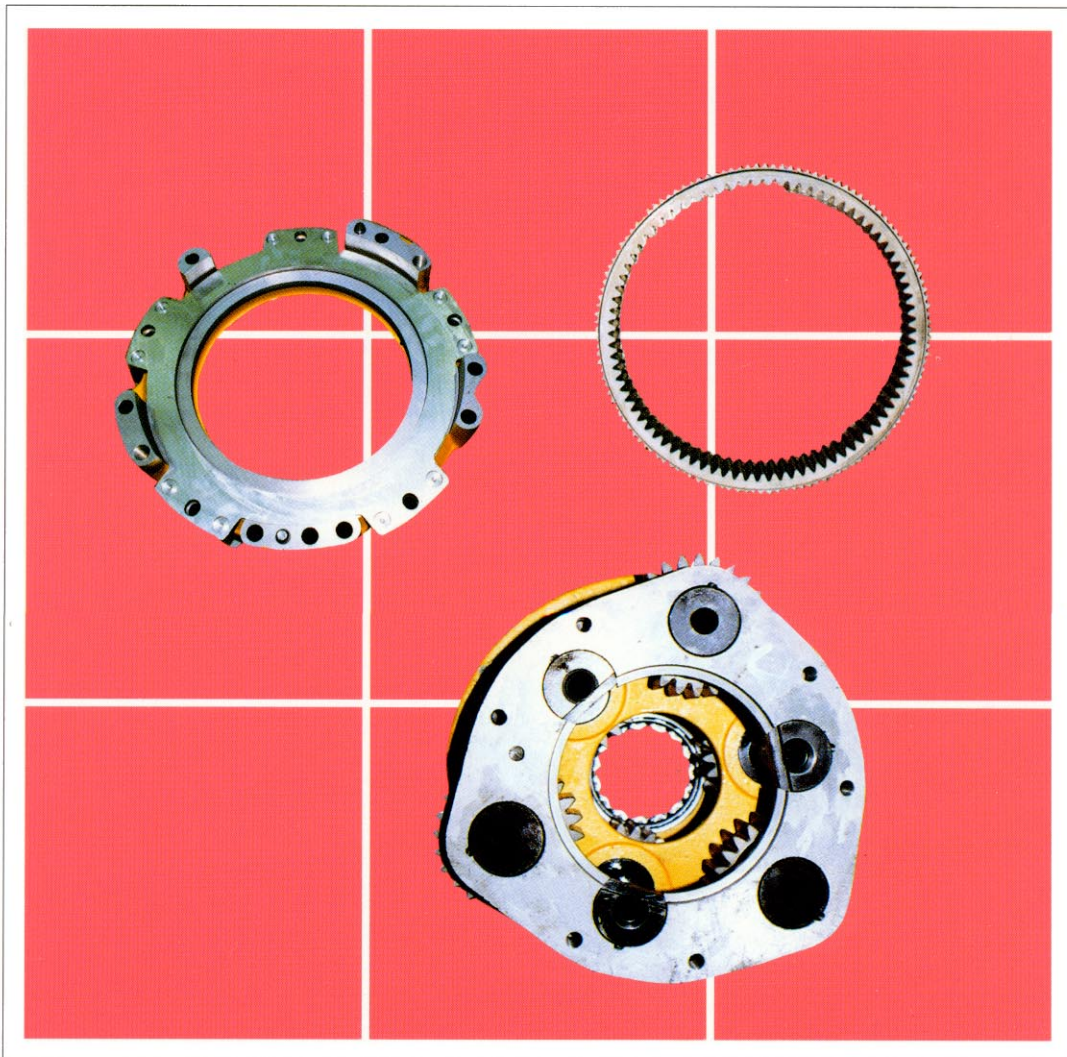




**GUIDANCE
FOR
REUSABLE PARTS**

**PLANETARY GEAR
TRANSMISSION**



GUIDANCE FOR REUSABLE PARTS
KOMATSU

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INTRODUCTION

This Guidance for Reusable Parts of the planetary gear transmission gives the knowledge of the basic structure and explanation of the causes of damage needed when carrying out disassembly and assembly or repairs of the TORQFLOW transmission. It also gives photographs with examples of damage to make it possible to judge easily whether a part can be used again or not.

This Guidance for Reusable Parts is designed to be used by a wide range of people dealing with repairs and maintenance.

We hope that the information will be used to reduce repair costs by distinguishing between parts that can be reused and those that must be replaced. We also hope that it will contribute towards prevention of reoccurrence of problems.

Note: This publication is intended for guidance only and KOMATSU LTD. hereby expressly denies and excludes any representation, warranty or implied warranty for the reuse of planetary gear transmission.

MAIN CAUSES OF DAMAGE

Damage and drop in performance arise when various problems occur together. With the transmission, improper maintenance of the oil (oil level, oil pressure, dirt in oil) and improper operation (overloading, overrunning, sudden starting) are the most common factors causing damage.

Operation

The planetary gear transmission can be shifted without stopping the machine (except for dump trucks traveling in reverse). However, if the gear is suddenly shifted from the highest forward speed to reverse (or vice versa), there is an excessively high load brought to bear on the transmission.

On downhill slopes, if the speed for the selected speed range is exceeded, the internal parts of the transmission will rotate at abnormally high speed (overrunning). With dump trucks, if the dump truck is overloaded, an excessive force is brought to bear on the transmission.

In all of these cases, a load exceeding the permitted limit is brought to bear on various parts, so if this is repeated, the performance will drop, or parts will be damaged.

Oil Level

If the oil level is too low, and the machine is on even a slight slope, the pump will suck in air, and the hydraulic pressure will drop. This causes damage to the clutch. In addition, the oil will become dirty and will deteriorate quickly, so this will cause wear and damage.

Oil Change

If proper oil changes are not carried out, the oil will become dirty and will deteriorate, and this will cause wear and damage.

Oil Temperature

If the proper speed range of the transmission is not selected (Note 1), and the machine continues to be operated with the oil at an abnormally high temperature, the seals (oil seals, seal rings, O-rings) will harden and this will cause oil leakage. It will also increase the speed of deterioration of the oil, and this will cause wear and damage.

Note 1: This section does not apply to automatic transmissions.

Entry of Dirt

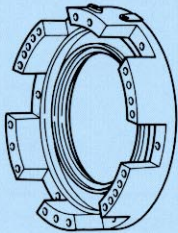

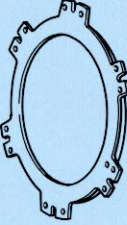
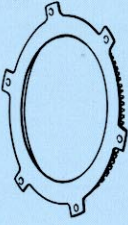
If dirt or dust gets into the oil (particularly when changing the oil), this will cause wear of parts and defective function of the valves.

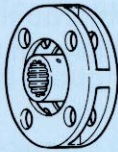

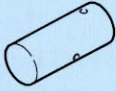
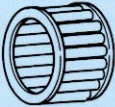
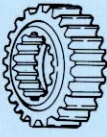
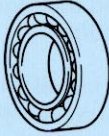
JUDGEMENT ABOUT DAMAGE

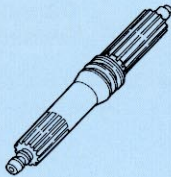
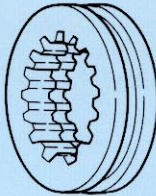
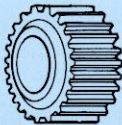
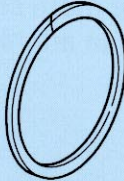
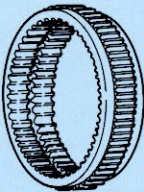
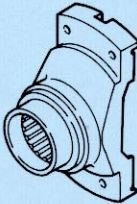
When judging whether a part can be reused again, it is necessary to consider the daily maintenance and operating conditions to determine why such damage occurred, and to follow up the cause. This manual gives photographs ranking the damage into categories A, B, and C. These photographs should be used together with the know-how obtained from long years of experience to judge if the part can be reused.

Check Points when Judging Parts

To make accurate judgement on damaged parts, the part must first be thoroughly washed and cleaned, and then the following check points must be considered carefully. In the case of some parts, there may be no applicable check points given.

Part	Check point	Part	Check point
Housing 	<ul style="list-style-type: none"> ● Wear and damage of seal ring contact surface ● Wear and damage of disc contact surface ● Wear and damage of inside and outside surface of piston insertion portion ● Wear and damage of ring gear sliding surface 	Disc 	<ul style="list-style-type: none"> ● See Disc and Plate Volume
Piston 	<ul style="list-style-type: none"> ● Wear and damage of disc contact surface ● Wear of inside and outside surface of piston portion ● Settling of torque pin hole 	Plate 	<ul style="list-style-type: none"> ● See Disc and Plate Volume

Part	Check point	Part	Check point
Carrier 	<ul style="list-style-type: none"> ● Settling of shaft hole ● Surface roughness and damage of thrust washer contact surface ● Settling of spline ● Wear and damage of seal ring contact surface 	Thrust washer 	<ul style="list-style-type: none"> ● Wear and damage of side surface
Planet gear shaft 	<ul style="list-style-type: none"> ● Damage, flaking, wear of bearing rolling surface ● Wear of thrust washer contact surface 	Needle bearing 	<ul style="list-style-type: none"> ● Flaking of needle ● Cracking of cage
Planet gear 	<ul style="list-style-type: none"> ● Wear of thrust washer contact surface ● Flaking and damage of bearing rolling surface ● For details of teeth, see Gear Volume 	Bearing 	<ul style="list-style-type: none"> ● See Bearing Volume

Part	Check point	Part	Check point
Drive shaft 	<ul style="list-style-type: none"> ● Wear and damage of seal ring groove ● Settling of spline ● Cracking of spline tooth bottom, stepped portion ● Cracking at mouth of drill hole 	Collar 	<ul style="list-style-type: none"> ● Wear of seal ring groove ● Wear of spline
Drive gear 	<ul style="list-style-type: none"> ● See Gear Volume 	Seal ring 	<ul style="list-style-type: none"> ● Breakage at end gap ● Wear of outside circumference and side surface
Ring gear 	<ul style="list-style-type: none"> ● Damage of housing sliding surface (side surface) ● Wear of inner teeth ● Wear of outer teeth 	Coupling 	<ul style="list-style-type: none"> ● Wear of oil seal contact surface ● Wear of spline

JUDGEMENT STANDARDS

Category	Damage Standard	Remedy
A	The part is as good as new; there is no problem for the performance of the machine; there is no risk of secondary damage being caused by this damage.	Can be used as it is
B	If this part is used as it is, the damage will progress, and there is risk that it may cause secondary damage. If the part is rebuilt, it can maintain the function of the machine.	Repair and reuse
C	Part cannot be repaired, the defect will clearly cause a drop in the performance of the machine, and there is danger that it may cause serious damage if used.	Cannot be reused

Judgement Standards for Reuse

The following standards are applied when judging whether any part can be reused.

When there is more than one type of damage to the same part, judge the category according to the condition of the more serious damage.

(Example: If two types of damage are rated respectively as A and B, rank the part as category B.)

Part Name	Check Position	Judgement		
		A	B	C
Housing	● Ring gear sliding surface	Slight contact	Slight damage and surface roughness	Wear
	● Piston insertion portion	Slight contact	Slight damage and surface roughness*	Wear
	● Disc contact surface	Slight contact	Slight damage, surface roughness, and discoloration	Wear
	● Seal ring contact surface	Slight contact	—	Wear, damage
Piston	● Disc contact surface	Slight contact	Slight damage, surface roughness, and discoloration	Wear
	● Torque pin hole	Slight contact	—	Deformation

* See values in Shop Manual for clearance limit between piston and housing insertion portion.

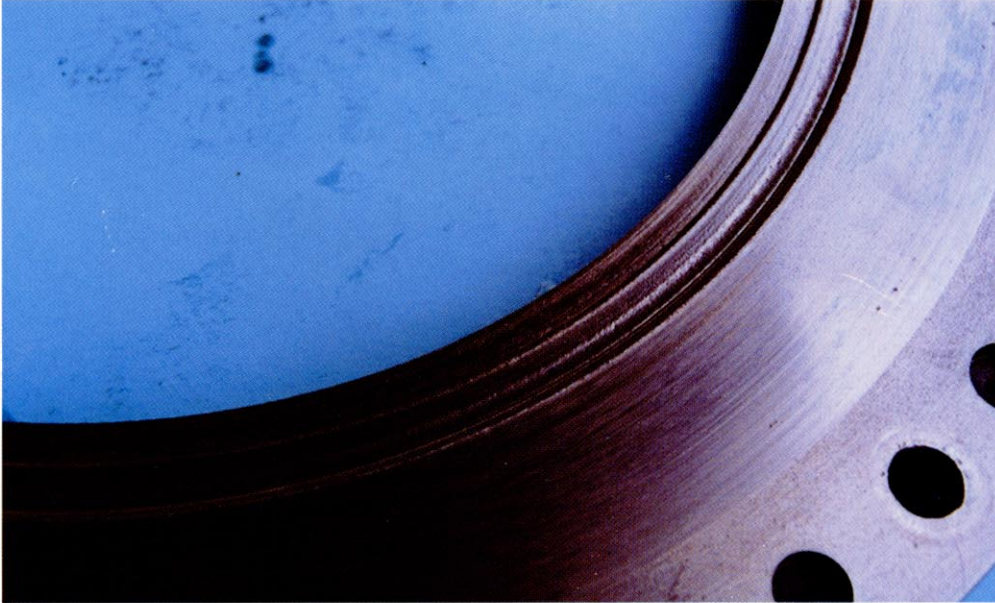
Part Name	Check Position	Judgement		
		A	B	C
Carrier	● Shaft hole	Slight contact	—	Settling
	● Thrust washer surface	Slight contact	—	Surface roughness, damage
	● Spline	Slight contact	—	Settling
	● Seal ring contact surface	Wear, damage	—	Wear, damage
Planet gear shaft	● Bearing rolling surface	Slight contact	—	Flaking, wear, damage
	● Thrust washer contact surface	Slight contact	—	Stepped wear
Planet gear	● Bearing rolling surface	Slight contact	—	Flaking, damage
	● Thrust washer contact surface	Slight contact	—	Damage
Thrust washer	● Side surface	Slight contact	—	Stepped wear
Needle bearing	● Needle	Slight contact	—	Flaking
	● Cage	Normal	—	Cracking
Drive shaft	● Spline tooth portion	Slight contact	—	Settling
	● Spline tooth bottom	Normal	—	Cracking
	● Mouth of drill hole	Normal	—	Cracking
	● Stepped portion	Normal	—	Cracking
	● Seal ring groove	Normal	—	Damage, burrs

Part Name	Check Position	Judgement		
		A	B	C
Ring gear	● Inner teeth	Slight contact	—	Wear
	● Outer teeth	Slight contact	—	Wear
	● Housing sliding surface (side surface)	Slight contact	—	Damage
Collar	● Seal ring groove	Normal	—	Damage, burrs
	● Spline	Slight contact	—	Settling
Seal ring	● End gap	Normal	—	Breakage
	● Side surface	Slight contact	—	Wear*
	● Outside circumference	Slight contact	—	Wear
Coupling	● Oil seal contact surface	Slight contact	Less than 0.05 mm wear	More than 0.05 mm wear
	● Spline	Slight contact	—	Settling

* See values in Shop Manual for service limit of wear of seal ring.

EXAMPLES OF DAMAGE

Housing (Ring gear sliding surface)



Category: C

Condition

- Wear of ring gear sliding surface (more than 1 mm of stepped wear)

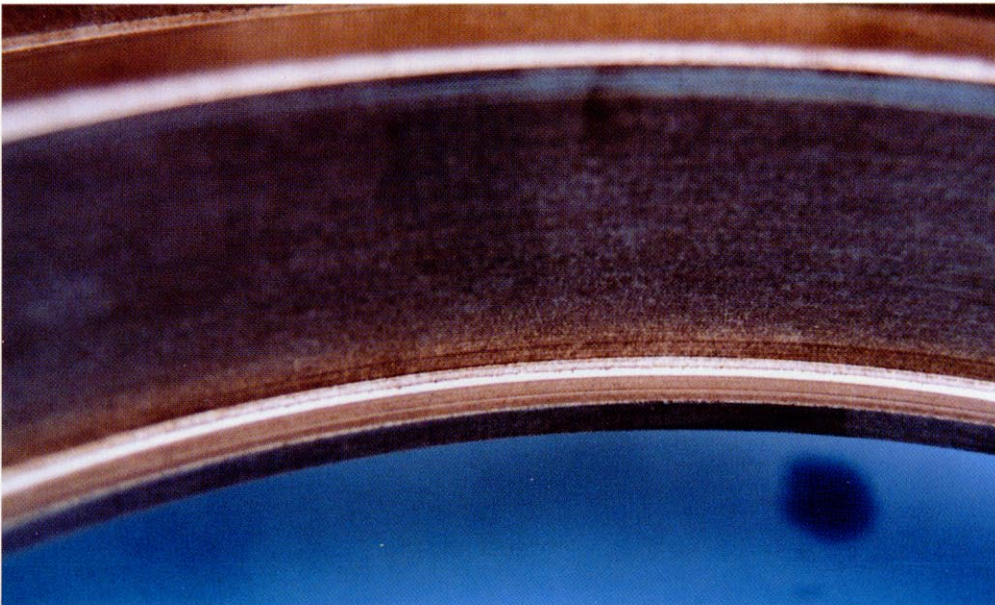
Cause

- Insufficient hardening of the housing
- Defective surface roughness of the ring gear sliding surface
- Defective flatness of the ring gear side surface

Remedy

- Replace

Housing (Ring gear sliding surface)



Category: C

Condition

- Wear of ring gear sliding surface (more than 1 mm of stepped wear)

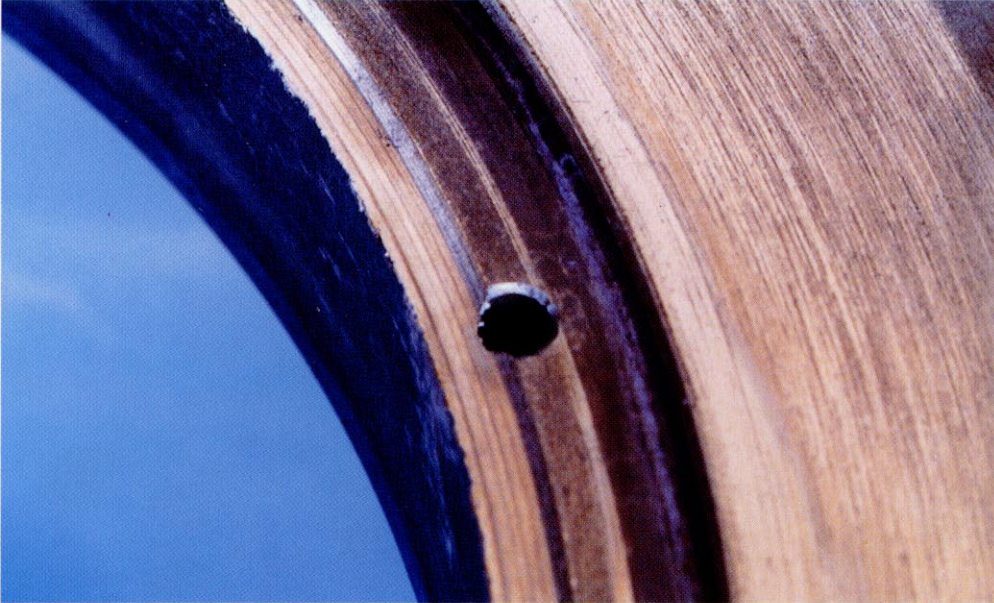
Cause

- Insufficient hardening of the housing
- Defective surface roughness of the ring gear sliding surface
- Defective flatness of the ring gear side surface

Remedy

- Replace

Housing (Ring gear sliding surface)



Category: C

Condition

- Wear of ring gear sliding surface (more than 1mm of stepped wear)

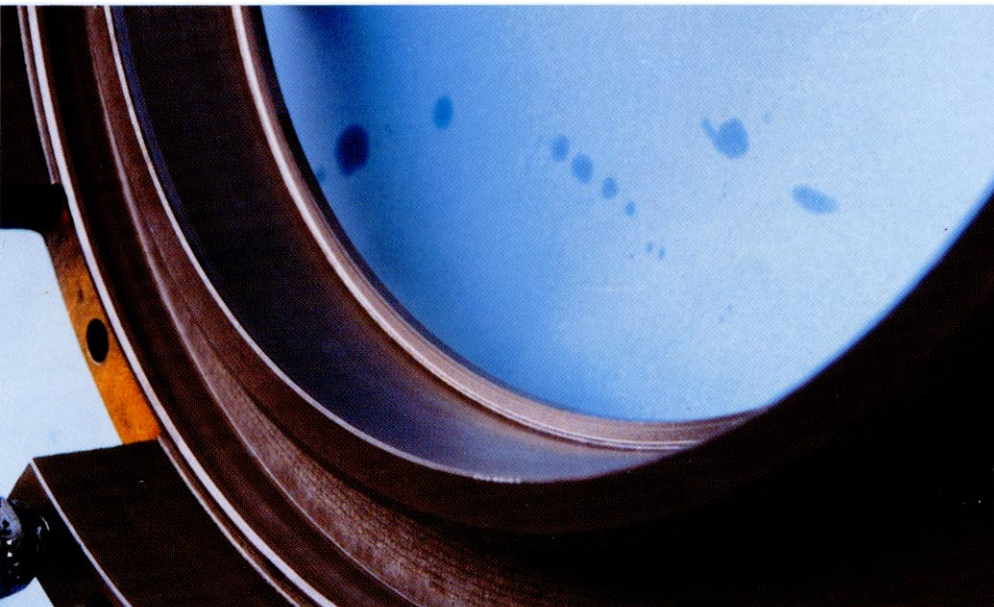
Cause

- Insufficient hardening of the housing
- Defective surface roughness of the ring gear sliding surface
- Defective flatness of the ring gear side surface

Remedy

- Replace

Housing (Seal ring (top) contact surface)



Category: A

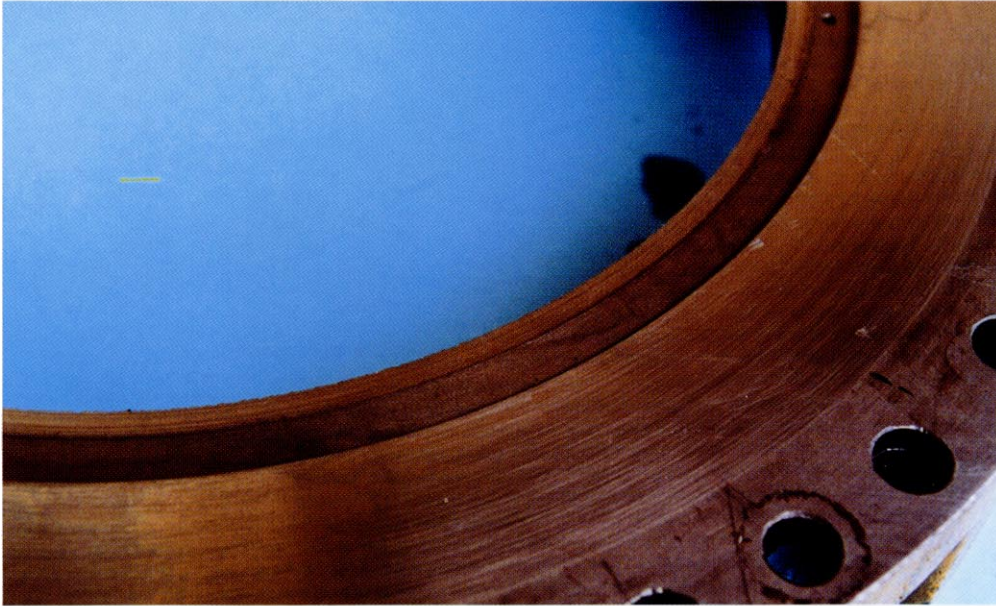
Condition

- Slight contact

Remedy

- Can be used as it is

Housing (Disc contact surface)



Category: B

Condition

- Scratches
- Surface roughness (Wear limit: 0.4 mm)

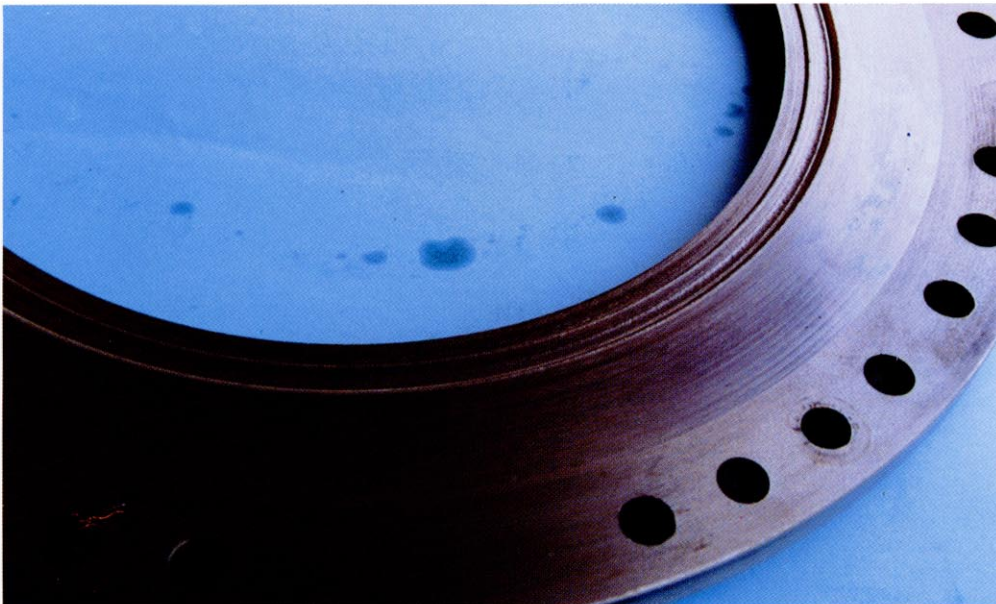
Cause

- Secondary damage caused by seizure or wear of mating disc
- Catching of wear particles on ring gear sliding surface

Remedy

- Can be used again after polishing with an oilstone

Housing (Disc contact surface)



Category: B

Condition

- Scratches
- Surface roughness (Wear limit: 0.4 mm)

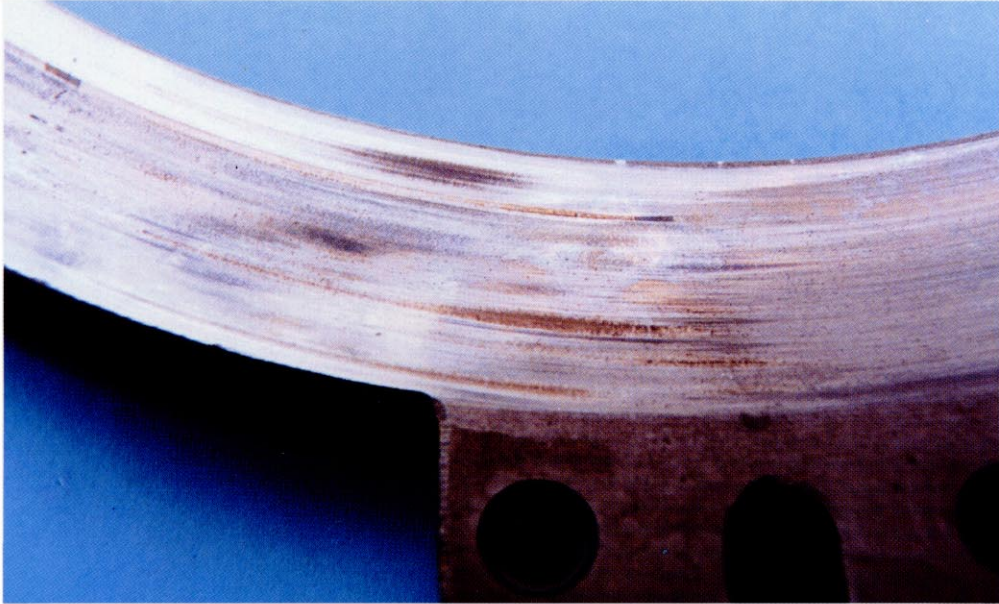
Cause

- Secondary damage caused by seizure or wear of mating disc
- Catching of wear particles on ring gear sliding surface

Remedy

- Can be used again after polishing with an oilstone

Piston (Disc contact surface)



Category: B

Condition

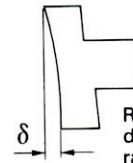
- Damage and seizure of disc contact surface

Cause

- Secondary damage caused by seizure or wear of mating disc

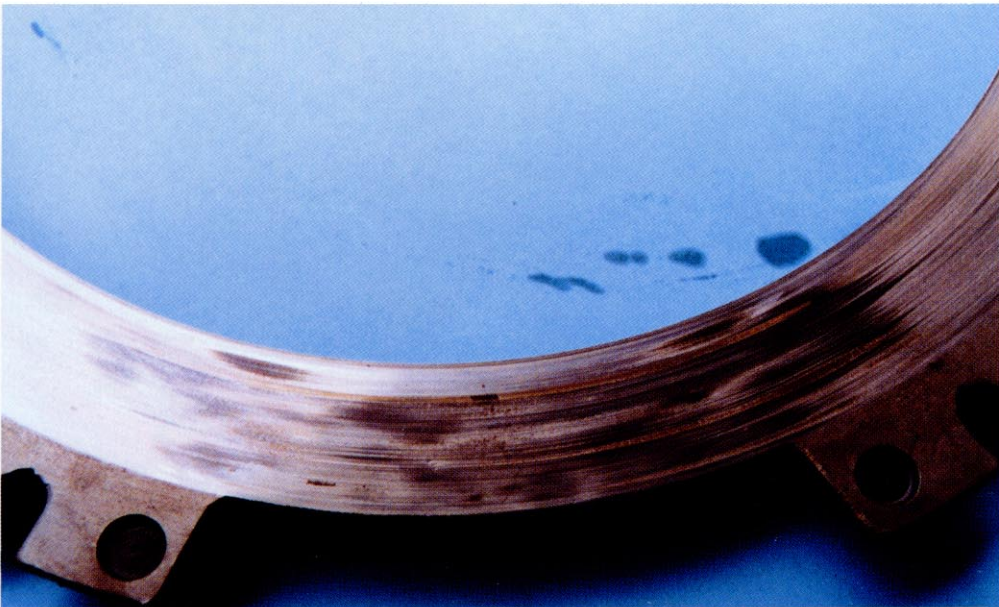
Remedy

- Can be used again after polishing with an oilstone
(Note: Wear must be less than 0.2 mm)



Replace if the deformation in the radial direction $\delta \geq 0.3$ mm

Piston (Disc contact surface)



Category: B

Condition

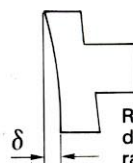
- Damage and seizure of disc contact surface

Cause

- Secondary damage caused by seizure or wear of mating disc

Remedy

- Can be used again after polishing with an oilstone
(Note: Wear must be less than 0.2 mm)



Replace if the deformation in the radial direction $\delta \geq 0.3$ mm

Piston (Torque pin contact surface)



Category: A

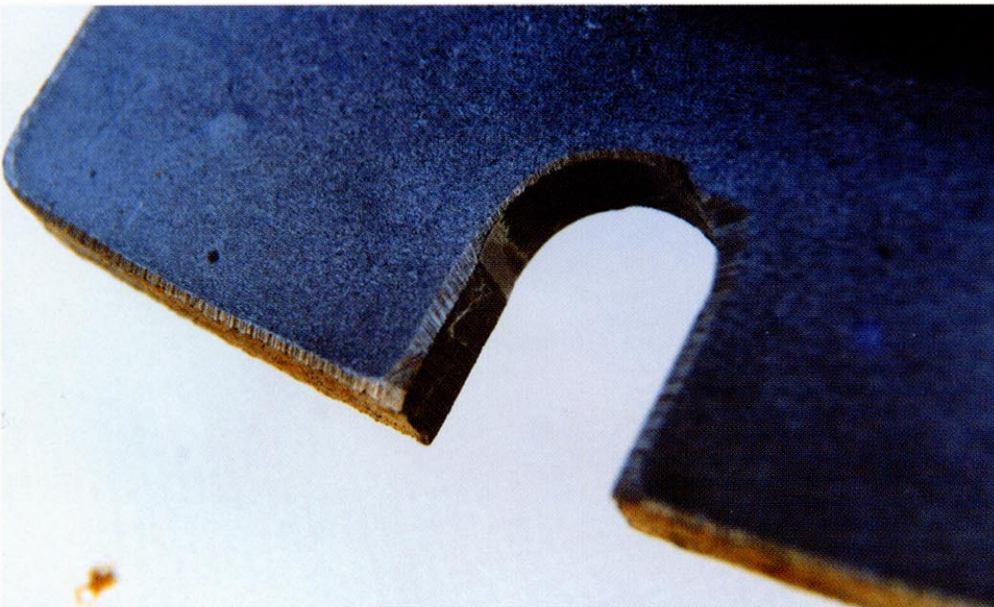
Condition

- Slight contact

Remedy

- Use as it is

Piston (Torque pin contact surface)



Category: C

Condition

- Settling (Wear is more than 0.5 mm)

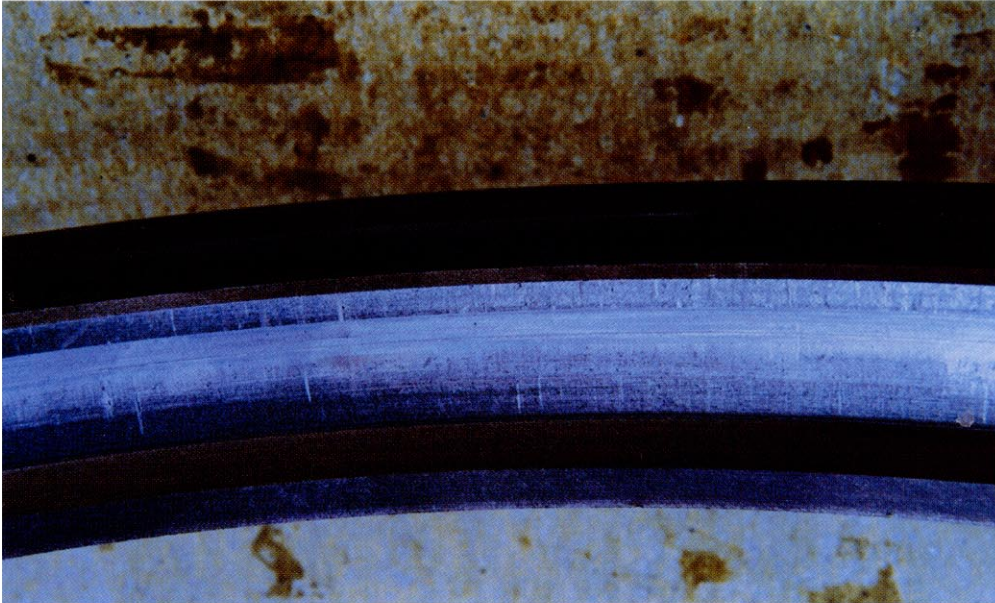
Cause

- Insufficient hardening of piston
- Secondary damage caused by seizure of disc

Remedy

- Replace

Piston (Inside seal ring contact surface)



Category: B

Condition

- Scratches

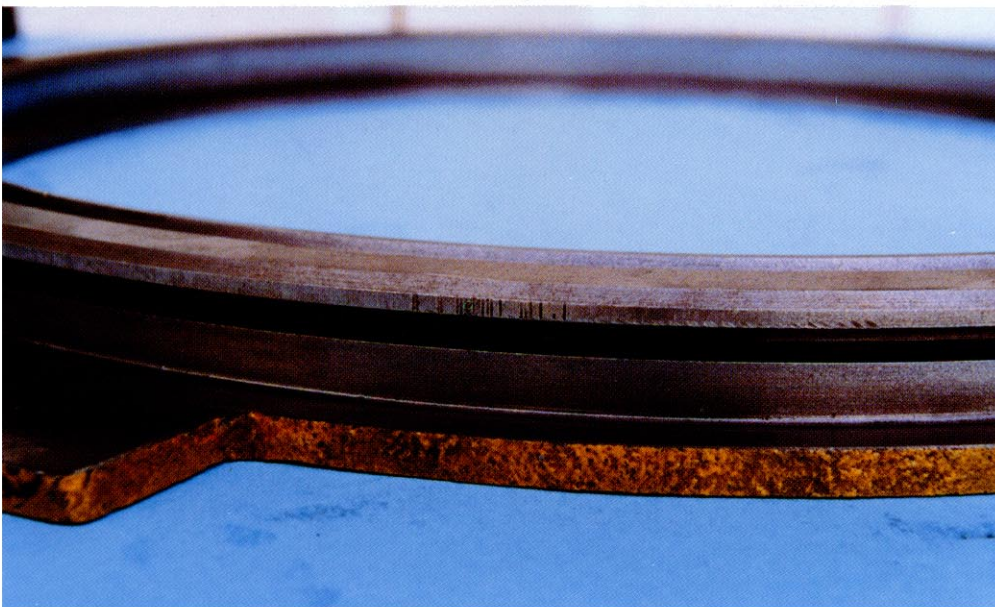
Cause

- Catching of dirt or dust

Remedy

- Can be used again after correcting with sandpaper

Piston (Contact surface with housing)



Category: B

Condition

- Scratches

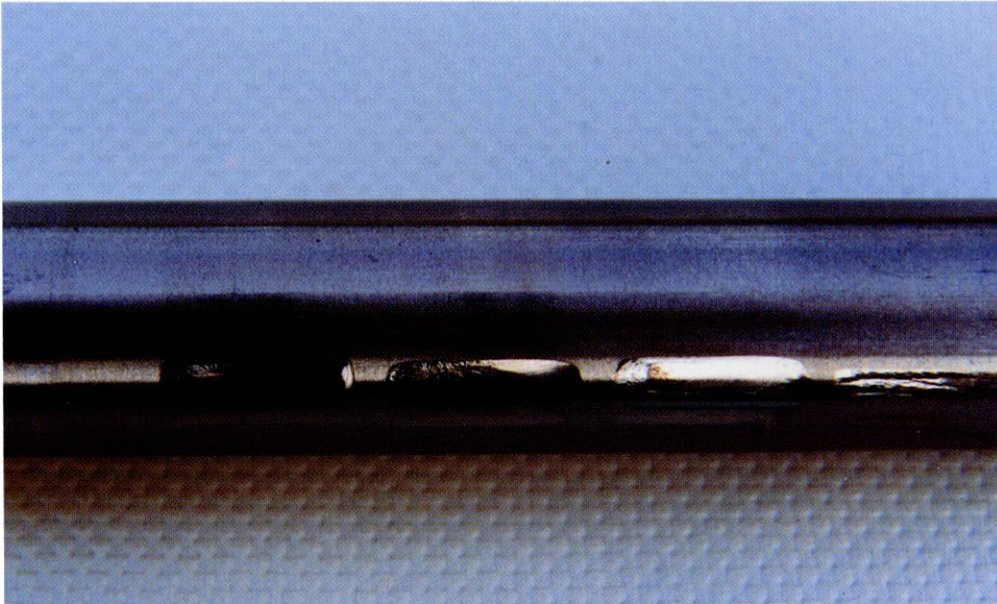
Cause

- Catching of dirt or dust

Remedy

- Can be used again after correcting with an oilstone or sandpaper

Torque pin (Contact surface with piston and plate)



Category: C

Condition

- Stepped wear, seizure of clutch sliding surface

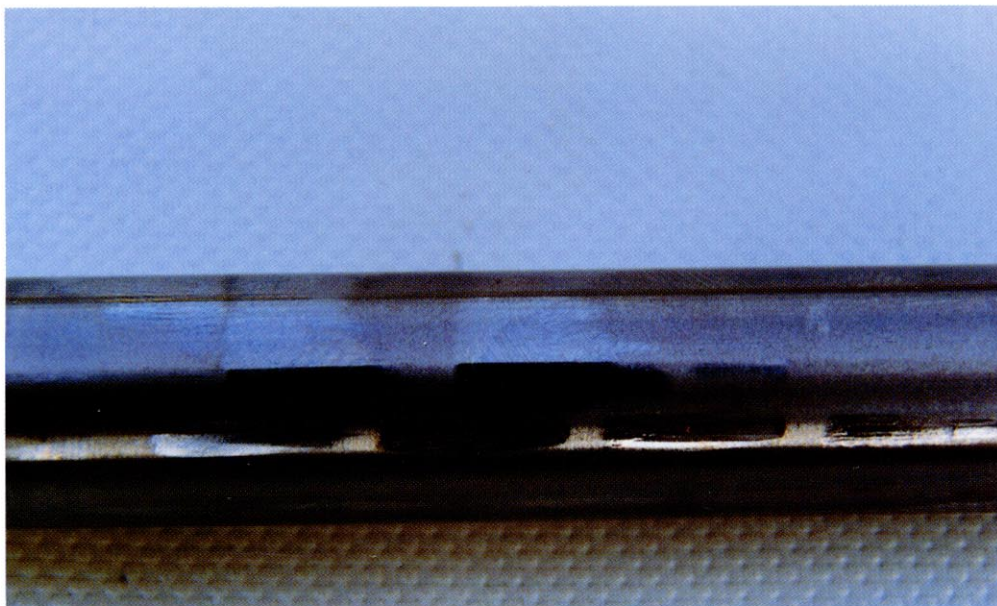
Cause

- Secondary problem caused by damage to the clutch disc

Remedy

- Replace

Torque pin (Contact surface with piston and plate)



Category: C

Condition

- Stepped wear, seizure of clutch sliding surface

Cause

- Secondary problem caused by damage to the clutch disc

Remedy

- Replace

Carrier (Thrust washer contact surface)



Category: C

Condition

- Uneven wear together with wear and damage

Cause

- Insufficient flatness of seat surface

Remedy

- Replace

Carrier (Thrust washer contact surface)



Category: B

Condition

- Fine wear and surface roughness of thrust washer seat face (Service limit of stepped wear: 0.2 mm)

Cause

- Defective surface roughness of seat surface
- Defective flatness of thrust washer

Remedy

- Can be used again after correcting the seat surface with an oilstone or sandpaper

Carrier (Shaft hole)



Category: B

Condition

- Slight vertical damage

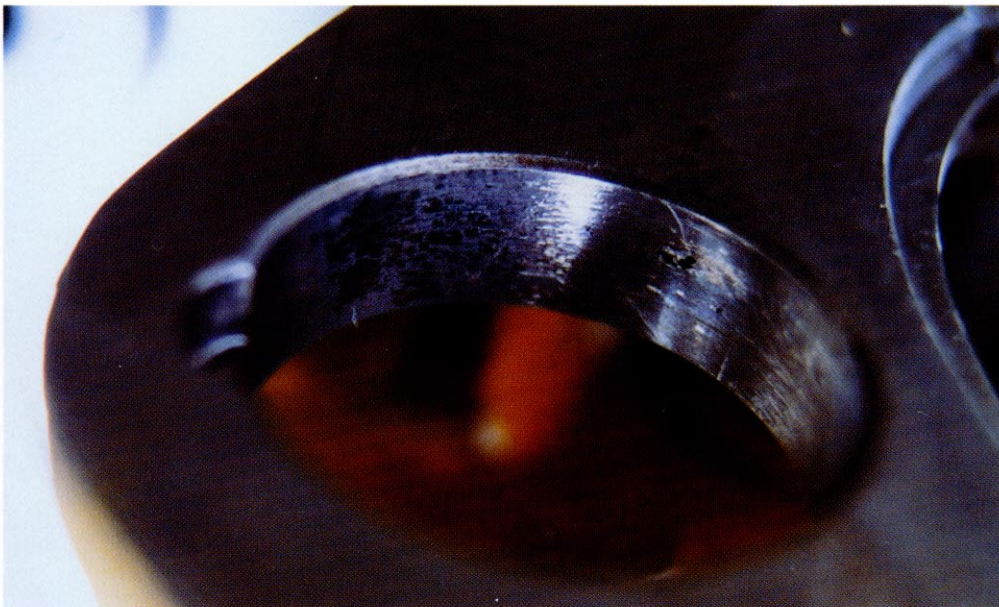
Cause

- Damage caused when fitting during assembly or disassembly

Remedy

- Can be used again after removing the burrs with sandpaper

Carrier (Shaft hole)



Category: C

Condition

- Worm holes and slight wear (Wear limit: 0.1 mm)

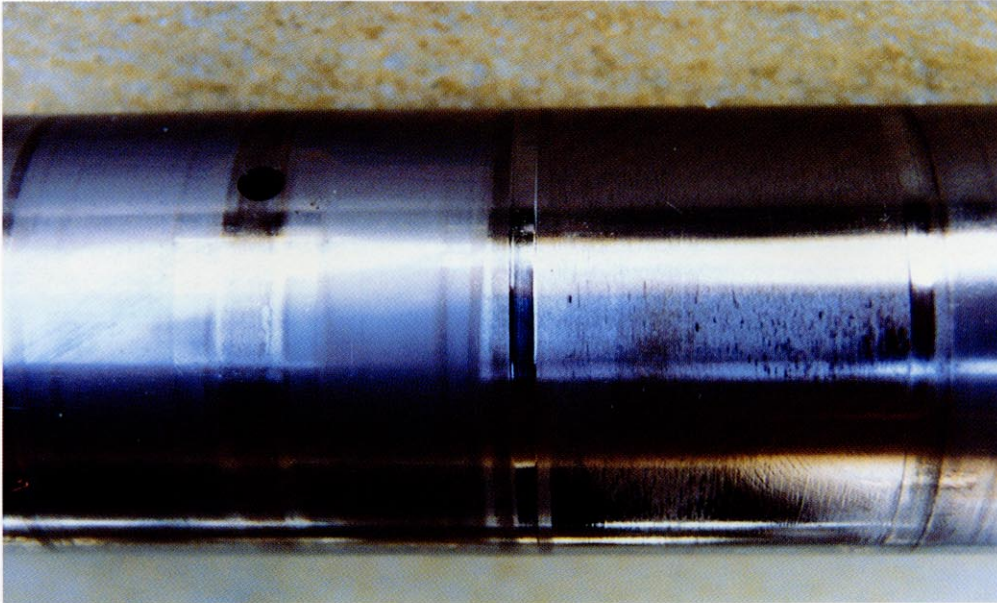
Cause

- Casting defect

Remedy

- Relace

Planet gear shaft (Thrust washer contact surface)



Category: C

Condition

- Wear of thrust washer contact surface
(Wear service limit: 0.5 mm)

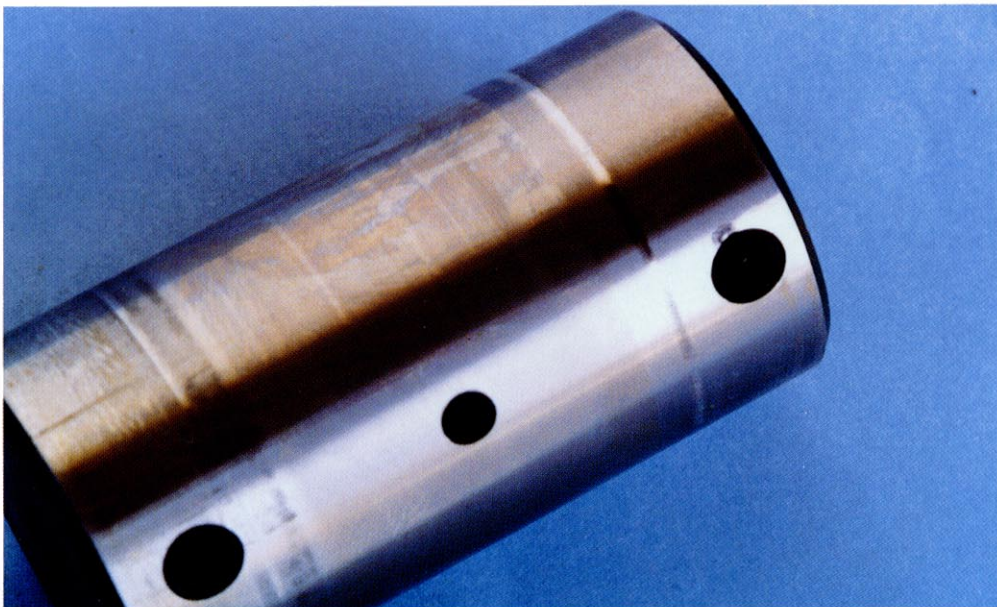
Cause

- Insufficient lubrication
- Defective surface roughness of thrust washer contact surface

Remedy

- Replace

Planet gear shaft (Thrust washer contact surface)



Category: A

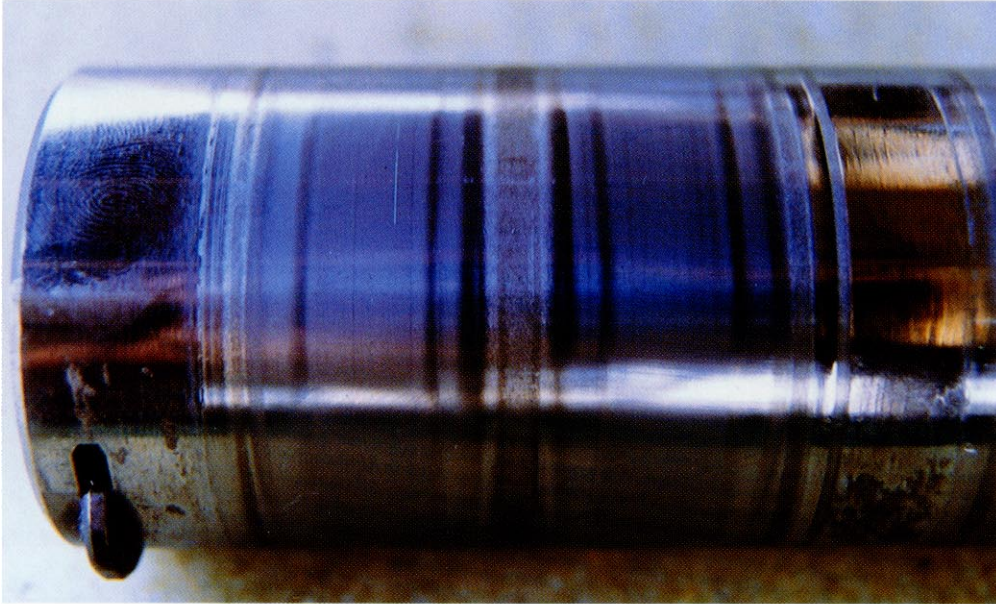
Condition

- Extremely fine natural wear

Remedy

- Can be used as it is

Planet gear shaft (Bearing rolling surface)



Category: A

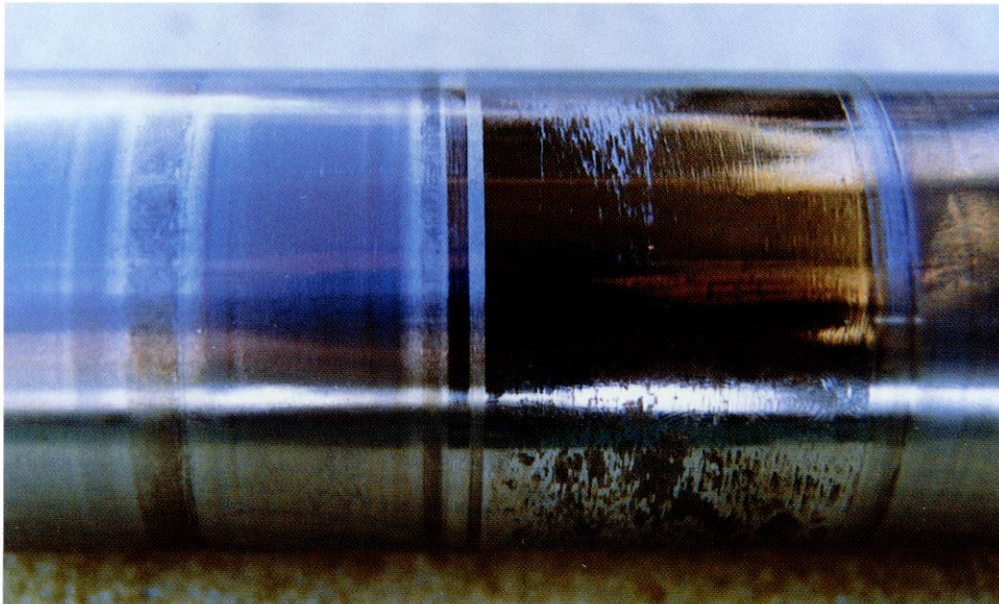
Condition

- Extremely fine natural wear

Remedy

- Can be used as it is

Planet gear shaft (Carrier insertion portion)



Category: C

Condition

- Settling, wear (Service limit: 0.2 mm)

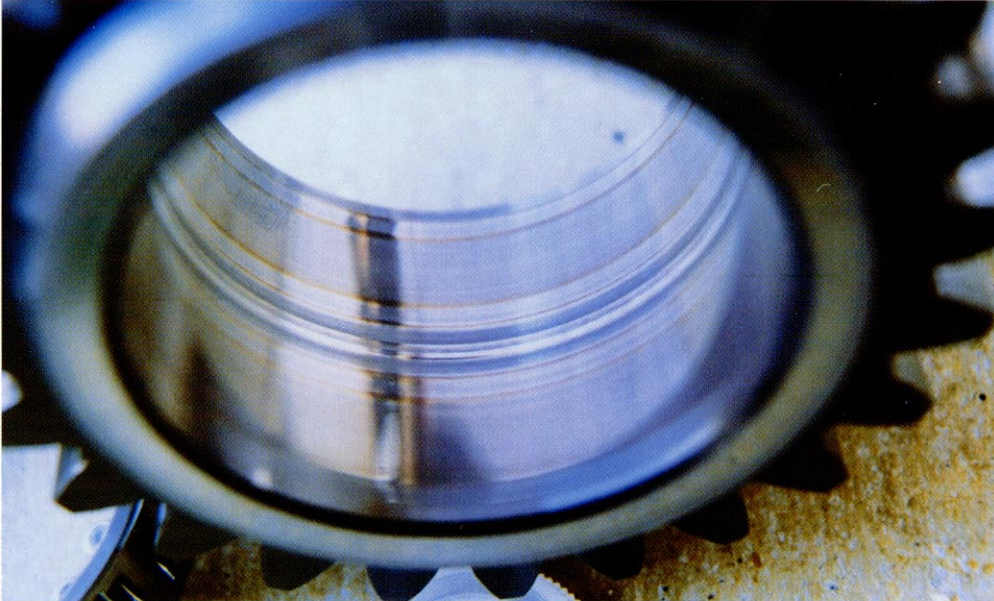
Cause

- Rotation caused by play in the key groove

Remedy

- Replace

Planet gear (Bearing rolling surface)



Category: A

Condition

- Extremely fine natural wear

Remedy

- Can be used as it is

Planet gear (Thrust washer contact surface)



Category: A

Condition

- No wear

Remedy

- Can be used as it is

Thrust washer (Side surface)



Category: C

Condition

- Scratches

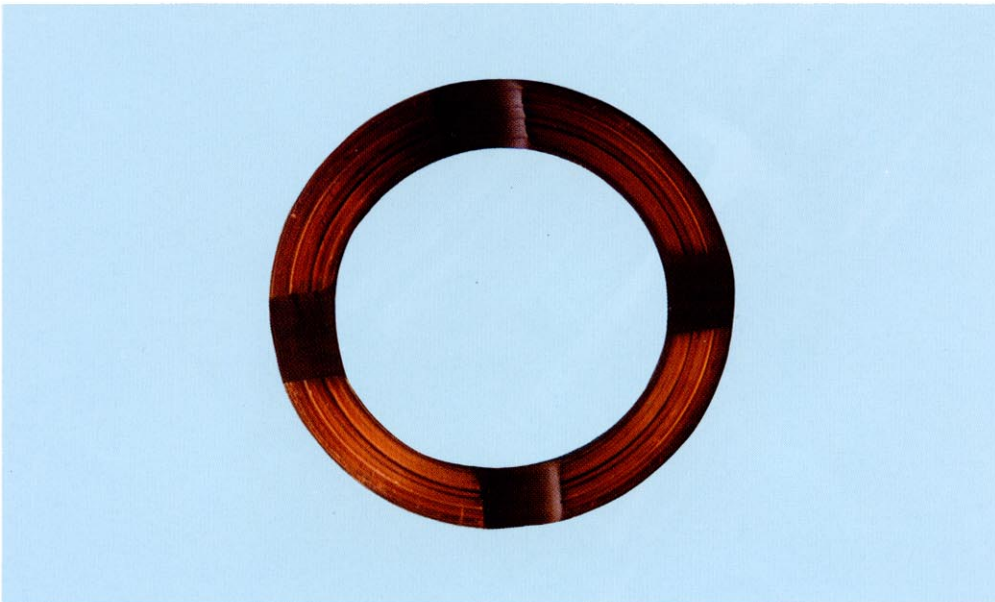
Cause

- Catching of dirt or dust

Remedy

- Replace

Thrust washer (Side surface)



Category: C

Condition

- Wear and damage of sliding surface
(Wear service limit: 0.3 mm) with overall thickness

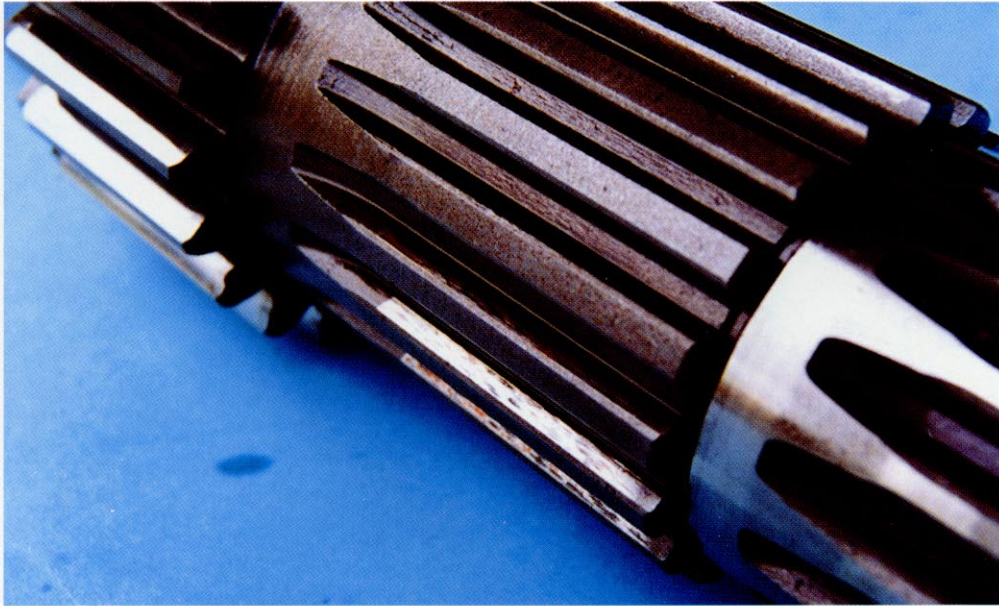
Cause

- Catching of dirt or dust, insufficient lubrication

Remedy

- Replace

Drive shaft (Spline)



Category: B

Condition

- Fretting (Backlash limit caused by settling: 0.75 mm)

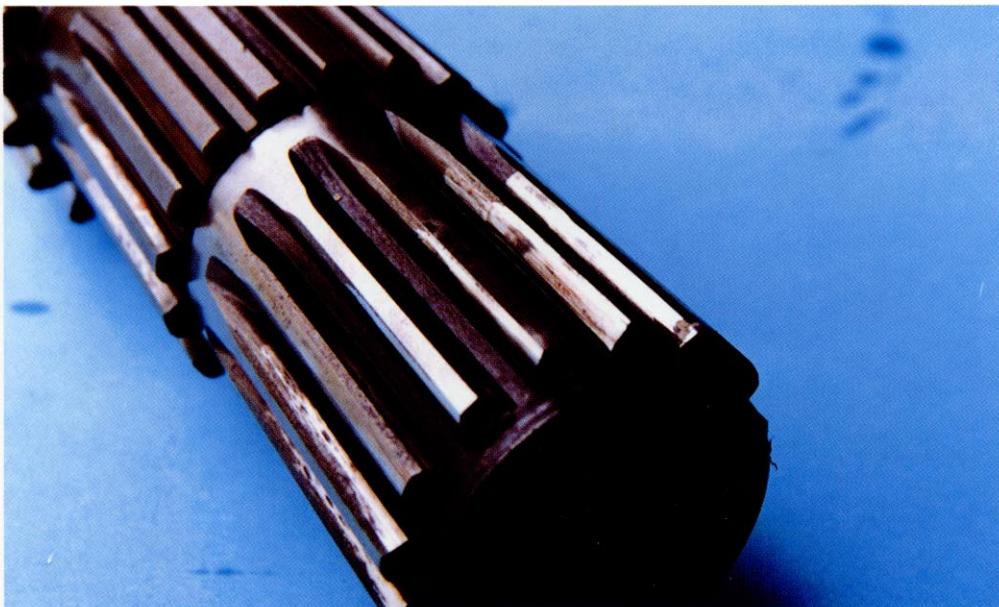
Cause

- High frequency of gear shifting

Remedy

- Can be used again after correcting the surface with sandpaper

Drive shaft (Spline)



Category: B

Condition

- Fretting (Backlash limit caused by settling: 0.75 mm)

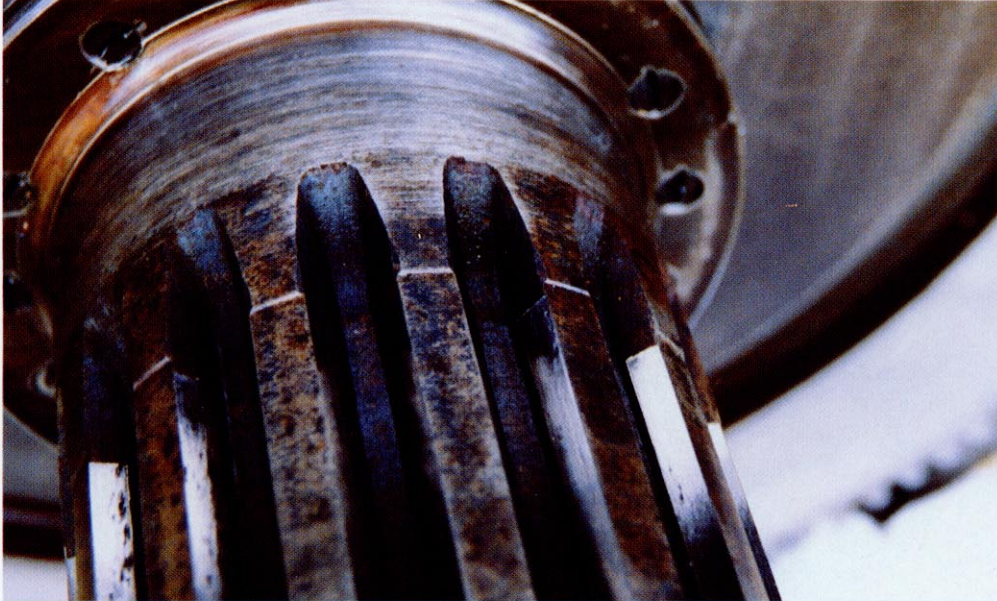
Cause

- High frequency of gear shifting

Remedy

- Can be used again after correcting the surface with sandpaper

Output shaft (Spline)



Category: A

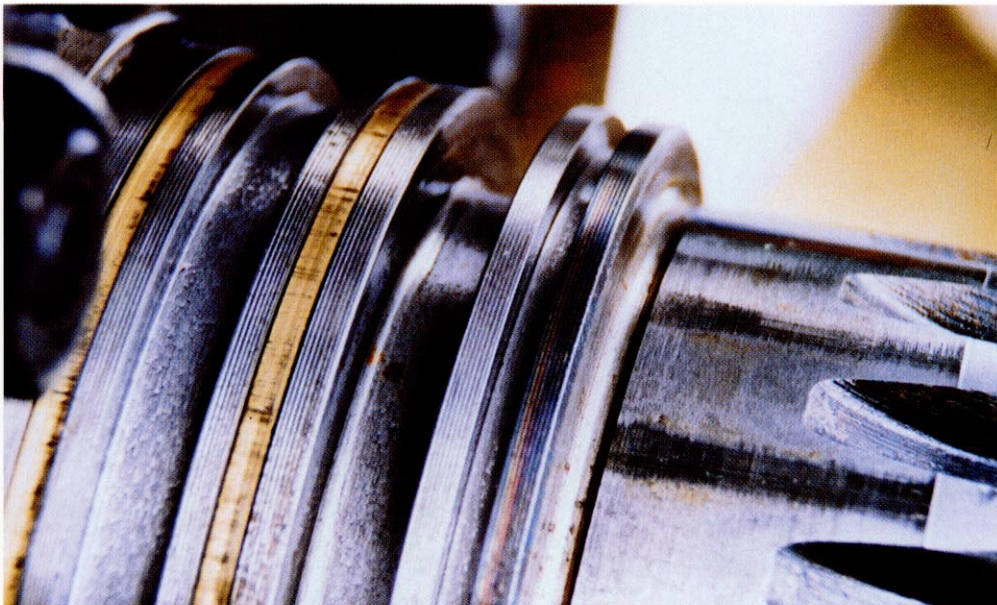
Condition

- Fine wear (Service limit with backlash: 0.75 mm)

Remedy

- Can be used as it is

Output shaft (Seal ring contact surface)



Category: C

Condition

- Heat discoloration of seal ring sliding surface
(Wear limit of groove side face: 0.5 mm)

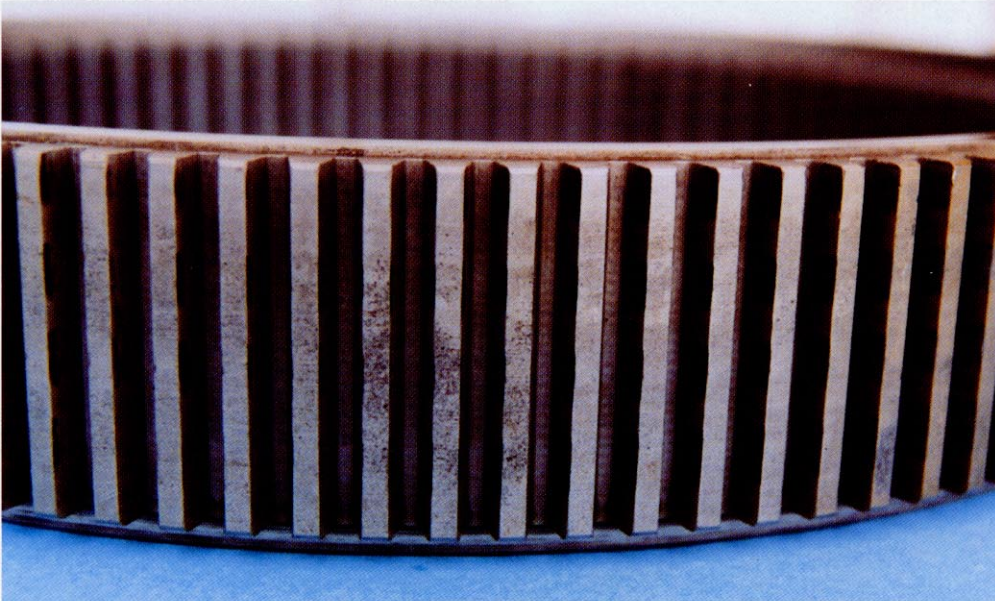
Cause

- Catching of dirt or dust, dents damage to side surface of seal ring groove

Remedy

- Replace

Ring gear (Outer teeth)



Category: A

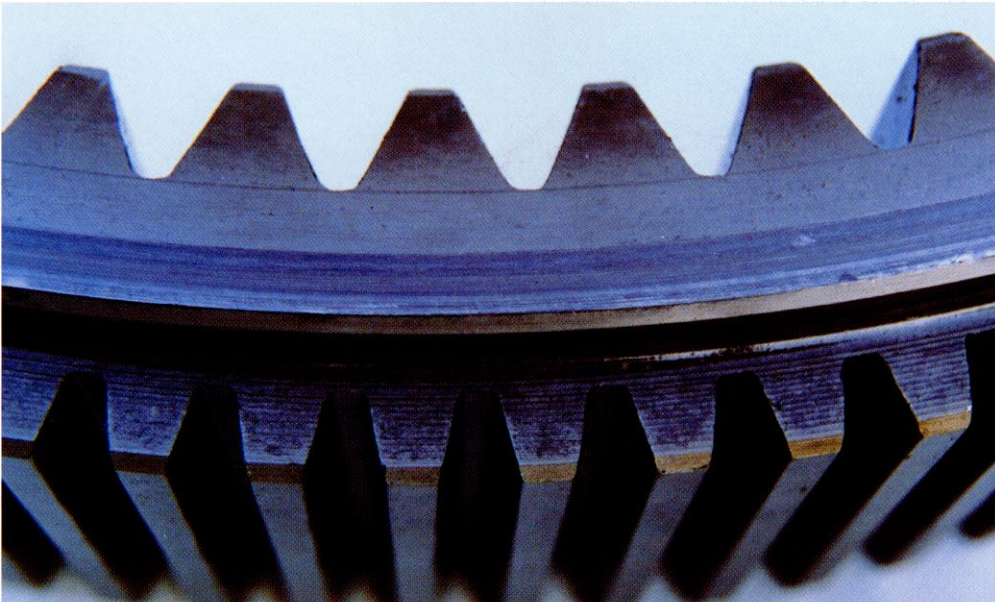
Condition

- Fine wear

Remedy

- Can be used as it is

Ring gear (Contact surface with housing)



Category: B

Condition

- Surface roughness of housing sliding surface

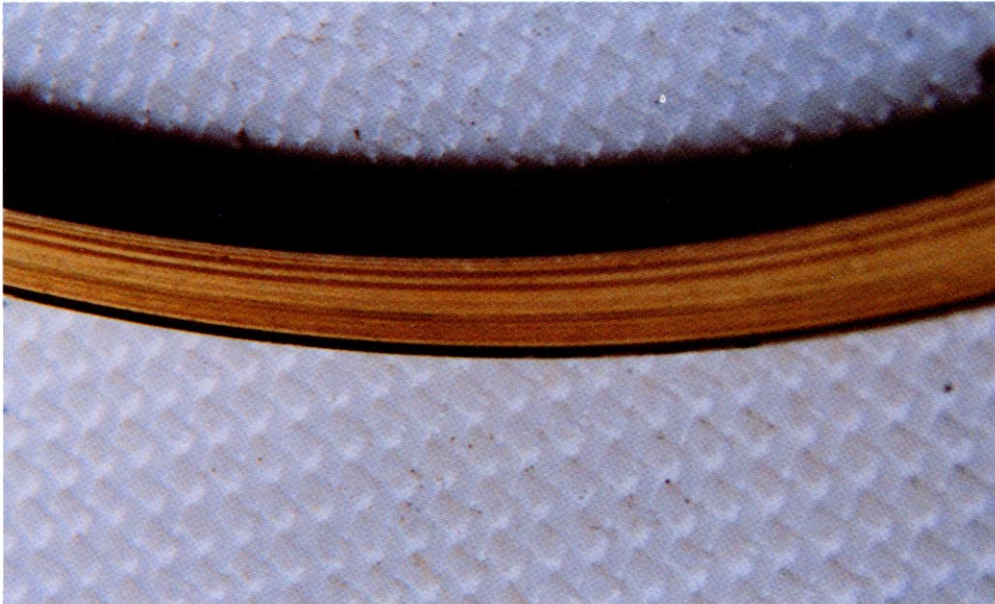
Cause

- Insufficient hardening of housing

Remedy

- Can be used again after correcting with an oilstone

Seal ring (Contact surface with ring groove) (Side)



Category: C

Condition

- Wear

Cause

- Improper cleaning of oil

Remedy

- Replace

Seal ring (Contact surface with top)



Category: C

Condition

- Scratches

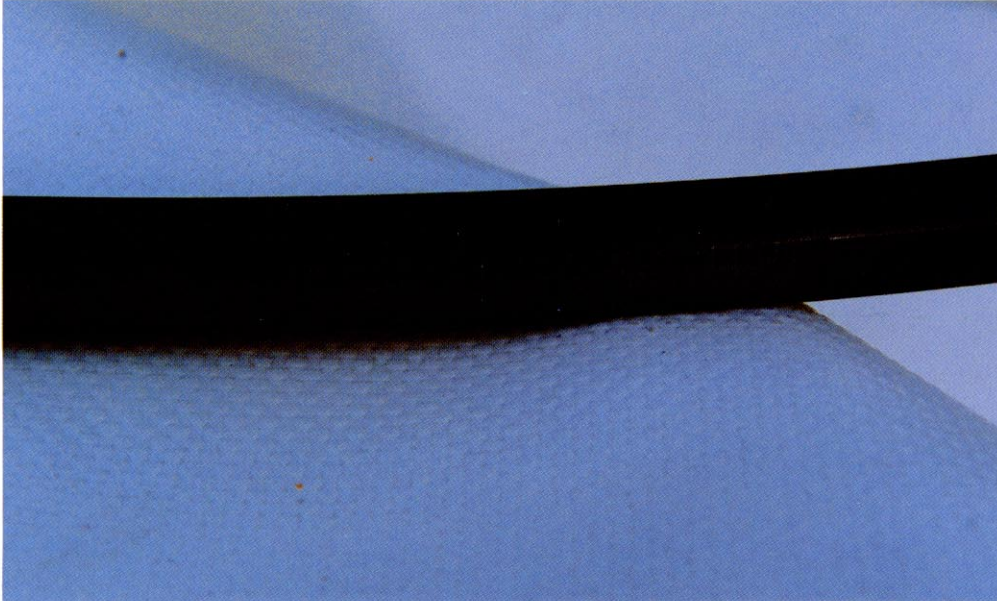
Cause

- Catching of dirt or dust

Remedy

- Replace

Seal ring (Outside circumference contact surface)



Category: C

Condition

- Scratches

Cause

- Catching of dirt or dust

Remedy

- Replace

Needle bearing



Category: C

Condition

- Partial contact of cage side surface

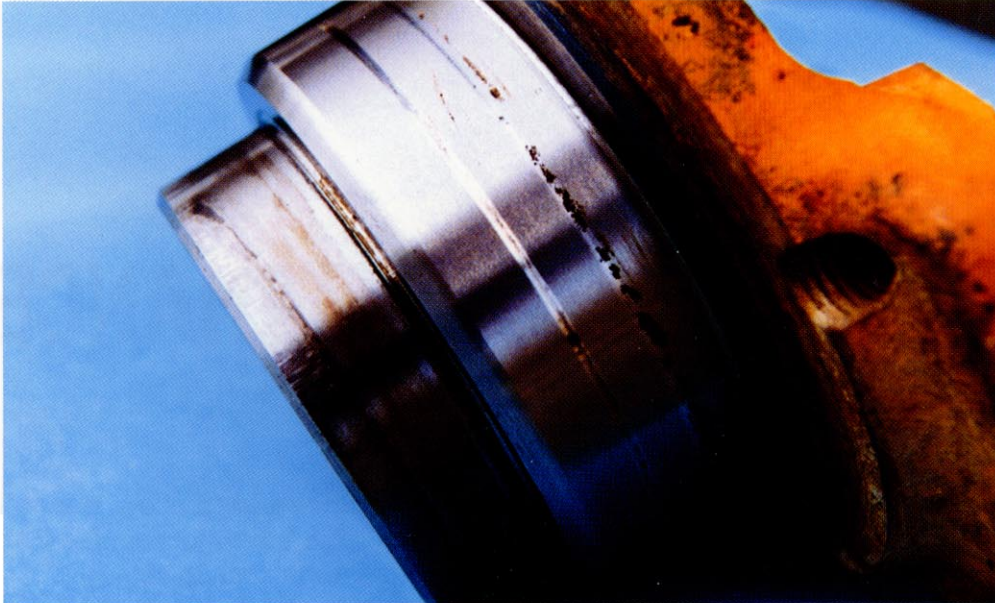
Cause

- Defective flatness of cage side surface

Remedy

- Replace

Coupling



Category: B

Condition

- Wear of oil seal contact surface (Wear limit: Max. 0.05 mm), replace if more than 0.05 mm

Remedy

- Can be used again after correcting chrome plating

PREVENTIVE MAINTENANCE

To prevent failures in the machine before they occur, and to allow the machine to perform at 100%, it is necessary always to know the condition of the machine, and in particular to note overheating, oil pressure, and abnormal noise.

In addition, by carrying out maintenance correctly as given in the operation manual, most damage can be prevented, but be particularly sure to have the user carry out the following points properly.

1. Always use Komatsu genuine lubricating oil, keep to the specified change intervals, and use the lubricating oil that matches the changes in the ambient temperature.
2. Always warm up the engine thoroughly. Avoid sudden gear shifting (shifting between forward and reverse at high speed) and avoid traveling at speeds above those specified for the selected speed range when going down hills.

★ If it is felt that there is any abnormality, use the equipment listed below and look for the cause.

Measuring equipment	Part No.	Measurement item
Shift checker (HD, WS)	792-201-6104	Gear shifting function
Hydraulic tester	790-301-1103	Oil pressure
Thermistor kit	790-500-1300	Water temperature, oil temperature

See the TESTING AND ADJUSTING section in the Shop Manual for details of standard values and the measurement procedures when using the above instruments.

