TGB
GROUP TECHNOLOGIES

SLEW DRIVES

Installation & Maintenance Manual

Series:

BE, LBE, PRO, BO, GE, LGE, TE, TO, TGE, TGO

V.01 – 01 June 2023

MODEL CODE:		A XXX – ZF – CD			
A:		TGB Group Slew drive			
X:		Size			
F:		Other characteristics. Examples:			
		0	With encoder output & Ø25mm shaft entrance	**1, 2, …**	Other special configurations
C:		Side of motor installation			
	L	Left side			
	R	Right side			
D:		Threads			
	M	Metric threads			
	I	Imperial threads			

Notice

- The following text includes notices and procedures which should be observed when installing the slew drives and during the maintenance.
- Read carefully this manual before any operation is performed. The working features can only be ensured if the steps have been followed correctly.
- All steps listed below must be carried out by qualified* personal.
- This manual should be kept near the structural element and has to be always accessible to the personal.
- The purchaser is responsible for protective measures and installation of all the equipment.
- Please contact our technical department for any further assistance.
- The technical data for each slew drives can be found in our data sheets.
- The contents and illustrations presented in this manual may vary for special versions.
- We reserve the right to make changes for the purpose of improvement and/or optimisation.
- This manual replaces the following manuals in any revision:
  TGB Slew Drives - BE & LBE Installation & Maintenance Manual
  TGB Slew Drives - TE & TGE Installation & Maintenance Manual
  TGB Slew Drives - TE & TGE & TGO Installation & Maintenance Manual
- Warnings in this manual are marked by the symbol (⚠) and/or signal words. Indicates an imminently hazardous situation which, if not avoided, could result in death or serious injury.

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1. Security

This section provides an overview of relevant safety aspects to ensure the protection of personnel as well as safe and trouble-free operation. Non-compliance with the operating instructions and safety guidelines provided in this manual may result in significant risks.

- **Trained:**
  Ensure that the personnel involved have adequate knowledge of safety procedures, necessary tools and working protocols.

- **Personal Protective Equipment (PPE):**
  Before starting any assembly or maintenance activity, personnel must wear appropriate personal protective equipment. This includes safety glasses, resistant gloves, hard hat, and safety footwear. Proper use of PPE helps prevent injuries and protects personnel from potential hazards.

- **Energy blocking:**
  Before carrying out any work on the slew drive, make sure that all power sources are properly locked. This avoids the risk of accidental start-up during assembly or maintenance. Check that all switches are in the off position and fit locking devices to prevent unintentional activation.

  The slew drives provide self-locking when the efficiency of the gearbox is less than 50%.
  ⚠ **It is imperative to lock the load supported by the slew drive to ensure the immobilisation of the system.**
  TGB shall not be liable for any damage or injury resulting from non-compliance with the previous point.

- **Visual inspection:**
  Before carrying out any work, perform visual inspection of the slew drive to identify possible damage, wear, or loose parts. If any anomalies are detected, such as cracks, corrosion or worn components, corrective action must be taken before proceeding with assembly or maintenance.

- **Appropriate tools:**
  Ensure that tools are in good condition and are used in accordance with the manufacturer's instructions. Use of unsuitable tools may damage the equipment or cause injury.

- **Safe loading and unloading:**
  During assembly and disassembly of slew drives, use appropriate lifting equipment and follow safe loading and unloading practices. Ensure that equipment is properly balanced and secured to prevent accidental falling or shifting that could cause injury or damage to the equipment.

- **Periodic maintenance:**
  Establish a regular maintenance schedule for the slew drives according to the manufacturer's recommendations. This includes proper lubrication, inspection of components, tightening of bolts and any other necessary maintenance tasks. Fulfil with the maintenance schedule helps prevent failures and ensure safe and reliable operation.

- **Moving parts:**
  ⚠ Do not insert hands and/or other body parts into moving parts during operation. Rotating components and/or components with linear movements can cause serious injury.

2. Transport, handling, and storage provision

- Transport only in horizontal position, Impacts should be avoided.
- Wear work gloves and be careful when handling the Slew drives. Slew drives are generally provided with threaded holes in the inner and in the outer ring into which eyebolts can be assembled. This enables safe handling on a hoisting device. The threaded length of the bolt should be at least 1.5 times the diameter of the bolt. It should be transported without other assembled components.
- Store only in horizontal position and in closed rooms. Keep it away from the areas where it could get wet. The surface corrosion protection holds for approx. 5 months in the enclosed packaging. Longer periods of storage require special protective measures.

3. Installation

3.1. Previous checks

- Check the slew drive for physical damage.
- Check that the slew drive turns smoothly. In case the slew drive does not turn, please check whether there is impediment, or check connection power (hydraulic or electric) to be sure it is properly in supply.
- If the slew drive makes noise, please check whether lubrication is good enough or the flatness of the slew drive is as required, or the rotation frequency is as expected.
- Check whether the dimension of the bolt is as expected.
- Check whether the type of the bolt (metric or imperial) is as expected.

3.2. Clean the slew drive and the mounting structure

- Remove extraneous materials from supporting surfaces.
- Clean the outer mounting surfaces using a cold solvent that doesn't damage the rubber seals.
- Cleaning a Slew drive with steam jet or high-pressure cleaner is not permissible.

3.3. Determine permissible flatness deviation δp and perpendicular deviation δw of the supporting surfaces of the mounting structure.

The surfaces that are going to be in contact with the slew drive must satisfy some specifications of flatness and perpendicular deviation which are described below.
The maximum value for flatness deviation δ_p (waviness) along the circumference can be reached only once each 180 deg. The form must resemble a sine curve that gradually rises and falls. The maximum values for each drive are the ones listed in the table below.

Slew drive size		236	314	400	435	523	639	700
Flatness δ_p deviation supporting surface	[in]	0,004	0,005	0,006	0,006	0,006	0,008	0,008
	[mm]	0,1	0,12	0,15	0,15	0,15	0,2	0,2

Table 1: Permissible flatness deviations for Slew drives mounting surface.

Permissible perpendicular deviation δ_w (tilting) is based on the flange width and must be measured in the transverse direction. The maximum values for each drive are the ones listed in the table below.

Slew drive size		236	314	400	435	523	639	700
Perpendicular δ_w deviation supporting surface	[in]	0,004	0,006	0,009	0,01	0,013	0,017	0,018
	[mm]	0,11	0,16	0,23	0,26	0,32	0,42	0,46

Table 2: Permissible perpendicular deviations for Slew drives mounting surface.

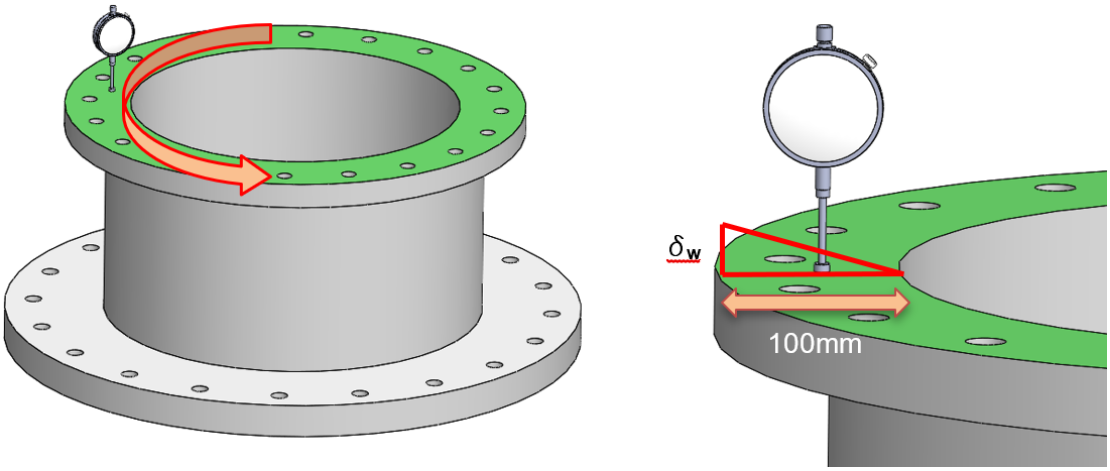

Image 1: Flatness deviation measuring procedure (left).
Perpendicularity deviation measuring procedure (right)

3.4. Lubricate the Slew drive

There are three places which need to be lubricated: the slewing ring raceway, the screw worm, and the bearings.

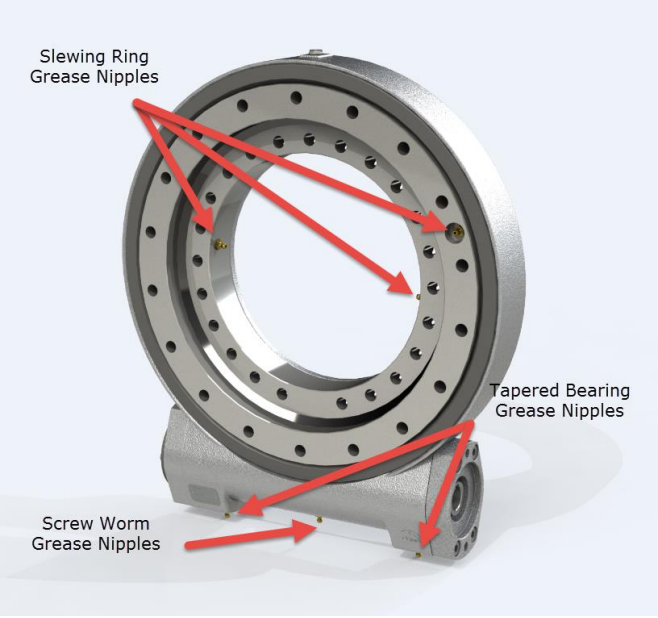

Image 2: Grease nipples location on the slew drive

Slew drives are supplied with slewing ring raceway, screw worm and bearings pre-lubricated. They shall be greased again prior to initial operation and re-lubricated accordingly depending on working conditions.

Suitable grease types for normal cases are listed on "*table 10*":

In case the drive has to withstand extreme loads and working conditions or lower re-lubrication intervals are required, optimum grease can be used (See Annex I).

Note: On the L/BE100 the screw worm grease nipple was eliminated and is greased from the bearing grease nipples, with the grease quantity from "*Table 11"* the main components are greased. The plug must be opened to prevent internal pressure, and close it at the end of greasing.

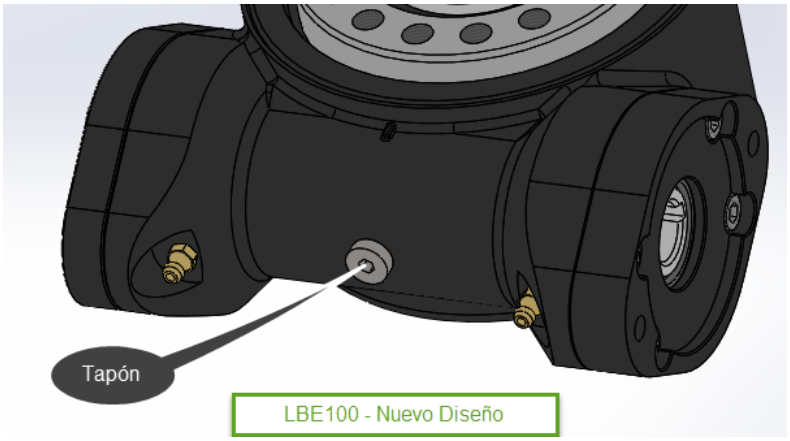

Image 3: LBE100 plug detail

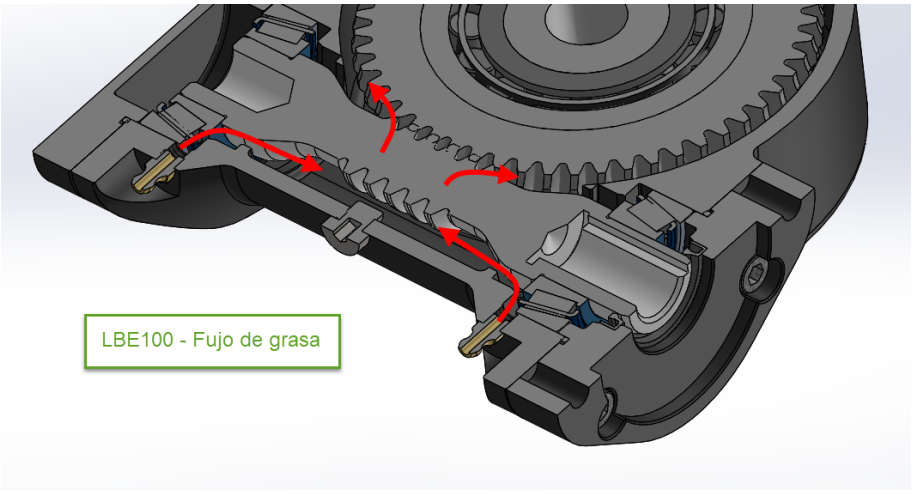

Image 4: LBE100 gresase flow detail.

The models that include the indicated plug "*image 5*" should also be opened to eliminate excessive pressure:

Image 5: Detail of plug included in some drives series.

3.5. Choice of mounting bolts

As the gearbox manufacturer, we do not recommend the use of the fasteners that we supply only for transportation. Please take great care in specifying this item which will attach our product to yours.

- Prescribed sizes, number and quality grades shall be used.
- All the holes in the slew drive must be used to fix it to the mounting structure.
- Grip ratio (grip length to diameter of bolt) shall be observed, from minimum ≥ 2 to maximum ≤ 10.
- Bolts with a fully threaded shaft should not be used.
- Slew drive function, lifespan, and durability of the bolt connection are affected in case of non-compliance.
- To reduce the pressure on the material, the use of washers DIN6916 is recommended.
- Make sure that the washers do not press on the slewing ring seal (if the model requires them).
- Do not reuse bolts, nuts and washers and they must be replaced if they are in bad condition.

Materials	Max. surface pressure in MPa
50Mn / C45N / 46Cr2N	420
42CrMo4	700

Table 3: Table of admissible interfacial pressures

3.6. Choice of tightening torques

Under normal conditions, the mounting bolts must be secured by correct preloading using a torque wrench. The use of split rings, split washers, etc. is not permitted.

Mounting bolt Dimension	Tightening torque M_A in Nm Quality class 10.9
M6	15 ± 1
M8	37 ± 3
M10	72 ± 6
M12	126 ± 10
M16	312 ± 25
M20	609 ± 50

Table 4: Tightening torques for Metric mounting bolts (non-lubricated thread).

Mounting bolt Dimension	Tightening torque M_A in lbs·ft Quality SAE grade 8
1/4-20 UNC	12 ± 1
5/16-18 UNC	24 ± 2
3/8-16 UNC	45 ± 4
1/2-13 UNC	110 ± 7
5/8-11 UNC	210 ± 18
3/4-10 UNC	380 ± 36

Table 5: Tightening torques for Imperial mounting bolts (non-lubricated thread).

3.7. Slew drive installation

- Determine the main load-carrying zone.
- The soft zone is marked with a filling plug.
- Remove the shipping bolts. Do not remove the shoulder bolts or the Allen bolts that fix the top plate and the housing to the slewing ring.
- With a gauge, check whether the Slew drives supporting surfaces of are fully supported by the mounting structure.
- The Slew drive shall be mounted in an unloaded condition.
- Assemble the flanges to the housing and the slewing ring.
- In case the slew drive is used in vertical /radial position (horizontal rotational axis), the slew drive must be installed with the screw worm in the lower part.

Image 6: Recommended slew drive position

The following procedure shall be followed in order to avoid deviations between bolt tightening forces.

i. Slightly apply thread locker to the bolt threads (last three to five filets) to ensure uniform frictional resistance.

ii. Preload the bolts incl. washers, if required, crosswise in 3 steps: 30%, 80% and 100% of the tightening torque. The scheme below shows the order to be followed when tightening the bolts.

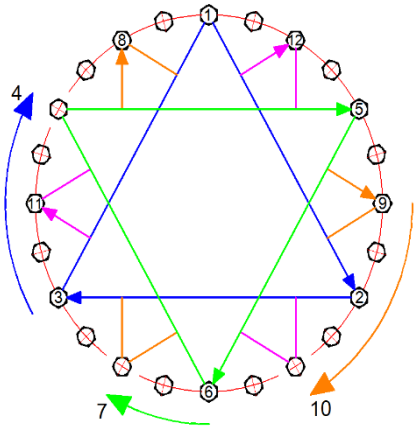

Image 7: Tightening torque generic scheme

iii. Once the bolt has been tightened, please make a mark on the surface of the bolt that continues to the surface of the structure. This mark is useful when inspecting whether the bolts have loosened or not.

3.8. Motor installation

- Check the motor before installing it, whether the shield is intact, the power is expected, or there is electric protector for motor (in case of AC or DC motor).
- In case of using a flange to install the motor to the slew drive it is recommended to apply gasket sealant between both surfaces or install an O-ring between them.
- Connect it to the power supply.
- Begin to operate the motor under no load.
- When the operation is correct, then increase the load gradually.

4. Operation test

If the mounting bolts are properly tightened and the drive motor is correctly connected, then the Slew drive shall rotate uniformly. Deviations of the mounting structure and the effect of extraneous loads can strongly impact the friction torque.

- Rotate mounted slew drive several times.
- Check whether slew drive runs smoothly without ripple.
- Perform further test under full load.
- After operation test, recheck the tightening torques of mounting bolts.

5. Raceway clearance & backlash measurement

5.1. Raceway clearance inspection

Determine the available **tilting clearance**.

- The tilting clearance increase raceway wear. To determine the increase in tilting clearance, it is necessary to take basic periodic measurements.
- Permanently designate the measuring point in the main load direction.
- Record all measured values into *"Table 6"*.
  Follow the procedure below:
  i. All bolts and nuts must be tightened correctly to avoid play.
  ii. Measuring points should be as close as possible to the raceway to introduce less deflections.
  iii. Always apply the same load on all the measurements.
  iv. Determine and mark the measuring spot at the point of load, both on the housing as well as on the worm wheel or on the slewing ring.
  v. Repeat this procedure so that you can control the entire slew ring as in "*Image 8"*.

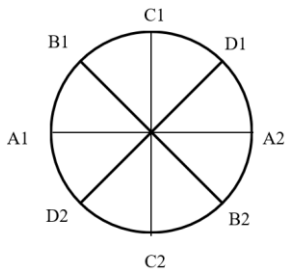

Image 8: Medition poitns

  vi. Fix the dial gauge.
  vii. Apply a minimum of 50% of the maximum operational load in "X1" direction.
  viii. Set the dial gauge on zero.
  ix. Apply a minimum of 50% of the maximum operational load in "X2" direction.
  x. The measured difference "mx" between "X2" and "X1" corresponds to the tilting clearance and serves as the basis for comparison for later inspections. mx=X2-X1

xi. The increase clearance "δ_T" is the difference between "mx" and "m0".

$\delta_T = mx - m0$

mx → "x" corresponds to the inspection number

X1 & X2 → "X" corresponds to the measuring points (A, B, C, D)

Inspection 0	Load	Direction "1"	Direction "2"	m0	Remark
A					
B					
C					
D					
Inspection X	**Load**	**Direction "1"**	**Direction "2"**	**mx**	**Remark**
A					
B					
C					
D					

Table 6: Table example of measurement record.

All the measured values are recorded.

All subsequent measurements are performed at the same measuring point, with the same load, at the same position of the housing relative to the worm wheel or gear ring and in the same sequence.

For purely axial or radial loads, tilting clearance is inspected by applying an additional tilting load.

If it is not possible to measure the **tilting clearance**, use **bearing height reduction.**

Determine the **bearing height reduction**:

- To determine bearing height reduction, it is necessary to take basic periodic measurements.
- Permanently designate the measuring point in the main load direction.
  Follow the procedure below:
  i. All bolts and nuts must be tightened correctly to avoid play.
  ii. Measuring points should be as close as possible to the raceway to introduce less deflections.
  iii. Always apply the same load on all the measurements.
  iv. Determine and mark the measuring spot at the point of load, both on the inner ring and outer ring.

v. Repeat this procedure so that you can control the entire slewing ring as in *"Image 9"*.

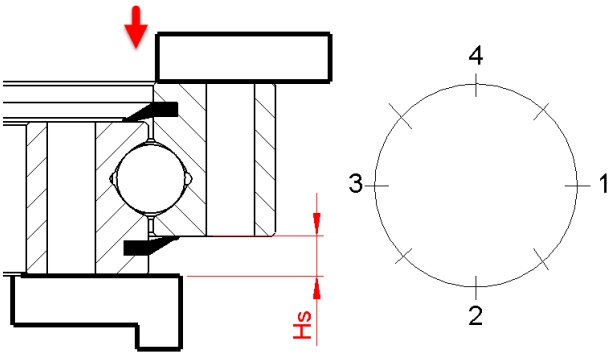

Image 9: Scheme and measuring points.

- The clearance with height reduction method is equal to the initial measured value minus the value after use.

$$\Delta_{Hw} = H_{s0} - H_{s1}$$

Position	Load	Inspection 0 "Hs0"	Inspection 1 "Hs1"	Remark
1				
2				
3				
4				

Table 7: Table example 2 of measurement record.

All the measured values must be recorded.
All subsequent measurements are performed at the same measuring point, with the same load, at the same position of the housing relative to the worm wheel or gear ring and in the same sequence.

5.2. Check the raceway clearance

Raceway wear leads to increase the clearance. It is therefore necessary to check the clearance after 500 operating hours or at the latest after 6 months.
Check the increase in **tilting clearance** (δ_T) or **height reduction** (Δ_{Hw}) directly on a Slewing drive or slewing ring. The clearance values determined may not exceed the tolerances shown in the following table "*Table 8*".

	Ball diameter [mm]						
	<20	*<25*	*<30*	*<38*	*<45*	*<60*	*≥60*
Clearance (mm)	1,4	1,9	2,2	2,4	2,6	2,8	2,9
Critic clearance (mm)	0,7	0,95	1,1	1,2	1,3	1,4	1,45
***Critic clearance: Take into consideration as critical clearance when the integrity of people can take risks**							

Table 8: Table of permissible clearance increase.

For both checks:

- Reduce the inspection interval to 200 operating hours if the measured clearance increases amounts to approx. 75% of the maximum permissible clearance increase.
- Reduce the inspection interval once again after further clearance increase (to 50-100 operating hours).
- Replace the Slewing drive if the maximum permissible clearance is reached.

5.3. Backlash inspection (rotational clearance)

Gear wear leads to increased rotational backlash. Therefore, it is necessary to check the rotational backlash after 700 operation hours or at the latest after 6 months. The values for rotation tolerance given below must not be exceeded.

Follow the procedure below:

- Switch off the system and protect it against restarting.
- Determine the measuring point in the main load zone, either on the housing, worm gear or ring gear and mark these points permanently.
- It may be necessary to remove the motor and/or brake. If this is the case, as already mentioned in the safety section above, the load must be blocked to prevent unintentional movement. ⚠
- Determine the circumferential backlash angle of the worm shaft in the area where the worm shaft engages most of the time. The measured value determined serves as a comparison value with the initial (factory) value and for subsequent checks.
- Record and document the measured values. All subsequent measurements must be carried out at the same measuring point.
- If the difference between the initial backlash value and the new measurement is greater than that given in "*Table 9"*, it is recommended to replace the slew drive.
- The inspection interval should be reduced by 200h if the detected clearance is approximately 75% of the allowable clearance.
- If further increases are detected after 75% of the permissible clearance has been reached, the inspection hours should be reduced by 50-100h.

The following table shows the limit values for the increase of the backlash. The table allows to work in degrees or in mm, specifically in the outer ring hole position (this is the one used in the factory to check the backlash).

Serie	Model	Permissible increase	
		Degrees [º]	Holes OR [mm]
TE TO TGE TGO	160	0,55	0,63
	236	0,48	0,85
	314	0,56	1,32
	400	0,44	1,37
	435	0,40	1,37
	523	0,33	1,40
	639	0,27	1,39
	760	0,23	1,34
	920	0,19	1,44
	1050	0,23	1,99
BE LBE BO PRO	100	0,63	0,45
	130	0,55	0,48
	236	0,78	1,29
	314	0,56	1,32
	435	0,40	1,37
	500	0,37	1,36
	523	0,33	1,39
	600	0,37	1,69
	639	0,28	1,41
	700	0,34	1,97
	702	0,28	1,66
GE LGE	236	0,74	1,27
	314	0,56	1,32
	435	0,40	1,37
	523	0,40	1,37

Table 9: Limit values for backlash increase.

6. Periodic maintenance / safety and lubrication

6.1. Checking mounting bolts

To compensate the possible settling, it is necessary to retighten the bolts to the prescribed torque. This shall be done after no more than 100 hours of the first operation and without external load applied to the bolt connection. It is recommended to inspect the bolts every year (using the marks done during assembly) and retighten the bolts if necessary.
If the slew drive is supplied with motorization (reducer or motor) then the bolts that fix those parts between them and to the drive should also be checked.

The inspection frequency can be increased if there is no special working or extreme weather conditions. In case of loose bolts, replace those bolts, nuts and washers with new ones.

6.2. Re-lubrication of slew drive

Suitable substitute lubricants can be found in "*Table 10"*. Manufacturer provisions about handling the respective lubricants must be observed.
"Table 11" shows the amounts of fat for the different zones.

Recommended grease type	Mineral or Synthetic grease. (In case of using Synthetic grease type, be sure that is 100% compatible with any mineral grease.)
EP (Extreme Pressure)	YES
Consistency NLGI (ISO2137)	Grade 2
Oil Separation	< 3%
Corrosion and water protection	YES
Acceptable Thickeners	Calcium, Lithium or Aluminium sulphates
Temperature range in ºC	-20ºC / +125ºC
Base oil viscosity (at 40ºC)	>125mm^2/s
Welding Load	>200kg

Table 10: Table of standard grease properties

Parts of the slew drive that need lubrication	Each Screw Worm	Each Ring raceway	Each Tapered Bearing
Quantity of grease	(0.5 x slew drive size) cc	$\left(\frac{racewayØ\ (mm)}{8}\right) cc$	10cc
Quantity of grease (only in L/BE100)	25cc each		

Table 11: Grease quantity for each part of the drive

Follow the procedure below:

- If the model is fitted with a plug, open the top plug to allow the air to escape more easily.
- To lubricate the slewing ring, inject grease into one grease nipples on the inner ring while rotating the Slew drive at least 180º.
- Inject grease through the other grease nipple on the inner ring while rotating the Slew drive at least 180º.
- In case none of these grease nipples is available the slewing ring can be greased by the grease nipple on the top plate. To achieve the proper lubrication from these lubrication points the slewing ring must do a whole turn.
- For the screw worm and bearings lubrication, inject grease in the proper grease nipples for at least 3 turns on the screw worm.
  If you have a plug and no grease nipple, unplug, insert the grease with a suitable tool and plug again (see "*table 12"* for re-lubrication time and "*table 11"* for grease quantity).
- Close the top plug at 10Nm (if a breather is installed in place of the plug it is not necessary).

6.3. Re-lubrication intervals

Re-lubrication is needed to assure a minimum quality on the grease inside the drive. In case no comparative results are available, the following table can be used as a reference.

Working conditions	Slewing Ring and Screw Worm Re-lubrication intervals
Rotational speeds <0,5rpm Non extreme environmental conditions (solar trackers)	Every 400 hours of operation or once every 12 months
Rotational speeds >0,5rpm	Every 200 hours of operation or

Non extreme environmental conditions (man lift, industrial applications)	once every 6 months
Extreme climatic conditions (sea / desert / Arctic climate / very dirty surrounding) (tunnelling machines/steel mills)	Every 100 hours of operation or once every 3 months
Bearing re-lubrication intervals	
All Working conditions	Every 400 hours or every 12 months

Table 12: Re-greasing intervals depending on working conditions.

The specified values are valid for the following conditions:

- Operating temperature on Slew drive < 65ºC
- Drive rotational speed < 1rpm
- Low to medium loads

The table can never replace values established through experience. The most frequent cause of failure of Slew drives is insufficient lubrication.

Slew drives shall generally be re-lubricated after every cleaning and also before and after long inactive periods, e.g. for crane and construction machines during winter months.

Cleaning a Slew drive with steam jet or high-pressure cleaner is not permissible.

7. Last indications

The instructions give you the information you need to be able to correctly install and maintain a TGB Slew drive.

Please always check that you are working with the latest revision.

These instructions shall be sent to all new customers. All work steps listed here are to be executed by suitably qualified personnel.

Please do not hesitate to contact our Engineering Department for any further assistance.
All the information in this document has been carefully evaluated and checked.
We do not, however, accept responsibility for any omissions or errors.

TGB accepts no liability for:
1. Non-compliance with Installation and Maintenance Instructions
2. Failure to pass on content to third part.

ANNEX I

Optimum grease type properties and re-lubrication intervals

In case the loads applied to the drive are extreme loads or lower re-lubrication intervals are required, an optimum kind of grease could be used. The recommended properties for this kind of grease are the one shown in the table below:

Recommended grease type	Mineral or Synthetic grease. In case of using Synthetic grease type, be sure that is 100% compatible with any mineral grease.
EP (Extreme Pressure)	YES
Consistency NLGI (ISO2137)	Grade 2
Oil Separation	< 2%
Corrosion and water protection	YES
Acceptable Thickeners	Calcium, Lithium or Aluminium sulphates
Temperature range in ℃	-20ºC / +150ºC
Base oil viscosity (at 40ºc)	>350mm^2/s
Welding Load	>600kg

Table A1: Table of optimum grease properties.

On the following table general re-lubrication intervals can be found. In case some tests approaching real working conditions have been performed to check the optimum re-lubrication intervals the table cannot replace the values established through experience.

Working conditions	Slewing Ring and Screw Worm re-lubrication intervals
Rotational speeds <0,5rpm Non extreme environmental conditions (solar trackers)	Every 1200 hours of operation or once every 24 months
Rotational speeds >0,5rpm Non extreme environmental conditions (man lift, industrial applications)	Every 600 hours of operation or once every 12 months
Extreme climatic conditions (sea / desert / Arctic climate / very dirty surrounding) (tunnelling machines/steel mills)	Every 300 hours of operation or once every 6 months
Bearing re-lubrication intervals	
All Working conditions	Every 1200 hours or every 36 months

Table A2: Re-greasing intervals depending on working conditions.

TGB

GROUP TECHNOLOGIES

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