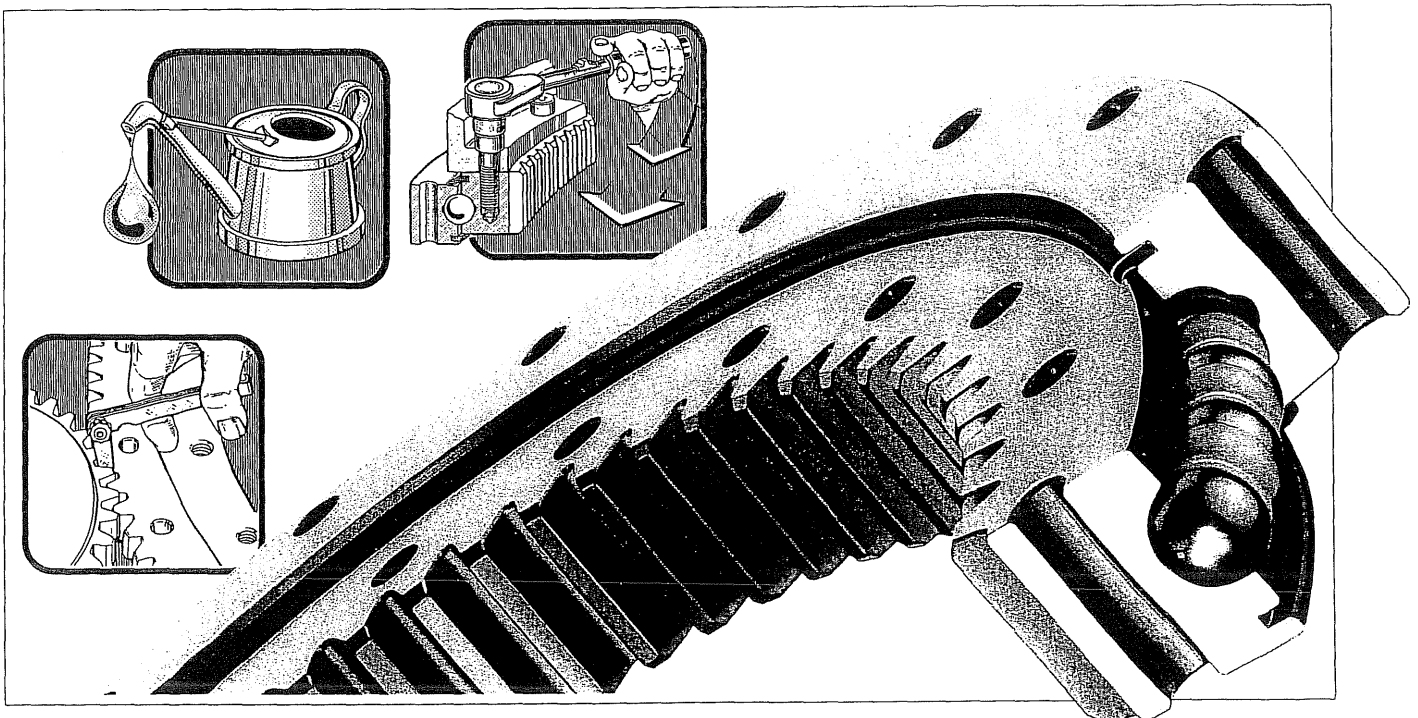


Installation and Maintenance Instructions for Slewing Rings

Pg. 8 - 13

English



Installation and Maintenance Instructions for Slewing Rings (EW DV Rev. 6.0)

Preface

The following instructions give you all the information you need to be able to correctly install and maintain an IMO Slewing Ring.

All instructions are provided with a revision number. Installation and Maintenance Instructions with preceding revision numbers are invalid. The latest version is published on our homepage and can be downloaded from there in numerous languages (www.goimo.com). Please always check that you are working with the latest revision!

These instructions shall be attached to your product or to the final product or to the Installation and Maintenance Instructions. 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.

IMO Momentenlager GmbH
Imostraße 1
91350 Gremsdorf
Germany

Telephone: +49 (0)9193-63 95-0
Fax.: +49 (0)9193-63-95-40
Homepage: www.goimo.com
Email: sales@goimo.com

Copyright © March 2005 by IMO Momentenlager GmbH, Gremsdorf



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.

No part of this document may be reproduced without the written permission of the publisher. All rights reserved, even if patent is granted.

Only the German version is legally binding.

IMO accepts no liability for:



1. Non-compliance with Installation and Maintenance Instructions.
2. Failure to pass on content to third party.

Notice

The following text includes special notices and procedures that shall be observed.

The technical properties of Slewing Rings are to be found in our product catalogue or in the technical offer.

Contents

0. Transport, handling and storage provisions

0.1 Transport, handling and storage

1. Installation

1.1 Preparation for installation

1.1.1 Cleaning the Slewing Ring and the mounting structure

1.1.2 Determining permissible deviations and deformations of mounting structure

1.1.3 Lubricating of the Slewing Ring

1.1.4 Choice of mounting bolts

1.1.5 Choice of tightening torques

1.1.6 Tightening the bolts with a hydraulic tightening device

1.2 Installing the Slewing Ring

1.2.1 Positioning the Slewing Ring

1.2.2 Securing the Slewing Ring with bolts

1.2.3 Determining the existing tilting clearance

1.2.4 Setting the backlash

1.2.5 Operating test

2. Maintenance / safety checks and lubrication

2.1 Checking the mounting bolts

2.2 Checking the tilting clearance

2.3 Relubrication

2.4 Relubrication intervals

2.5 Lubricants

2.6 Dismantling the bearing

0. Transport, handling and storage provisions

0.1 Transport, handling and storage

Transport only in horizontal position. Impacts shall be avoided.

Wear work gloves when handling the Slewing Rings. Slewing Rings are generally provided with threaded holes in which eye bolts can be fixed. This enables safe handling on a hoisting device. Please observe the relevant legal regulations when doing this.

Slewing Rings must be transported with the hoisting device connected to three uniformly-distributed lifting points around the perimeter. Internal factory transport and installation shall only take place in a horizontal position. Transport crosses must be left in the Slewing Ring until it is properly installed.

Store only in horizontal position in closed rooms, if stacked there must be a stable intermediate layer. The corrosion protection coating has a shelf-life of approx. 3 months in closed packaging. Longer storage periods require special protective measures. If in doubt, please contact IMO.

1. Installation

1.1 Preparation for installation

1.1.1 Cleaning the Slewing Ring and the mounting structure

1. Remove extraneous material from supporting surfaces (including paint residues, welding beads, burr formation).
2. Clear corrosion protection coating from supporting surfaces of the Slewing Ring.

In doing this, ensure that:

- Cleaning material does not penetrate into the Slewing Ring.
- Applicable provisions are observed (e.g. manufacturer provisions, protection of workers, environmental protection etc.).
- Cleaning material that attacks the sealing material is not used.

Applicable cleaning materials:

Cold solvents (e.g. white spirit, diesel oil, Kaltryl KEV).

1.1.2 Determining permissible flatness deviation δ_p , perpendicularity deviation δ_w and permissible deformation δ_v of the mounting surface of the supporting structure

Table 1: Permissible flatness and perpendicularity deviations for standard Slewing Rings

Use the values of Roller Slewing Rings for preloaded Ball Slewing Rings

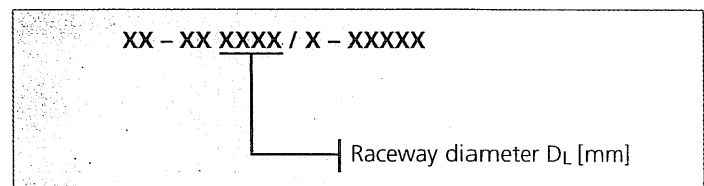
Raceway diameter [mm]		250	500	750	1000	1250
Flatness including perpendicularity deviation per supporting surface [mm]	Ball	0.08	0.10	0.13	0.15	0.18
	Roller	0.06	0.08	0.09	0.10	0.11
Raceway diameter [mm]		1500	1750	2000	2500	3000
Flatness including perpendicularity deviation per supporting surface [mm]	Ball	0.20	0.23	0.25	0.30	0.35
	Roller	0.13	0.14	0.15	0.17	0.20
Raceway diameter [mm]		3500	4000	4500	5000	5500
Flatness including perpendicularity deviation per supporting surface [mm]	Ball	0.40	0.45	0.50	0.55	0.60
	Roller	0.23	0.25	0.28	0.30	0.33

Table 2: Permissible deformation of mounting structure under maximum load for standard Slewing Rings

Raceway diameter [mm]		250	500	750	1000	1250
Flatness including perpendicularity deviation per supporting surface [mm]	Ball	0.21	0.27	0.35	0.40	0.48
	Roller	0.16	0.21	0.24	0.27	0.29
Raceway diameter [mm]		1500	1750	2000	2500	3000
Flatness including perpendicularity deviation per supporting surface [mm]	Ball	0.50	0.61	0.67	0.80	0.93
	Roller	0.35	0.37	0.40	0.45	0.48
Raceway diameter [mm]		3500	4000	4500	5000	5500
Flatness including perpendicularity deviation per supporting surface [mm]	Ball	1.06	1.20	1.33	1.46	1.59
	Roller	0.60	0.66	0.73	0.79	0.86

For Slewing Rings between the specified sizes the closest smaller value shall be taken. For Slewing Rings larger than the largest diameter, the value for the largest diameter given shall be used.

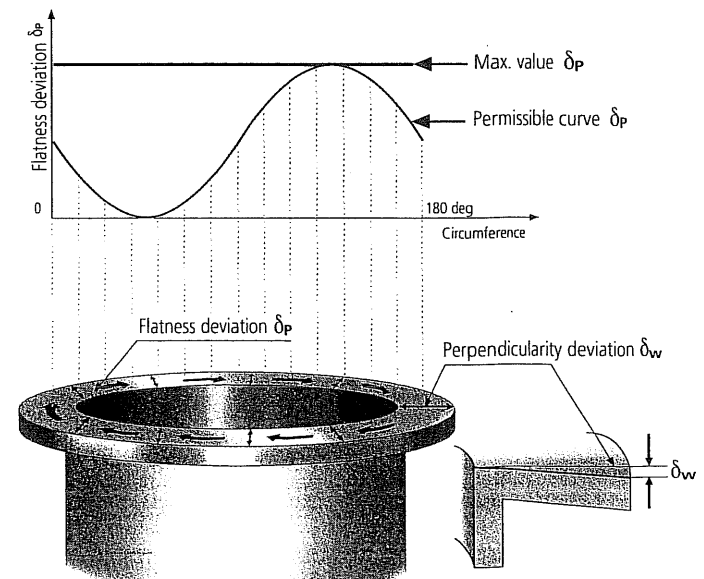
The size of the Raceway diameter D_L can be taken from our identity number.



Permissible perpendicularity deviation δ_w (tilting) is based on the actual flange width and may only amount to one half of the values in Table 1.

The maximum residual value for flatness deviation δ_p (waviness) along the circumference may total to only once per 180 deg. The form must resemble a sine curve that gradually rises and falls.

Sketch: Permissible curve of flatness deviation of the mounting structure and flatness and perpendicularity deviations on the mounting structure



Installation and Maintenance Instructions for Slewing Rings (EW DV Rev. 6.0)

1.1.3 Lubricating the Slewing Ring

Slewing Rings are supplied fully lubricated. They shall be greased again prior to initial operation. It is essential to use the greases specified on the delivery drawing. Suitable grease types for normal cases are listed on Table 9.



- Inject grease into all grease nipples one after the other, while rotating the Slewing Ring, until a bead of grease forms at least on one sealing lip.

1.1.4 Choice of mounting bolts

Prescribed sizes, number and quality grades shall be used

- Grip ratio (grip length to diameter of bolt) shall be observed from minimums ≥ 5 to maximum ≤ 10 .
- Bolts with a fully threaded shaft are not permissible.
- The function and lifespan as well as the durability of the bolt connection are affected in the case of non-compliance.
- If the permissible interfacial pressure is exceeded, use suitable washers of appropriate size and strength.
- Do not reuse bolts, nuts and washers.

Table 3: Permissible interfacial pressure for different materials

Materials	Max. surface pressure in N/mm ²
St50 / C45N / 46Cr2N / 42CrMo4N	420
46Cr4V / 42CrMo4V	700

1.1.5 Choice of tightening torques

Mounting bolts are in normal cases adequately secured by correct preloading.

- Mounting bolts can be secured by Loctite. Nord-Lock bolt lock washers may be necessary in case of shock or vibration.
- Use of split rings, split washers etc. is not permissible.
- If washers are used ensure that they are of the correct strength class.

Table 4: Tightening torques and bolt tension forces for regular metric threads according to DIN13

Mounting bolt dimension	Tension cross-section A_s mm ²	Core cross section A_d mm ²	Tightening torque $M_A^{1)}$ in Nm bolt strength class			Mounting initial preload $F_M^{2)}$ in kN strength class		
			8.8	10.9	12.9	8.8	10.9	12.9
M4	8.78	7.75	2.25	3.31	3.87	4.05	5.95	6.96
M5	14.2	12.7	4.61	6.77	7.92	6.63	9.74	11.4
M6	20.1	17.9	7.80	11.5	13.4	9.36	13.7	16.1
M8	36.6	32.8	19.1	28.0	32.8	17.2	25.2	29.5
M10	58.0	52.3	38.0	55.8	65.3	27.3	40.2	47.0
M12	84.3	76.2	66.5	97.7	114	39.9	58.5	68.5
M14	115	105	107	156	183	54.7	80.4	94.1
M16	157	144	168	246	288	75.3	111	129
M18	192	175	229	336	394	91.6	134	157
M20	245	225	327	481	562	118	173	202
M22	303	282	450	661	773	147	216	253
M24	353	324	565	830	972	169	249	291
M27	459	427	837	1230	1439	223	328	384
M30	561	519	1131	1661	1944	271	398	466

¹⁾ M_A according to VDI guideline 2230 (February 2003) for $\mu_k = 0.08$ and $\mu_g = 0.12$

²⁾ F_M according to VDI guideline 2230 (February 2003) for $\mu_g = 0.12$

1.1.6 Tightening the bolts with a hydraulic tightening device

We recommend the use of a hydraulic tightening device for mounting bolts above M30.

Table 5: Bolt tension forces for using a hydraulic tightening device on regular metric threads according to DIN 13.

Mounting bolt dimension	Tension cross-section A_s mm ²	Core cross section A_d mm ²	Mounting initial preload $F_M^{1)}$ in kN strength classes		
			8.8	10.9	12.9
M24	353	324	198	282	324
M27	459	427	258	367	422
M30	561	519	314	448	515
M33	694	647	389	554	637
M36	817	759	458	653	750
M39	976	913	547	780	896
M42	1121	1045	629	896	1029
M45	1306	1224	733	1043	1199
M48	1473	1377	826	1177	1352
M52	1758	1652	986	1405	1614
M56	2030	1905	1139	1622	1864
M60	2362	2227	1325	1887	2168
M64	2676	2520	1501	2138	2457
M68	3055	2888	1714	2441	2804

¹⁾ F_M for hydraulic tensioning device with preload to 85% of tensile limit

1.2 Installing the Slewing Ring

1.2.1 Positioning the Slewing Ring

- Determine the main load-carrying zone.
- For all Slewing Rings the soft zone of the Slewing Ring raceway shall be placed at a 90 deg point to the maximum load zone. The soft zone is designated with a filling plug or a punched "S" mark.
- With a gauge, check whether the supporting surface of the Slewing Ring is fully supported by the mounting structure.

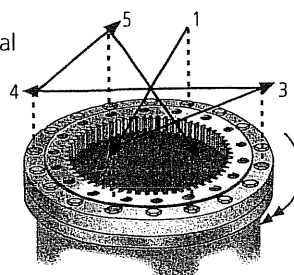
1.2.2 Securing the Slewing Ring with bolts

The Slewing Ring shall be mounted in the unloaded condition. First the toothless bearing ring is attached and then the gear bearing ring.



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

- Lightly lubricate bolt threads in order to ensure uniform frictional resistance (does not apply to bolt locking devices with adhesive).
- Preload the bolts, including washers, if required, cross-wise in 3 steps with 30%, 80%, 100% of the tightening torque or the hydraulically-applied pretension force.
- Thereby rotate the unbolted ring several times. Repeat the procedure for the bearing ring which has not yet been bolted.



When applying a hydraulic fastening device, the tightening forces for preloading shall not exceed 90% of yield stress. The values given in Table 5 correspond with 85% of yield stress.

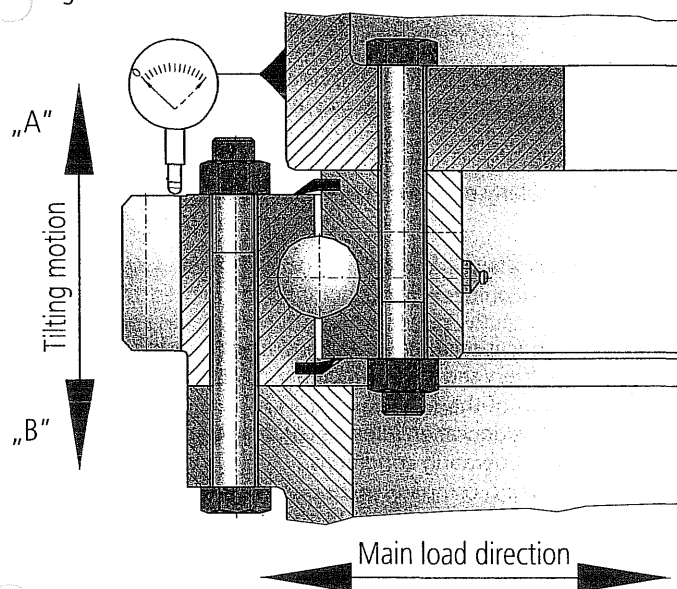
1.2.3 Determining the existing tilting clearance

▲ The tilting clearance increases with raceway wear. To determine the increase in tilting clearance, it is necessary to take basic measurements after installation prior to putting the Slewing Ring into operation for the first time.

- Permanently designate the measuring point in the main load direction.
- Record all measured values.

Procedure

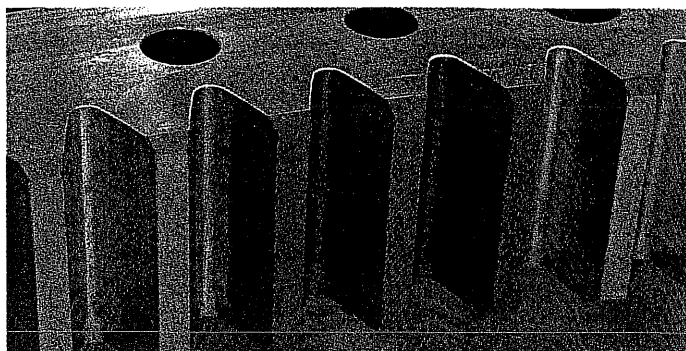
Tilting clearance measurement



1. Determine and mark the measuring point, if possible in the main load direction, on all bearing rings.
2. Attach the dial gauge – see sketch.
3. Apply the defined tilting torque, minimum 50% of the maximum operational load in "A" direction.
4. Set the dial gauge to zero.
5. Apply the defined tilting torque, minimum 50% of the maximum operational load in "B" direction.
6. The measured value displayed corresponds to the tilting clearance and serves as a basis for comparison for later inspections.

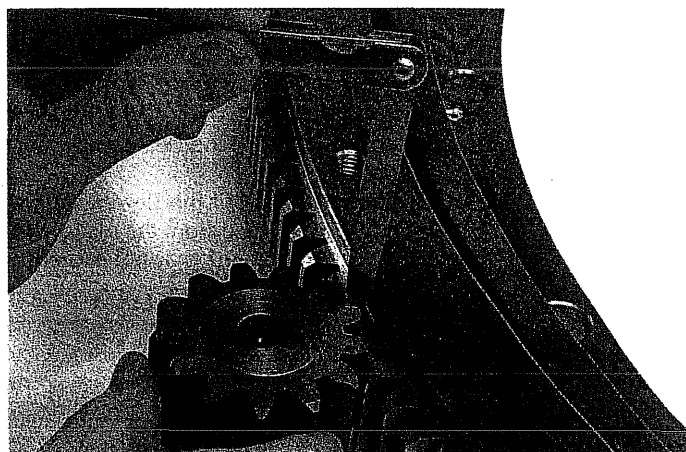
- All subsequent measurements are performed at the same measuring point, with the same loads, at the same position of the bearing rings relative to one another and in the same sequence.
- All the measured values are to be recorded.
- For purely axial or radial loads, tilting clearance is inspected by applying an additional tilting load.

1.2.4 Setting the backlash



In the case of geared Slewing Rings the backlash shall be set during the mounting procedure. The narrowest point of the gearing is marked in green for this purpose.

The set value is: $\delta_f = 0,03 \text{ to } 0,04 \times m$



A gauge shall be used to measure the backlash. If deviations from the specified values are established the axis spacing shall be corrected by moving the pinion. Afterwards the Slewing Ring shall be rotated by one complete turn making sure that no narrow points occur.

Table 6: Permissible backlash

Module m in mm	4	5	6	8	10
Perm. backlash δ_f in mm	0.12 - 0.16	0.15 - 0.20	0.18 - 0.24	0.24 - 0.32	0.30 - 0.40
Module m in mm	12	14	16	18	20
Perm. backlash δ_f in mm	0.36 - 0.48	0.42 - 0.56	0.48 - 0.64	0.54 - 0.72	0.60 - 0.80
Module m in mm	22	24	25	28	30
Perm. backlash δ_f in mm	0.66 - 0.88	0.72 - 0.96	0.75 - 1.00	0.84 - 1.12	0.90 - 1.20

1.2.5 Operating test

If the mounting bolts are properly tightened, then the Slewing Ring shall rotate uniformly. Deviations of the mounting structure and the effect of external loads can strongly impact the friction torque.

1. Rotate the mounted Slewing Ring several times.
2. Check whether the Slewing Ring runs smoothly without jumping.
3. Perform further test runs under full load.

After the operating test, recheck the tightening torques of the mounting bolts.

Installation and Maintenance Instructions for Slewing Rings (EW DV Rev. 6.0)

2. Maintenance / safety checks and lubrication

2.1 Checking mounting bolts

▲ To compensate for possible settling, it is necessary to retighten the bolts to the prescribed torque. This shall be done after no more than 100 hours of operation and without external load applied to the bolt connection.

The inspection shall be repeated after every 700 hours in operation or at least every 6 months. The inspection period shall be reduced under special operating conditions. In case of loose bolts, nuts and washers, replace all bolts, nuts and washers with new ones.

2.2 Checking the tilting clearance

▲ Raceway wear system leads to increased tilting clearance. It is therefore necessary to check the tilting clearance after 700 operating hours, or at the latest after 6 months.

Checking the increase in tilting clearance δ_k directly on the Slewing Ring

For the procedure to check increase in the tilting clearance, see P. 11.

The value (m1) determined after installation of the Slewing Ring is considered as the basic value and is deducted from the measured value (mx). The difference between mx and m1 may not exceed 0.45 mm.

$$\delta_k = mx - m1 \leq \delta_k \text{ perm}$$

$\delta_k \text{ perm}$ = according to Table 7

Checking the increase in tilting clearance δ_k not directly on Slewing Ring

The increase in tilting clearance is to be converted proportionally for each measurement (after the installation measurement) and compared with δ_k permissible.

For both checks:

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

The limits for δ_k permissible are given in the following table at which the Slewing Ring must always be exchanged.

Table 7: Supporting clearance

Rolling element diameter [mm]	12	16	20	25	32	40
Ball supporting clearance δ_k [mm]	1.02	1.16	1.30	1.48	1.72	2.00
Roller supporting clearance δ_k [mm]	0.18	0.25	0.32	0.40	0.52	0.65

Rolling element diameter [mm]	45	50	60	70	80	100
Ball supporting clearance δ_k [mm]	2.18	2.35	2.70	3.05	3.40	4.10
Roller supporting clearance δ_k [mm]	0.74	0.82	0.99	1.16	1.33	1.67

2.3 Relubrication of Slewing Ring



Grease types specified in the delivery drawing shall be used. Substitute lubricants which can be mixed together can be found in Tables 9 & 10.

Legal and manufacturer provisions about handling the respective lubricants must be observed.

2.3.1 Raceway system

1. Inject grease into all cleaned grease nipples one after the other while rotating the Slewing Ring, until a bead of fresh grease forms at least on one sealing lip or at the bearing gap.
2. Ensure that old grease can flow out of the Slewing Ring freely.
3. If possible continue to rotate the Slewing Ring.

2.3.2 Gear

1. Apply grease to the teeth of the Slewing Ring with a clean brush. Instead of a brush the grease can also be sprayed on, or applied by means of a suitable lubricating device (e.g. a lubricating pinion).
2. Remove excess and used grease. Adhesive lubricants have proved to be particularly effective in open gearing.

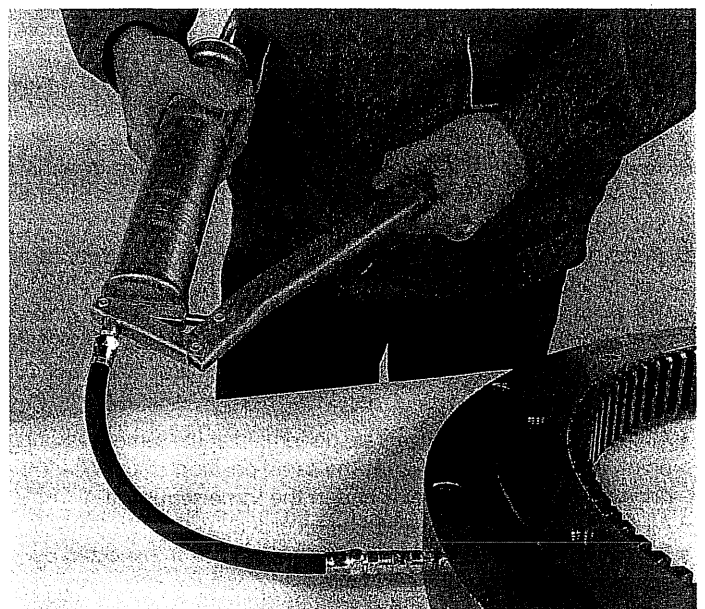
2.4 Relubrication intervals



Relubrication intervals depend mainly on the prevailing operating and environmental conditions as well as the version of the Slewing Ring.

Exact relubrication intervals can only be determined by tests under operating conditions.

In case no comparative results are available, the following table can be used for reference values.



Rotate the bearing rings during regreasing. Follow the accident prevention regulations while doing this.

Table 8: Lubricating intervals

Work conditions	Lubrication intervals
Dry and clean workshop (turntables / robots etc.)	approx. every 300 operating hours, or once every 6 months
Difficult conditions in open ground (crane / bulldozer etc.)	every 100-200 operating hours, or once every 4 months
Aggressive climatic conditions - sea/desert/ Arctic climate / very dirty environments / more than 70 operating hours per week	every 50 operating hours, or once every 2 months
Extreme conditions (tunnelling / steelmills / wind turbines)	Continuous lubrication (by central lubrication system or lubricators)

The specified values given are valid for the following conditions:

- Operating temperature on Slewing Ring in the range from -25°C to 70°C
- Circumferential velocity in the permissible ranges
- Low to medium loads

The table can never replace values established through experience; the most frequent cause of failure of Slewing Rings is insufficient lubrication!

Slewing Rings shall generally be relubricated:

- after every cleaning, e.g. spraying off with water, washing system etc, before and after long inactive periods, e.g. for cranes and construction machines during winter months.

Cleaning the Slewing Ring with a steam jet or high-pressure cleaner is not permissible!



2.5 Lubricants

Lubricants for the raceway system

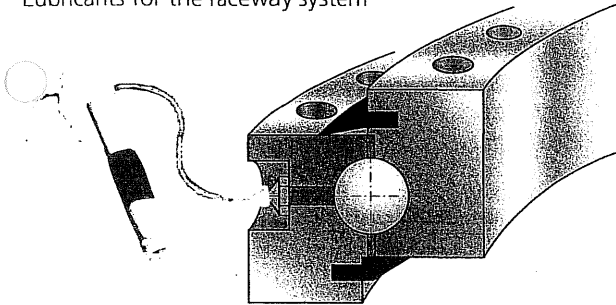


Table 9: Lubricants for the raceway

Supplier	Product name	Applicable temperature range
Aral	Aralub HLP 2	-30°C to + 130°C
Bechem	High-Lub L 2 EP	-20°C to + 120°C
BP	Energrease LS-EP 2	-25°C to + 130°C
Elf	Epexelf 2	-30°C to + 120°C
ExxonMobil	Mobilith SHC 460	-30°C to + 130°C
Klüber	Centoplex 2 EP	-20°C to + 130°C
Rhenus	Norlith MZP 2	-30°C to + 130°C
Shell	Alvania EP (LF) 2	-25°C to + 130°C

Lubricants for the gear

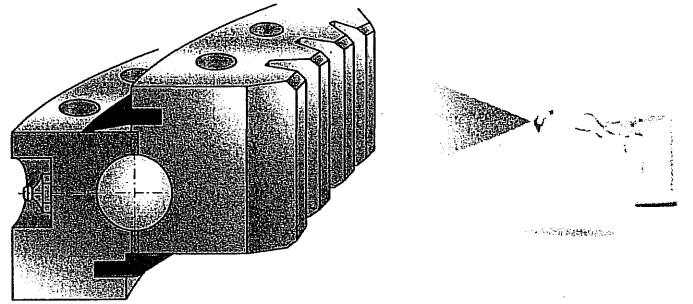


Table 10: Lubricants for the gear

Supplier	Product name	Applicable temperature range
Aral	Aralub LFZ 1	-30°C to + 130°C
Bechem	Berulit GA 400	-20°C to + 120°C
BP	Energol WRL	-20°C to + 120°C
Elf	Cardrexa DC 1	-20°C to + 125°C
Klüber	Graflosen CA 901	-20°C to + 180°C
Rhenus	Norplex AKG 0	-20°C to + 200°C
Shell	Aeroshell Grease 14	-54°C to + 93°C
Manke	Voler Compound 2000E	-30°C to + 120°C

2.6 Checking the seals

Within the course of maintenance work it is also essential to check the seals. Damaged seals must be exchanged. To obtain replacement seals please contact IMO and have the complete drawing number ready. The replacement seals can be cut to the required length and installed with simple tools.

2.7 Dismantling the bearing

If it is found that the limits of tilting clearance have been exceeded during an inspection according to 2.2, the Slewing Ring must be exchanged. It is thereby necessary to proceed in the general sense in the reverse order to that for installation.

Slewing rings shall be disposed of according to the materials of the individual components and are not taken back by the manufacturer. The corresponding environmental regulations shall be strictly observed during their disposal.