Bearing Health Management

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We have always been grateful for your great love for Dalian Chengfeng Bearing, and we would like to express our deep gratitude here.

In addition to the rolling fatigue life of the bearing itself, there are also cases of early damage.

These situations are more likely to occur when the bearing operation and maintenance management are not properly carried out.

This booklet is intended to prevent early damage "accidents" of these bearings, and if an "accident" occurs, it is used as a reference manual for identifying its cause and taking appropriate countermeasures.

Health Management of Bearings
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1. Foreword

Although rolling bearings are an essential element of a machine, they play a very important role. They can not only affect the function of the machine, but also cause damage (or accidents) such as bearing damage or sticking during operation, which not only causes the machine to stop running, but also has the impact of stopping the production line. In addition, if the axle bearings of cars or vehicles fail, it may also cause major accidents.

Therefore, although bearing manufacturers should make every effort to ensure bearing quality, they also hope that users can fully manage the operation and maintenance of bearings.

Even if the bearing is properly installed, properly lubricated, etc. are used to make the bearing operate normally, there will be a situation where the bearing cannot continue to be used after a period of time. This is because the raceway surface or the rolling surface of the rolling element is repeatedly subjected to compressive loads, and the surface peels off, that is, peeling occurs.

The life of a rolling bearing is defined as the total number of revolutions (total operating time at a constant rotational speed) before this peeling occurs.

In addition, conditions such as biting, damage, wear, indentation, corrosion, etc. can also cause the bearings to become less durable. These should be referred to as bearing failures and can be considered to be caused by errors in bearing selection or improper operation of the bearings. Through appropriate selection, correct operation, or maintenance management, these problems can be avoided

In practice, it is also true that the damage caused by the use method including the design of the bearing and its surroundings and improper maintenance management account for most of the damage caused by the rolling fatigue of the bearing itself.

2.Maintenance and management of bearings

Managing the condition of bearings in machinery and equipment in operation is important to prevent bearing failures. The following items are often used as a general method of bearing maintenance.

(1) Check the running status of the machine
Through the point inspection of bearing temperature, sound and vibration, and the investigation of lubricant characteristics, judge the interval of lubricant replenishment or replacement.

(2)Observation of bearings after use
Carefully observe the phenomenon of bearings after use and during regular inspections, and take measures to prevent recurrence when bearing damage is found. It is very necessary from the perspective of maintenance management to determine the inspection items and regular inspection cycle according to the importance of the device and machinery.

3.Inspection of machine running status

3.1 Bearing Temperature

Generally speaking, the temperature of the bearing will rise after starting to operate, and after a period of time, it will be in a normal state at a lower temperature (usually 10-40°C higher than room temperature). The time to normal state varies from 20 minutes to several hours depending on the size, type, speed, lubrication method, and heat dissipation conditions around the bearing.

When the bearing temperature does not reach the normal state but the temperature rises abnormally, the reasons shown in Table 3.1 can be considered, and the operation must be stopped and measures should be taken.

In order to ensure the proper life of the bearing and prevent the deterioration of the lubricant, etc., the temperature of the bearing should not be too high, and it is generally ideal to use it below 100°C.

Table 3.1 Main causes of abnormal temperature rise

(1) Too little or too much lubricant
(2) Poor installation of bearings
(3) The internal clearance of the bearing is too small or the load is too large
(4) The friction of the sealing device is too large
(5) The lubricant is not suitable
(6) Creep of mating surfaces

3.2 Bearing Sound

The rotation sound of the bearing can be judged to be normal by putting the sound tester close to the bearing seat to investigate the size and sound quality of the sound. If a clear sound is heard, it can be judged as normal, but this judgment is difficult and requires extensive experience. It is difficult to describe the sound in words, and personal feelings are also different, so the description may not be appropriate. Table 3.2 shows typical abnormal noise characteristics of bearings and related causes.

Table 3.2 Typical abnormal noise characteristics of bearings and related causes

Voice description	Features	Related reasons
Za ~ Zha ~ Ga ~	The sound quality does not change with changes in rotational speed (abnormal objects). The sound quality changes with the speed of rotation (scratches).	● Abnormal object ● Rough surface of raceway surface, steel ball, and roller ● Scratches on the surface of raceways, steel balls, and rollers
Zi la~	Small bearings	● Rough surface of raceway surface, steel ball, and roller.
Zi la~Zi la	Intermittent and regular occurrence.	● Contact with labyrinth seals, etc . ● Contact with holder and sealing ring.
Wu~ Wu~ Wuwu (sound of a flute)	As the rotational speed changes, both the size and height change. The sound is loud at a specific rotational speed. The sound may be loud or low. Sometimes it sounds like an alarm or a flute sound.	● Resonance, poor fit (poor shaft shape) ● Ferrule deformation ● Vibration marks on raceway surfaces, steel balls, and rollers.(It is normal for large bearings to have mild noise)
Ga zhi~ga zhi~ Ka chi~ka chi~	Sound when turning manually.	● Raceway scratches (regular) ● Scratches (irregularity) of steel balls and rollers ● Abnormal objects, deformation of rings (partial clearance is negative)
Gulu gulu~ Gululu~	Big bearings small bearings } Continuous sound at high speed	● Scratches on raceway surfaces, steel balls, and rollers.
Wong wong~ Wu~	Instantaneous stop when power is cut off.	● Electromagnetic sound of motor
Zhila zhila~	Irregularly emitted (does not change due to changes in rotational speed) Mainly small bearings	● Mixed with abnormal substances
Qiala~qiala~ Kaba~kaba~ Pada~pada~ Bada~bada~	Tapered roller bearings Big bearings Small bearings } Regular and continuous at high speeds	● If the sound of the cage is clear, it is normal ● If the grease is not suitable at low temperature → it is better to choose a soft grease ● Operation when the pockets of the cage are worn, the lubrication is insufficient, and the bearing load is insufficient.
Dida~dida~ Dingdang~dingdang~ Dang~dang	More noticeable at low speeds Continuous sound at high speed	● Crashing noise inside cage pocket, insufficient lubrication. Reduce internal clearance,Or the abnormal sound disappears after preload is applied. ● If the rollers are full, it is the collision sound between the rollers
Bang~bang~	Larger metal impact noise, low-speed thin-walled large bearings, etc.	● Rolling element collapse sound ● Ferrule deformation ● The creaking sound of keys
Chiliu~chiliu~ Zhi~zhi~ Hua~hua~	The main reason is that cylindrical roller bearings change due to changes in rotational speed, and metal sounds can be heard when it is loud. After supplementing the lubricating oil, it will temporarily stop.	● Lubricant (grease) too thick ● Excessive radial internal clearance ● Insufficient lubricant
Si~si~ zhi~zhi~ Qiang~qiang~	Gluing sound between metals Sharp sound	● Gluing between rollers and retaining edges of roller bearings ● Internal clearance too small ● Insufficient lubricant
zila~zila~	Small bearings make irregular noises	● Bubble rupture sound in lubricating grease
Paca~paca~ Peng~peng	Make an irregular creaking sound	● Slipping of the mating part ● The installation surface is creaking ● The creaking sound of keys
Overall, the sound pressure is too high		● Rough surface of raceway surface, steel ball, and roller. ● Deformation of raceway surface, steel ball, and roller due to friction. ● Excessive internal clearance due to friction.

3.3 Vibration of bearings

If the vibration of a running machine is measured, bearing damage can be detected early. That is to say, through the quantitative measurement and analysis of the vibration amplitude and frequency, the damage degree of the bearing can be inferred. However, differences in measured values may also occur depending on the measurement location and the usage conditions of the bearings, so it is best to store the measurement information for each machine in advance and set the criteria for judgment.

3.4 Lubricant Selection

The purpose of lubricating the bearing is to form a thin layer of oil film on the rolling surface and sliding surface of the bearing to prevent direct contact of the metal surface, which has the following effects.

(1)Reduce friction and wear

(2)Release the heat generated by friction

(3)Extend bearing life

(4)Prevent rust

(5)Prevent the mixing of abnormal substances

In order to achieve the above effects, please refer to the following when selecting a lubricant.

(1) Grease

Grease is easy to operate and the design of the sealing device can be simplified, so it is widely used in the lubrication of rolling bearings.

When selecting lubricating grease, it is necessary to carefully consider the types and characteristics of base oil, thickener, and additives, and choose the lubricating grease suitable for the service conditions of the bearing. In addition, the general relationship between the consistency and application of grease can be referred to Table 3.3.

Table 3.3 Grease Consistency

NLGI Consistency no.	JIS (ASTM) 60 times mix consistency	Purpose
0	355～385	For centralized fat supply
1	310～340	For centralized fat supply
2	265～295	General use, sealed bearings for general use, high temperature special purpose
3	220～250	
4	175～205	

(2) Oil lubrication

In general, oil lubrication is more suitable for high-speed rotating or high-temperature applications than grease lubrication. In addition, when it is necessary to discharge the heat generated by the bearing or the heat applied to the bearing to the outside, it is more suitable to use lubricating oil.

The lubrication of rolling bearings, depending on their operating temperature, requires matching of the viscosity ranges shown in Table 3.4.

When selecting a lubricating oil, it is necessary to fully consider the viscosity, viscosity index, oxidation stability, rust prevention, defoaming and other aspects. Table 3.5 is an example of selection criteria for lubricating oil viscosity.

Also, Fig. 3.1 shows the viscosity-temperature curve of lubricating oil. It is used to select the lubricating oil with proper viscosity according to the operating temperature.

Table 3.4 Necessary Viscosities for Bearings

Bearing type	Dynamic viscosity mm²/s
Ball bearings, cylindrical roller bearings, needle roller bearings	13
Spherical roller bearings, tapered roller bearings, thrust needle roller bearings	20
Thrust spherical roller bearings	30

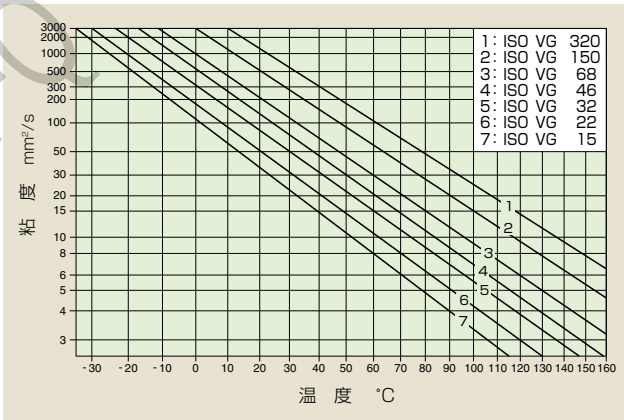


Figure 3.1 Viscosity-temperature curve of lubricating oil

3.5 Lubricant replenishment and replacement period

As the lubricating performance of the grease becomes weaker with time, new grease must be replenished at appropriate intervals. The interval of replenishing grease varies according to the bearing type, size, speed, bearing temperature and the type of grease.

The replacement period of lubricating oil varies depending on the operating conditions of the machine and the method of refueling, etc. Tables 3.6 and 3.7 show the approximate replacement period calculated from the characteristic analysis test of the lubricating oil and the interval standard of the test frequency.

Table 3.5 Selection Criteria for Lubricating Oil Viscosity

The operating temperature of the bearing ℃	*dn* value[1)]	ISO viscosity grade (VG) of lubricating oil		Bearing application
		Normal load	Heavy load or impact load	
−30～ 0	To limit rotation	22, 32	46	All kinds
0～ 60	to15000	46, 68	100	All kinds
	15000 ～80000	32, 46	68	All kinds
	80000 ～150000	22, 32	32	Except for thrust ball bearings
	150000～500000	10	22, 32	Single Row Radial Ball Bearings Cylindrical Roller Bearings
60～100	to 15000	150	220	All kinds
	15000 ～80000	100	150	All kinds
	80000 ～150000	68	100, 150	Except for thrust ball bearings
	150000～500000	32	68	Single Row Radial Ball Bearings Cylindrical Roller Bearings
100～150	To limit rotation	320		All kinds
0～ 60		46, 68		Spherical roller bearing
60～100		150		

Note 1) [dn=bearing inner diameter dimension d (mm) × Using speed n (min-1)

Lubrication methods that are only applicable to oil bath lubrication or cyclic lubrication.

Table 3.6 Example of Characteristics and Replacement Period of Lubricating Oil

Characteristic		Judgment basis for replacement period		Summary
		Engine oil	Other oil	
Changes in viscosity compared to new oil mm²/s		within25%, 10～15% most comfortable	10%以内	The occurrence of oxidative degradation and the mixing of heterogeneous oils
Moisture volume %		Below 0.2	Below 0.2	Dehydration can sometimes be reused.
Weight of insoluble portion	N-pentane %	Below 1.0	Below 0.2	Oxidative degradation, carbon, wear particles, dust.
	Methylbenzene %	Below 0.5	Below 0.1	Carbon, wear particles, dust
Sedimentation value mℓ/ 10mℓ			Below 0.1	Abnormal objects such as moisture and dust, as well as metal wear particles
Total acid value KOHmg/g		2～3 times of the new oil		Take a higher value based on the additive.
Ash content %		Below 0.2	—	
Iron content in ash %		Below 0.1	—	

Table 3.7 Frequency of Characteristic Test for Lubricating Oil

Lubrication method	Checking time	
	Normal operating conditions	Severe operating conditions
Flywheel splash lubrication	1 time per year	1 time per 6 months
Oil bath, splash lubrication	1 time per 6 months	1 time per 3 months
Flywheel splash lubrication	1 time per 9 months	1time per 1~3 month

*Severe operating conditions are as follows

(1) Moisture condensation or immersion is obvious.

(2) Intrusion of dust gas etc. is obvious.

(3) The operating temperature is above 120°C.

4. Observation of bearings after use

Carefully observe the appearance of each part of the disassembled bearing after use and during regular inspections to judge whether the bearing is in good condition.

If any abnormalities are found on the appearance of the bearing,it is necessary to communicate with Compare and compare e amples of bearing damage and countermeasures to e plore their causes and countermeasures.

5.Damage to bearings and countermeasures

Generally speaking, if the bearing is used correctly, it can be used for a long time before reaching the rolling fatigue life. If unexpected premature damage occurs, it is likely to be due to the selection, operation, lubrication and other aspects of the bearing. properly caused.

When the damage of rolling bearings is considered from the phenomenon, it is difficult to judge the real cause because the causes involve many aspects and many aspects are intertwined with each other. At this time, on the basis of mastering the bearing application machinery, installation position, application conditions and surrounding structure of the bearing, comprehensively analyze the state and damage phenomenon when the damage occurs, and obtain several possible reasons. After comprehensive analysis and discussion, similar damage can be prevented. damage occurred again.

In this catalog, pictures of damage cases, main causes of occurrence, and countermeasures are recorded for each type of bearing damage, as a reference for judging the cause of bearing damage.

Figures 5.1 to 5.7 show the names of the parts of the bearing used in the description of the damage examples below.

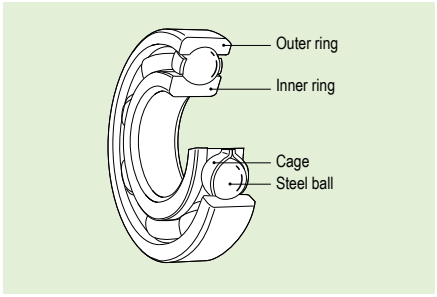


Figure 5.1 Deep Groove Ball Bearing

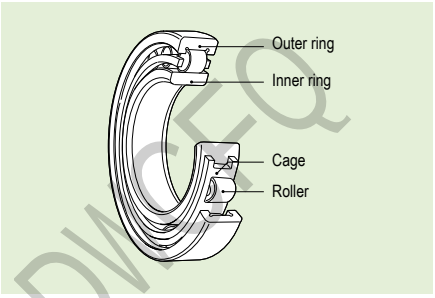


Figure 5.2 Cylindrical Roller Bearing

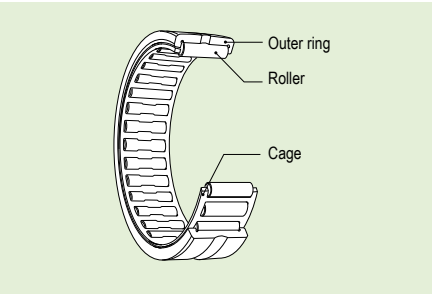


Figure 5.3 Needle Roller Bearing

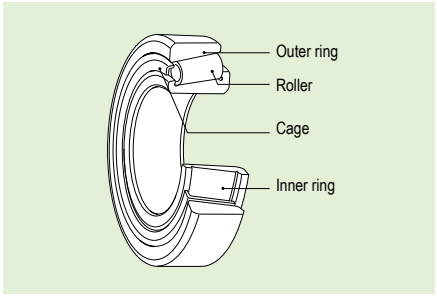


Figure 5.4 Tapered Roller Bearing

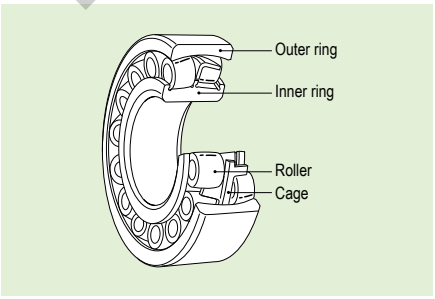


Figure 5.5 Self aligning Roller Bearing

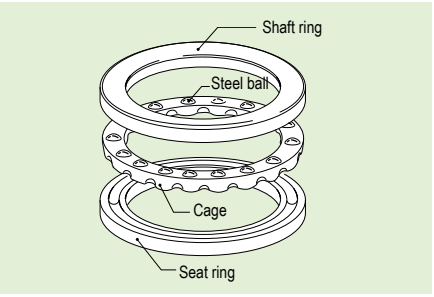


Figure 5.6 Thrust Ball Bearing

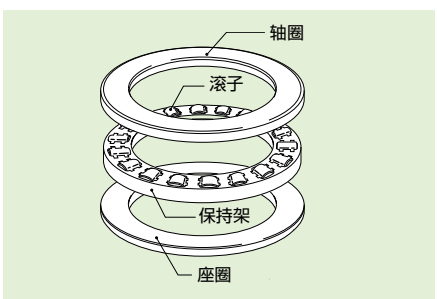


Figure 5.7 Thrust Roller Bearing

5.1 Peeling off

Phenomenon	Main reason	Main Countermeasures
The raceway surface flakes off in scales. The detachment area is obviously concave-convex.	Although it is a fatigue phenomenon caused by rotation, it can also occur at an early stage when abnormal loads such as excessive load, poor application, poor precision of the shaft or housing, installation errors, etc., foreign matter intrusion, or corrosion occur.	(1) Investigate whether an abnormal load has been applied. (2) Confirm the conditions of use, and use the load capacity according to the situation Larger bearings. (3) Increase the viscosity of the lubricant and improve the lubrication method to form a sufficient lubricating oil film. (4) Prevent installation errors.

Photo A-1

- Deep groove ball bearings
- The inner ring, outer ring, and steel balls peel off.
- The reason is that the load is too large.

Photo A-2

- Outer ring of angular contact ball
- Ball pitch peeling occurs on the raceway surface. ● The reason is that the application is not suitable.

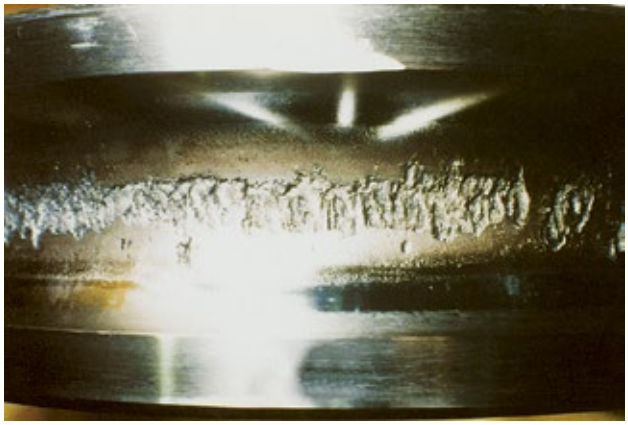


Photo A-3

- Inner ring of deep groove ball bearing

Photo A-4

- Outer ring of deep groove ball bearing

Photo A-5

- Inner ring of deep groove ball bearing.
- Peeling occurs on one side of the raceway surface.
- The reason is that the axial load is too large.

Photo A-6

- Inner ring of spherical roller bearing.
- Only a single row of the raceway surface peels off.
- The reason is that the axial load is too large.

Photo A-7

- Tapered roller bearing
- 1/4 of the raceway surface of the inner ring peeled off, and the rollers and outer ring turned light brown.
- The reason is that the preload is too large.

Photo A-8

- Outer ring of double row angular contact ball bearing.
- Spalling occurs on 1/4 turn of the raceway surface of the outer ring.
- The reason is improper installation

Photo A-9

- Thrust ball bearing
- .The shaft ring (the washer on the matching side of the shaft) and the steel ball are peeled off
- The reason is poor lubrication.

Photo A-10

- Outer ring of double row tapered roller bearing.
- Spalling of the raceway surface.
- The reason is galvanic corrosion.

5.2 Peeling

Phenomenon	Main reason	Main Countermeasures
Areas of concentration of tiny exfoliations (approximately 10 μm in size). Lots of cracks that look like strands of hair but haven't reached the point of peeling off.	Often occurs in roller bearings. In addition, it is more likely to occur when the surface of the mating parts is rough and the lubrication performance is poor. Peeling can develop into flaking.	(1) Do a good job of surface roughness and prevent foreign matter from invading manage. (2) Confirm the lubricant again. (3) Implement running-in operation.

Photo B-1

- Rollers of spherical roller bearings.
- Peeling occurs on the rolling surface.
- The reason is poor lubrication.

Photo B-2

- Tapered roller bearing
- The peeling of the inner ring and the roller is developing towards peeling.
- The reason is poor lubrication.

5.3 Glued

Phenomon	Main reason	Main Countermeasures
Scratch with bite. Scratches during installation appear in the axial direction. The scratches on the end faces of the rollers and the guide ribs are cycloidal. Scratches in the direction of rotation caused by raceway surfaces and rolling surfaces.	Poor application such as installation and disassembly Excessive axial load causes the oil film on the contact surface to break, foreign matter to engage, and preload to be too large Rolling element slipping, poor lubrication	((1) Improve the installation and disassembly methods. (2) Discuss the conditions of use again. (3) Discuss the amount of preload again. (4) Confirm the lubricant and lubrication method again. (5) Strengthen the sealing function.

Photo C-1

- Inner rings of cylindrical roller bearings
- Gluing occurs on the sidewall
- The reason is that the load is too large

Photo C-2

- Inner ring of tapered roller bearing
- Gluing occurs on the raceway surface and large retaining edge surface
- The reason is poor lubrication

Photo C-3

- Roller of tapered roller bearing
- Cycloidal gluing appears on the end surface of the roller
- The reason is poor lubrication

Photo C-4

- Roller of cylindrical roller bearing
- Axial scratches on the rolling surface during installation
- The reason is improper installation method

5.4 蹭伤

Phenomenon	Main reason	Main Countermeasures
Surface roughening with material transfer.	The rolling elements slip during the rolling motion and the performance of the lubricant is insufficient.	(1) In order to better form a lubricating oil film, reconfirm the lubrication agent and lubrication method. (2) Choose a lubricant containing extreme pressure additives. (3) Take measures to prevent slippage (reducing radial internal clearance, applying preload , etc.)

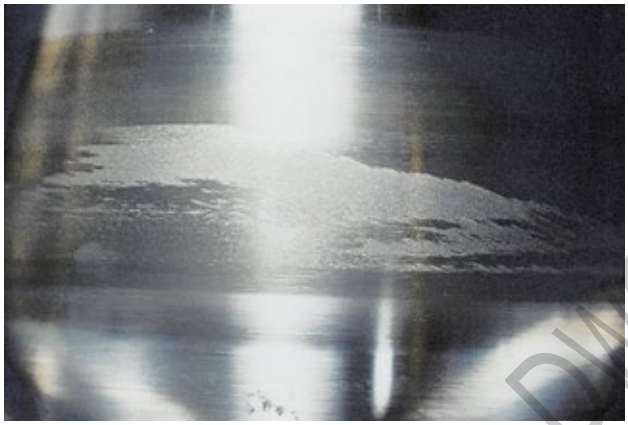


Photo D-1

- Inner rings of cylindrical roller bearings
- Scuffing on the raceway surface
- The reason is that the rollers slip due to the engagement of abnormal objects

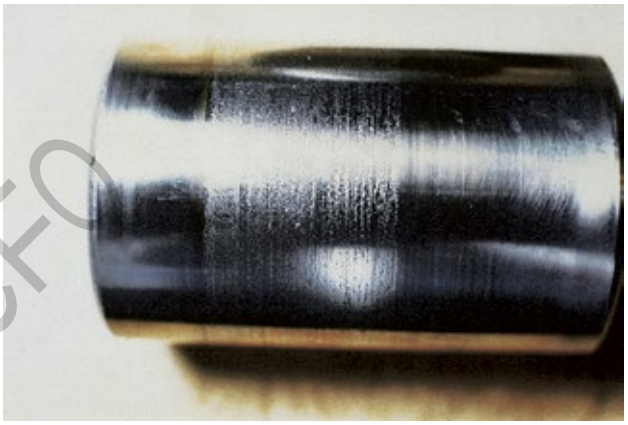


Photo D-2

- Rollers of cylindrical roller bearings (rollers of photo D-1)
- Scuffing on the rolling surface
- The reason is that the rollers slip due to the engagement of foreign objects

Photo D-3

- Rollers of thrust spherical roller bearings.
- Scuffing occurs in the center of the rolling surface.
- The reason is that the rollers slip due to the engagement of foreign objects.

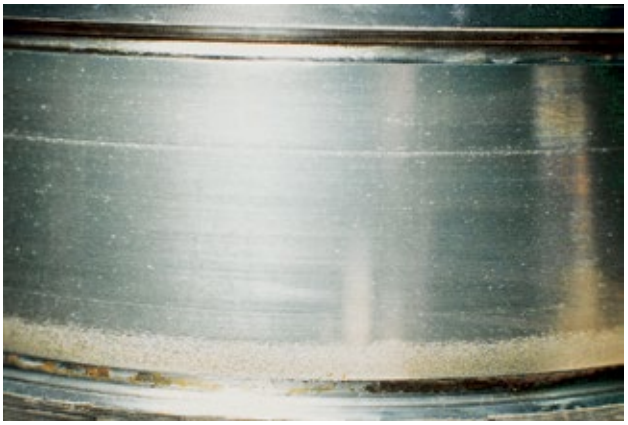


Photo D-4

- Inner ring of double row tapered roller bearing.
- Scuffing on the raceway surface.

5.5 Wear 1

Phenomenon	Main reason	Main Countermeasures
Surface wear, causing dimensional changes. Often accompanied by surface roughness and scratches.	Intrusion of solid foreign objects Poor lubrication such as foreign matter mixed into the lubricant Roller skew	(1) Confirm the lubricant and lubrication method again. (2) Strengthen the sealing performance. (3) Filter the oil through the filter. (4) Avoid tilting caused by installation errors.

Photo E-1

- Outer ring of cylindrical roller bearing
- Differential wear on the raceway surface
- The reason is poor lubrication

Photo E-2

- Inner ring of a cylindrical roller bearing (inner ring of photo E-1)
- The raceway surface wears out in one week
- The reason is poor lubrication

Photo E-3

- Outer ring of double row angular contact ball bearing.
- Wearing of raceway surface on one side.
- The reason is poor lubrication.

Photo E-4

- Cages for cylindrical roller bearings.
- The pocket part of the car-made high-strength brass cage is worn.

Wear 2

Phenomenon	Main reason	Main Countermeasures
Wear and tear. Refers to the raceway or rolling surface, roller end surface caused by friction. Material damage caused by the shoulder surface, cage pocket surface, etc.	Intrusion of foreign matter Caused by the development of rust and electrocorrosion Slipping caused by irregular movement of poorly lubricated rolling elements	(1) Improved sealing (2) Clean the bearing seat (3) Lubricating oil is fully filtered, (4) Check the lubricant and lubrication method (5) Prevent the midline from not overlapping.

Photo R-1

- Inner ring of cylindrical roller bearing
- Wavy wear on the raceways and many pits caused by galvanic corrosion
- Reason: due to the development of electrical corrosion

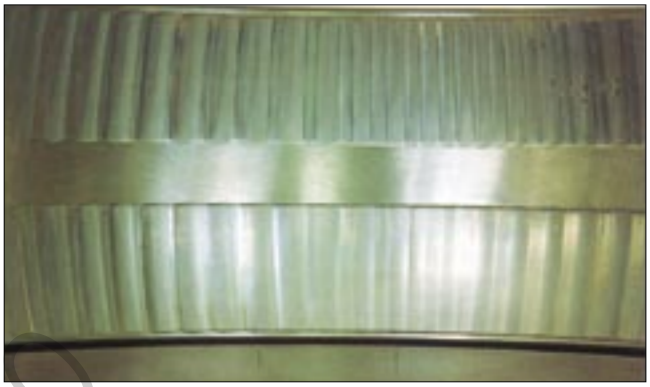


Photo R-2

- Outer ring of spherical roller bearing
- Rough and wavy wear on the load side raceway
- Reason: Repeated vibration in a stationary state caused foreign objects to invade the bearing

Photo R-3

- Inner race of double row tapered roller bearings.
- Step like wear on the shoulder surface and micro motion wear on the raceway.
- Reason: Due to the development of fretting wear caused by excessive load in a stationary state

Photo R-4

- Tapered rollers for double row tapered roller bearings.
- Step like wear on the top end face of the roller.
- Reason: It is caused by the development of fretting wear caused by excessive load in a stationary state.

5.6 Pear noodles, discoloration

Phenomenon	Main reason	Main Countermeasures
Pear noodles The raceway surface is matte, and the surface is rough like a pear surface. Concentration of tiny indentations change color Discoloration of the surface.	Intrusion of abnormal objects poor lubrication Heating causes tempered color Oxidized oil stains (deteriorated oil adheres to the surface)	Pear noodles (1) Study the sealing device again. (2) Filter the oil through the filter. (3) Confirm the lubricant and lubrication method again. Discoloration (1) Oxygenated oil can be removed with oxalic acid. (2) The unevenness left after sanding is rust and corrosion. Tempering color caused by heat can be completely removed.

Photo F-1

- Inner ring of double row tapered roller bearing.
- Pear surface roughness occurs on the raceway surface.
- The reason is galvanic corrosion.

Photo F-2

- Steel balls for deep groove ball bearings
- The entire spherical surface has obvious pear surface roughness
- The reason is foreign matter meshing and poor lubrication

Photo F-3

- Outer spherical roller bearing
- Partial discoloration of the raceway surface
- The reason is oxidized oil pollution

Photo F-4

- Spherical Roller Bearings
- Discoloration of the raceway surfaces of the inner and outer rings
- The reason is the deterioration of the lubricant

5.7 Indentation

Phenomenon	Main reason	Main Countermeasures
Indentation (Brinelling) of the raceway surface due to engagement or impact of solid foreign objects.	Intrusion of solid foreign objects Engagement of spalled fragments Shock and drop caused by poor application	(1) Prevent the intrusion of abnormal objects. (2) If it is caused by metal flakes, confirm whether there is peeling, etc. including other be arings. (3) Filter the oil through the filter. (4) Improve the installation procedure and inst allation method.

Photo G-1

- Inner ring of spherical roller bearing (cut block).
- Indentation on raceway surface on one side.
- The cause is the engagement of solid foreign objects.

Photo G-2

- Rollers of spherical roller bearings
- There are indentations on the rolling surface
- The cause is the engagement of solid foreign objects

Photo G-3

- Rollers of tapered roller bearings
- Indentation on the rolling surface (return color at both ends)
- The reason is that abnormal substances in the lubricating oil have invaded

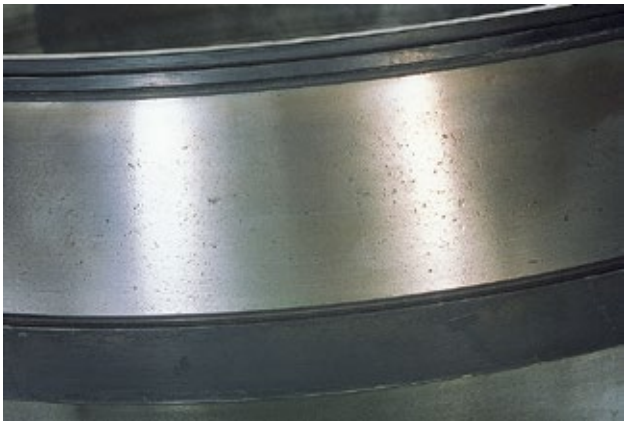


Photo G-4

- Inner ring of tapered roller bearing
- There are indentations on the raceway surface
- The cause is the engagement of solid foreign objects

5.8 Break

Phenomenon	Main reason	Main Countermeasures
Local drop.	Meshing of solid anomalies Impact, excessive load Poor application	(1) Investigate the causes of impact and excessive load and make improvements (2) Improve installation procedures. (3) Improve sealing performance.

Photo H-1

- Cylindrical Roller Bearing
- The guide edges of the inner and outer rings are broken
- The reason is that the impact load is too high

Photo H-2

- Tune the inner ring of the roller bearing
- A Broken edge blocking
- The reason is that the impact load is too high

Photo H-3

- Inner ring of tapered roller bearing
- Broken large retaining edge
- The reason is the impact caused by improper installation

Photo H-4

- Inner ring of double row tapered roller bearing
- End fracture
- The reason is the impact caused by poor response

5.9 Crack

Phenomenon	Main reason	Main Countermeasures
Cracks, hairlike cracks, and friction cracks.	Excessive load Excessive impact Excessive heat generation and rapid cooling interference caused by creep Large scale peeling	(1) Investigate the cause of abnormal loads and make improvements. (2) Prevent creep. (3) Discuss the interference amount again.

Photo I-1

- Adjusting the inner ring of the roller bearing
- Axial and tangential cracks in the raceway
- The reason is that the interference is too large

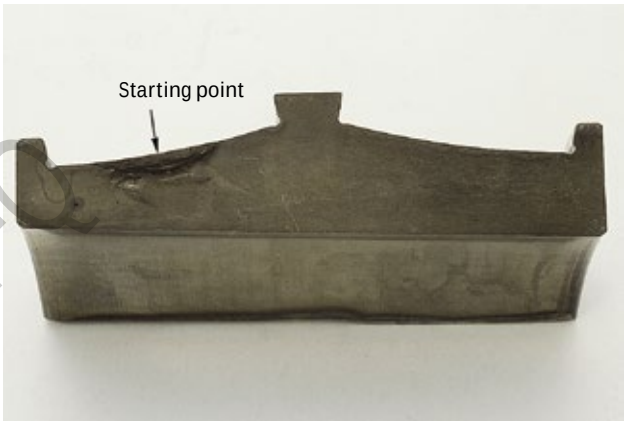


Photo I-2

- Section of Figure I-1
- The middle of the left raceway is the starting point

Photo I-3

- Outer ring of four row cylindrical roller bearings
- Circumferential cracks in the raceway
- Peeling is the starting point of cracks

Photo I-4

- Outer ring of angular contact ball bearing
- Circumferential cracks in the raceway
- The reason is the steel ball slipping caused by poor lubrication

5.10 Rust and corrosion

Phenomenon	Main reason	Main Countermeasures
The surface of the rings and rolling elements becomes rough, accompanied by material transfer. Spacing rust on rolling elements.	Moisture, corrosive substances (acid, etc.) mixed Moisture condensation in the air Improper packaging and storage conditions, direct hand contact	(1) Strengthen the sealing performance. (2) Regularly check the lubricating oil. (3) Improve the installer. (4) Take anti-rust measures when long-term operation stops.

Photo J-1

- Inner ring of tapered roller bearing
- Rolling element spacing corrosion on the raceway surface

Photo J-2

- Outer ring of tapered roller bearing
- Rolling element spacing corrosion on the raceway surface

Photo J-3

- Rollers of spherical roller bearings
- Rust and corrosion of rolling surfaces
- The reason is the immersion of water

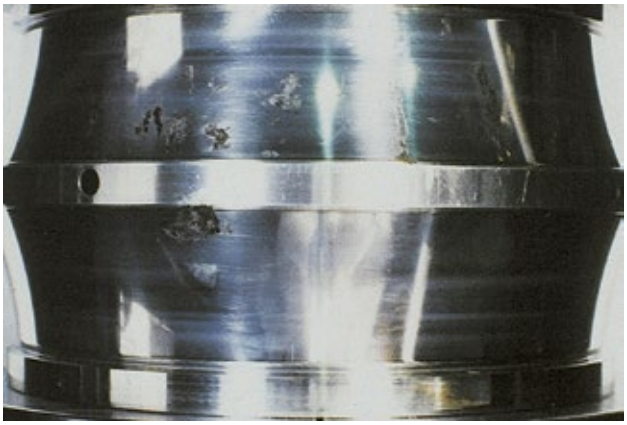


Photo J-4

- Inner ring of spherical roller bearing
- Raceway surface rust and corrosion
- The reason is the immersion of water

5.11 Bite sticky

Phenomenon	Main reason	Main Countermeasures
Bearings get hot, seize, and won't turn. Cause discoloration, softening and welding of raceway surface, rolling surface and rib surface.	Insufficient cooling capacity of the bearing Insufficient lubrication or improper lubricant clearance too small Too much load (too much preload) Roller skew, installation error	(1) Improve the cooling conditions of the bearing. (2) Confirm the lubricant and the amount of lubrication again. (3) Avoid tilting caused by installation errors. (4) Discuss the clearance and preload again. (5) Discuss the conditions of use again.

Photo K-1

- Inner ring of double row tapered roller bearing
- Biting causes discoloration and softening, and the raceway surface produces a step difference grinding at an equal distance from the rollers
- The reason is poor lubrication

Photo K-2

- Rollers of double row tapered roller bearings
- The roller matching the inner ring of photo K-1, the rolling surface and end surface of the roller are discolored, glued and welded due to sticking.

Photo K-3

- Outer ring of spherical roller bearing
- Step grinding due to raceway surface seizure
- The reason is poor lubrication

Photo K-4

- Inner ring of tapered roller bearing
- The large diameter side of the raceway surface is stuck to the large rib surface
- The reason is poor lubrication

5.12 Fretting wear and corrosion

Phenomenon	Main reason	Main Countermeasures
The contact surface produces red wear particles and then wears out to form pits. In the case of raceway surfaces, dimples equally spaced from the rolling elements appear, also known as fretting indentations. If it occurs on the mating surface, it is called mating corrosion.	The contact part is subjected to vibration load, which produces a small swing, and the lubricant is thrown out of the contact surface, resulting in a non-lubricated state and significant wear. The swivel angle of the bearing is too small. Insufficient lubrication (no lubrication condition) load change Vibration in Transport Vibration, shaft deflection, installation error, insufficient interference	(1) The inner ring and outer ring are packed s eparately during transportation, if they cannot be separated, they should be preloaded. (2) When using in a swinging state, lubricating oil or thick grease should be used. (3) Rethink lubricants. (4) Fix the shaft and bearing housing. (5) Reconsider the amount of interference.

Photo L-1

- Inner rings of cylindrical roller bearings
- Corrugated plate-shaped fretting wear occurs on the entire circumference of the raceway surface;
- Cause of damage is vibration

Photo L-2

- Inner ring of deep groove ball bearing
- Fretting wear occurs on the entire circumference of the raceway surface
- Cause of damage is vibration

Photo L-3

- Outer ring of cylindrical roller bearing
- Fit corrosion occurs on the outer diameter surface

Photo L-4

- Outer ring of tapered roller bearing
- Fit corrosion occurs on the outer diameter surface

5.13 Electric corrosion

Phenomenon	Main reason	Main Countermeasures
The surface is pear-like rough, and the concentration of pitting pits can be seen under the microscope. It further develops into a corrugated plate shape.	The current passing through the inside of the bearing creates sparks that cause the raceway surfaces to melt.	Lead the current out of the circuit through a collector ring, etc., or take insulation measures to prevent the current from passing through the bearing.

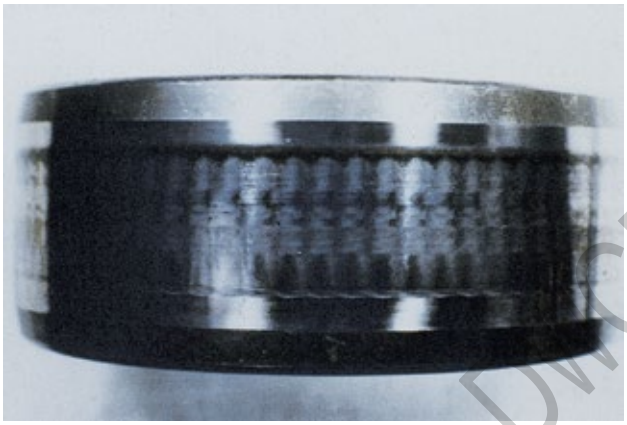


Photo M-1

- Inner rings of cylindrical roller bearings
- Corrugated electric corrosion occurs on the raceway surface

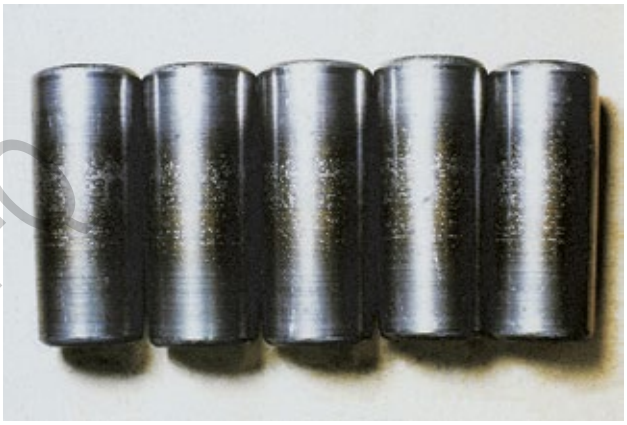


Photo M-2

- Tapered roller bearings
- Galvanic corrosion occurs in the middle of the rolling surface

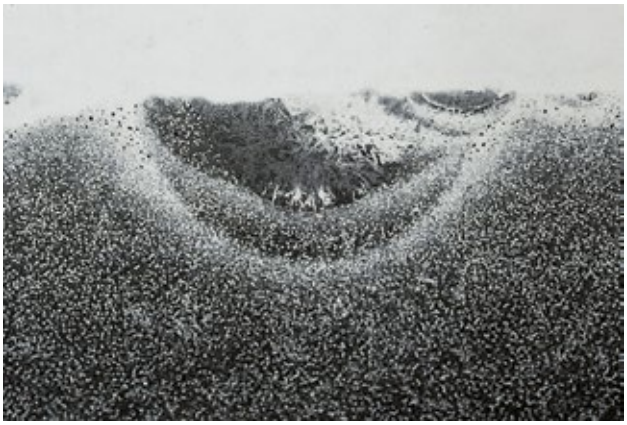
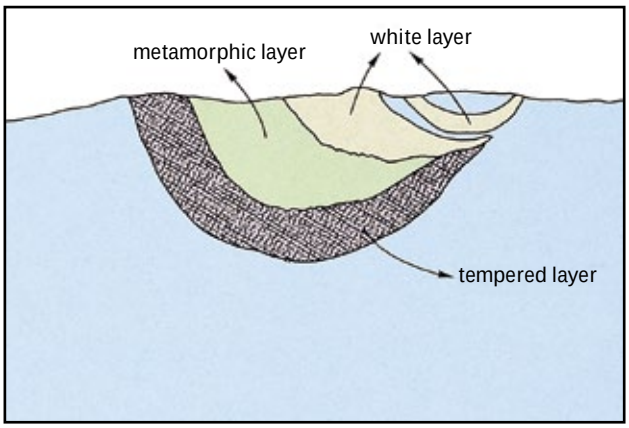


Photo M-3

- Photo M-2 is a cross-section of electric corrosion on the rolling surface of the roller (magnified 400 times)
- After etching with nitric acid, the section produces a white layer



- Explanation of the magnified cross-section photo M-3 of electrocorrosion

5.14 Skew of rotation marks

Phenomenon	Main reason	Main Countermeasures
Skewed or irregular rolling element wear marks on raceway surfaces.	Poor precision of the shaft or housing causes deformation of the ring and tilting Insufficient rigidity of the shaft and housing Excessive clearance causes the shaft to swing and rotate	(1) Improve the machining accuracy of the shaft and bearing housing. (2) Reconfirm the rigidity of the shaft and housing. (3) Discuss the clearance again.

Photo N-1

- Spherical Roller Bearings
- Contact traces of the inner ring, outer ring, and rollers are inconsistent
- The reason is bad installation

Photo N-2

- Outer ring of tapered roller bearing
- The contact marks on the raceway surface are crooked
- The reason for the oblique is poor installation

Photo N-3

- Roller of tapered roller bearing (roller of photo N-2)
- Inconsistent contact marks on rolling surfaces

5.15 Damaged cage

Phenomenon	Main reason	Main Countermeasures
Cage broken Wear on the pocket or guide area Loose or broken rivets	Excessive torque load High speed rotation or frequent changes in speed Poor lubrication Foreign object engagement Excessive vibration Poor installation (tilted installation) Abnormal temperature rise (especially for resin material holders)	(1) Discuss the load conditions again. (2) Confirm the lubricant and lubrication method again. (3) Discuss the selection of the cage again. (4) Reconfirm the application conditions. (5) Discuss the rigidity of the shaft and bearing seat again.

Photo O-1

- Retainer for Contact Ball Bearings
- Machined high-strength brass cage broken
- The reason is poor lubrication

Photo O-2

- Cages for spherical roller bearings
- The pocket column of the stamped steel cage is broken

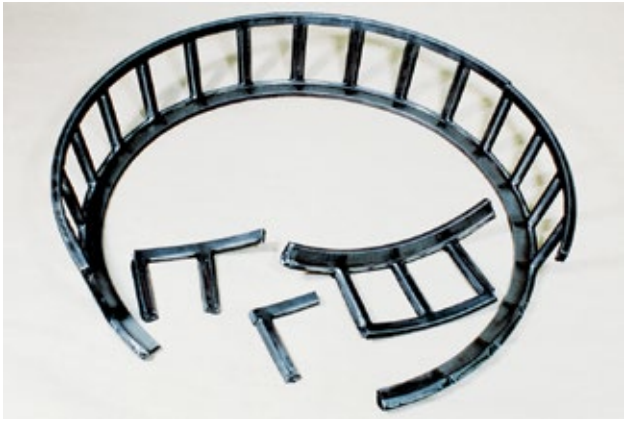


Photo O-3

- Cages for tapered roller bearings
- The pocket of the stamped steel cage is damaged.

Photo O-3

- Cages for cylindrical roller bearings
- Broken pocket post of machined high-strength brass cage.

5.16 Partial load

Phenomenon	Main reason	Main Countermeasures
The raceway shows single-raceway load wear, with no obvious load or running marks on the other side Severe peeling of one side of the raceway, slight peeling of the other side of the raceway (late use)	The function of the installation position of the spherical roller bearing at the free end of the equipment cannot be achieved or the displacement is limited after the temperature rises Strong axial loads beyond design capabilities	1) Investigate for abnormal axial loads (2) Whether the processing error of the equipment is within the required range (3) Whether the variation of equipment operating components in the operating environment conflicts with the maximum allowable variation of equipment design (4) Prevent installation errors

Photo T-1

- Spherical roller bearing inner ring
- Significant load wear on one side of the raceway due to eccentric loading

Photo T-2

- Inner ring of spherical roller bearing
- Due to eccentric loading, one side of the inner raceway is severely peeled off, and the other side has no traces of use

Photo T-3

- Inner ring of spherical roller bearing
- Severe spalling on one side of the inner raceway due to eccentric loading

5.17 Creep (slip) 1

Phenomenon	Main reason	Main Countermeasures
The mating surface that creeps will become a mirror or foggy surface. Sometimes with gluing.	When the inner ring bears the rotating load, the interference of the inner ring is insufficient; When the outer ring bears the rotating load, the interference of the outer ring is insufficient; When the housing is made of light metal such as aluminum, the interference may be insufficient due to the difference in expansion .	(1) Discuss the interference again. (2) Improve the machining accuracy of the shaft and bearing housing.

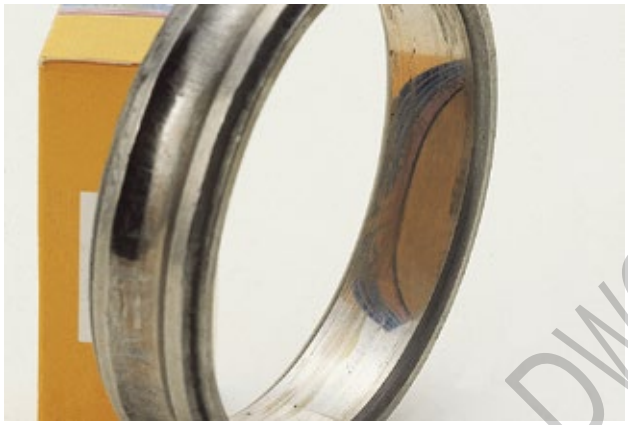


Photo P-1

- Inner ring of deep groove ball bearing
- Due to creep, the inner diameter surface becomes a mirror surface

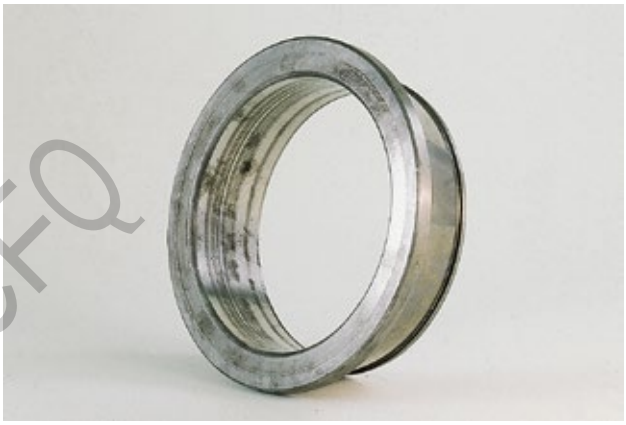


Photo P-2

- Inner ring or tapperd roller bearing.
- Gluing in the middle of the ID face due to creep.

Photo P-3

- Shaft rings of thrust ball bearings
- Due to creep, gluing occurs on the ID face and friction cracks develop.

Photo P-4

- inner ring of tappered roller bearing.
- Due to creep, the end faces are glued together, friction cracks occur, and grow into large cracks that develop toward the inner diameter face.

Creep (slip) 2

Phenomenon	Main reason	Main Countermeasures
Slip refers to the relative displacement between the mating surfaces when there is clearance in the mating surfaces of the bearing. The mating surface that has slipped, its appearance is mirror-like or tarnished, and some are even accompanied by adhesive wear	Insufficient interference or insufficient tightening of the clearance fit withdrawal bushing.	(1) Check the interference and implement the brake (2) Adjust the tightening degree of withdrawal bushing (3) The accuracy of the shaft and bearing seat should be appropriate (4) Apply axial preload (5) Tighten the sides of the ferrule (6) Close to the mating surface (7) Apply lubricant to the mating surface

Photo S-1

- Inner ring of spherical roller bearing
- Slip with adhesive wear occurs on the inner diameter surface
- Reason: Insufficient interference

Photo S-2

- Shaft rings of thrust ball bearings
- Bonding of ID faces due to creep and friction cracking

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