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Slewing Bearings
Installation and Maintenance Manual

LYC BEARING CORPORATION
China National Standard Founder for Slewing Bearing

INDEX

Printed in China

1 Slewing Bearing Basic Structures

• Four-point contact ball bearing, see Fig.1. 3～Fig. 1. 5.

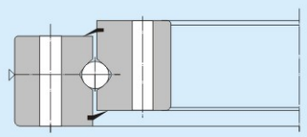

Fig.1.3 Four-point contact ball bearing without gear

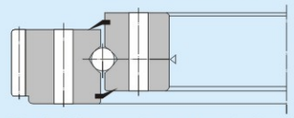

Fig.1.4 Four-point contact ball bearing with external gear

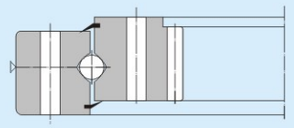

Fig.1.5 Four-point contact ball bearing with internal gear

• Cross cylindrical roller bearing, see Fig.1. 6～Fig. 1. 8.

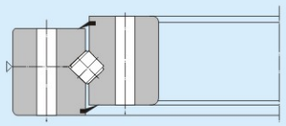

Fig.1.6 Cross cylindrical roller bearing without gear

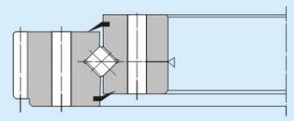

Fig.1.7 Cross cylindrical roller bearing with external gear

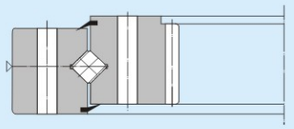

Fig.1.8 Cross cylindrical roller bearing with internal gear

• Double-row ball bearing, see Fig. 1. 9～Fig1. 11.

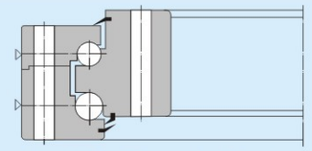

Fig.1.9 Double-row ball bearing without gear

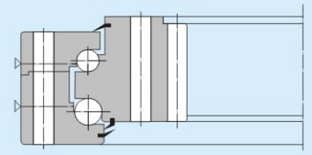

Fig.1.10 Double-row ball bearing with internal gear

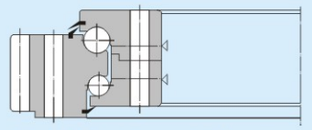

Fig.1.11 Double-row ball bearing with external gear

• Three-row cylindrical roller combined bearing, see Fig.1. 12～Fig. 1. 14.

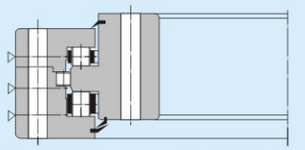

Fig.1.12 Three-row cylindrical roller combined bearing without gear

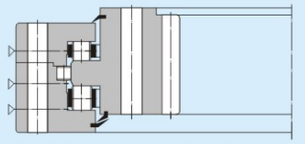

Fig.1.13 Three-row cylindrical roller combined bearing with internal gear

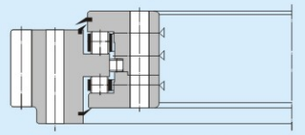

Fig.1.14 Three-row cylindrical roller combined bearing with external gear

• Double-row roller/ball combination slewing bearing, See Fig.1. 15.

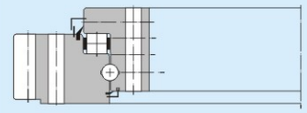

Fig. 1. 15 Double-row roller/ball combination bearing with external gear

2 Lubrication and Seal

Providing optimum lubrication and sealing systems are an essential measure to ensure that bearings run safely and avoid the potential for early failure.

2.1 Lubrication

There are two methods of lubricating the slewing bearing, these include oil lubrication and grease lubrication. The grease lubrication method not only provides a lubrication action, but has the additional advantages such as a sealing method with good adhesion and allows for simple seal structure at a low cost etc, consequently, this lubrication method is most widely used.

There are two main sections that require lubrication, namely the interior rolling elements and the external gear, in some cases there can be differences in the type of lubrication properties. Some applications may have two types of lubrication, whilst others will maintain a common lubrication. When there are two differing lubricants, care should be taken to ensure that the correct lubricant is applied to the specific application. (During the course of maintenance).

If there are no special requirements from the customer for lubrication, then LYC would not normally lubricate the bearing. Before using the bearing the customer should select the appropriate lubricants according to the actual working condition. You may also contact the LYC Technical Department for further advice on this subject.

2.1.1 Lubrication Grease Performance Requirement

Lubrication grease selections are mainly according to loading, temperature, vibration and working environment etc. Additional considerations should also be taken into account:

- Good performance on high and low temperature range, And preferably waterproof.
- Operating temperature should be 20℃ or higher than the bearing working temperature.
- Good performance in extreme pressure situations, in addition to antiwear Properties.
- Where bearings adopt a centralized lubrication system, then it is important to ensure consistency within the system, so as to maintain a smooth flow of lubricant at All times.

Commonly used grease for slewing bearings include calcium based grease, lithium based grease, and aluminum based grease .

2.1.2 Lubrication Period

The slewing bearing's lubrication intervals are dependent on the working conditions, environment, in addition to the run time. Some recommendations are detailed as below:

- Generally lubrication maintenance should be performed every 150 hours. If under extreme working conditions then this period should be reduced to 50～100 hours. (Typical extreme conditions are high moisture conditions, high temperature, dusty environment, etc)
- If the bearing is scheduled to be out of service for a long period of time, then the bearing needs to be fully filled with lubrication grease.

2.1.3 Lubrication Methods

Grease should be injected through the respective lubrication holes (the greasing points are generally a screwed hole with a size M10×1 plug). After greasing, slowly turn the bearing so as to ensure that the grease is distributed evenly.

If there are no special greasing requests, then grease should be inserted within the bearing until grease leaks out from the sealing lip in an even manner.

The lubricating hole can be used as the intake point or the extract point. When re-lubricating, the old grease should be purged out by new grease that is being injected.

After re-lubrication ensure that lubrication plug is placed back into the grease point.

2.2 Seal

2.2.1 Seal Function

Prevent the leakage of lubrication grease filled in the bearing.

Avoid the possibility of any ingress of dust, impurity or moisture entering the bearing.

2.2.2 Seal Structure

The seal structure for a slewing bearing generally includes a rubber lip seal and a metal labyrinth seal. Rubber seals have many advantages, such as their simple structure, small occupation of space, good sealing performance etc. However, after a long period of time in use the rubber seal is subject to wear and can become brittle. Higher operating and environmental temperatures can also subject the seal to early replacement; this should be factored into the maintenance scheduling. In extreme applications where rubber seals would fail in a short space of time then labyrinth seals are adopted.

LYC can design and manufacture special seal structures according to their customer's requirements.

3 Packing, Transport & Storage

3.1 Packing

3.1.1 Rust Prevention

LYC's slewing bearings are always treated with rust preventative prior to delivery. The general period for life expectancy for the rust preventative is 12 months.

3.1.2 Packing Material

LYC's slewing bearings' packaging materials include:

- Polyethylene/Plastic films
- Polyethylene composite paper
- High strength PVC plastic packing
- Composite plastic woven belting
- Flax pieces
- Wooden case

3.1.3 Packing

After the rust prevention treatments are applied, the slewing bearings are generally wrapped in polyethylene and composite plastic woven belting.

Where there are special requirements (such as long distance transportation, high precision or thin section bearing), then a wooden or steel case would be applied as the outer package.

3.2 Transport

Improper transportation can lead to bearing damage. If improper handling during transportation occurs then this can lead to damaged packaging, fretting wear, surface and internal damage to the bearing. In extreme cases rough handling and poor transportation methods can lead to bearing failure.

Attention to the points detailed below must be adhered to during transportation.

- The slewing bearing should be horizontally placed on the lifting tools or transportation vehicles (automobile, ship, plane etc.). No external force in the radial direction is allowed, which could cause the deformation of the slewing bearing. If necessary, auxiliary supports could be added on the inner diameter direction (See Fig.3.1).
- The bearing should be placed in the horizontally when transporting.

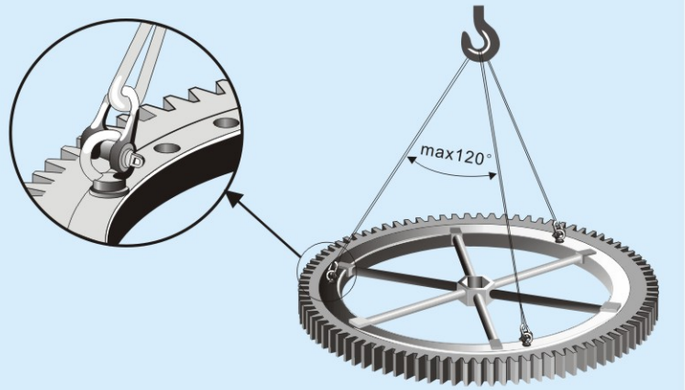

Fig 3.1

Place anti-slip/ anti-vibratory methods in and around the bearing to avoid any potential movement. Bearings should be firmly fixed with ropes/strops. If there is any possibility of inclement weather then the bearings must be covered by a waterproof membrane during transportation.

- Eliminate any possibility of vibration during transportation.
- Reduce where possible the time taken for the bearing being in an unusual stressed position (orientation). Handel these types of bearing with caution. Where possible reduce transportation time.

3.3 Storage

Slewing bearing is large precision machinery products, so it has higher requirement for the storage environment than the normal machinery products. Otherwise, slewing bearing is easy to lose its original precision or rust.

3.3.1 The Requirements for Warehousing

The integrity of warehousing where a slewing ring is stored can play a vital role in the bearing's performance at a later date. The roof should be sound and not leak, there should be numerous air changes (good ventilation). The slewing ring must not be located in direct sunlight. Placement of the bearing within its packaging should be off the ground, the ground surface should be constructed of concrete.

Warehousing should be kept in a dry condition. The relative humidity should be controlled at under 80% Rh. The temperature should be controlled at 25℃±10℃. High humidity and large temperature swings can lead to the propagation of rust within the bearing. At lower temperatures the antirust may crystallize and crack, this results in making the rust preventative ineffective. Conversely, at higher temperatures the antirust tends to evaporate resulting in an ineffective rust prevention.

Do not place corrosive materials such as acid, alkali, or salt in the same storage area as the slewing ring. Avoid any contact with any chemicals, gases, especially water ingress to the bearing.

Do not store the bearing in a place where there could be a continuous vibration/oscillation as this causes fretting.

3.3.2 Requirement for Storage

The integrity of the bearing's packaging should be checked prior to been placed into storage. If the bearing's packaging should be found to be damaged, then the bearing should be cleaned and rust prevention should be re-applied, the packaging should be repaired or replaced.

All the Product Specification information should be kept in a safe place. External information on the packaging should indicate the type and storage conditions.

3.3.3 Stacking Requirements

Slewing bearings should be stacked horizontally. A spacer plate between each ring should be placed at 100 mm distance from the ground (see Fig. 3.2) so as to avoid the potential for corrosion.

The stacking quantity in total should not be more than 5 sets of bearings. There should be a minimum of 3 wooden support blocks at 120 degrees spacing to support the weight of each bearing (see Fig.3.2). These blocks should be in the same position within the same vertical stack height. Apply caution when setting bearings in a stack; caution should limit the possibility of damage and the stack becoming unstable.

All slewing bearings should be placed in order of classification type, precision, manufacturer, manufacturing date, etc.

3.3.4 Maintenance Period in Storage

The precision of a slewing ring can alter during an extended period of time in storage, consequently where possible, inventory time should be kept to a minimum.

Warehousing should be ventilated often and clean Indoor air temperature, humidity, and air changes should all be monitored.

Slewing bearings packaging should not be opened unless the bearing is going to be installed or a service schedule is to be carried out; this none opening of the packaging will avoid any potential contaminants entering the bearing. using in order to prevent from contaminants from entering.

In the event bearings are kept in storage closing to rustproof life then the bearings' should be removed from their packaging, the rust inhibitor should be removed, and a new coat reapplied.

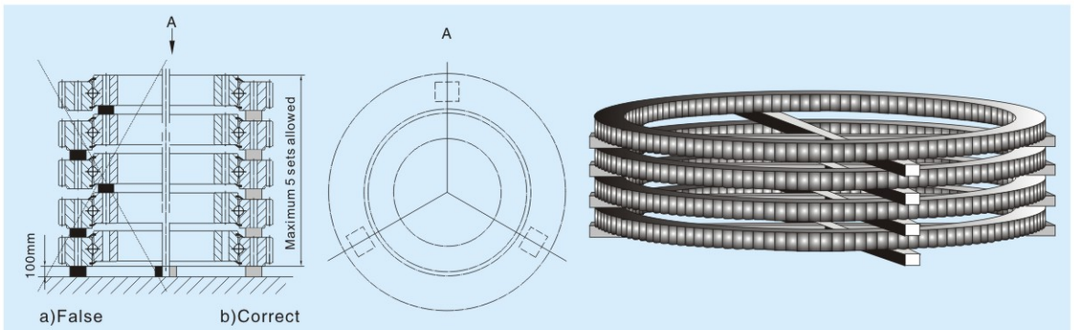

Fig. 3.2

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4 Installation

The details below are the main factors that can influence the normal performance, reliability and the life of a slewing bearing.

- Processing quality (tolerance classification)
- Lubrication and maintenance
- Structural rigidity of supporting frame work
- Flatness of the mounting surface bolt quality
- Preload of mounted bolt
- Mounting quality
- Overloading condition and frequency

4.1 Mounting Surface

The slewing bearing's design is that of a large and thin section shaped ring. Based on this description it is essential that the slewing bearing be connected to a strong supporting frame work in order to maintain rigidity. If the mounting surface is not flat, then ultimately distortion and warping will occur, similarly the torqueing down of the bolts in the correct sequence is also important. If the aforementioned requirements are not followed then this will result in distortion of the bearing, this distortion will have the net result of poor performance and shorten the life expectancy of the bearing (premature failure)

In order to ensure the accuracy (flatness) of the mounting surface, it is recommended that the mounting surface for the support frame work is milled by machining .

If machining is not available, then special plastic fillers with high tensile strength may be used as a gap-filler so as to ensure the precision/integrity of the mounting surface. See Fig. 4.1. You may also contact the LYC Technical Department for further advice on this subject.

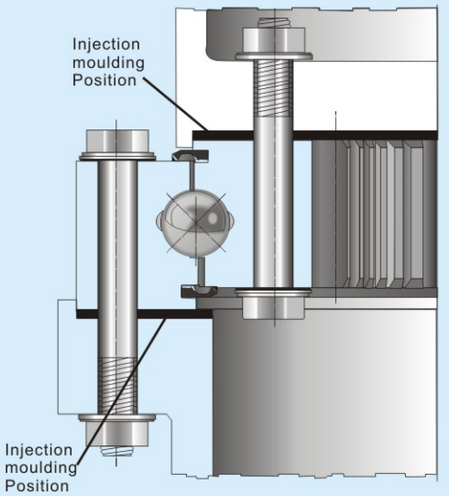


Fig. 4.1

The machining precision for the mounting surface on the supporting frame work should meet the requirements in Table 4.1, Table 4.2 and Fig.4.2.

Table 4.1

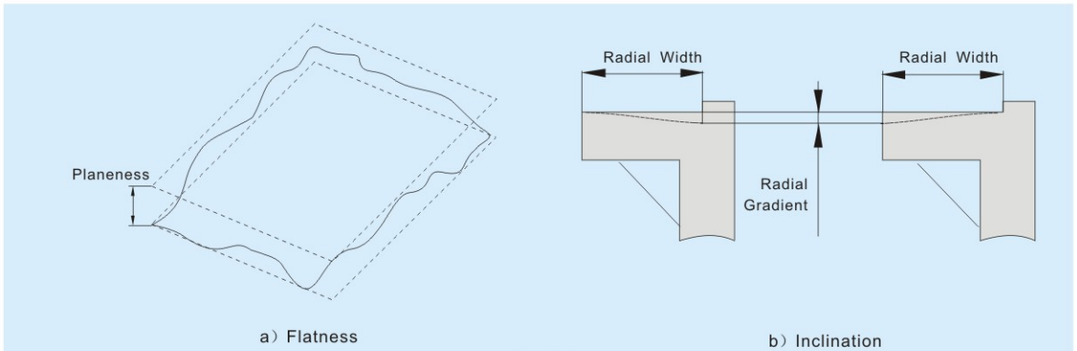
mm

Center Diameter of Raceway		Flatness		
Over	Incl.	Four-point Contact Ball Bearing	Double-row Ball Bearing	Cylindrical Roller Bearing
~	1000	0.15	0.20	0.10
1000	1500	0.19	0.25	0. 12
1500	2000	0.22	0.30	0.15
2000	2500	0.25	0.35	0.17
2500	4000	0.30	0.40	0.20
4000	6000	0.40	0.50	0.30
6000	8000	0.50	0.60	0.40

Note: The flatness within the above table are the maximum permitted values. Each value should only appear once in the scope of 180 degree, and steadily increase or fall off. Wave trend is not allowed.

Table 4.2

Raceway Center Diameter（mm）		Inclination of Radial Width ∠	Roughness Ra（μm）
Over	Incl.		
~	1000	0.10	2.5
1000	1500	0.12	2.5
1500	2000	0.12	2.5
2000	2500	0.15	3.2
2500	4000	0.20	3.2
4000	6000	0.25	3.2
6000	8000	0.30	3.2



a）Flatness　　b）Inclination

Fig.4.2

4.2 Supporting Frame Work

The following issues should be considered when designing the supporting frame work.

The supporting frame work should have enough axial and radial rigidity, otherwise deformation within the axial or radial direction will occur (See Fig.4.3). This will ultimately influence the performance of the bearing in addition to the loading distribution, as well as service life.

Table 4.3 shows graphically the deflection that can occur under the maximum allowable loading.

The gauge of material for the mounting plate that may be welded to the supporting frame work should not be less than the values as shown in Table 4.4.

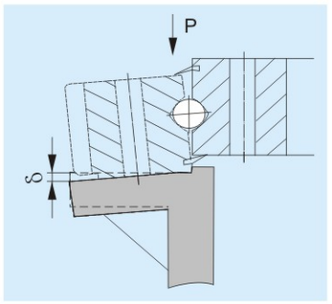


Fig.4.3

Table 4.3

mm

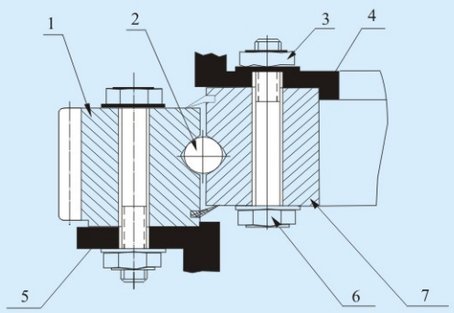
Center Diameter of Raceway		Deflection under Maximum Allowed Loadings	Center Diameter of Raceway		Deflection under Maximum Allowed Loadings
over	Incl.		over	Incl.	
～	1000	0.6	4000	4500	3.0
1000	1500	0.8	4500	5000	3.6
1500	2000	1.0	5000	5500	4.2
2000	2500	1.3	5500	6000	4.8
2500	3000	1.6	6000	7000	5.8
3000	3500	2.0	7000	8000	7.0
3500	4000	2.5			

The size of the mounting plate for the support frame work must exceed the rotating center diameter and the radial cross sectional dimension (see Fig. 4.4)of the ring (outer ring or inner ring) in order to carry and transmit loads, this will reduce the possibility of deformation.

Table 4.4

mm

Center Circle Diameter of Rolling Elements		Min. Thickness
over	Incl.	
	500	25
500	750	30
750	1000	35
1000	1250	40
1250	1500	50
1500	2000	60
2000	2500	70
2500	3000	85



1. Outer ring
2. Rolling elements
3. Screw
4. Upper supporting frame work
5. Bottom supporting frame work
6. Bolt
7. Inner ring

Fig. 4.4

When the radial load of the bearing is 10% higher than that of axial load, than the radial location at mounting plate of the supporting frame work must be considered, so as to prevent radial displacement after carrying the load. When manufacturing under radial location, the oval of location spigot dimension should not be more than 1/2 tolerance zone of spigot dimension.

Except in special circumstances, welding is not allowed on or near the bearing location.

4.3 Bolt

Bolt sizes should meet the requirements of GB/T5782 and GB/T5783, the mechanical properties should be not less than grade 8.8 as stipulated in GB/T3098.1.

Nut sizes should conform to GB/T6170 and GB/T6175, the mechanical property should meet the requirement of GB/T3098.2.

Washer sizes should meet the requirement of GB/T97.1 and GB/T97.2, washers are required to be quenched and tempered. Spring washers are not to be used in a slewing ring installation.

A preload should be applied to all bolts. With the exception of special circumstances the preload should be 0.7 times of the yield limit of the bolt. Preloads are shown in Table 4.5.The bolts clamping length must be 5 times the bolt diameter.

Table 4.5

Bolt Strength Grade	8.8	10.9	12.9
Yield Limit（N/mm²）	640（M≤16），660（M＞16）	940	1100
Bolt Diameter	Preload（kN）		
M10	26	38.5	45
M12	38.5	56	66
M14	53	77	90
M16	72	106	124
M18	91	129	151
M20	117	166	194
M22	146	208	243
M24	168	239	280
M27	221	315	370
M30	270	385	450
M33	335	480	560
M36	395	560	660
M39	475	670	790
M42	542	772	904
M45	635	905	1059
M48	714	1018	1191
M52	857	1211	1429
M56	989	1408	1648
M60	1156	1647	1927

4.4 Installation Requirement

The following requirements need be met when carrying out installation.

Prior to installation do not open the outer or inner packaging, this will avoid the ingress of dust or moisture into the bearing. Carrying out installation and lubrication within a short period of time once the bearing is removed from the packaging.

Prior to installation, It is essential to ensure the mounting plane of the supporting frame remove oil stains, burrs or any other debris that may affect the mounting of the bearing. See Fig.4.5

Before installation, check the appearance and rotational state of the bearing, such as rotational precision, clearance (see Fig.4.6), rotating flexibility, seals position, lubrication grease etc.

Red marking and letter "S" indicate the zone where the raceway is not hardened(soft zone). For the rings with a plugged hole this zone coincides with the position of the plug. When installing the bearing it is important to ensure that this area is placed in a non-load or infrequent load zone (The load plug is always located in soft zone), see Fig.4.7

When the bearing is placed on the supporting frame work it is important to check the interface between these two surfaces. This check should be carried out with the insertion of feeler gauges between the two surfaces. If a gap should exist then it is recommended to plane/resurface the effective area so as to remove the gap. If machining is not practical, LYC allows the use of special plastic fillers with high tensile strength or the use of high tensile shims. The use of filler or shims are to prevent the bearing from suffering deformation during the lock down process with the bolts.

The axis within the mounting holes on the mounting plane should maintain alignment with that of the bearings mounting holes. When adopting oil lubrication the location of oil intake port should be given careful consideration.

All bolts are required to be tightened evenly as shown in Fig 4.8 and Fig 4.9.The preload to the bolts should be applied as requirement aforementioned.

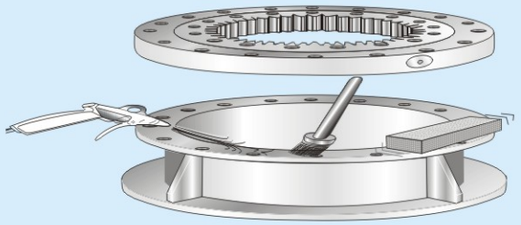
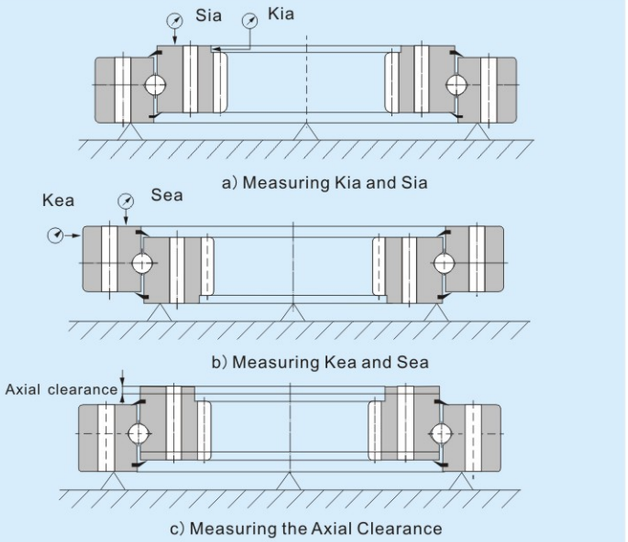


Fig.4.5



a) Measuring Kia and Sia

b) Measuring Kea and Sea

c) Measuring the Axial Clearance

Fig.4.6

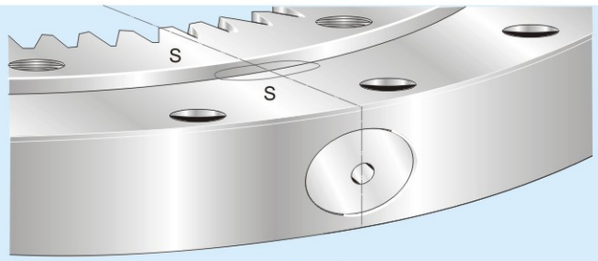


Fig.4.7

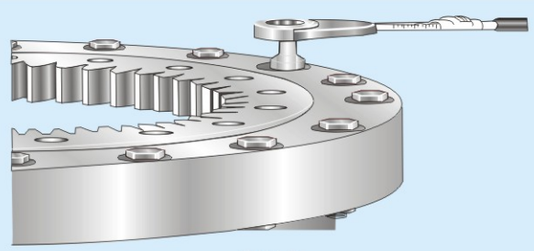


Fig 4.8

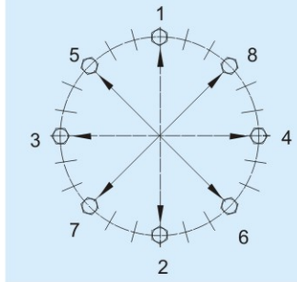


Fig. 4.9

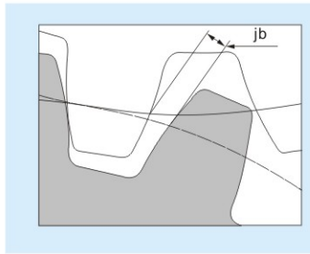


Fig. 4.10

Welding of the bearing is not allowed. In the event of welding any adjacent parts, heat transfer shall be avoided so as not to cause the bearing to become deformed or change the hardness.

When bearings are supplied with a gear drive, it is essential to ensure rotating stability and meshing geometry. During the installment of the slewing bearing and gear drive, adequate backlash (see Fig.4.10) must be assured. The backlash is adjusted at 3 teeth marked in green and is to be at least 0.03×module .

After installation, the bearing should be rotated to check for smooth operation and any emission of unusual noise. If either of the aforementioned are noted, then the bearing should be adjusted to eliminate them. The teeth of the largest run-out are coated with green paint.

Check the clearance between the bearing and fitting surface of the supporting frame work, if a gap should exist (see Fig.4.11), then this must be rectified.

When equipment is frequently operated outdoors, precautions should be taken to avoid water ingress.

Where the application is operating in a corrosive environment, it is recommended to carry out surface treatment of the bearing, such as aluminizing, zinc spraying, spray painting, or a phosphate coating. These types of protective coatings will ensure longevity in performance.

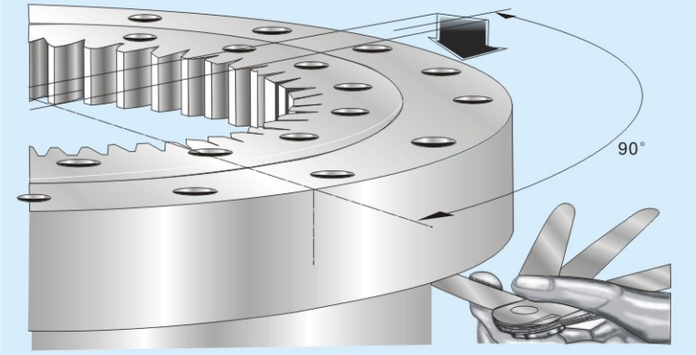


Fig.4.11

5 Maintenance

Scheduled maintenance is essential so as to ensure that the bearing operates at optimum performance and is able to achieve its calculated life expectancy. Maintenance is generally divided into two sections. The first section being after the bearing has been mounted and has passed the run in period; the second section named routine maintenance is the period after the bearing has entered into normal operation.

The first section of maintenance is generally carried out after the bearing has been running 100 hours. Particular emphasis at this inspection period is to clean the tooth surfaces and seal, check mesh precision and re-torque the bolts.

The second section for maintenance is divided into routine maintenance and periodic maintenance.

Routine maintenance is performed prior to the equipment being started, this includes checking for abnormal noises, vibration checks, electric current changing or power discharge in the case of electrical equipment. If there should be abnormal or unusual noises identified then the equipment should be stopped and checked immediately.

Periodic/scheduled maintenance should be according to the workload of the equipment's environmental conditions in addition to other factors. Under normal circumstances this schedule should be carried out every 500 hours. The bearing should be checked prior to periodic maintenance, if anything unusual i.e. noise, appearance, or if the running condition should deteriorate etc. **Bearings must not be opened without the expressed consent of LYC.**

Please see below the content and measurement for maintenance in Table 5.1

Table 5.1

Part	Inspection Content	Measurements
Bearing	1. If there are any unusual vibrations has (abnormal change while running).	1. Check that there is no interference between adjacent parts and the Bearing. 2. Replace contaminated lubricant or the failed seals. 3. Inspect the internal components of the Bearing, ONLY under the instruction of the Bearing Manufacturer.
	2. If there are any abnormal changes in the sound of the Bearing while running.	1. Check for adequate lubrication. 2. Flush and refill the contaminated lubricant or failed seals. 3. Check the internal components within the Bearing, ONLY under the instruction of the Bearing Manufacturer.
	3. If an increased resistance is noted.	Check the clearance for any deformation between the Bearing and the Supporting Frame work.
Gear	1. Backlash.	Adjust the center distance between the two gears to bring the backlash into specification.
	2. Contact length or width.	Adjust the deflection between the Bearing and Supporting Frame work when the length and width are uneven.
	3. Lubrication.	1. Remove contaminated lubricant and re-lubricate. 2. Lubricant where appropriate
	4. Wear on tooth surface.	Eliminated bumps, scratches, and dirt caused by surface wear.
	5. Foreign material at the root of teeth.	Eliminate the foreign material.
Bolt	1. Loose bolt.	1. Re-torque loose bolt. 2. Re-torque bolts every 500 hours.
	2. Install surface joint clearance between bearing and supporting frame work.	Remove the clearance.
	3. Fracture.	Replace the bolt.
	4. If there is any deformation of the washer.	Replace the bolt and washer.
	5. Replacement intervals.	Replace the bolts which have been used for 7 years or over 14,000 hours.
Seals	1. Breakage, cracking.	Replace the seal.
	2. Excessive stretching, seal dislodged.	Adjust or re-install, install replacement seal.
	3. Seal lip broken.	1. Replace the seals that are aged or worn. 2. Add lubricant to the seal lip.
	4. Contact condition between bearing and seal lip.	1. Clean the immediate contact area. 2. Remove/resurface any sharp edge at the seal contact position.
Lubrication	1. If there is any abnormal leakage of the lubricant.	1. Add fresh lubricant or purge and carry-out complete refill 2. Replace broken seals. 3. Remove/resurface any sharp edge at the seal contact position.
	2. Lubricant contaminated.	1. Replace seriously contaminated lubricant. 2. Replace the failed seal.
	3. Lubricant failure .	Replace the failed lubricant.

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