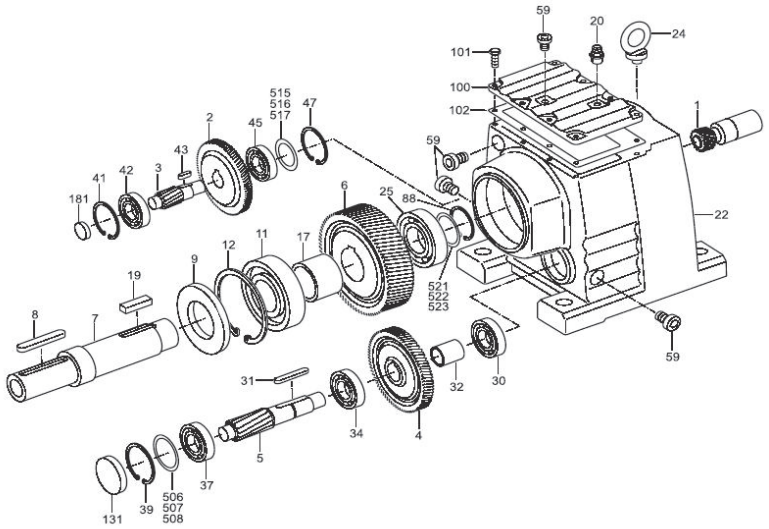


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Figure 1: Basic structure of helical gear units

Key

1 Pinion	19 Key	42 Anti-friction bearing	507 Shim ring
2 Gear	20 Breather valve	43 Key	508 Shim ring
3 Pinion shaft	22 Gearcase	45 Anti-friction bearing	515 Shim ring
4 Gear	24 Lifting eyebolt	47 Circlip	516 Shim ring
5 Pinion shaft	25 Anti-friction bearing	59 Screw plug	517 Shim ring
6 Gear	30 Anti-friction bearing	88 Circlip	521 Shim ring
7 Output shaft	31 Key	100 Gearcase cover	522 Shim ring
8 Key	32 Spacer	101 Hex head bolt	523 Shim ring
9 Oil seal	34 Anti-friction bearing	102 Gasket	
11 Anti-friction bearing	37 Anti-friction bearing	131 Closing cap	
12 Circlip	39 Circlip	181 Closing cap	
17 Spacer	41 Circlip	506 Shim ring	

3.2 Basic structure of parallel shaft helical gear units

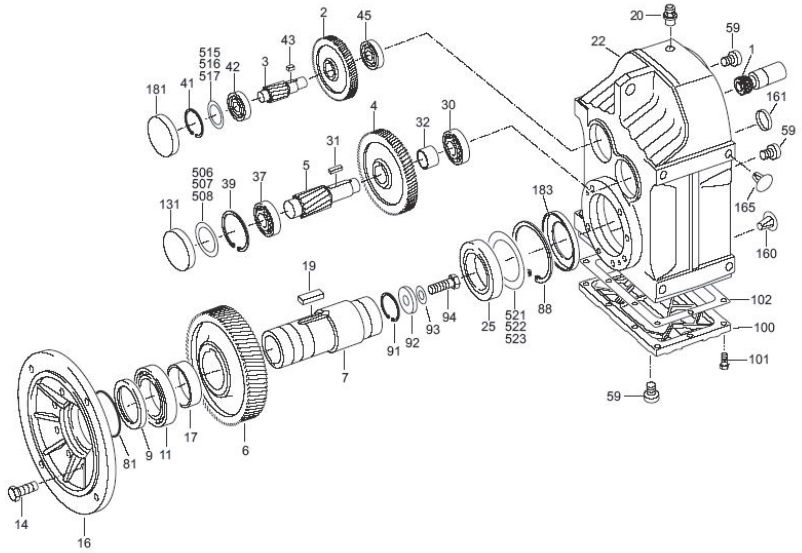

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Figure 2: Basic structure of parallel shaft helical gear units

Key

1 Pinion	22 Gearcase	91 Circlip	506 Shim ring
2 Gear	25 Anti-friction bearing	92 Washer	507 Shim ring
3 Pinion shaft	30 Anti-friction bearing	93 Lock washer	508 Shim ring
4 Gear	31 Key	94 Hex head bolt	515 Shim ring
5 Pinion shaft	32 Spacer	100 Gearcase cover	516 Shim ring
6 Gear	37 Anti-friction bearing	101 Hex head bolt	517 Shim ring
7 Hollow shaft	39 Circlip	102 Gasket	521 Shim ring
9 Oil seal	41 Circlip	131 Closing cap	522 Shim ring
11 Anti-friction bearing	42 Anti-friction bearing	160 Closing plug	523 Shim ring
14 Hex head bolt	43 Key	161 Closing cap	
16 Output flange	45 Anti-friction bearing	165 Closing plug	
17 Spacer	59 Screw plug	181 Closing cap	
19 Key	81 O-ring	183 Oil seal	
20 Breather valve	88 Circlip		

3.3 Basic structure of helical-bevel gear units

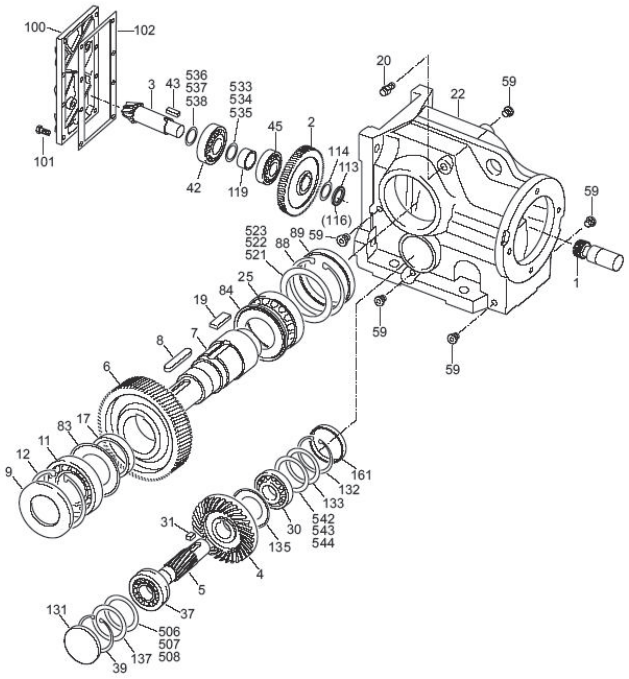

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Figure 3: Basic structure of helical-bevel gear units

Key

1	Pinion	25	Anti-friction bearing	102	Adhesive and sealing compound	522	Shim ring
2	Gear	30	Anti-friction bearing	113	Slotted round nut	523	Shim ring
3	Pinion shaft	31	Key	114	Multi-tang washer	533	Shim ring
4	Gear	37	Anti-friction bearing	116	Thread lock	534	Shim ring
5	Pinion shaft	39	Circlip	119	Spacer	535	Shim ring
6	Gear	42	Anti-friction bearing	131	Closing cap	536	Shim ring
7	Output shaft	43	Key	132	Circlip	537	Shim ring
8	Key	45	Anti-friction bearing	133	Spacer	538	Shim ring
9	Oil seal	59	Screw plug	135	Nilos ring	542	Shim ring
11	Anti-friction bearing	83	Nilos ring	161	Closing cap	543	Shim ring
12	Circlip	84	Nilos ring	506	Shim ring	544	Shim ring
17	Spacer	88	Circlip	507	Shim ring		
19	Key	89	Closing cap	508	Shim ring		
20	Breather valve	100	Gearcase cover	521	Shim ring		
22	Gearcase	101	Hex head bolt	521	Shim ring		

3.4 Basic structure of helical-worm gear units

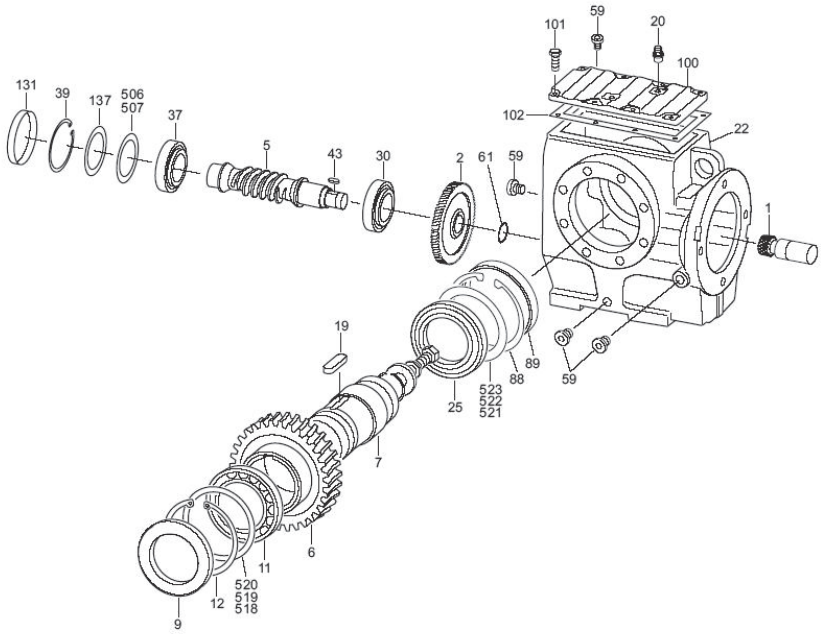

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Figure 4: Basic structure of helical-worm gear units

Key

1	Pinion	20	Breather valve	88	Circlip	518	Shim ring
2	Gear	22	Gearcase	89	Closing cap	519	Shim ring
5	Worm	25	Anti-friction bearing	100	Gearcase cover	520	Shim ring
6	Worm gear wheel	30	Anti-friction bearing	101	Hex head bolt	521	Shim ring
7	Output shaft	37	Anti-friction bearing	102	Rubber seal	522	Shim ring
9	Oil seal	39	Circlip	131	Closing cap	523	Shim ring
11	Anti-friction bearing	43	Key	137	Spacer		
12	Circlip	59	Screw plug	506	Shim ring		
19	Key	61	Circlip	507	Shim ring		

4 Mechanical Installation

4.1 Required tools /Auxiliary material . Set of spanners

. Torque wrench for:

. Shrink discs

. AQH motor adapter

. Input shaft assembly with centering shoulder

. Mounting device

. Shims and distance rings if necessary

. Fixing devices for input and output elements

. Lubricant

. Bolt adhesive (for input shaft assembly with centering shoulder).

. Standard parts are not parts of the delivery

Installation tolerances

Shaft end	Flanges
Diameter tolerance in accordance with DIN 748 • ISO k6 for solid shafts with ∅ ≤ 50 mm • ISO m6 for solid shafts with ∅ > 50 mm • ISO H7 for hollow shafts • Center bore in accordance with DIN 332, shape DR	Centering shoulder tolerance in accordance with DIN 42948 • ISO j6 with b1 ≤ 230 mm • ISO h6 with b1> 230 mm

4.2 Prerequisites for assembly

Check that the following conditions have been met:

. The data on the nameplate of the gear motor matches the voltage supply system.

. The drive has not been damaged during transportation or storage.

. Ensure that the following requirements have been met:

. For standard gear units:

Ambient temperature according to the lubricant table in Sec. "Lubricants" (see standard).

The drive must not be assembled in the following ambient conditions:

. Potentially explosive atmosphere

. Oil

. Acids

. Gas

. Vapors

. Radiation

. For special versions:

The drive configured in accordance with the ambient conditions.

. For helical-worm gear units:

No large external mass moments of inertia which could exert a decelerative load on the gear unit.

[At η. (decelerative) = 2-1/η < 0.5 self-locking]

. You must clean the output shafts and flange surfaces thoroughly to ensure they are free of anti-corrosion agents, contamination or similar. Use a commercially available solvent. Do not let the solvent come into contact with the sealing lips of the oil seals danger of damage to the material!

. When the drive is installed in abrasive ambient conditions, protect the output end oil seals against wear.

4.3 Installing the gear unit

The gear unit or gear motor is only allowed to be installed in the specified mounting position.

The support structure must have the following characteristics:

. Level

. Vibration damping

. Torsionally rigid

Maximum permitted flatness error for foot and flange mounting (approximate values with reference to DIN ISO):

. Gear unit size ≤ 67: max. 0.4 mm

. Gear unit size 77 ... 107: max. 0.5 mm
. Gear unit size 137 ... 147: max. 0.7 mm
. Gear unit size 157 ... 187: max. 0.8 mm

Do not tighten the housing legs and mounting flanges against one another and ensure that you comply with the permitted overhung and axial loads!

Secure the gear motors with bolts of quality 8.8.

Secure the following gear motors with bolts of quality 10.9:

. RF37, R37F with flange . 120 mm
. RF47, R47F with flange . 140 mm
. RF57, R57F with flange . 160 mm

The oil checking and drain screws and the breather valves must be freely accessible!

At the same time, also check that the oil fill is as specified for the mounting position (see Sec. "Lubricants" / "Lubricant fill quantities" or refer to the information on the nameplate).

The gear units are filled with the required oil volume at the factory. There may be slight deviations at the oil level plug as a result of the mounting position, which are permitted within the manufacturing tolerances.

Adjust the lubricant fill volumes and the position of the breather valve accordingly in the event of a change of mounting position. Please contact our FLK customer service if you change the mounting position of K gear units to M5 or M6 or between M5 and M6.

Please contact our DONLY customer service if you change the mounting position of size S47 S97 S gear units to mounting position M2.

Use plastic inserts (2 ... 3 mm thick) if there is a risk of electrochemical corrosion between the gear unit and the driven machine. The material used must have an electrical bleeder resistor < 109 .. Electrochemical corrosion can occur between various metals, for example, cast iron and high-grade steel. Also install the bolts with plastic washers! Ground the housing additionally . use the grounding bolts on the motor.

Installation in damp locations or in the open

Drives are supplied in corrosion-resistant versions for use in damp areas or in the open air. Repair any damage to the paint work (e.g. on the breather valve).

When mounting the motors onto AM, AQ, AR, AT adapters, seal the flange areas with a suitable sealing compound, e.g. Loctite. 574.

Gear unit venting

No breather plug is required for the following gear units:

. R17, R27 and F27 in mounting positions M1, M3, M5 and M6

F L K supplies all other gear units with the breather valve installed and activated according to the particular mounting position.

Exceptions:

1. F L K supplies the following gear units with a screw plug on the vent hole provided:

. Gear units for extended storage
. Pivoted mounting positions, if possible
. Gear units for mounting on a slant

The breather valve is placed together with accessory. Before start up, you must replace the highest screw plug with the breather valve supplied.

2. FLK supplies a breather valve in a plastic bag for gear head units requiring venting on the input end.

3. **Enclosed gear units** are supplied without a breather valve.

Activating the breather valve

As a rule, the breather valve is already activated at the factory. If the

1. Breather valve with transport fixture
2. Remove the transport fixture
3. Breather valve activated

breather valve has not been activated, you must remove the transport fixture from the breather valve before starting up the gear unit!

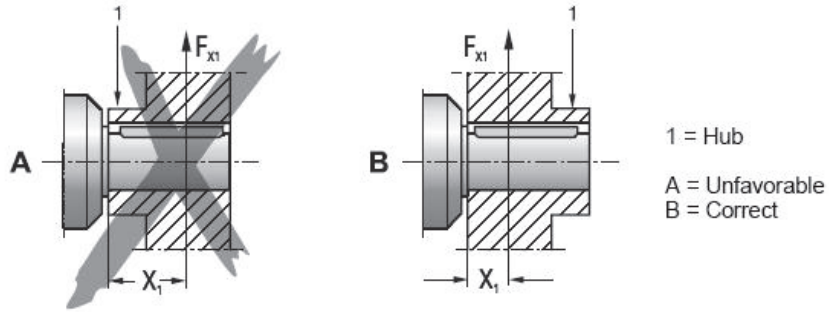
Painting the gear unit

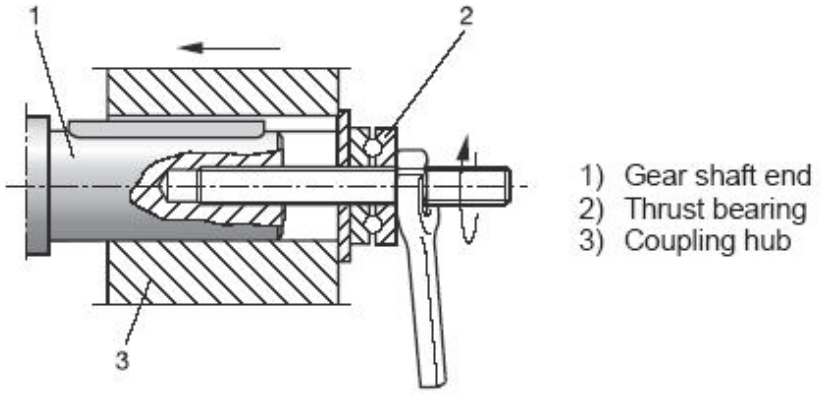
If you paint or respray the drive, ensure that you cover the breather valve and oil seals carefully. Remove the strips of tape after completing the painting work.

4.4 Gear unit with solid shaft

Installing input and output elements

The following figure shows a mounting device for installing couplings or hubs on gear unit or motor shaft ends. It may be possible to dispense with the thrust bearing on the mounting device.





Avoid inadmissibility high overhung loads: Install the gear or chain sprocket according to figure B.

. Only use a mounting device for installing input and output elements. Use the center bore and the thread on the shaft end for positioning.

. Never drive belt pulleys, couplings, pinions, etc. onto

the shaft end by hitting them with a hammer This will damage the bearings, housing and the shaft!

. In the case of belt pulleys, make sure the belt is tension correctly in accordance with the manufacturer's instructions.

. Power transmission elements should be balanced after fitting and must not give rise to any impermissible radial or axial forces (see the "Gear motor" or "Explosion-Proof Drives" catalogs for permitted values).

Note:

Assembly is easier if you first apply lubricant to the output element or heat it up briefly
(to 80 ... 100 °C).

Installing couplings

Couplings must be mounted and balanced according to the information provided by the coupling manufacturer:

a) Maximum and minimum clearance

b) Axial misalignment

c) Angular misalignment

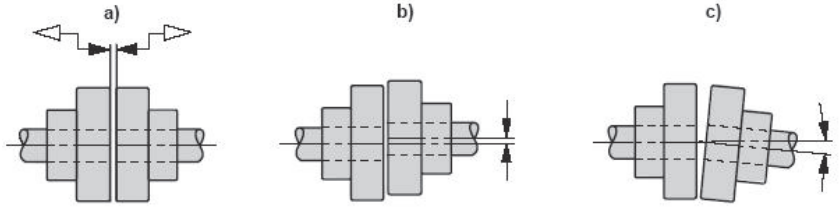


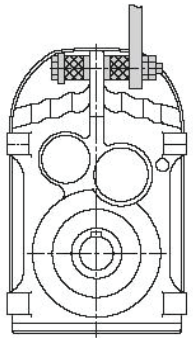
Fig: Clearance and misalignment for coupling installation

Input and output elements such as belt pulleys, couplings, etc. must be protected against contact!

4.5 Torque arms for mounted gear units

Parallel shaft helical gear units

Do not place torque arms under strain during installation!



Helical-bevel gear units

. Bush with bearings on both ends → (1).

. Install connection end B as a mirror image of A.

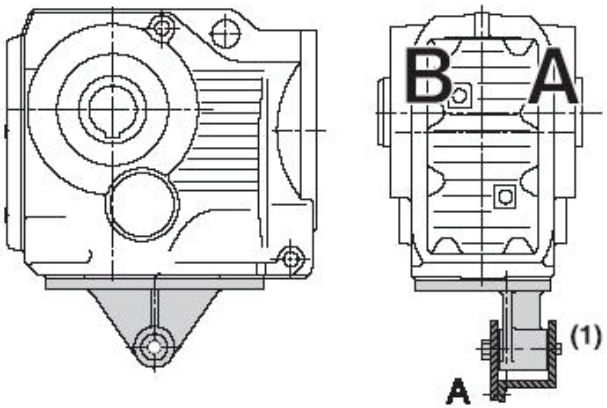


Fig: Torque arm for parallel shaft helical

Gearbox Type	Bolts	Tightening Torque
KA37	4 × M10 × 25 -8.8	48 Nm
KA47	4 × M10 × 30- 8.8	48 Nm
KA67	4 × M12 × 35- 8.8	86 Nm
KA77	4 × M16 × 40 -8.8	210 Nm
KA87	4 × M16 × 45 - 8.8	210 Nm
KA97	4 × M20 × 50- 8.8	410 Nm
KA107	4 × M24 × 60 -8.8	710 Nm
KA127	4 × M36 × 130 - 8.8	2500 Nm
KA157	4 × M36 × 130 -8.8	2500 Nm

Helical-worm gear units

. Bush with bearings on both ends → (1).

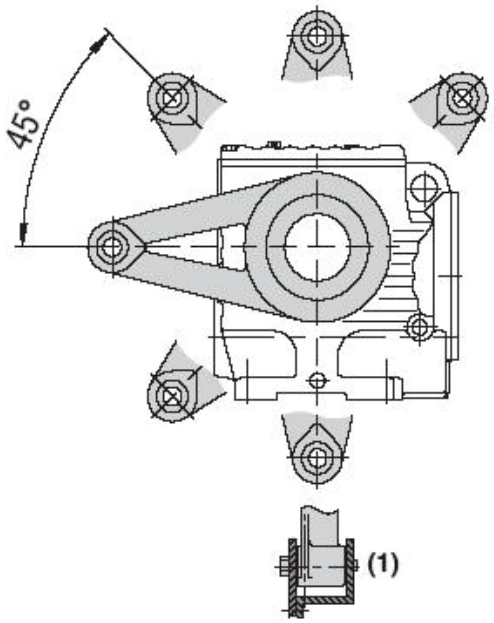


Fig: Torque arm for helical-worm gear units

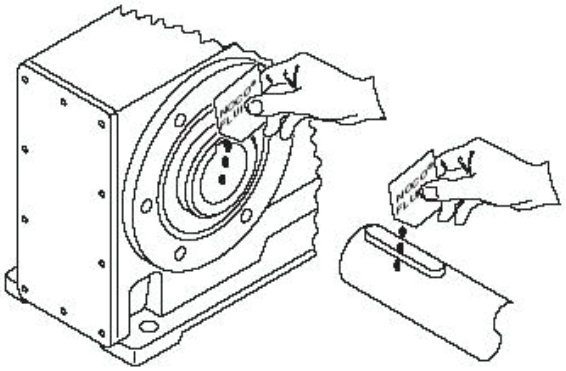
Gearbox Type	Bolts	Tightening Torque
SA37	M6 × 16- 8.8	11 Nm
SA47	M8 × 20 - 8.8	25 Nm
SA57	M8 × 20 -8.8	25 Nm
SA67	M12 × 25-8.8	86 Nm
SA77	M12 × 35 -8.8	86 Nm
SA87	M16 × 35- 8.8	210 Nm
SA97	M16 × 35- 8.8	210 Nm

4.6 Mounted gear unit with key way or splined hollow shaft

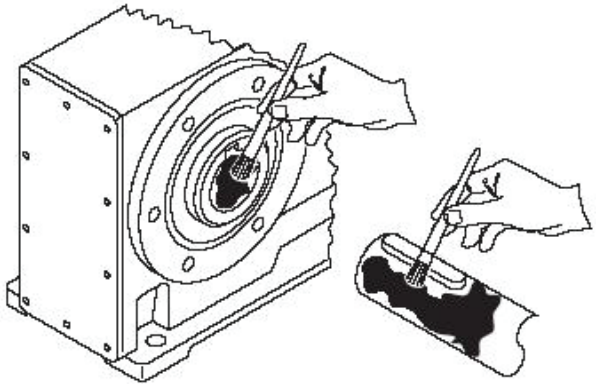
For the configuration of customer shafts, please also refer to the design notes in the Gear motors catalog!

Installation notes

1. Apply Grease.

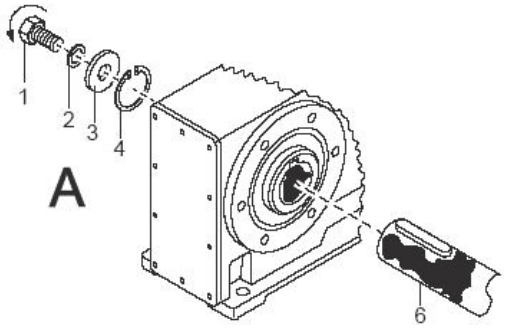


2. Distribute the Grease carefully.



3. Install the shaft and secure it axially
(mounting is facilitated by using a mounting device)

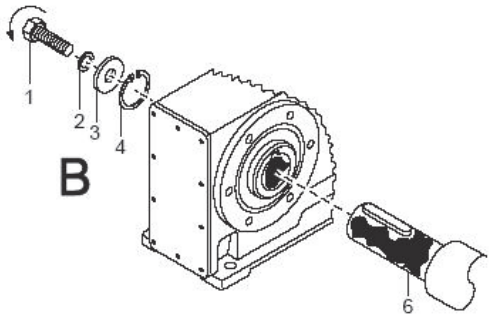
3A: Mounting with standard scope of delivery



1 Short retaining bolt (standard scope of delivery)
2 Lock washer
3 Washer
4 Circlip
6 Customer shaft

3B: Assembly with F L K assembly/disassemble kit

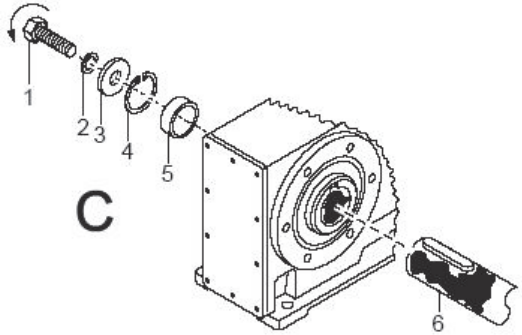
. Customer’s shaft with contact shoulder



1 Retaining bolt
2 Lock washer
3 Washer
4 Circlip
6 Customer's shaft with contact shoulder

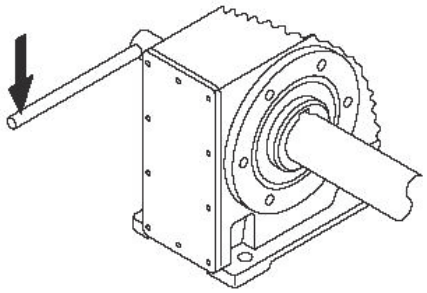
3C: Assembly with F L K assembly/disassemble kit

. Customer’s shaft without contact shoulder



1 Retaining bolt
2 Lock washer
3 Washer
4 Circlip
5 Spacer
6 Customer's shaft without contact shoulder

4. Tighten the retaining bolt to the appropriate torque (see table).



Bolt	Tightening torque [Nm]
M5	5
M6	8
M10/12	20
M16	40
M20	80
M24	200

Note:

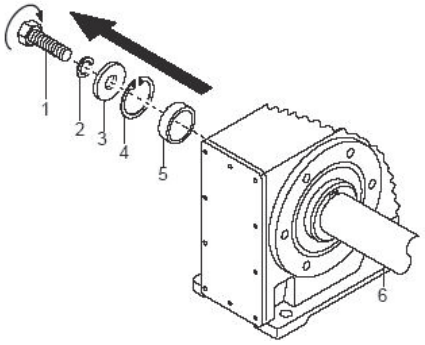
To avoid contact corrosion, we recommend that the customer's shaft should additionally be recessed between the two contact surfaces!

Removal notes

This description is only applicable when the gear unit was assembled using the installation/removal kit from FLK (see the previous description, point 3B or 3C).

1. Loosen the retaining bolt [1].

2.Remove parts 2 to 4 and, if fitted, spacer 5.

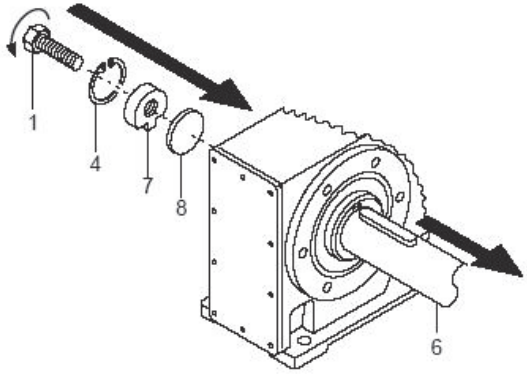


1 Retaining bolt
2 Lock washer
3 Washer
4 Circlip
5 Spacer
6 Customer shaft

3. Insert the forcing washer [8] and the fixed nut [7] from the FLK installation/removal kit between the customer's shaft [6] and the cir-clip [4].

4. Re-insert the Snap Ring. [4].

5. Screw the retaining bolt [1] back in. Now you can force the gear unit off the shaft by tightening the bolt.



1 Retaining bolt
4 Circlip
6 Customer shaft
7 Fixed nut
8 Forcing washer

F L K installation/removal kit

The FLK installation/removal kit can be ordered under the following part number.

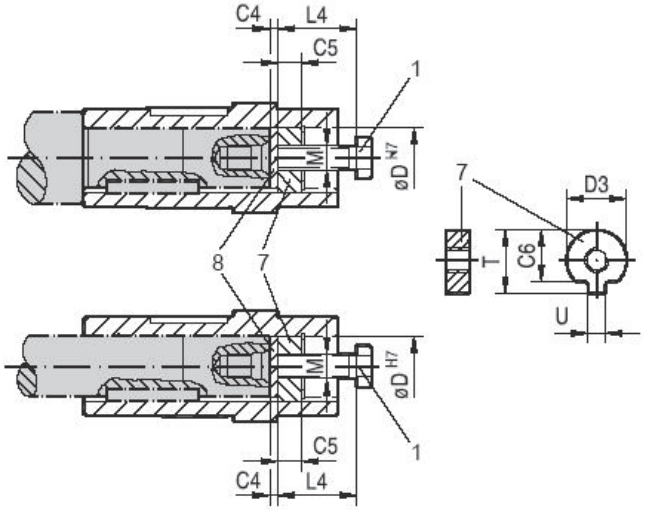


Fig: F L K installation/removal kit

1 Retaining bolt

7 Fixed nut for disassemble

8 Forcing washer

M：Fixed Screw

The application is described here used to fasten the user's shaft Donly installation package by F L K adoption.

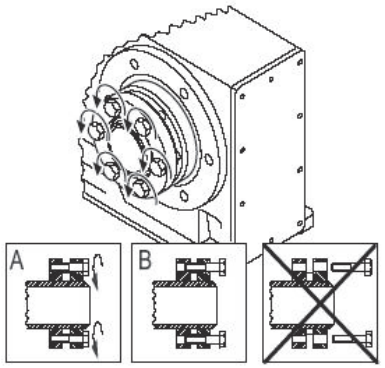
You must always check whether this design can compensate the axial loads. In particular applications (e.g. mounting mixer shafts), a different design may have to be used to secure the shaft axially. In these cases, customers can use their own devices. However, you must ensure that these designs do not cause potential sources of combustion according to ISO.

4.7 Mounted gear units with shrink disc

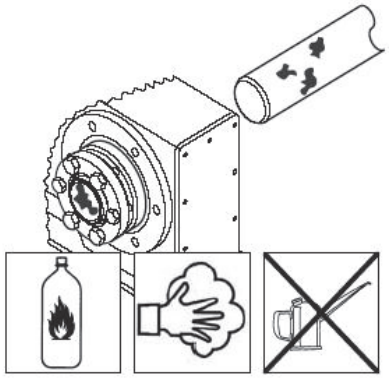
Installation notes .

Do not tighten the locking bolts unless the shaft is installed - the hollow shaft could become deformed!

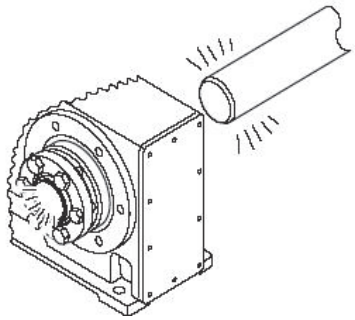
1. Loosen the locking bolts by a few turns (do not unscrew them completely!).



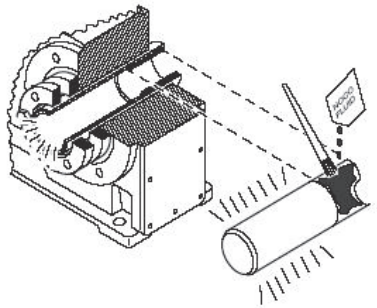
2. Carefully degrease the hollow shaft hole and the input shaft.



3. Hollow shaft/input shaft after degreasing



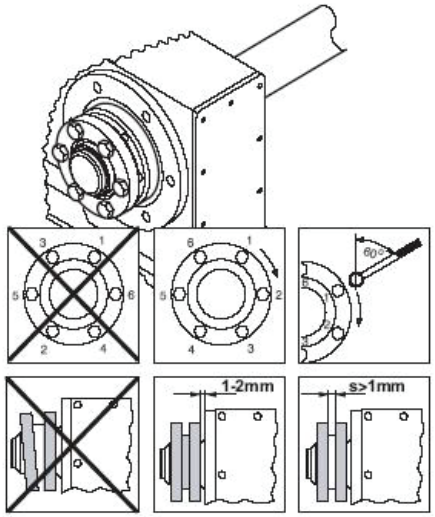
4. Apply NOCO® fluid to the input shaft[1)] in the area of the bushing.



1) It is essential to make sure that the clamping area of the shrink disk is free from grease!

For this reason, never apply fluid directly to the bushing as the paste may be able to get into the clamping area of the shrink disk when the input shaft is put on.

5. Install the input shaft, making sure that the locking collars of the shrink disk are installed in parallel to each other2). For gear unit housing with a shaft collar, mount the shrink disc to the stop on the shaft collar. For gear unit housing without a shaft collar, mount the shrink disk with a clearance of 1 to 2 mm from the gear unit housing. Tighten the locking bolts with the torque wrench by working round several times from one bolt to the next (not in diametrically opposite sequence) until the bolts cannot be tightened any more. See the following table for tightening torque.



2)After installation

. There must be gap s > 1 mm between the locking collars

. Grease the outside of the hollow shaft in the area of the shrink disk to prevent corrosion.

Gear unit type			Bolt	Nm	◁ max.[1]
		SH37	M5	5	
KH37...77	FH37...77	SH47...77	M6	12	
KH87/97	FH87/97	SH87/97	M8	30	
KH107	FH107		M10	59	60°
KH127/157	FH127		M12	100	
KH167			M16	250	
KH187			M20	470	

1) Maximum tightening angle per cycle

Notes on removing the shrink disk

1. Unscrew the locking bolts evenly one after the other. Each locking bolt may only be unscrewed by about one quarter turn in the initial cycle. This is in order to avoid tilting and jamming the locking collars. Do not fully unscrew the locking bolts!

2. Remove the shaft or pull the hub off the shaft. (You must first remove any rust that may have formed between the hub and the end of the shaft.)

3. Pull the shrink disk off the hub.

Caution!

Risk of injury if the shrink disk is not removed correctly!

Cleaning and lubricating the shrink disk

There is no need to strip down and re-grease disassembled shrink disks before they are screwed back on.

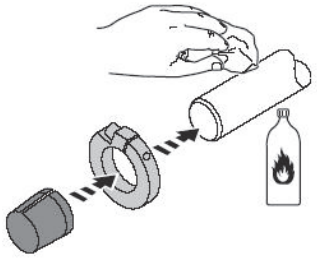
The shrink disk only needs to be cleaned and re-greased if it is contaminated.
Use one of the following solid lubricants for the tapered surfaces.

Lubricant (Mo S2)	Sold as
Molykote 321 (lube coat)	Spray
Molykote spray (powder spray)	Spray
Molykote G Rapid	Spray or paste
Aemasol MO 19P	Spray or paste
Aemasol DIO-sétral 57 N (lube coat)	Spray

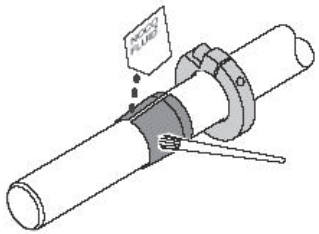
Grease the locking bolts with a multipurpose grease such as Molykote BR 2 or similar.

4.8 Mounted gear units with shrink disk.

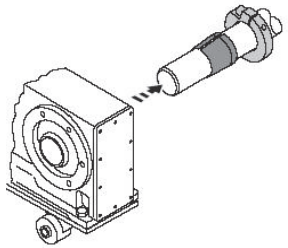
1. Clean the inside of the hollow shaft and the customer shaft. Ensure that all traces of grease or oil are removed.
2. Install the split ring and the bushing on the customer shaft.



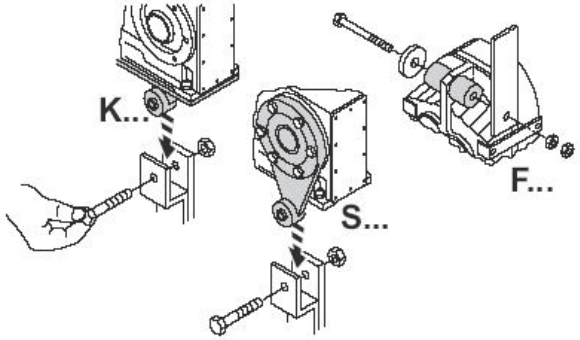
3. Apply fluid to the bushing and distribute it carefully.



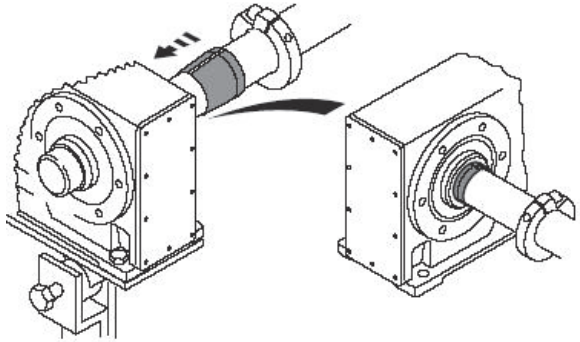
4. Push the gear unit onto the customer shaft.



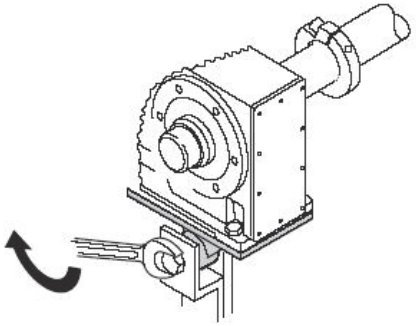
5. Preassemble the torque arm (do not tighten the bolts).



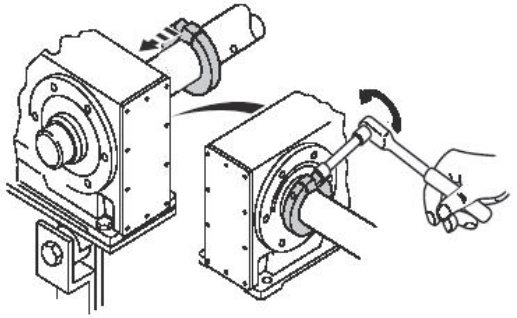
6. Push the busing onto the gear unit up to the stop.



7. Tighten all the retaining bolts for the torque arm.

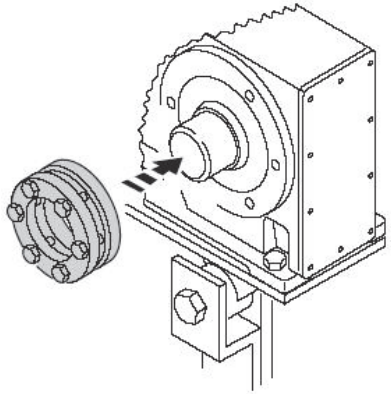


8. Secure the bushing with the split ring. Tighten the split ring on the bushing using the appropriate torque as specified in the following table.

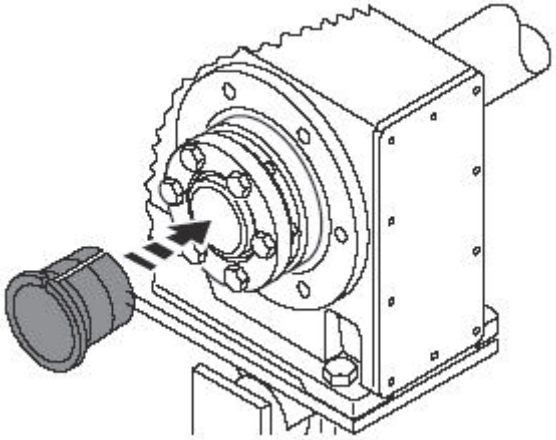


Type		Torque[Nm]	
K..T/F..T	S..T	Nickeling	Stainless Steel
	01	18	7.5
01	02	18	7.5
02	03	18	7.5
03、04	04	35	18
05	05	35	18
06	06	35	18
07	07	35	18

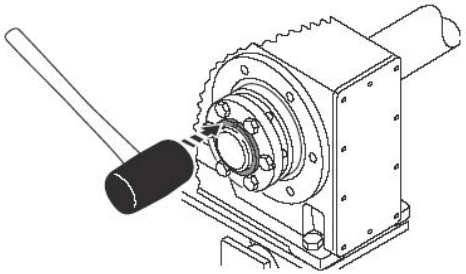
9. Slide the shrink disk onto the hollow shaft. Ensure that all bolts have been loosened.



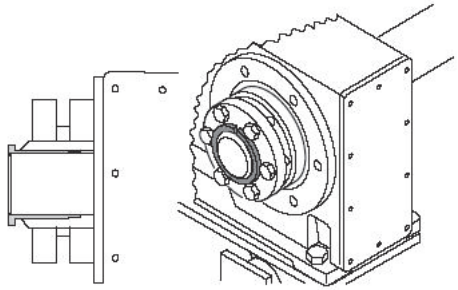
10.Push the counter bushing onto the customer shaft and into the hollow shaft or shrink disk right into the seat.



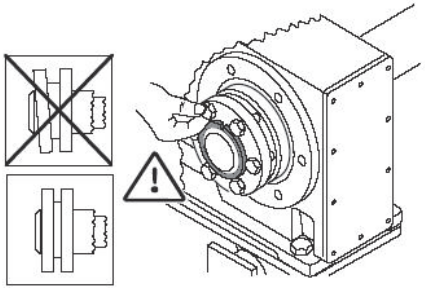
11.Tap lightly on the flange of the counter bushing to ensure that the socket is fitted securely in the hollow shaft.



12.Ensure that the customer shaft is fitted in the counter bushing.



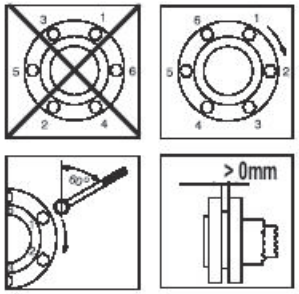
13.Tighten the bolts of the shrink disk by hand and ensure that the end rings of the shrink disc are parallel.

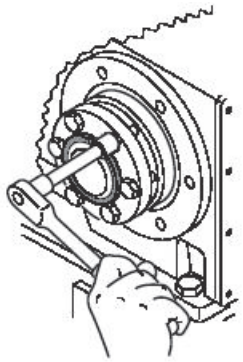


14.Tighten the locking bolts by working round several times from one bolt to the next (not in diametrically opposite sequence). See the table for

tightening torques.

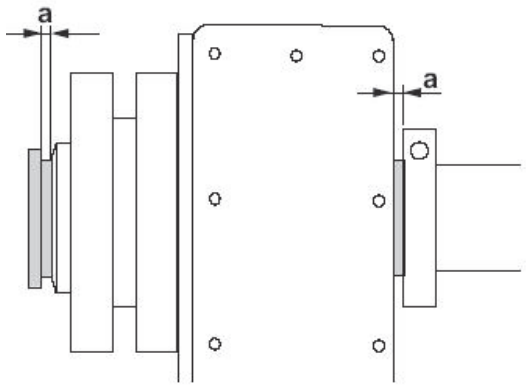
After installation, the remaining gap between the outer rings of the shrink discs must be > 0 mm.





Type		Torque[Nm]	
K..T/F..T	S..T	Nickeling	Stainless Steel
	01	4.1	6.8
01	02	10	6.8
02	03	12	6.8
03、04	04	12	15
05	05	30	30
06	06	30	50
07	07	30	50

15.The distance between the counter bushing and the hollow shaft end and between the split ring and the clamping ring must not exceed the following values. The following table lists the maximum and minimum gap width.



Type		Torque[Nm]	
K..T/F..T	S..T	Nickeling	Stainless Steel
	01	3.3	5.6
01	02	3.3	5.6
02	03	5	7.6
03、04	04	5	7.6
05	05	5	7.6
06	06	5.8	8.6
07	07	5.8	8.6

5 Start up

Prior to start up check that the oil level is as specified for the mounting position.

The oil checking and drain screws and the breather valves must be freely accessible.

5.1 Start up of helical-worm gear units

Note: The direction of rotation of the output shaft in series S..7 helical-worm gear units has been changed from CW to CCW. Change direction of rotation: Swap over two motor feeder cables.

Run-in period

helical-worm gear units require a run-in period of at least 24 hours before reaching their maximum efficiency. A separate run-in period applies for each direction of rotation if the gear unit is operated in both directions of rotation. The table shows the average power reduction during the run-in period.

No. of starts	Worm	
	Power reduction	i range
1 start	ca. 12 %	ca. 50...280
2 start	ca. 6 %	ca. 20...75
3 start	ca. 3 %	ca. 20...90
4 start	-	-
5 start	ca. 3 %	ca. 6...25
6 start	ca. 2 %	ca. 7...25

5.2 Start up of helical, parallel shaft helical and helical-bevel gear units

No special start up instructions are required for helical, parallel shaft helical and helical bevel gear units providing the gear units have been installed in accordance with Sec. "Mechanical Installation".

6 Inspection and Maintenance

6.1 Inspection and maintenance intervals

Frequency	What to do?
. Every 3000 machine hours, at least every 6 months.	. Check oil and oil level. . Check the seals visually for leakage. . For gear units with a torque arm: Check the rubber buffer and change it, if necessary
. Depending on the operating conditions (see chart below), every 3 years at the latest. . According to oil temperature.	. Change mineral oil. . Replace anti-friction bearing grease (recommendation). . Replace oil seal (do not install it in the same track).
. Depending on the operating conditions (see chart below), every 5 years at the latest. . According to oil temperature.	. Change synthetic oil . Replace anti-friction bearing grease (recommendation). . Replace oil seal (do not install it in the same track).
. Gear unitsR17, R27, F27 are have lubrication for life and are therefore maintenance-free	
.Varying (depending on external factors).	.Touch up or renew the surface/anti corrosion coating.

6.2 Lubricant change intervals

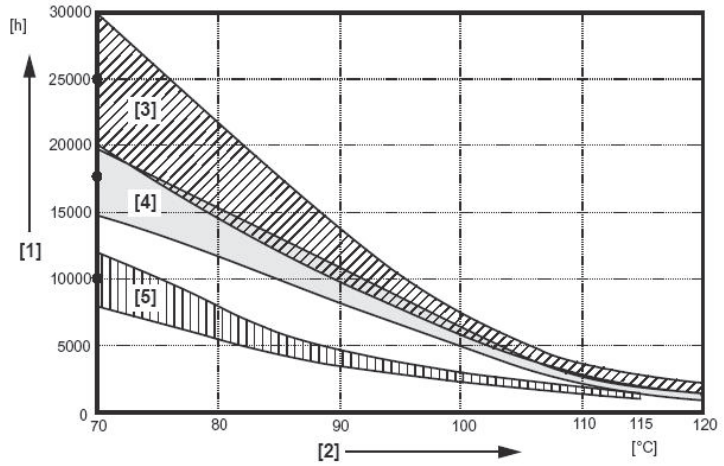


Fig: Oil change intervals for standard gear units under normal environmental conditions

[1] Operating hours [3] CLP PG

[2] Sustained oil bath temperature [4] CLP HC / HCE

. Average value per oil type at 70 °C [5] CLP / HLP / E

6.3 Inspection and maintenance of the gear unit

Do not intermix synthetic lubricants and do not mix synthetic and mineral lubricants together!

The standard lubricant is mineral oil.

The position of the oil level and oil drain plug and the breather valve depends on the mounting position. Refer to the diagrams of the mounting positions.

Checking the oil level

1. De-energize the gear motor and secure it to prevent it from being switched on inadvertently!

Wait until the gear unit has cooled off . Danger of burns!

2. Refer to Sec. "Installing the gear unit" when changing the mounting position!

3. For gear units with an oil level plug: Remove the oil level plug, check the fill level and

correct it if necessary. Screw the oil level plug back in.

Checking the oil

1. De-energize the gear motor and secure it to prevent it from being switched on inadvertently!

Wait until the gear unit has cooled off . Danger of burns!

2. Remove a little oil from the oil drain plug.

3. Check the oil consistency.

. Viscosity

. If you can see that the oil is heavily contaminated, we recommend that you change the oil even if this is outside the service intervals specified in "Inspection and maintenance periods".

4. For gear units with an oil level plug: Remove the oil level plug, check the fill level and correct it if necessary. Screw the oil level plug back in.

Changing the oil Only change the oil when the gear unit is at operating temperature.

Changing the oil

Only change the oil when the gear unit is at operating temperature

Switch off the gear motor and secure it to prevent it from being switched back on inadvertently!

Wait until the gear unit cools down - Danger of burns!

Note: The gear unit must still be warm otherwise the high viscosity of excessively cold oil will make it harder to drain the oil correctly.

With oil drain plug / oil level screw

1. Place a container underneath the oil drain plug
2. Remove the oil level plug, breather plug/breather valve and oil drain plug.
3. Drain all the oil.
4. Screw in the oil drain plug.
5. Pour in new oil of the same type through the vent hole (if changing the oil type, please first contact our customer service). Do not mix synthetic lubricants.

. Pour in the volume of oil in accordance with the mounting position (see Sec. "Lubricant fill quantities") or as specified on the nameplate.

. Check at the oil level plug.

6. Screw the oil level plug back in
7. Screw in the breather plug/breather valve.

Without oil drain plug / oil level plug

1. Remove cover plate.
2. Drain the oil through the cover plate opening.
3. Pour in new oil of the same type through the vent hole (if changing the oil type, please first contact our customer service). Do not mix synthetic lubricants.

. Pour in the volume of oil in accordance with the mounting position (see Sec. "Lubricant fill quantities") or as specified on the nameplate.

4. Check the oil level (→ Sec. "Check oil level for gear units with oil level plug")
5. Attach cover plate (observe the tightening torque and series → Sec. "Check the oil level for gear units without an oil level plug")

Changing the oil seal

1. Switch off the gear motor and secure it to prevent it from being switched on inadvertently!

Wait until the gear unit has cooled off . Danger of burns!

2. When changing the oil seal, ensure that there is a sufficient grease reservoir between the dust lip and protective lip, depending on the type of gear unit.
3. If you use double oil seals, the space has to be filled one-third with grease.

7 Malfunctions

Customer service

Please have the following information to hand if you require the assistance of our customer service:

- Data from the nameplate (complete)
- Nature and extent of the fault
- Time and peripheral circumstances of the fault
- Presumed cause

7.1 Gear unit malfunctions

Problem	Possible cause	Remedy
Unusual, regular running noise	A Meshing/grinding noise: Bearing damage. B Knocking noise: Irregularity in the gearing	A Check the oil (see Sec. "Inspection and Maintenance"), change bearings B Contact customer service
Unusual, irregular running noise	Foreign bodies in the oil	• Check the oil (see Sec. "Inspection and Maintenance") • Stop the drive, contact customer service
Oil leaking[1)] • From the gear cover plate • From the motor flange • From the motor oil seal • From the gear unit flange • From the output end oil seal	A Rubber seal on the gear cover plate leaking B Seal defective C Gear unit not vented	A Tighten the bolts on the gear cover plate and observe the gear unit. Oil still leaking: Contact customer service B Contact customer service C Vent the gear unit (see Sec. "Mounting Positions")
Oil leaking from breather valve	A Too much oil B Drive operated in incorrect mounting position C Frequent cold starts (oil foams) and/or high oil level	A Correct the oil level (see Sec. "Inspection and Maintenance") B Mount the breather valve correctly (see Sec. "Mounting Positions") and correct the oil level (see "Lubricants")
Output shaft does not turn although the motor is running or the input shaft is rotated	Connection between shaft and hub in gear unit interrupted	Send in the gear unit/gearmotor for repair

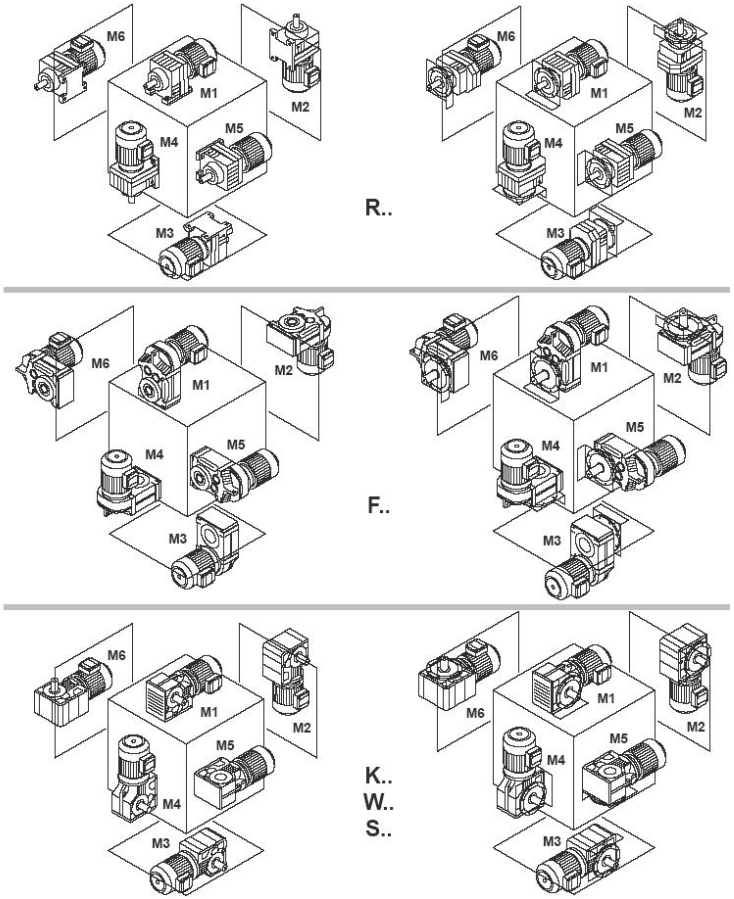
1) Short-term oil/grease leakage at the oil seal is possible in the run-in phase (24 hours running time).

8 Mounting Positions

8.1 General information on mounting positions

Mounting position designation

DONLY differentiates between six mounting positions M1 ... M6 for gear units. The following figure shows the spatial orientation of the gear motor in mounting positions M1 ... M6.



8.2 Key to the mounting position sheets

Symbols used

The following table shows the symbols used in the mounting position sheets and what they mean:

Symbol	Meaning
	Breather valve
	Oil level plug
	Oil drain plug

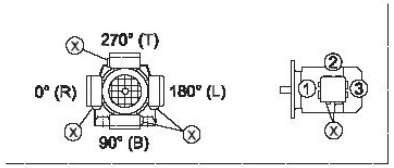
Churning losses

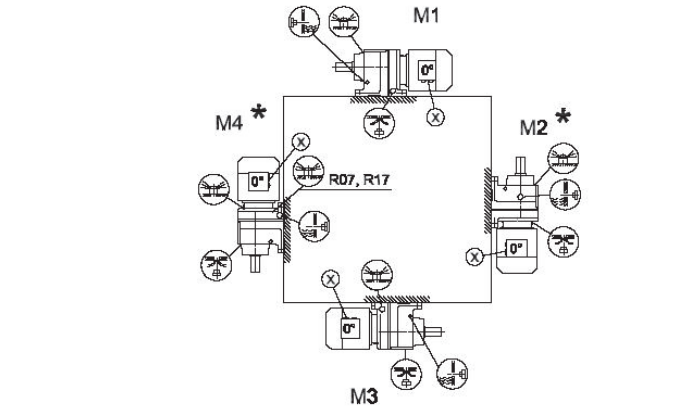
Increased churning losses may arise in some mounting positions. Contact F L K in case of the following combinations:

Mounting position	Gear unit type	Gear unit size	Input speed [1/min]
M2, M4	R	97 ... 107	> 2500
		> 107	>1500
M2, M3, M4, M5, M6	F	97 ... 107	> 2500
		> 107	> 1500
	K	77 ... 107	> 2500
		> 107	> 1500
	S	77 ... 97	> 2500

8.3 Mounting positions for R helical gear motors

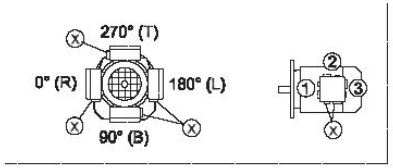
R17~R167

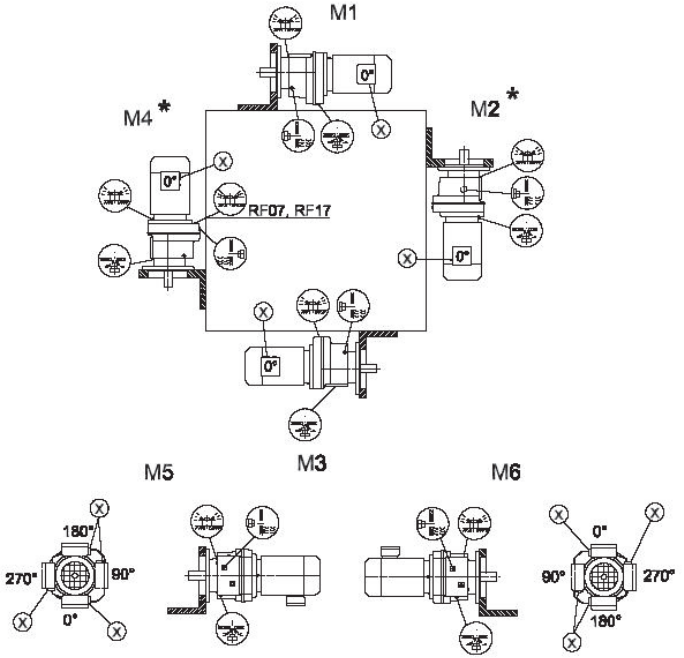




R07		M1, M2 , M3 , M5 , M6
R17, R27		M1, M3 , M5 , M6
R07, R17, R27		
R47, R57		M5

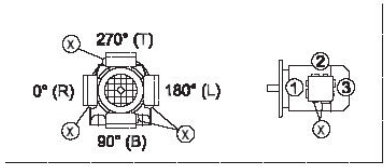
RF27~RF167

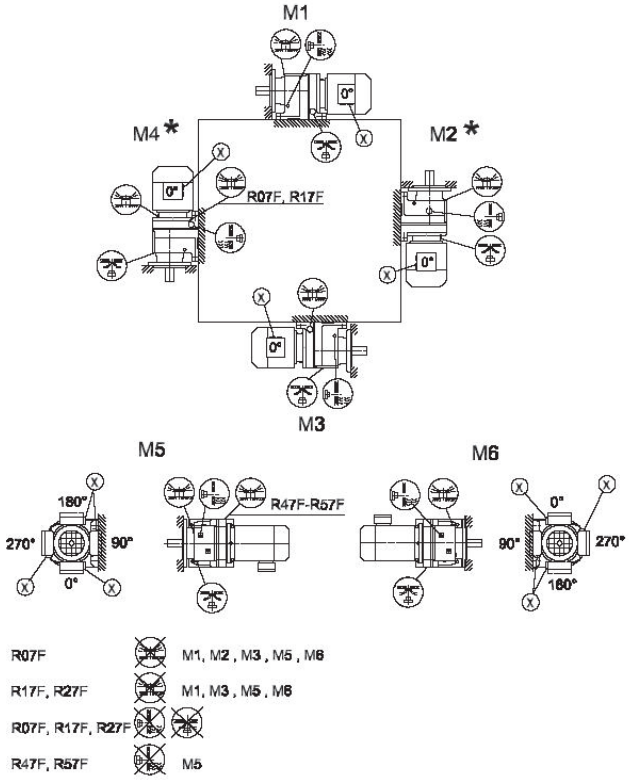




RF07		M1, M2 , M3 , M5 , M6
RF17, RF27		M1, M3 , M5 , M6
RF07, RF17, RF27		
RF47, RF57		M5

R57F~R107F

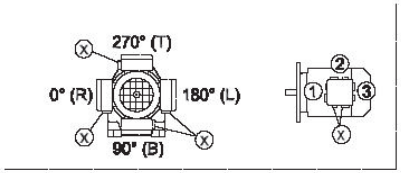


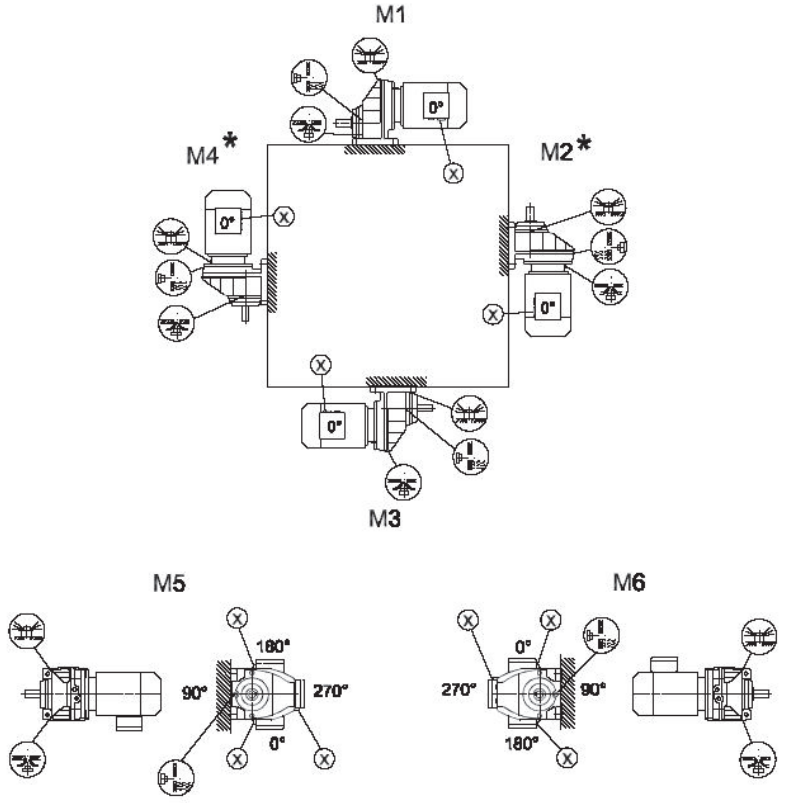


Important: See the information in the "Gear motors" catalog, section "Project Planning for Gear Units/Overhung and axial loads."

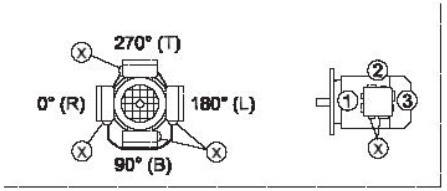
8.4 Mounting positions of RX helical gear motors

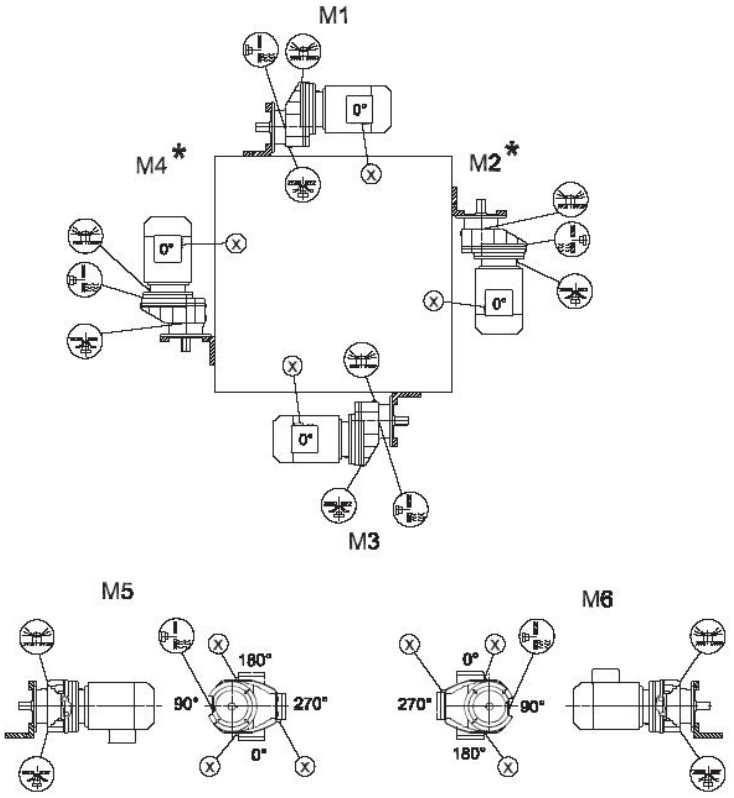
RX57~RX107





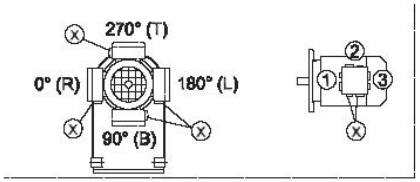
RXF57~ RXF107

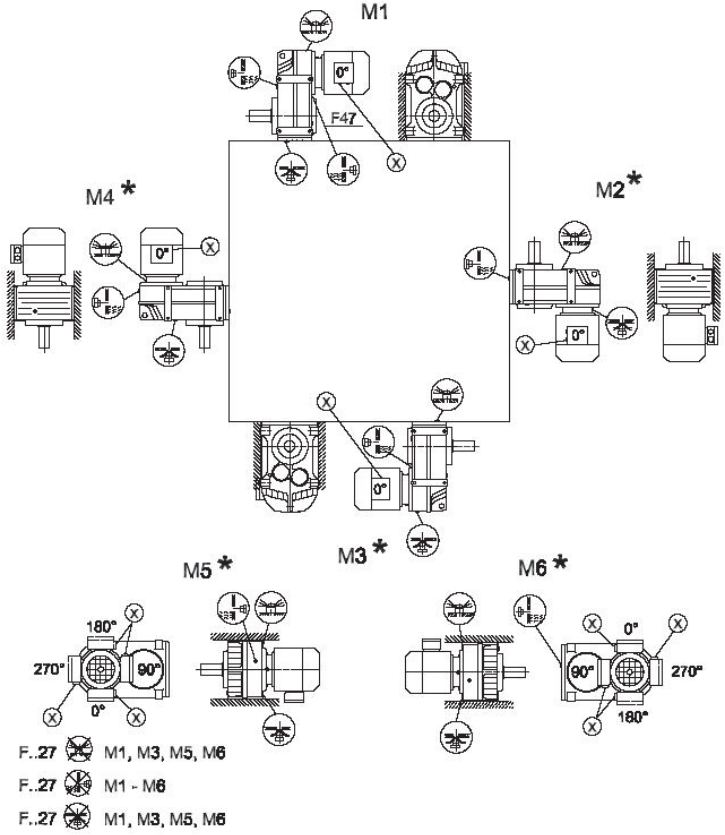




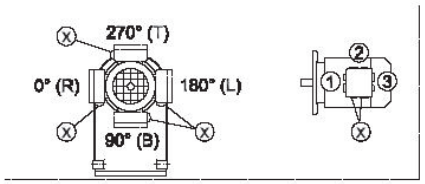
8.5 Mounting positions for parallel shaft helical gear motors

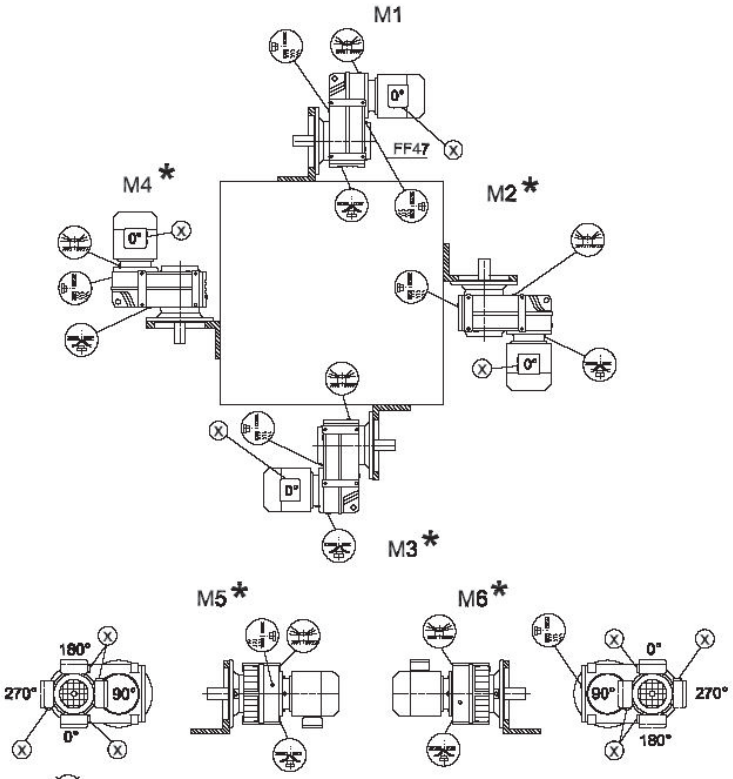
F/FA..B/FH, FV





FF/FAF/FHF/FAZ/FHZ, FVF/FVZ



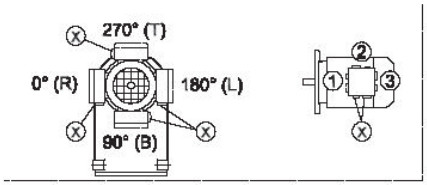


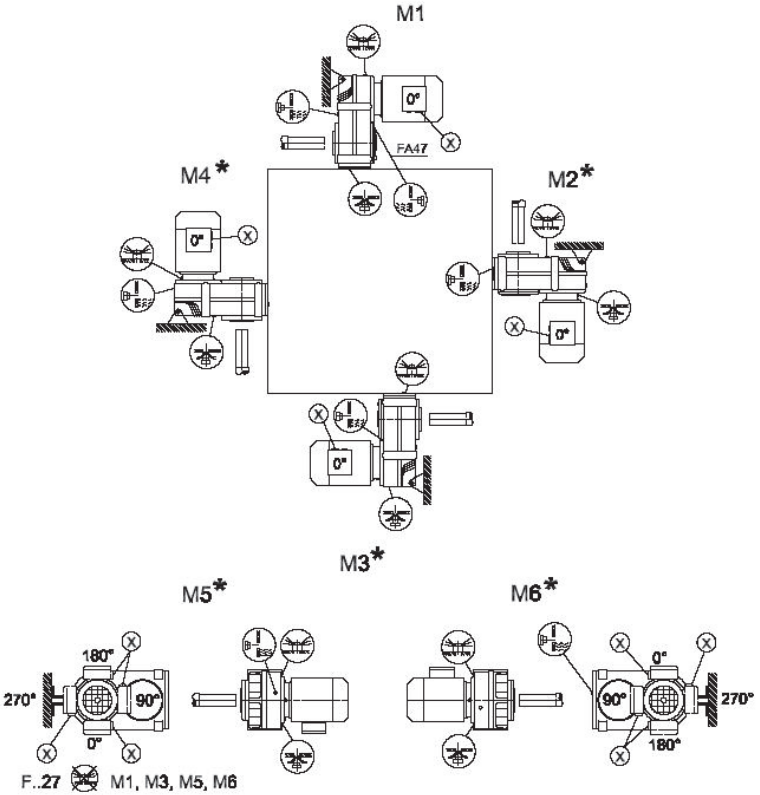
F..27 M1, M3, M5, M6

F..27 M1 - M6

F..27 M1, M3, M5, M6

FA/FH, FV





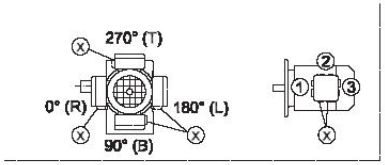
F..27 M1, M3, M5, M6

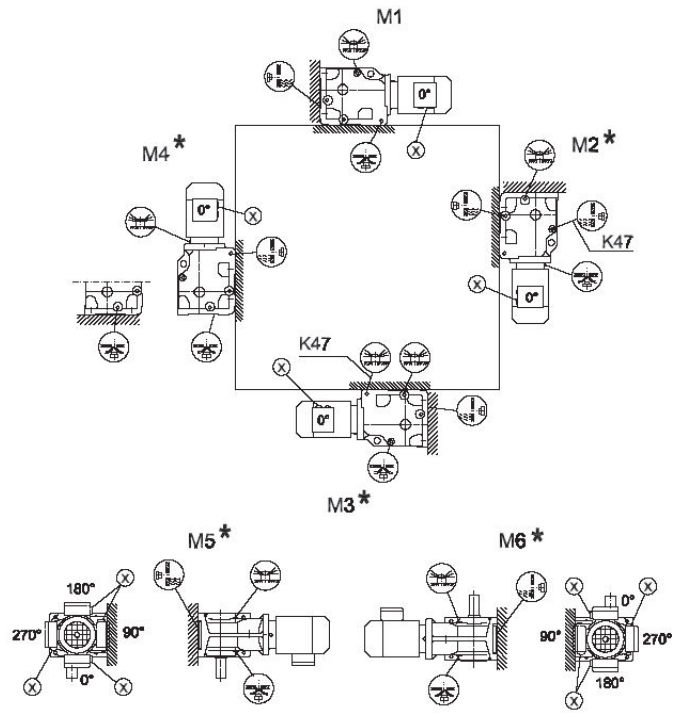
F..27 M1 - M6

F..27 M1, M3, M5, M6

8.6 Mounting positions for helical-bevel gear motors

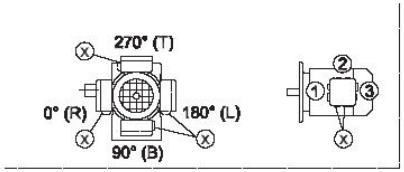
K/KA..B/KH, KV...B

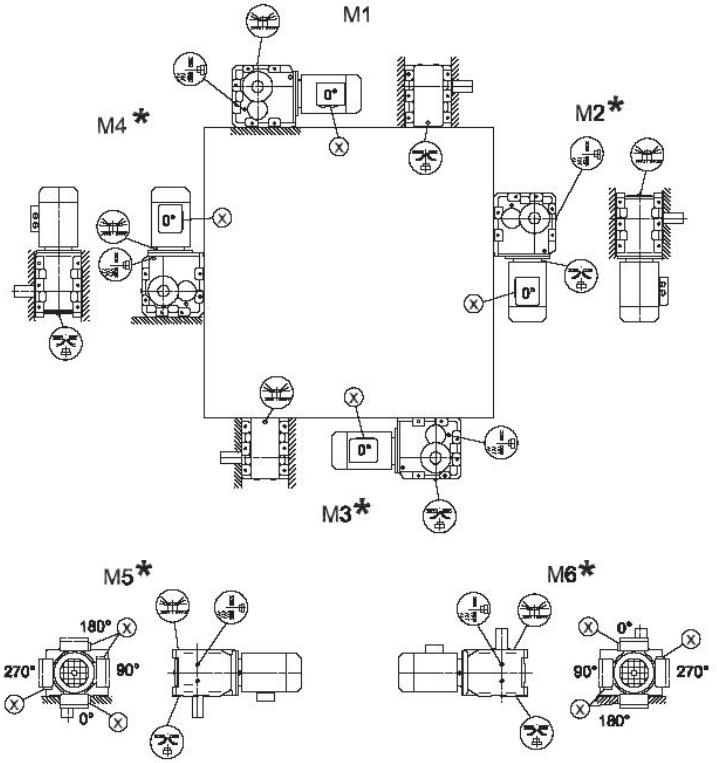




Important: See the information in the "Gear motors" catalog, section "Project Planning for Gear Units/Overhung and axial loads."

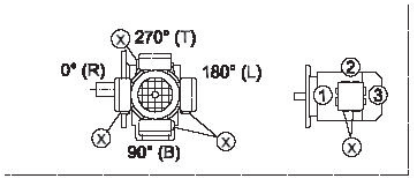
K, KHB

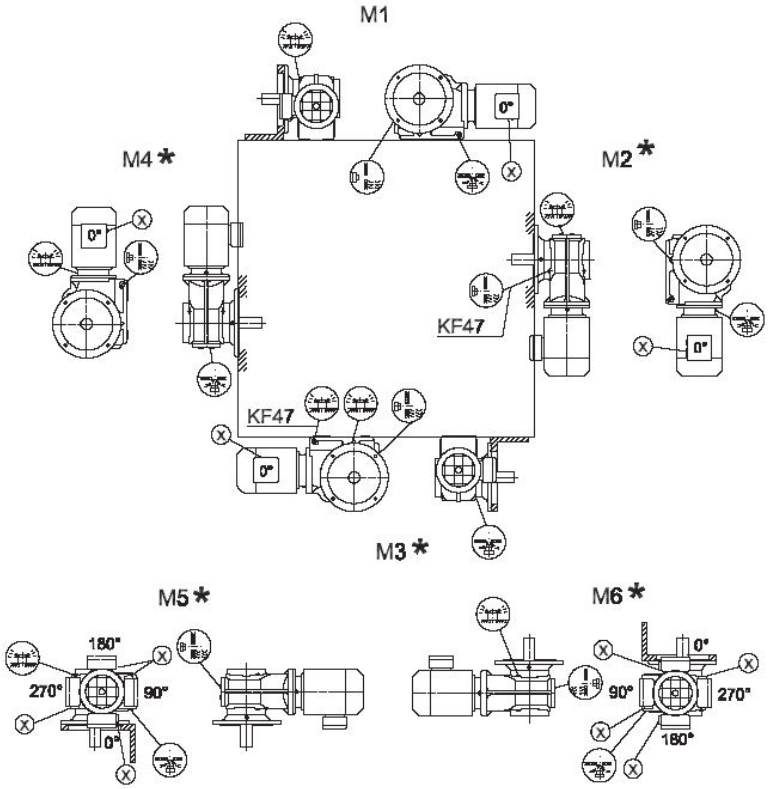




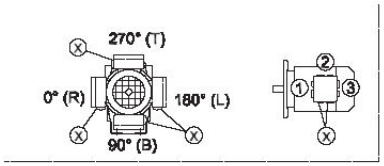
Important: See the information in the "Gear motors" catalog, section "Project Planning for Gear Units/Overhung and axial loads."

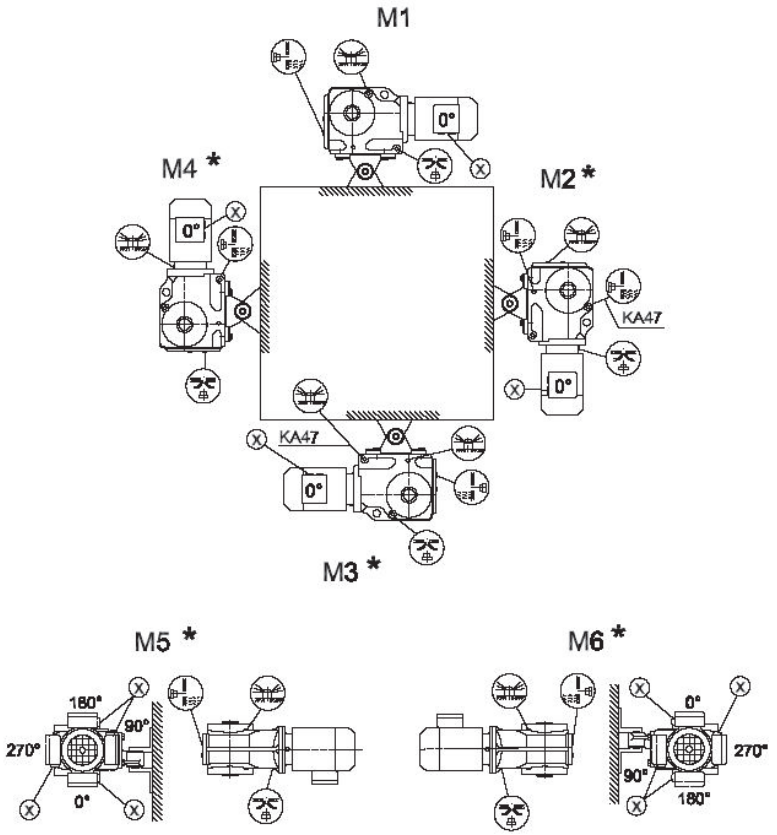
KF/KAF/KHF/KAZ/KHZ,KVF/KVZ



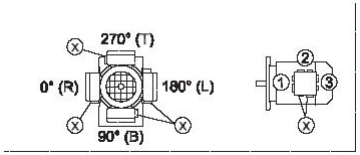


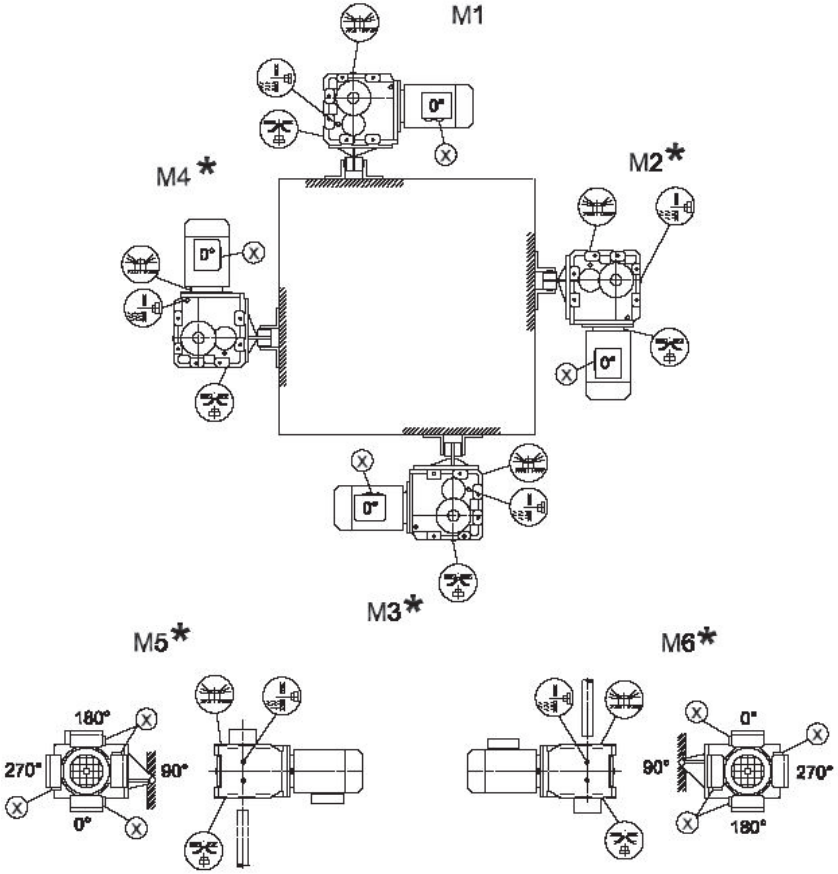
KA/KH, KV,KT





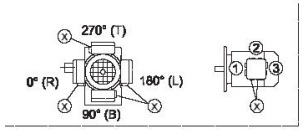
KH

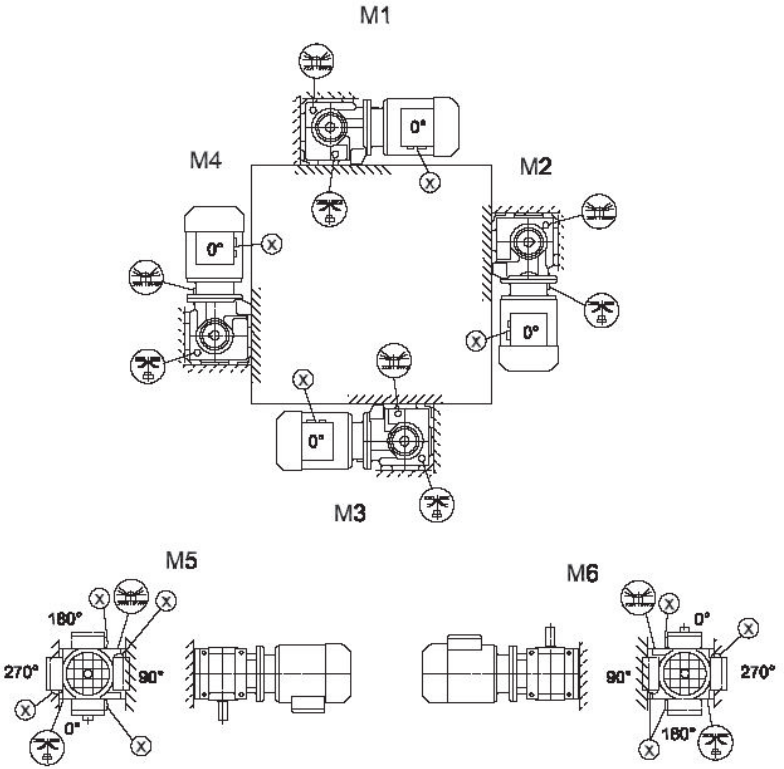




8.7 Mounting positions for helical-worm gear motors

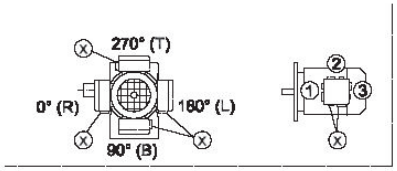
S series

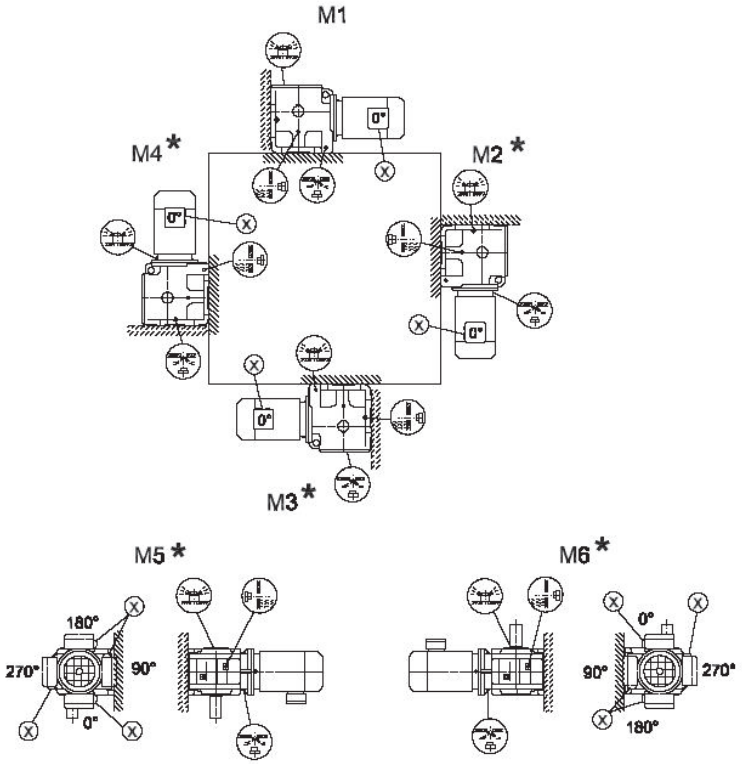




Important: See the information in the "Gear motors" catalog, section "Project Planning for Gear Units/Overhung and axial loads."

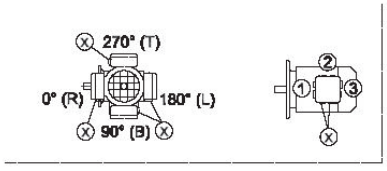
S

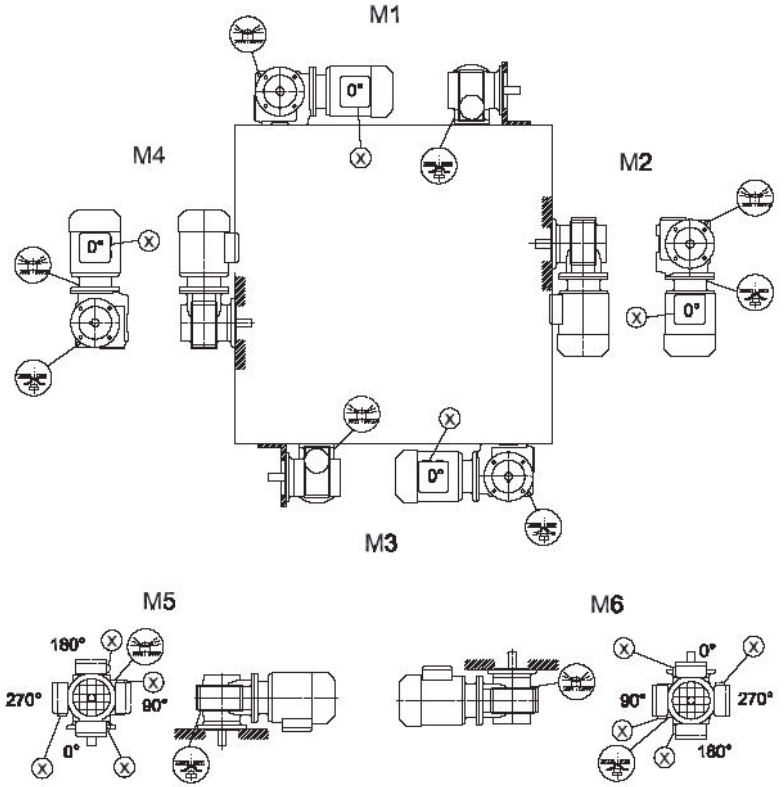




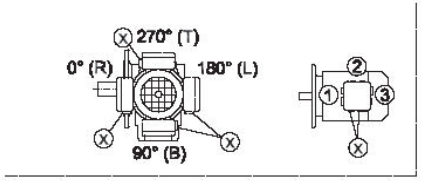
Important: See the information in the "Gear motors" catalog, section "Project Planning for Gear Units/Overhung and axial loads."

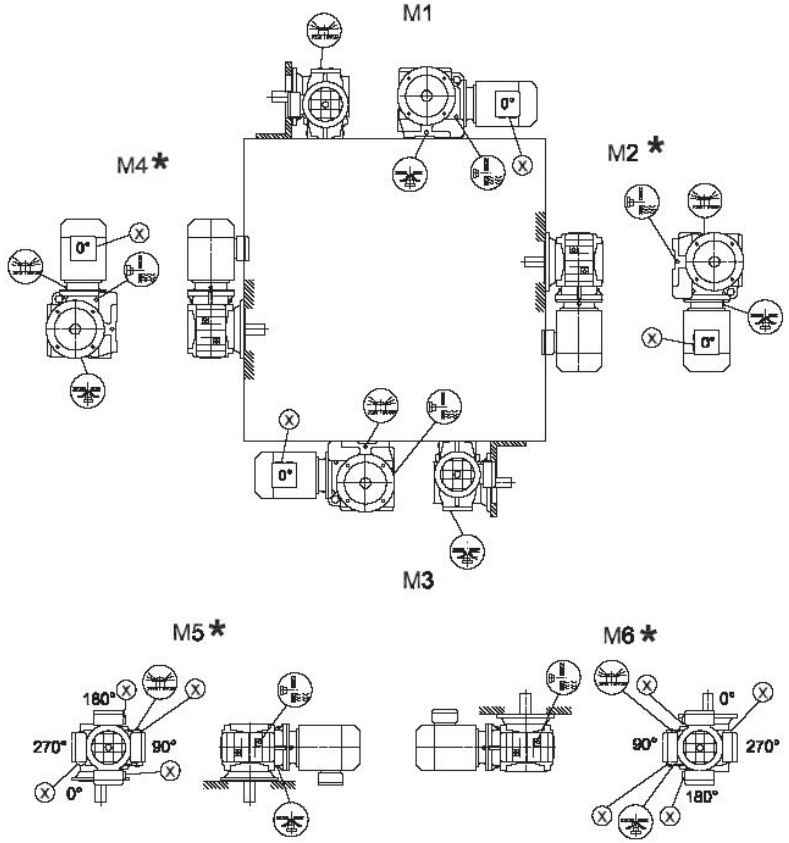
SF/SAF/SHF



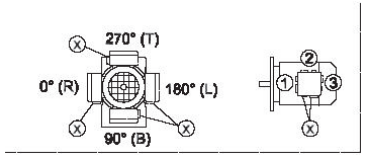


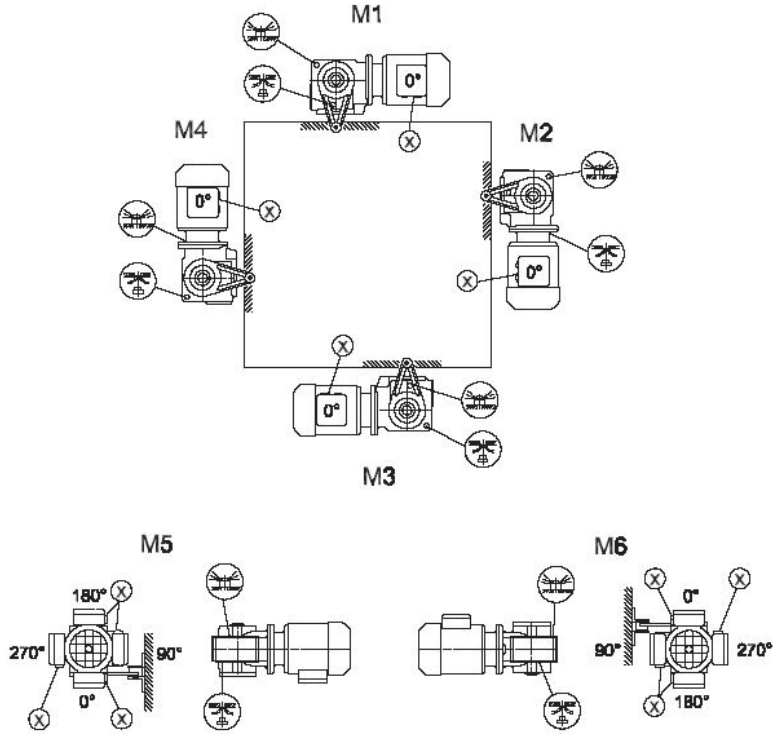
SF/SAF/SHF/SAZ/SHZ



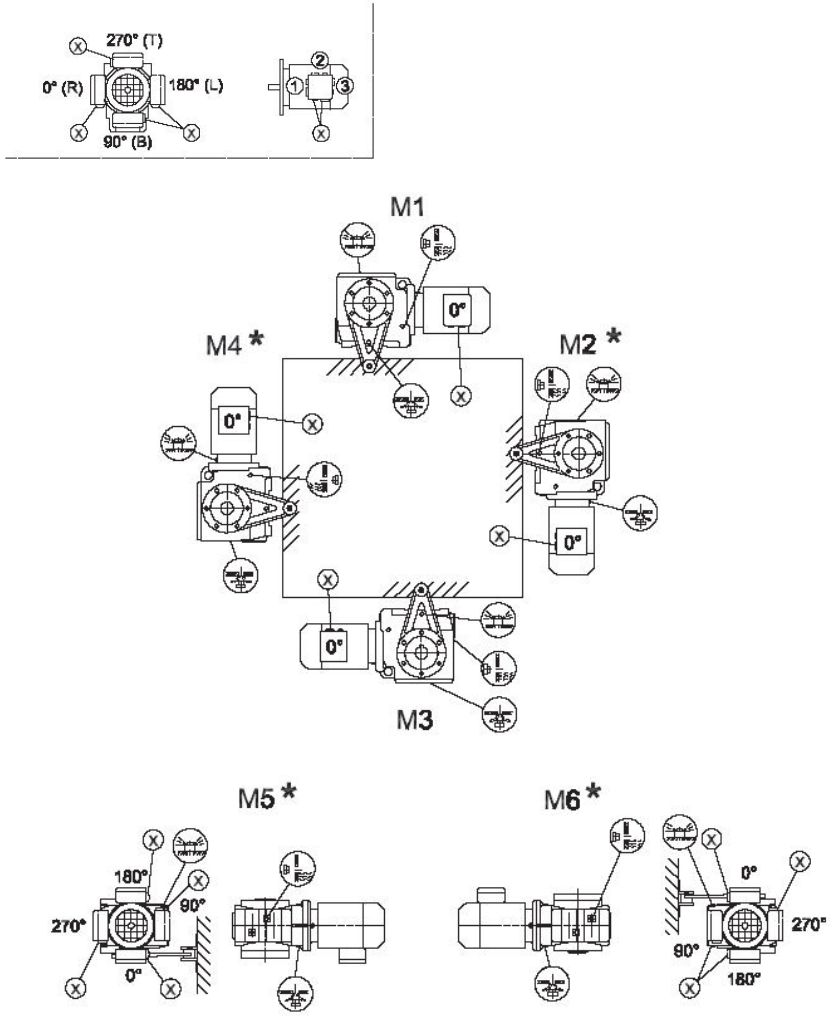


SA/SH/SAT





SA/SH/ST



9 Lubricants

Brief Introduction

Unless a special arrangement is made, FLK supplies the drives with a lubricant fill adapted for the specific gear unit and mounting position. The decisive factor is the mounting position (M1~M6, →"Mounting Positions and Important Order Information") specified when ordering the drive. You must adapt the lubricant fill to any subsequent changes made to the mounting position (→ Lubricant fill quantities).

9.1 Lubricant table

The lubricant table on the following page shows the permitted lubricants for FLK gear units. Please note the following key to the lubricant table.

Key to the lubricant table

Abbreviations used, meaning of shading and notes:

CLP = Mineral oil

CLP PG = Polyethylene Glycol

CLP HC = Synthetic hydrocarbons

E = Ester oil

HCE = Synthetic hydrocarbons + ester oil

HLP = Hydraulic oil

= Synthetic lubricant (= synthetic anti-friction bearing grease)

= Mineral lubricant (= mineral-based anti-friction bearing grease)

1) Helical-worm gear units with PG oil: Please contact FLK

2) Special lubricant for Spiro plan. gear units only

3) Recommendation: Select F L K fB ≥ 1.2

4) Pay attention to critical starting behavior at low temperatures!

5) Low-viscosity grease

6) Ambient temperature

Lubricant for the food industry (food grade oil)

Biodegradable oil (lubricant for use in agriculture, forestry and water resources)

Anti-friction bearing greases

The anti-friction bearings in gear units and motors are given a factory-fill with the greases listed below. FLK recommends regreasing anti-friction bearings with a grease fill at the same time as changing the oil.

	Ambient temperature	Manufacturer	Type
Anti-friction bearing in gear unit	-20 °C ... +60 °C	Mobil	Mobilux EP 2
	-40 °C ... +80 °C	Mobil	Mobiltemp SHC 100
Anti-friction bearing in motor	-20 °C ... +80 °C	Esso	Unirex EQ3
	-20 °C ... +60 °C	Shell	Alvania RL3
	+80 °C ... +100 °C	Klüber	Barrierta L55/2
	-45 °C ... -25 °C	Shell	Aero Shell Grease 16
Special greases for anti-friction bearings in gear units:			
	-30 °C ... +40 °C	Aral	Eural Grease EP 2
	-20 °C ... +40 °C	Aral	Aralube BAB EP2

The following grease quantities are required:

. For fast-running bearings (motor and gear unit input end): Fill the cavities between the rolling elements one third full with grease.

. For slow-running bearings (in gear units and at gear unit output end): Fill the cavities between the rolling elements two thirds full with grease.

Lubricant table

	6) °C	DIN (ISO)	ISO.NLGI	Mobil®	Shell		ARAL	bp	Tribol		Optimol	FUCHS
R...	Standard -10 ... +40	CLP(CC)	VG 220	Mobilgear 630	Shell Omala 220	Klüberoil GEM 1-220	Aral Degol BG 220	BP Energol GR-XP 220	Tribol 1100/220	Meropa 220	Optigear BM 220	Renolin CLP 220
	-25 ... +80	CLP PG	VG 220	Mobil Glygoyle 30	Shell Tivela HD 220	Klübersynth GH 6-220	Aral Degol GS 220	BP Enersyn SG-XP 220	Tribol 800/220	Synlube CLP 220	Optiflex A 220	
	4) -40 ... +80	CLP HC	VG 220	Mobil SHC 630	Shell Omala HD 220	Klübersynth EG 4-220	Aral Degol PAS 220		Tribol 1510/220	Pinnacle EP 220	Optigear Synthetic A 220	Renolin Unisyn CLP 220
K...(HK...)	4) -40 ... +40		VG 150	Mobil SHC 629	Shell Omala HD 150	Klübersynth EG 4-150				Pinnacle EP 150		
	-20 ... +25	CLP (CC)	VG 150 VG 100	Mobilgear 627	Shell Omala 100	Klüberoil GEM 1-150	Aral Degol BG 100	BP Energol GR-XP 100	Tribol 1100/100	Meropa 150	Optigear BM 100	Renolin CLP 150
F...	-30 ... +10	HLP (HM)	VG 68-46 VG 32	Mobil D.T.E. 13M	Shell Tellus T 32	Klüberoil GEM 1-68	Aral Degol BG 46		Tribol 1100/68	Rando EP Ashless 46	Optigear 32	Renolin B 46 HVI
	4) -40 ... +10	CLP HC	VG 32	Mobil SHC 624		Klüber-Summit HySyn FG-32				Cetus PAO 46		
	4) -40 ... +20	HLP (HM)	VG 22 VG 15	Mobil D.T.E. 11M	Shell Tellus T 15	Isoflex MT 30 ROT		BP Energol HLP-HM 15		Rando HDZ 15		
S...(HS...)	Standard 0 ... +40	CLP (CC)	VG 680	Mobilgear 636	Shell Omala 680	Klüberoil GEM 1-680	Aral Degol BG 680	BP Energol GR-XP 680	Tribol 1100/680	Meropa 680	Optigear BM 680	Renolin CLP 680
	-20 ... +60	CLP PG	VG 680 1)		Shell Tivela S 680	Klübersynth GH 6-680		BP Enersyn SG-XP 680	Tribol 800/680	Synlube CLP 680		
	4) -30 ... +80	CLP HC	VG 460	Mobil SHC 634	Shell Omala HD 460	Klübersynth EG 4-460				Pinnacle EP 460		
	4) -40 ... +10		VG 150	Mobil SHC 629	Shell Omala HD 150	Klübersynth EG 4-150				Pinnacle EP 150		
	-20 ... +10	CLP (CC)	VG 150 VG 100	Mobilgear 627	Shell Omala 100	Klüberoil GEM 1-150	Aral Degol BG 100	BP Energol GR-XP 100	Tribol 1100/100	Meropa 100	Optigear BM 100	Renolin CLP 150
	-25 ... +20	CLP PG	VG 220 1)	Mobil Glygoyle 30	Shell Tivela S 220	Klübersynth GH 6-220			Tribol 800/220	Synlube CLP 220	Optiflex A 220	
	4) -40 ... 0	CLP HC	VG 32	Mobil SHC 624		Klüber-Summit HySyn FG-32				Cetus PAO 46		
R...K...(HK...), F...,S...(HS...)	4) -30 ... +40	HCE	VG 460		Shell Caseida Fluid GL 460	Klüberoil 4UH1-460 N	Aral Eural Gear 460				Optileb GT 460	
	-20 ... +40	E	VG 460			Klüberbio CA2-460	Aral Degol BAB 460				Optisynt BS 460	

9.2 Lubricant fill quantities

The specified fill quantities are recommended values. The precise values vary depending on the number of stages and gear ratio. When filling, it is essential to check the oil level plug since it indicates the precise oil capacity.

The following tables show guide values for lubricant fill quantities in relation to the mounting position M1 ... M6.

Helical (R RX) gear units

机型号 / Size	润滑油量(升) / Lubricant (liter)					
	M1 [1)]	M2 [1)]	M3	M4	M5	M6
R27	0.25/0.4	0.7	0.4	0.7	0.4	0.4
R37	0.4/1	0.9	1	1.1	0.8	1
R47	0.75/1.5	1.6	1.5	1.7	1.5	1.5
R57	0.8/1.7	1.8	1.7	2	1.7	1.7
R67	1.2/2.5	2.7/3.6	2.7	3.1	1.9	2.1
R77	1.2/2.6	3.8/4.1	3.3	4.1	2.4	3
R87	2.4/6	6.8/7.9	7.1	7.7	6.3	6.4
R97	5.1/10.2	11.9/14	11.2	14	11.2	11.8
R107	6.3/14.9	15.9	17	19.2	13.1	15.9
R137	9.5/25	27	29	32.5	25	25
R147	16.4/42	47	48	52	42	42
R167	26/70	82	78	88	65	71

机型号 / Size	润滑油量(升) / Lubricant (liter)					
	M1 [1)]	M2 [1)]	M3	M4	M5	M6
RX57/RXF57	0.6/0.5	0.8	1.3/1.1	1.3/1.1	0.9/0.7	0.9/0.7
RX67/RXF67	0.8/0.7	0.8	1.7/1.5	1.9/1.7	1.1/1	1.1/1
RX77/RXF77	1.1/0.9	1.5	2.6/2.4	2.7/2.5	1.6	1.6
RX87/RXF87	1.7/16	2.5	4.8/4.9	4.8/4.7	2.9	2.9
RX97/RXF97	2.1	3.4/3.6	7.4/7.1	7	4.8	4.8
RX107/RXF107	3.9/3.1	5.6/5.9	11.6/11.2	11.9/10.5	7.7/7.2	7.7/7.2

注: 1)表示减速机为组合型时低速级所加油量为大值。 2.表中数值仅为参考值, 具体以减速机油位孔位为准。

Note: 1) Combinational type at low speed is the maximum quantity of oil.

2) Data in the table is for reference, operation is subject to oil level and oil sight glass.

Parallel shaft helical (F) gear units F.., FAB.., FHB.., FVB..:

机型号 / Size	润滑油量(升) / Lubricant (liter)					
	M1	M2	M3	M4	M5	M6
F37	1	1.2	0.7	1.2	1	1.1
F47	1.5	1.8	1.1	1.9	1.5	1.7
F57	2.6	3.7	2.1	3.5	2.8	2.9
F67	2.7	3.8	1.9	3.8	2.9	3.2
F77	5	7.3	4.3	8	6	6.3
F87	10	13.0	7.7	13.8	10.8	11
F97	18.5	22.5	12.6	25.2	18.5	20
F107	24.5	32	19.5	37.5	27	27
F127	40.5	55	34	61	46.5	47
F157	69	104	63	105	86	78

机型号 / Size	润滑油量(升) / Lubricant (liter)					
	M1	M2	M3	M4	M5	M6
FF37	1	1.2	0.7	1.3	1	1.1
FF47	1	1.9	1.1	1.9	1.5	1.7
FF57	2.8	3.8	2.1	3.7	2.9	3
FF67	2.7	3.8	1.9	3.8	2.9	3.2
FF77	5.1	7.3	4.3	8.1	6	6.3
FF87	10.3	13.2	7.8	14.1	11	112
FF97	19	22.5	12.6	25.5	18.9	20.5
FF107	25.5	32	19.5	38.5	27.5	28
FF127	41.5	56	34	63	46.5	49
FF157	72	105	64	106	87	79

注: 表中数值仅为参考值, 具体以减速机油位孔位置为准。

Note:
Data in the table is for reference, operation is subject to oil level and oil sight glass.

Helical-bevel (K) gear units K.., KA..B, KH..B, KV..B:

机型号 / Size	润滑油量(升) / Lubricant (liter)					
	M1	M2	M3	M4	M5	M6
K-37	0.5	1	1	1.3	1	1
K-47	0.8	1.3	1.5	2	1.6	1.6
K-57	1.2	2.3	2.5	3	2.6	2.4
K-67	1.1	2.4	2.6	3.4	2.6	2.6
K-77	2.2	4.1	4.4	5.9	4.2	4.4
K-87	3.7	8	8.7	10.9	7.8	8
K-97	7	14	15.7	20	15.7	15.5
K-107	10	21	25.5	33.5	24	24
K-127	21	41.5	44	54	40	41
K-157	31	62	65	90	58	62
K-167	35	100	100	125	85	85
K-187	60	170	170	205	130	130

机型号 / Size	润滑油量(升) / Lubricant (liter)					
	M1	M2	M3	M4	M5	M6
KA-F-37	0.5	1.1	1.1	1.5	1	1
KA-F-47	0.8	1.3	1.7	2.2	1.6	1.6
KA-F-57	1.3	2.3	2.7	3	2.9	2.7
KA-F-67	1.1	2.4	2.8	3.6	2.7	2.7
KA-F-77	2.1	4.1	4.4	6	4.5	4.5
KA-F-87	3.7	8.2	9	11.9	8.4	8.4
KA-F-97	7	14.7	17.3	21.5	15.7	16.5
KA-F-107	10	22	26	35	25	25
KA-F-127	21	41.5	46	55	41	41
KA-F-157	31	66	69	92	62	62

注: 表中数值仅为参考值, 具体以减速机油位孔位置为准。

Note: Data in the table is for reference, operation is subject to oil level and oil sight glass.

Helical-worm (S) gear units S..:

机型号 / Size	润滑油量(升) / Lubricant (liter)					
	M1	M2	M3 [1)]	M4	M5	M6
S-37	0.25	0.4	0.5	0.6	0.4	0.4
S-47	0.35	0.8	0.7	1.1	0.8	0.8
S-57	0.5	1.2	1	1.	1.3	1.3
S-67	1	2.0	2.2/3.1	3.2	2.6	2.6
S-77	1.9	4.2	3.7/5.4	6	4.4	4.4
S-87	3.3	8.1	6.9/10.4	12	8.4	8.4
S-97	6.8	15	13.4/18	22.5	17	17

SA-F-

机型号 / Size	润滑油量(升) / Lubricant (liter)					
	M1	M2	M3 [1)]	M4	M5	M6
SA-F-37	0.25	0.4	0.5	0.6	0.4	0.4
SA-F-47	0.4	0.9	0.9	1.2	1.0	1.0
SA-F-57	0.5	1.2	1	1.6	1.4	1.4
SA-F-67	1	2.2	2.3/3	3.2	2.7	2.7
SA-F-77	1.9	4.1	3.9/5.8	6.5	4.9	4.9
SA-F-87	3.8	8	7.1/10.1	12	9.1	9.1
SA-F-97	7.4	15	13.8/18.8	23.6	18	18

SA-A、SA-A-F、SA-A-F-

机型号 / Size	润滑油量(升) / Lubricant (liter)					
	M1	M2	M3 [1)]	M4	M5	M6
SA-A-F-37	0.25	0.4	0.5	0.6	0.4	0.4
SA-A-F-47	0.4	0.8	0.7	1.1	0.8	0.8
SA-A-F-57	0.5	1.1	1	1.6	1.2	1.2
SA-A-F-67	1	2.0	1.8/2.6	2.9	2.5	2.5
SA-A-F-77	1.8	3.9	3.6/5	5.9	4.5	4.5
SA-A-F-87	3.8	7.4	6/8.7	11.2	8	8
SA-A-F-97	7	14	11.4/16	21	15.7	15.7

注: 1)表示减速机为组合型时低速级所加油量为大值。

Note: 1) Combinational type at low speed is the maximum quantity of oil.