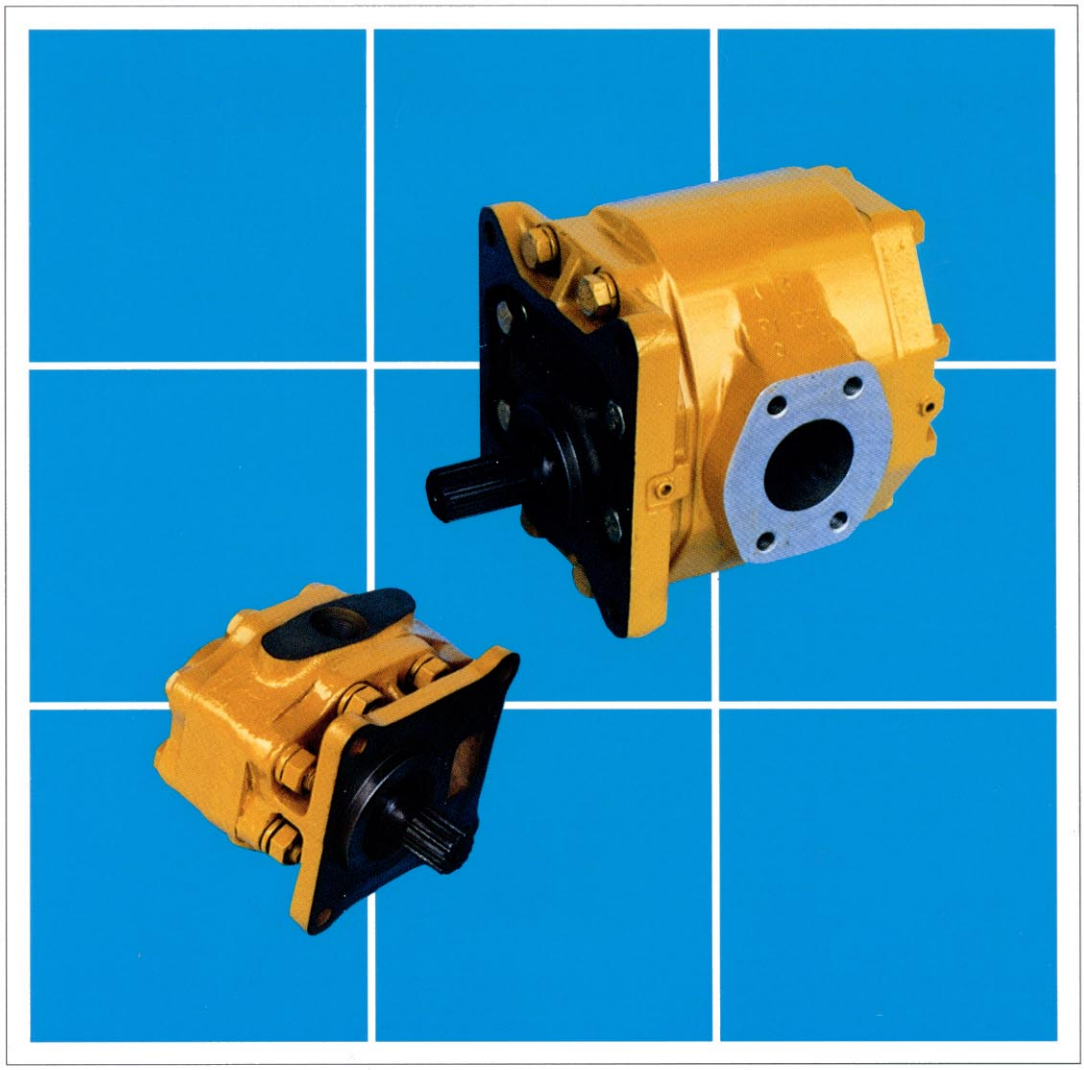
FORM: SEBG4130

SHOP MANUAL

GUIDANCE FOR REUSABLE PARTS

HYDRAULIC GEAR PUMPS



GUIDANCE FOR REUSABLE PARTS

KOMATSU

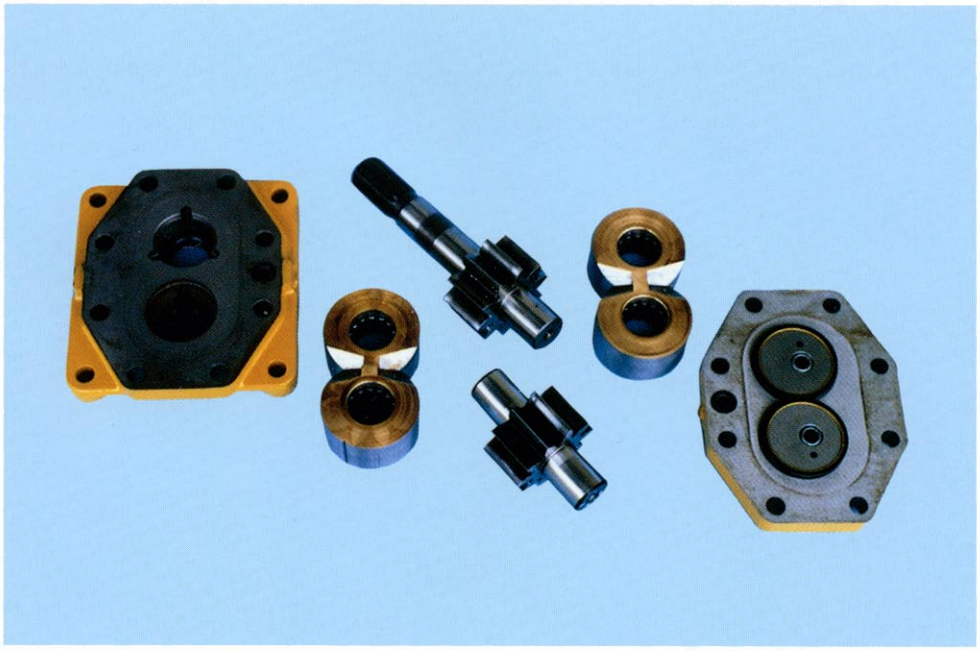
INDEX

INTRODUCTION

This Guide explains the basic knowledge required when disassembling and reassembling a gear-type hydraulic pump and the causes of troubles, then uses photographs to show the judgement for the reuse of parts.

Various hydraulic devices are used in many sections of construction machinery, and the pressure used for them has been getting higher and higher. The hydraulic pump is a very important device which must be able to supply oil with necessary pressure to the hydraulic devices when it is rotated at the specified speed.

We hope this Guide will be effectively used by the people who trouble-shoot and repair the hydraulic pumps, and we hope that your repair costs can be reduced by finding the correct causes of troubles early, replacing the parts properly, and taking measures to prevent the troubles from occurring again.



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 hydraulic gear pumps.

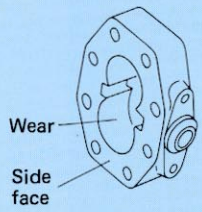
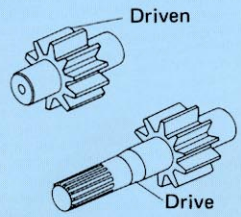
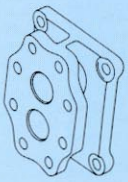
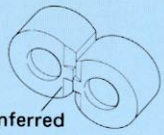
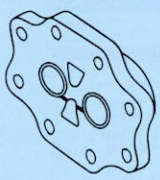
FAILURE SIGNS AND DIAGNOSIS FOR REUSE

The hydraulic pump is the heart of the hydraulic devices. It receives mechanical energy from the engine and converts it into the pressure energy required to operate the hydraulic cylinders through the control valve. If the parts of the hydraulic pump are worn, scuffed, hit, or seized, the performance of the hydraulic devices will decline, and that will result in other troubles at the jobsite. Therefore, the parts of the pump must be very carefully judged for the possibility of reuse.

One important criterion in determining whether or not a part can be safely reused is, of course, the degree of damage. However, due consideration must also be given to the location of the damage and the risk which it poses to the machine as a whole. To make correct judgements, the machine must be given regularly scheduled maintenance, careful consideration must be given to the operating conditions to reveal why such faults occur, and the mechanic should have plenty of experience in order to relate actual phenomena to the photographs appearing in this manual.

Inspection Points for Parts Reuse Diagnosis

For the correct judgement of the parts, wash and clean the parts before judging them, then judge them by observing the following check points.

Part	Check point	Part	Check point
Gear case 	• Scuffing, wear, and seizure of inside wall • Stain, hit marks, and flaws on both side faces	Gear 	• Damage and pitting of tooth surface • Flaws, wear, and scuffing of teeth • Wear and seizure of shaft
Bracket 	• Stain, scuffing, wear, and seizure of contact surface	Bushing (PAL and CAL Pumps) 	• Flaws and breaking away of surfaces in contact with gears • Wear, scuffing, and seizure of bearings
Housing (for low pressure) 	• Stain, scuffing, wear, and seizure of contact faces	Side plate (SAL Pump) 	• Wear and scuffing of sliding surfaces

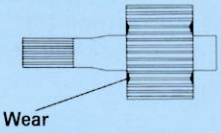
Cover, in case of housing for high pressure.

Standards for Failure Determination

Rank	Failure Degree
Use again	The functioning of the machine is not affected by the damage, and no troubles are caused by the damage.
Use after reconditioning	The function of the machine is not affected by the damage, but if the damage is not repaired, it may get worse and lead to serious troubles.
Do not use again	The machine does not function properly. If the machine continues to be used without repairing the damage, a major failure may occur.

Standards for Reuse of Hydraulic Gear Pump Parts

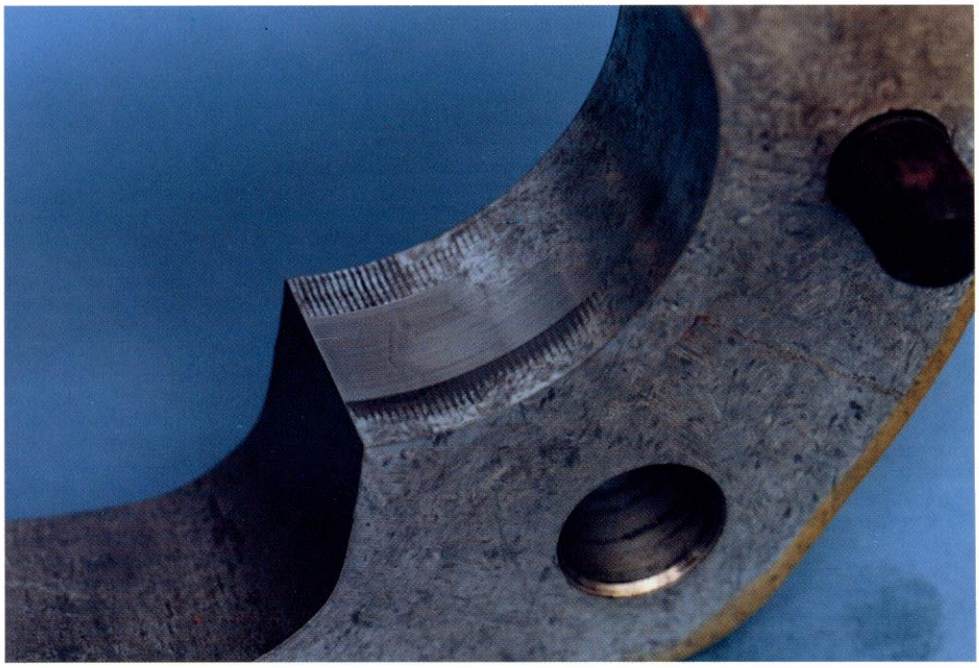
Part Name		Type of Failure	Failure Degree		
			Use again	**Use after reconditioning**	**Do not use again**
Gear case	1	• Scuffing and wear of the inside wall which contacts the tooth tops.	• Wear (Can be felt with your fingernail. 0.2 mm max.)		• Level difference larger than 0.2 mm
	2	• Hit marks and flaws on side faces (Gears for high pressure oil)	• Slight scratch		• Recongnizable hit marks and pressure marks. (If the contact face of the O-ring is dented more than 0.03 mm, oil will flow out.)
Bracket and housing	1	• Scratches and wear of faces which contact the side face of gears *Parts for low pressure only	• Slight scratch	• Light surface roughness and wear	• Serious surface roughness • Wear • Seizure

Part Name	Type of Failure		Failure Degree		
			Use again	**Use after reconditioning**	**Do not use again**
Gear	1	• Scratches, wear, and scuffing of side faces of gears	• Scratches which cannot be felt with your fingernail (0.01 mm max.)		• Scratches large enough to feel with your fingernail (larger than 0.01 mm) • Wear on gear side faces which cannot be felt with your fingernail, but wear on the tooth root is larger than 0.01 mm.  Wear
	2	• Shaft • Portions which the bearings contact • Contact faces of oil seal	• Slight scratches		• Flaws which can be felt with your fingernail
	3	• Shaft • Spline	• Slight wear (0.2 mm max.)		• Large wear • Uneven contact and wear (more than 0.2 mm)
Bearing	Needle 1	• Flaw and peeling • Heavy rotation and dragging	• No flaws or peeling • Smooth rotation		• Flaws or peeling • Rotation not smooth
	Plain 1	• Wear, seizure, and scuffing	• Slight wear 〔Surface plate (white) is left〕 • Only some SAL and FAL Pumps.		• Large wear 〔surface plate (white) is not left〕 • Discoloration, seizure, and scuffing
Bushing	1	• Wear, flaws, and peeling of surfaces which contact the gears	• Slight scratches and wear	• Flaws which can be felt with your fingernail (Repair is possible, but the squareness must be within 0.01 mm)	• Large wear • Deep scratches • Cracks and discoloration
Side plate	1	• Wear of sliding surface • Scratches and peeling • Discoloration • Slight wear	• Slight wear		• Large wear (Lead+tin plate is removed) • Deep flaws (felt with fingernail) • Discoloration and cracks
Pump flange		• Hit marks on the surfaces which contact the O-ring	• No flaws • Dents smaller than 0.01 mm	• Hit marks smaller than 1 mm • Repair is possible if it is possible to grind in parallel.	• Hit marks and dent larger than 1 mm

EXAMPLES OF FAILURES

Gear Caces

1



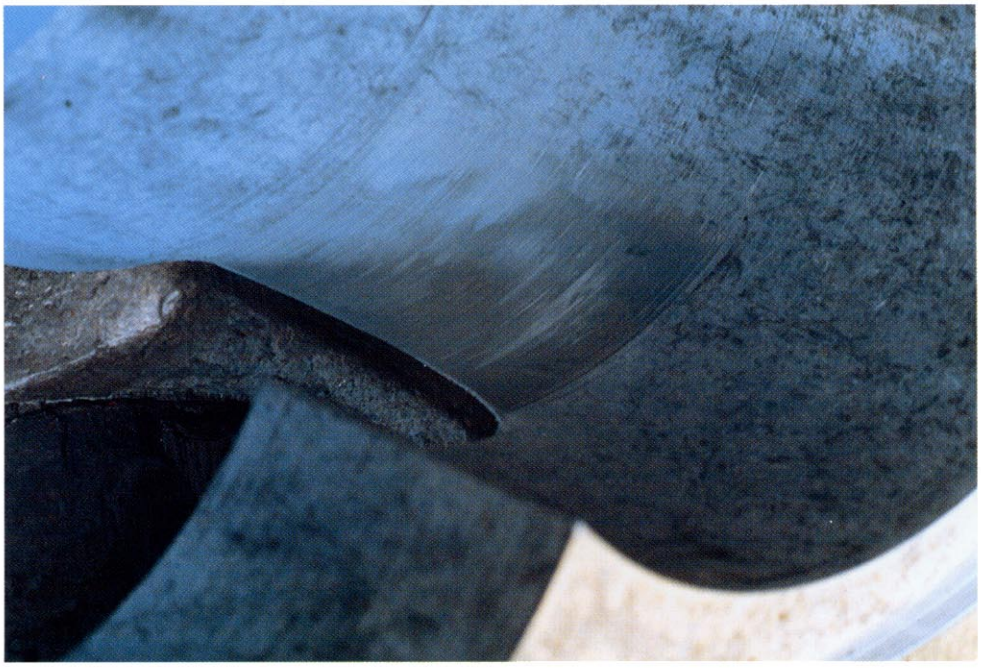
Example of SA type

USE AGAIN

Failure Sign
- Slight wear

Cause
- Normal wear

2



Example of PA and KA type

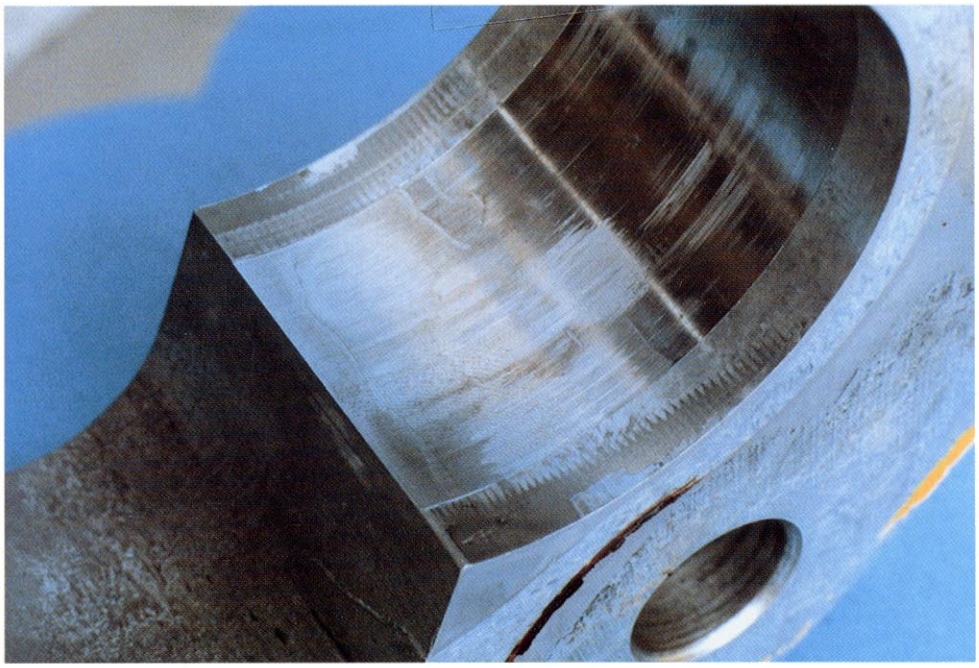
USE AGAIN

Failure Sign
- Slight wear

Cause
- Normal wear

Gear Cases (for high pressure)

3



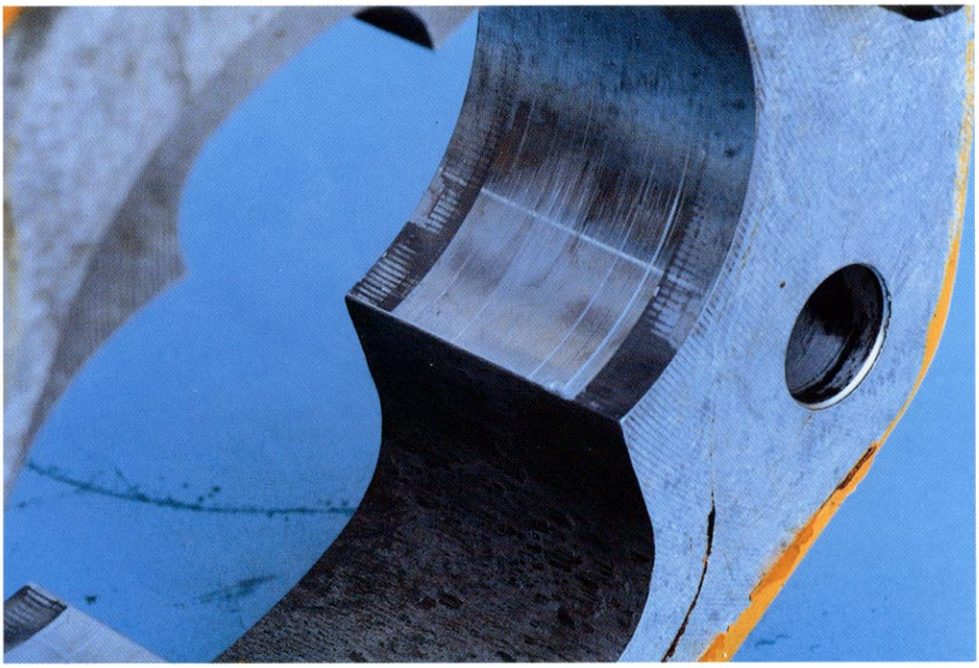
Example of SA type

USE AGAIN

Failure Sign
- Wear (Around 0.1 mm)

Cause
- Dust in hydraulic oil

4



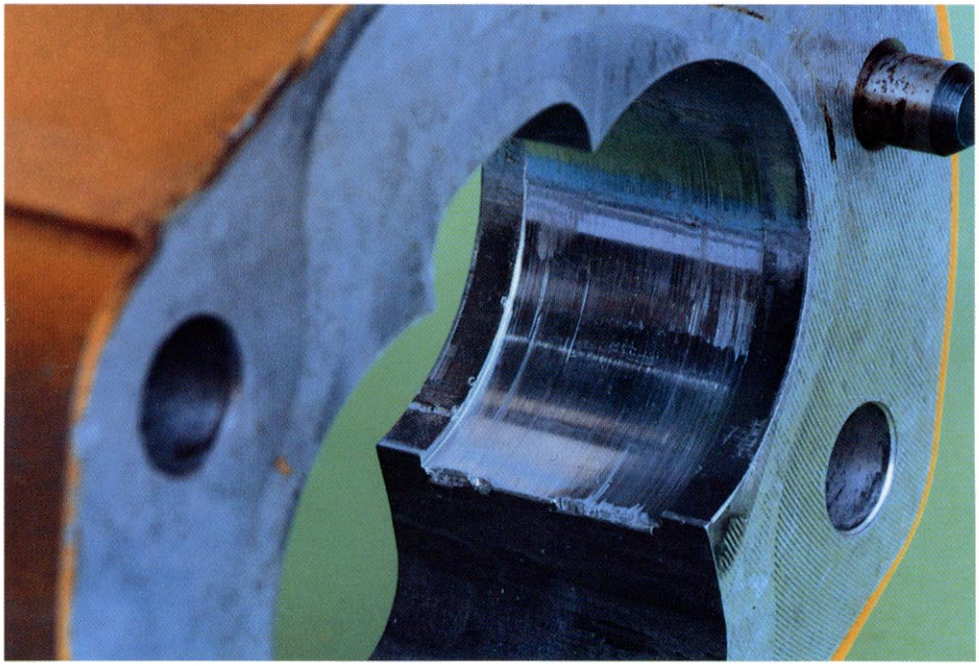
Example of SA type

USE AGAIN

Failure Sign
- Wear (Around 0.1 mm)

Cause
- Dust in hydraulic oil

5



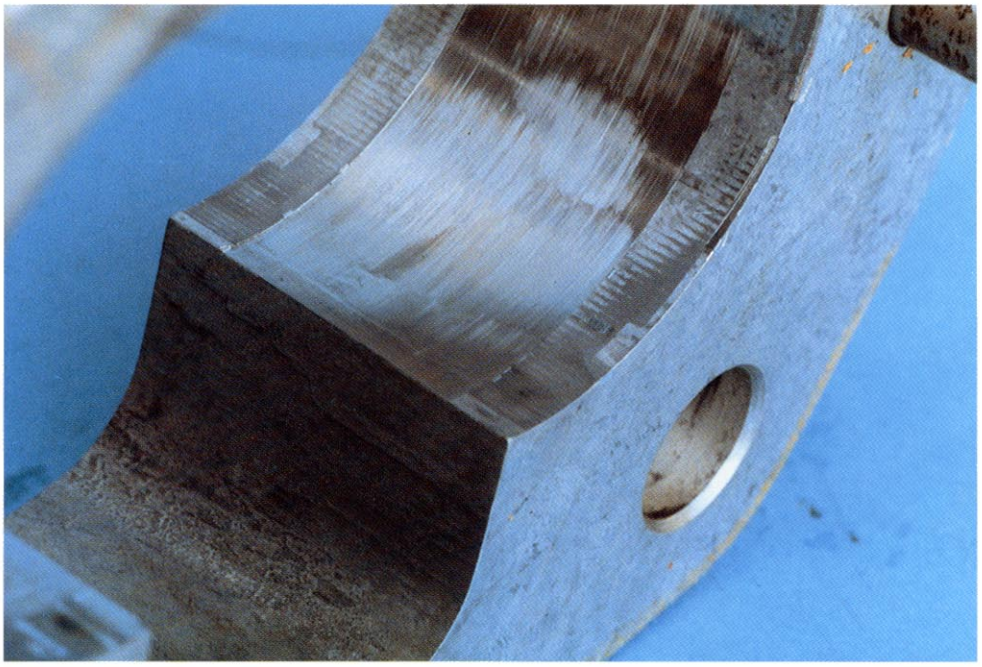
Example of SA type

DO NOT USE AGAIN

Failure Sign
- Large wear on inside wall which contacts gear teeth

Cause
- Abnormal pressure

6



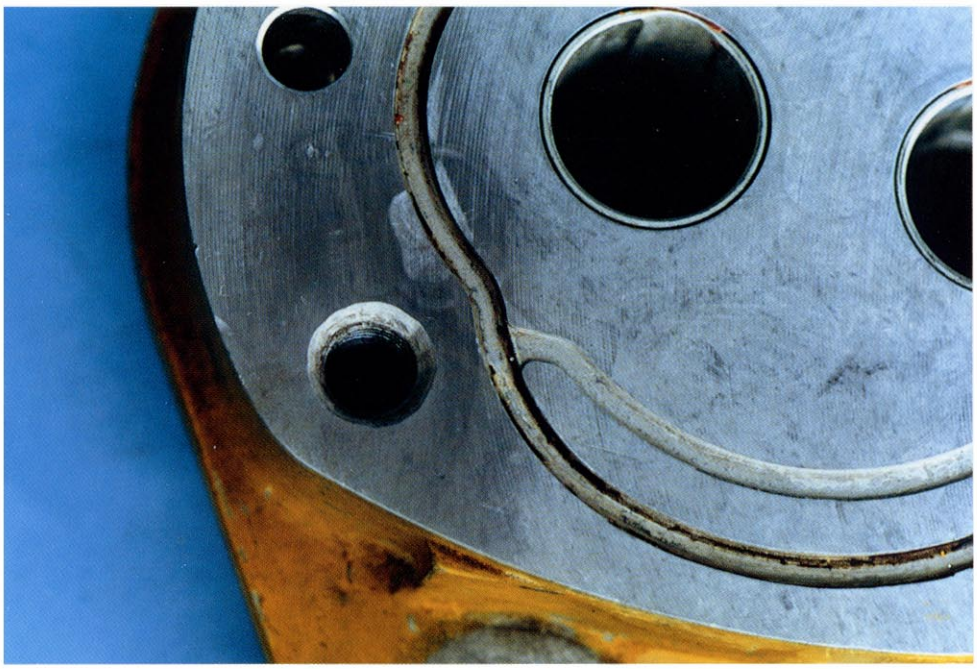
Example of SA type

DO NOT USE AGAIN

Failure Sign
- Wear

Cause
- Dust in hydraulic oil

7



Example of SA type

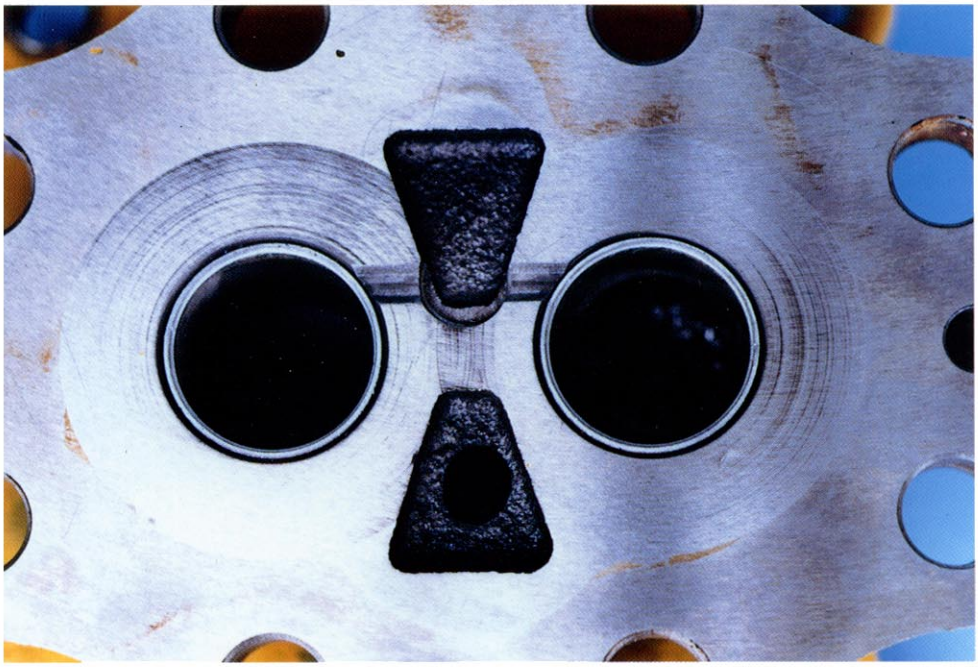
DO NOT USE AGAIN

Failure Sign
- Press marks on side faces

Cause
- Caught sealer or hit marks caused by external object

Bracket and Housings (for low pressure)

8



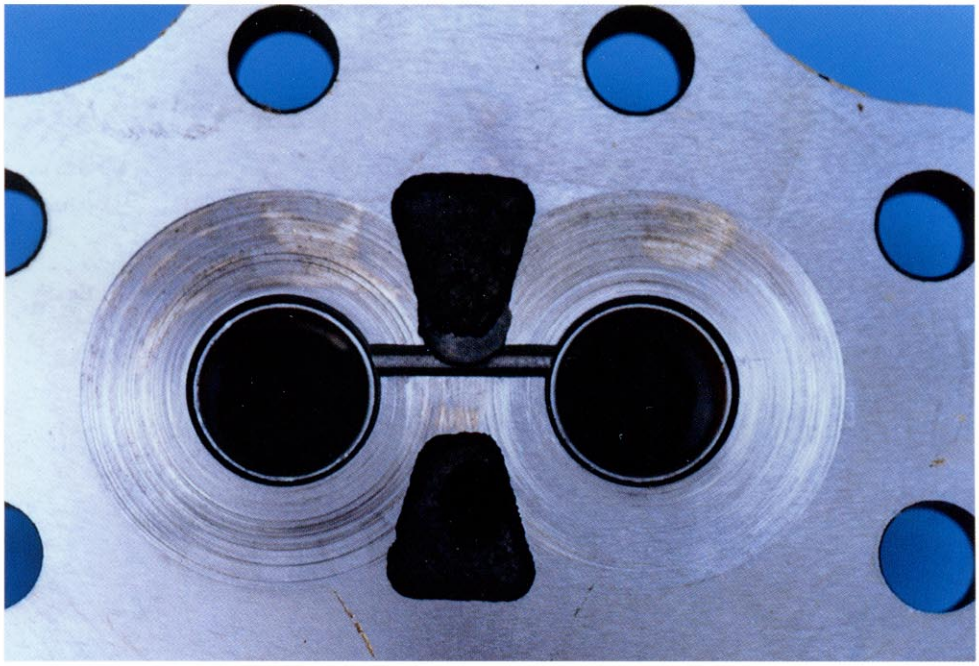
Example of FA type

USE AGAIN

Failure Sign
- Slight flaws on surface of bracket which gear contacts

Cause
- Dust in hydraulic oil

9



Example of FA type

USE AFTER RECONDITIONING

(after removing the flaws by lapping)

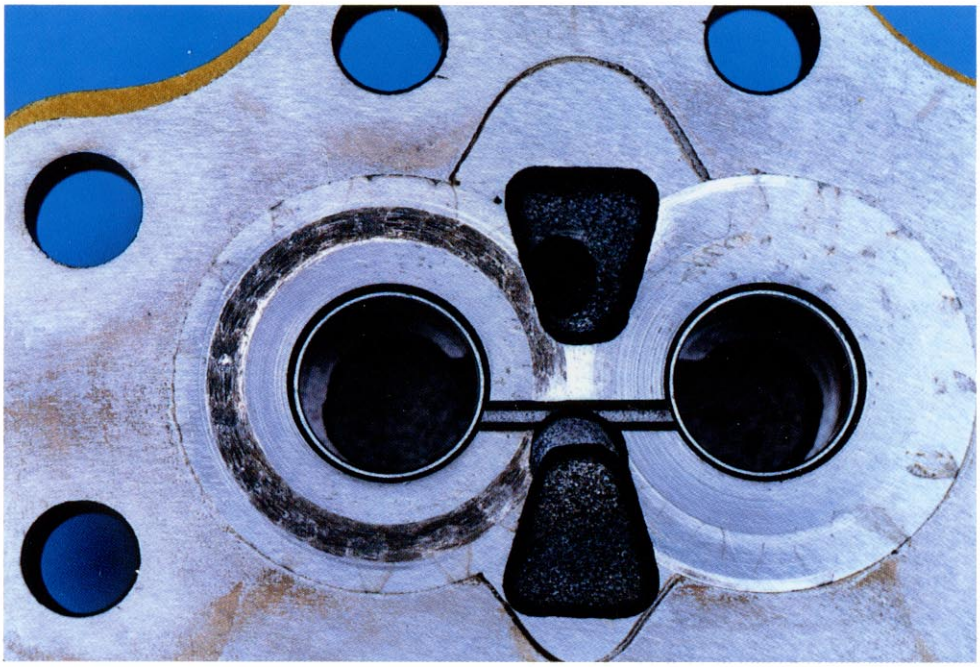
Failure Sign

- Light surface roughness of bracket (housing) which gear contacts

Cause

- Dust in hydraulic oil

10



Example of FA type

DO NOT USE AGAIN

Failure Sign

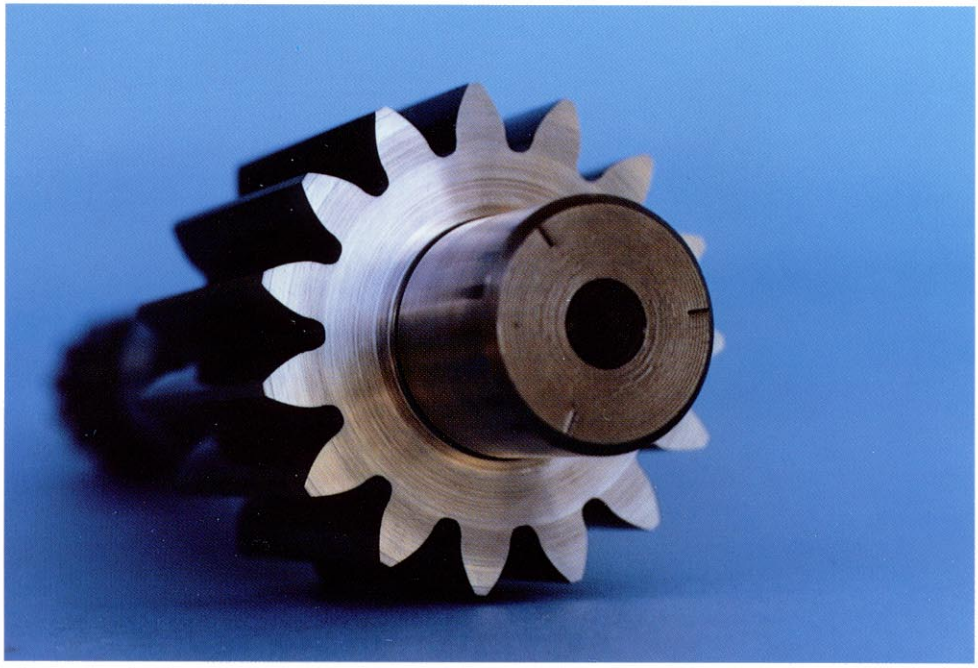
- Seized gear and bracket

Cause

- Dust in hydraulic oil

Gears

11



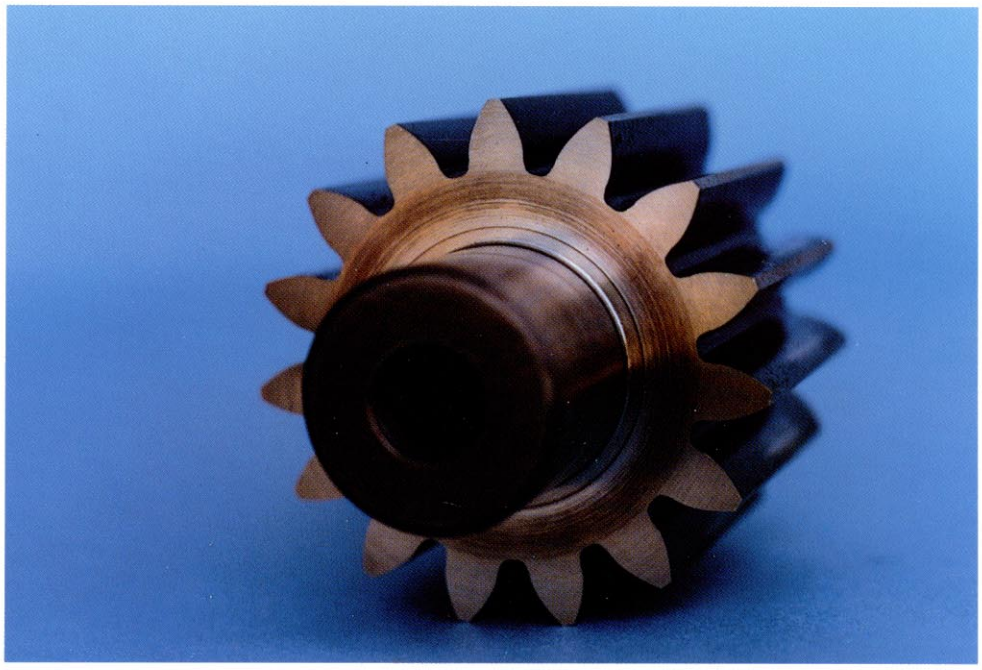
Example of FA type

USE AGAIN

Failure Sign
- Slight scratches on side faces of gear

Cause
- Dust in hydraulic oil

12



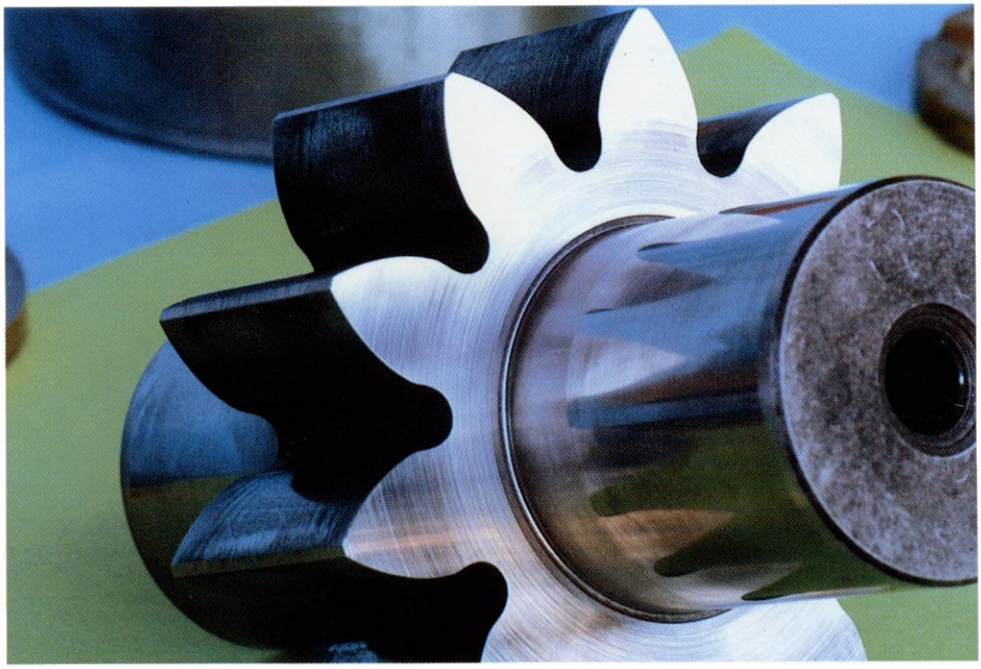
Example of FA type

DO NOT USE AGAIN

Failure Sign
- Scratches on side faces of gear

Cause
- Partial rise of temperature caused by bad contact due to wear resulting from dust in the hydraulic oil.

13



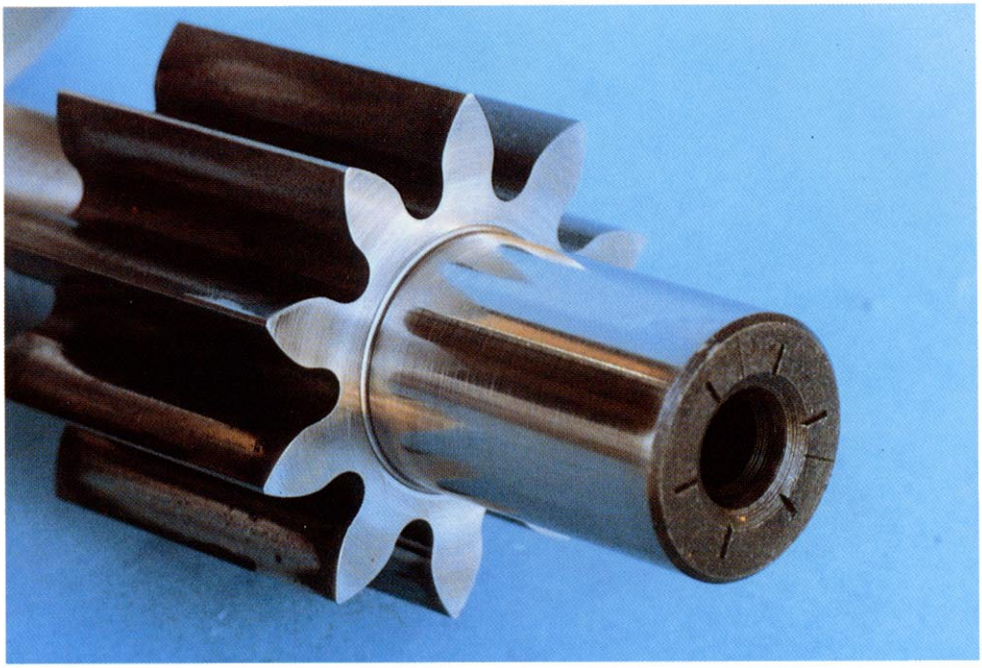
Example of PA type

USE AGAIN

Failure Sign
- Scratches on side faces of gear

Cause
- Dust in hydraulic oil

14



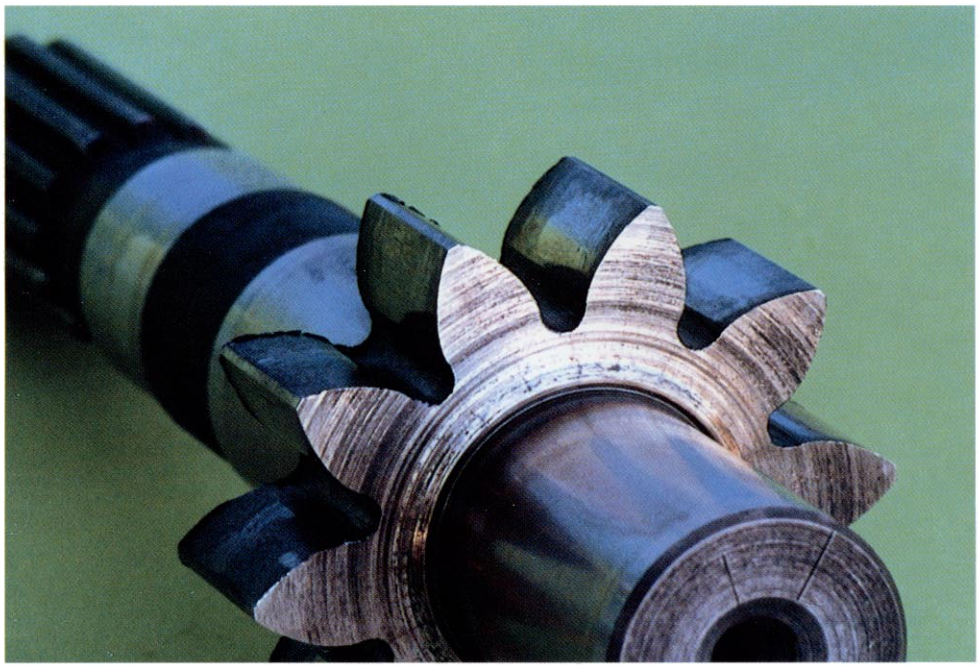
Example of KA type

USE AGAIN

Failure Sign
- Slight scratches on side faces of gear

Cause
- Dust in hydraulic oil

15



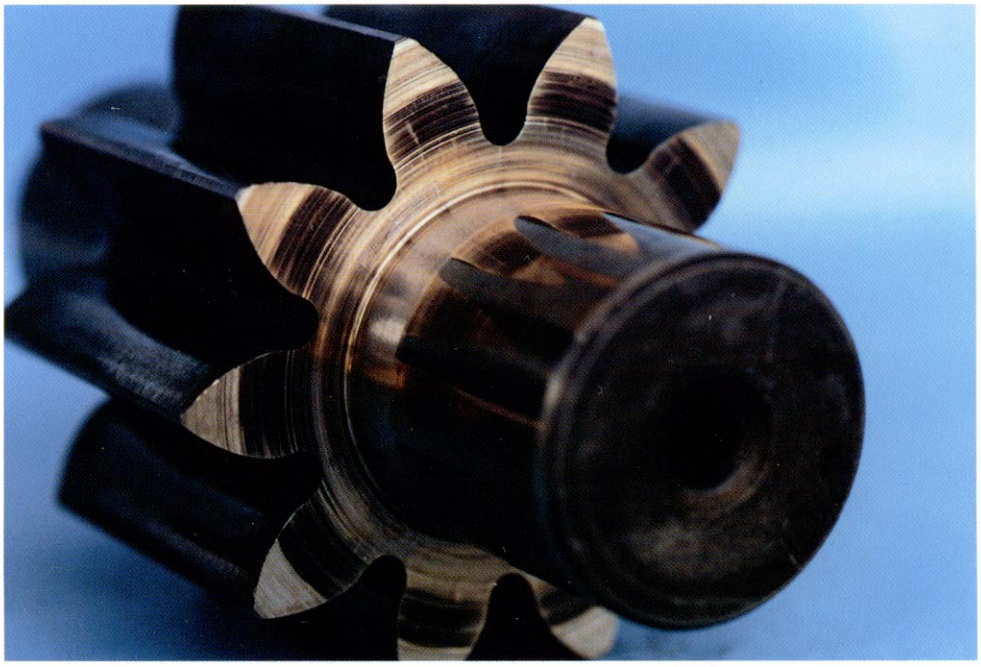
Example of PA type

DO NOT USE AGAIN

Failue Sign
- Wear and scratches

Cause
- Dust in hydraulic oil

16



Example of PA type

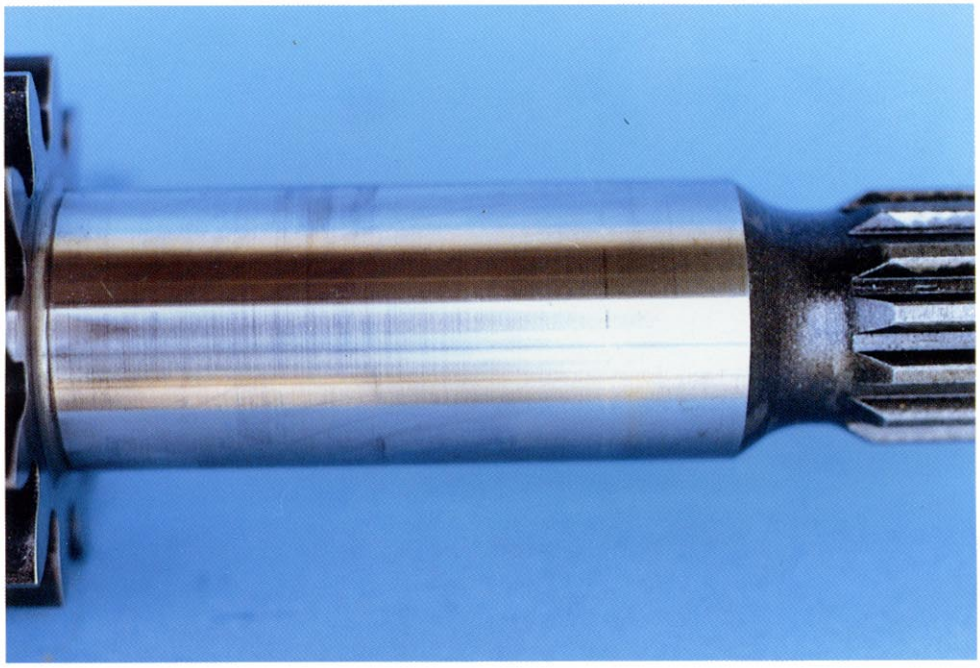
DO NOT USE AGAIN

Failure Sign
- Wear and discoloration

Cause
- Partial rise of temperature caused by bad contact due to wear resulting from dust in the hydraulic oil.

Gears (Shaft)

17



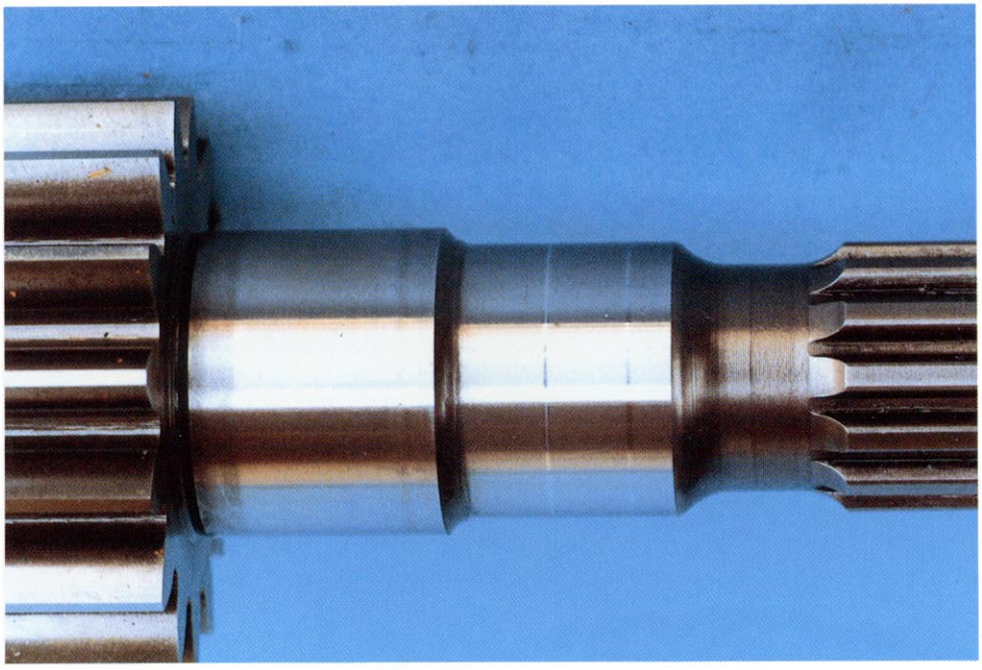
Example of SA type

USE AGAIN

Failure Sign
- Slight scratches on contact face of bearings

Cause
- Dust in hydraulic oil

18



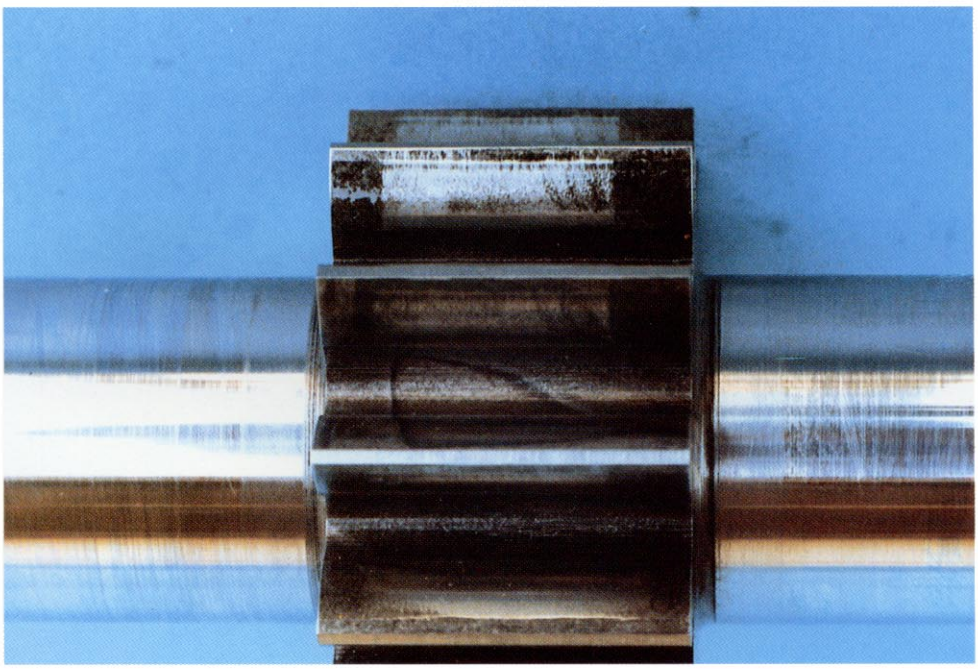
Example of FA type

USE AGAIN

Failure Sign
- Very slight wear of contact face of oil seal

Cause
- Normal wear

19



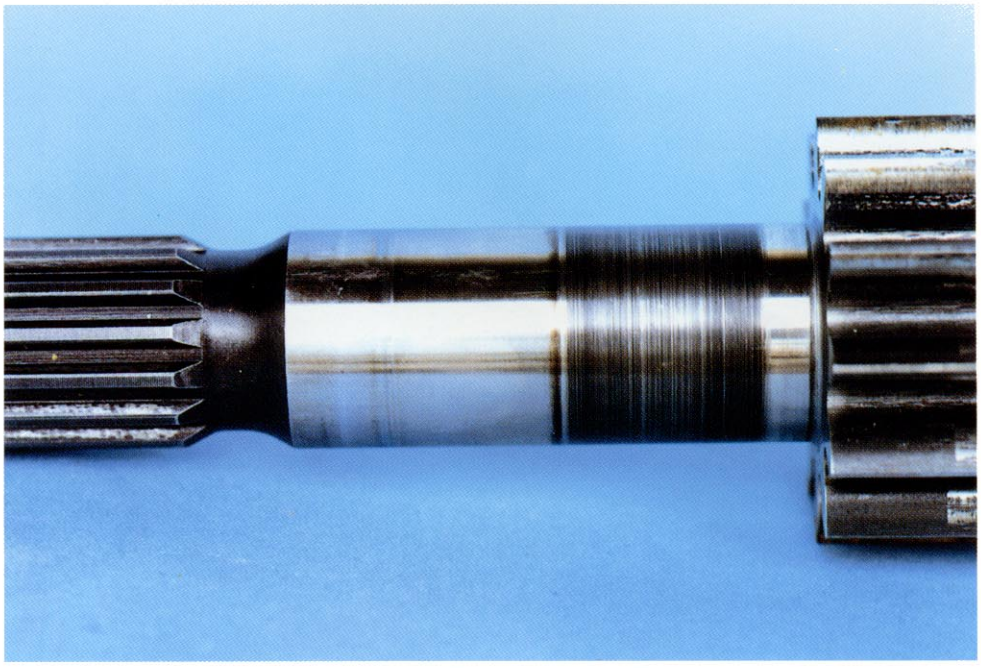
Example of SA type

USE AGAIN

Failure Sign
- Slight wear of contact face of bearings

Cause
- Dust in hydraulic oil

20



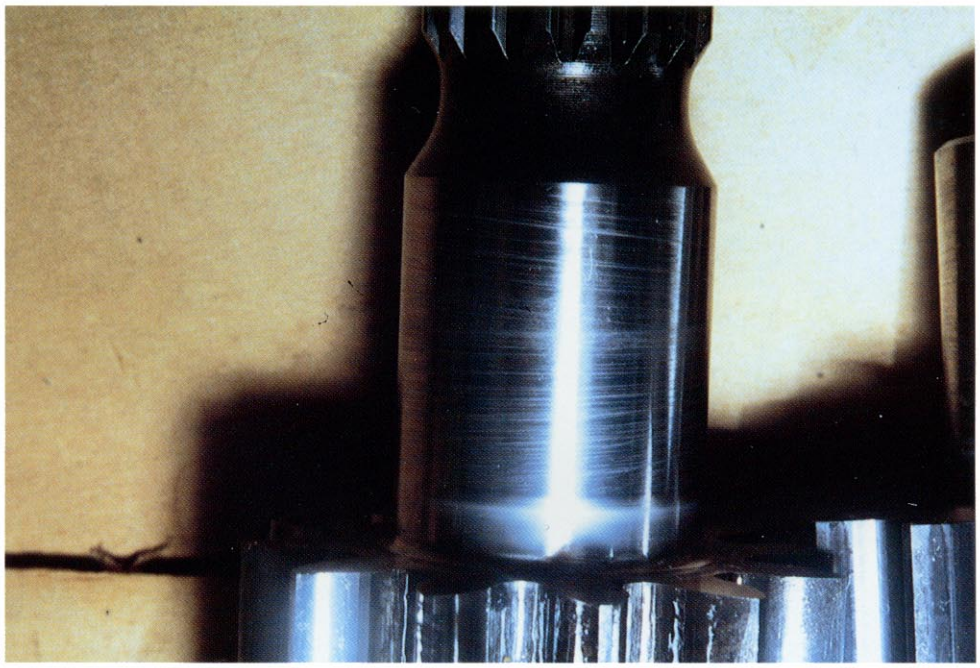
Example of SA type

DO NOT USE AGAIN

Failiure Sign
- Wear and scratches on contact face of bearings

Cause
- Dust in hydraulic oil

21



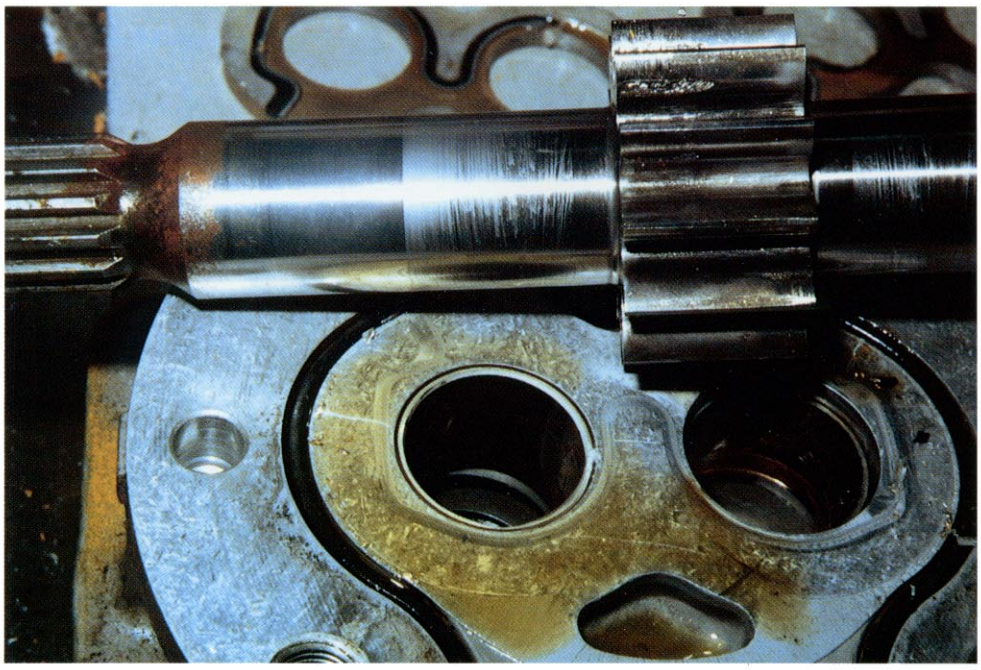
Example of SA type

DO NOT USE AGAIN

Failure Sign
- Scratches on contact face of bearings

Cause
- Dust in hydraulic oil

22



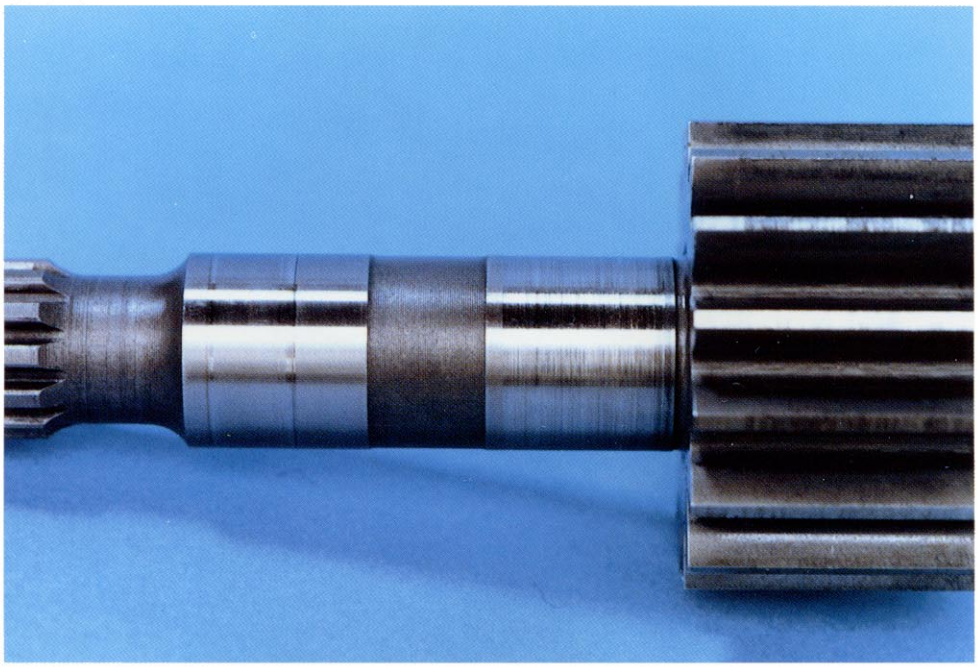
Example of SA type

DO NOT USE AGAIN

Failure Sign
- Scratches on contact face of bearings

Cause
- Dust in hydraulic oil

23



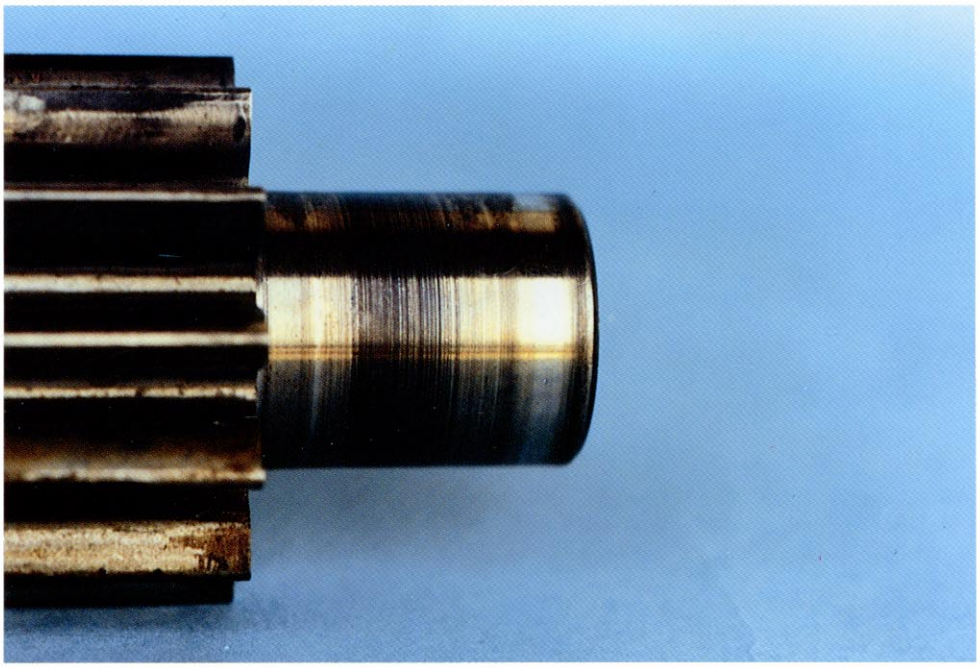
Example of FA type

DO NOT USE AGAIN

Failure Sign
- Scratches on contact face of bearings

Cause
- Dust in hydraulic oil

24



Example of FA type

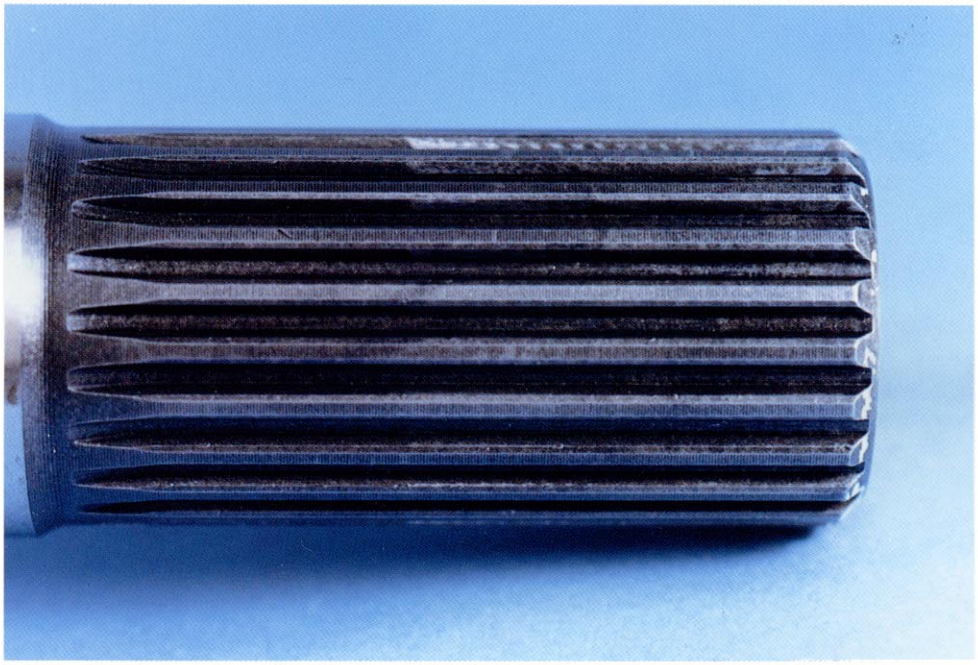
DO NOT USE AGAIN

Failure Sign
- Scratches and discoloration on contact face of bearings

Cause
- Partial rise of temperature caused by bad contact due to wear resulting from dust in the hydraulic oil

Splines

25



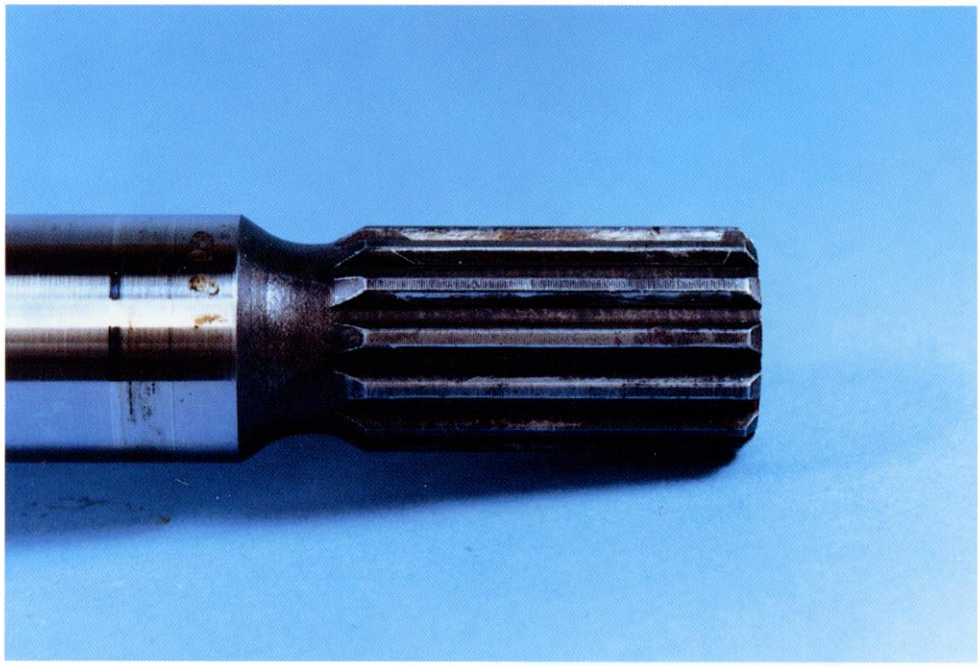
Example of PA type

USE AGAIN

Failure Sign
- Wear

Cause
- Normal wear

26



Example of SA type

USE AGAIN

Failure Sign
- Wear

Cause
- Normal wear

27

Example of SA type

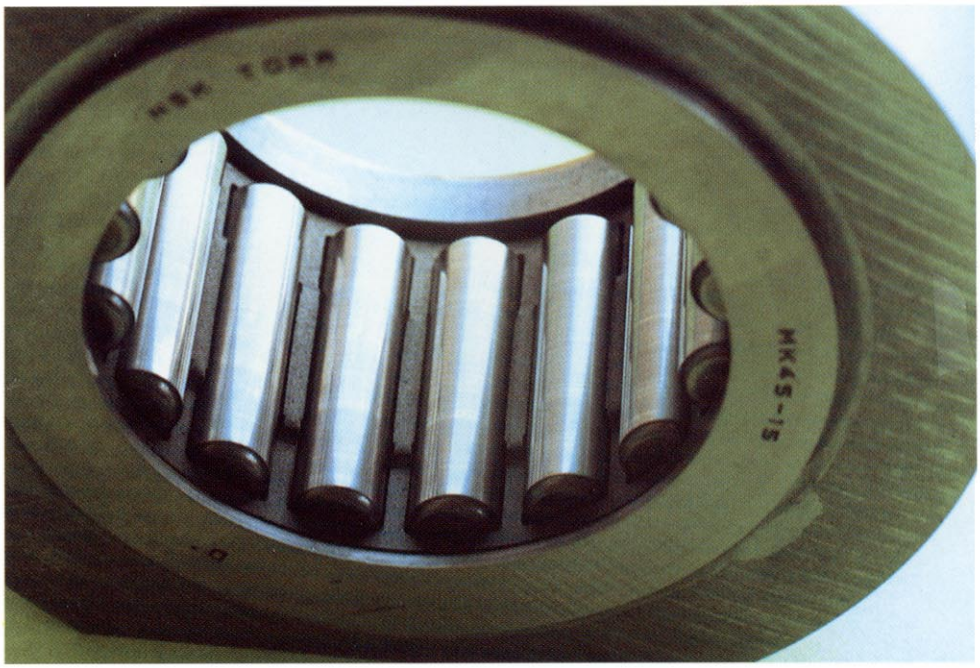
DO NOT USE AGAIN
(wear greater than 0.2mm)

Failure Sign
- Wear

Cause
- Normal wear (caused by insufficient lubrication of spline)

Needle Bearings

28



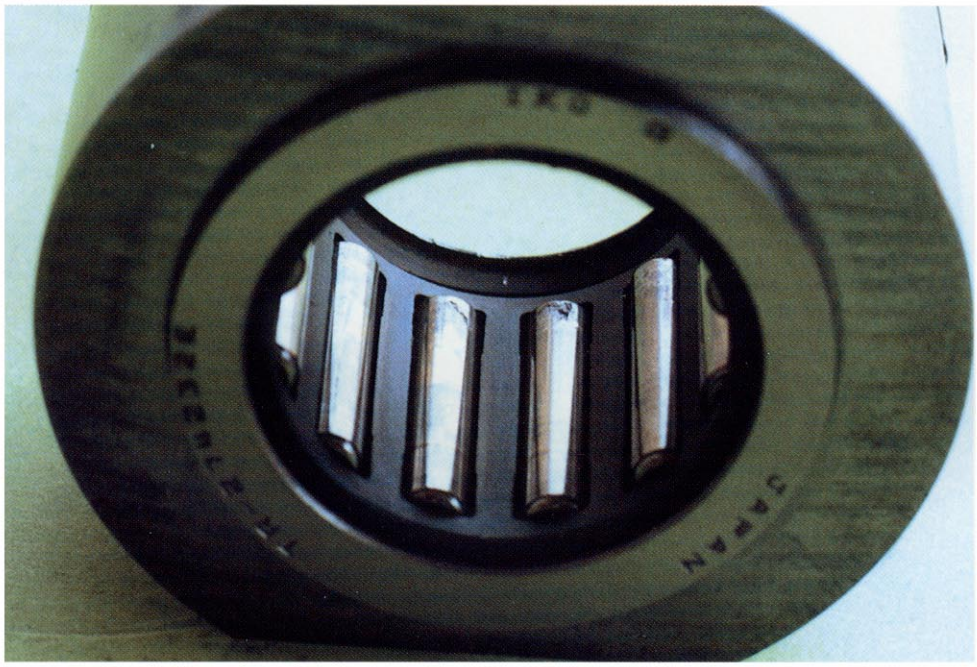
Example of PA type

USE AGAIN

Failure Sign
- Very slight streaks on rollers

Cause
- Dust in hydraulic oil

29



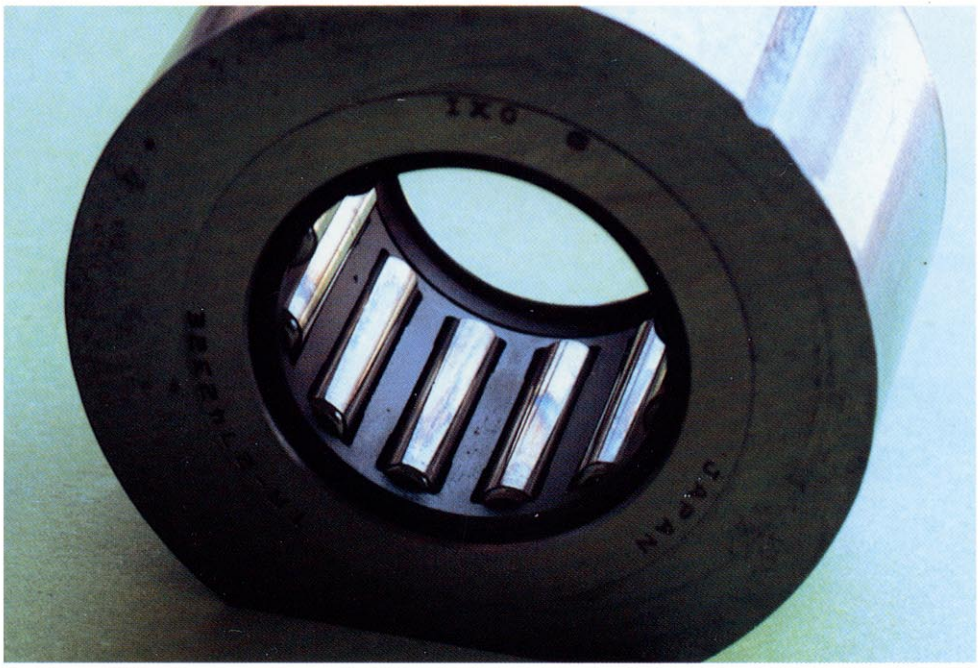
Example of PA type

DO NOT USE AGAIN

Failure Sign
- Peeling

Cause
- Foreing matter trapped inside

30



Example of PA type

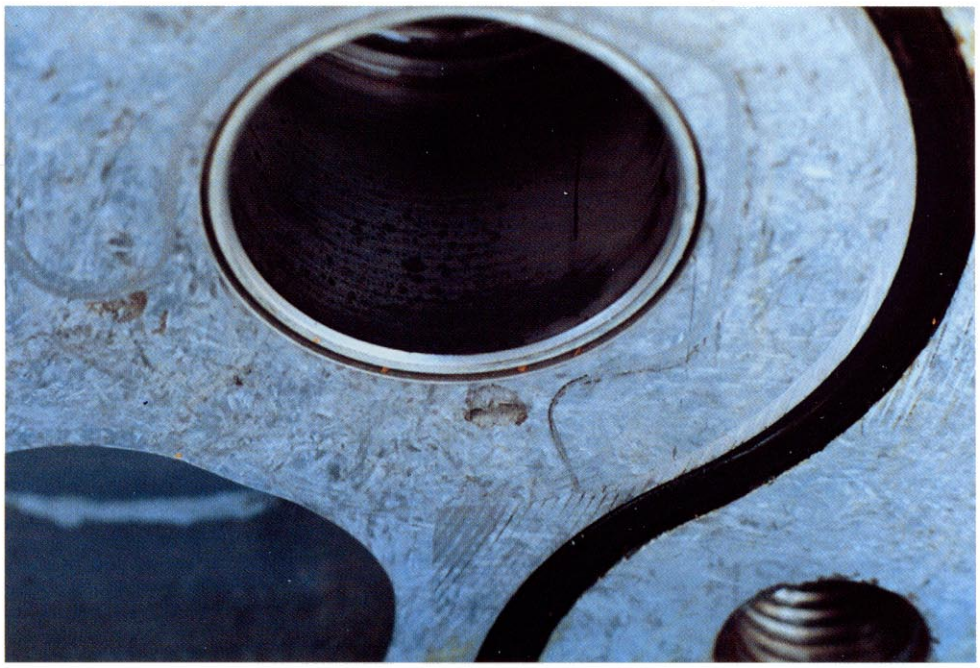
DO NOT USE AGAIN

Failure Sign
- Discoloration

Cause
- Partial rise of temperature caused by poor contact (Wear of bearing, bushing, etc.)

Plain Bearings

31



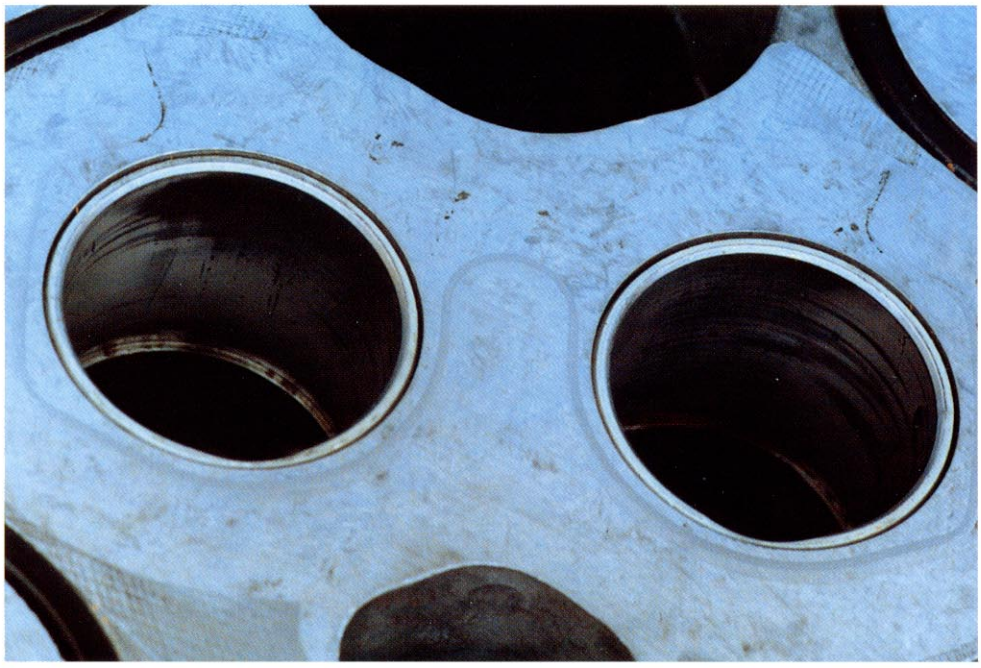
Example of SA type

USE AGAIN

Failure Sign
- Very slight wear

Cause
- Normal wear

32



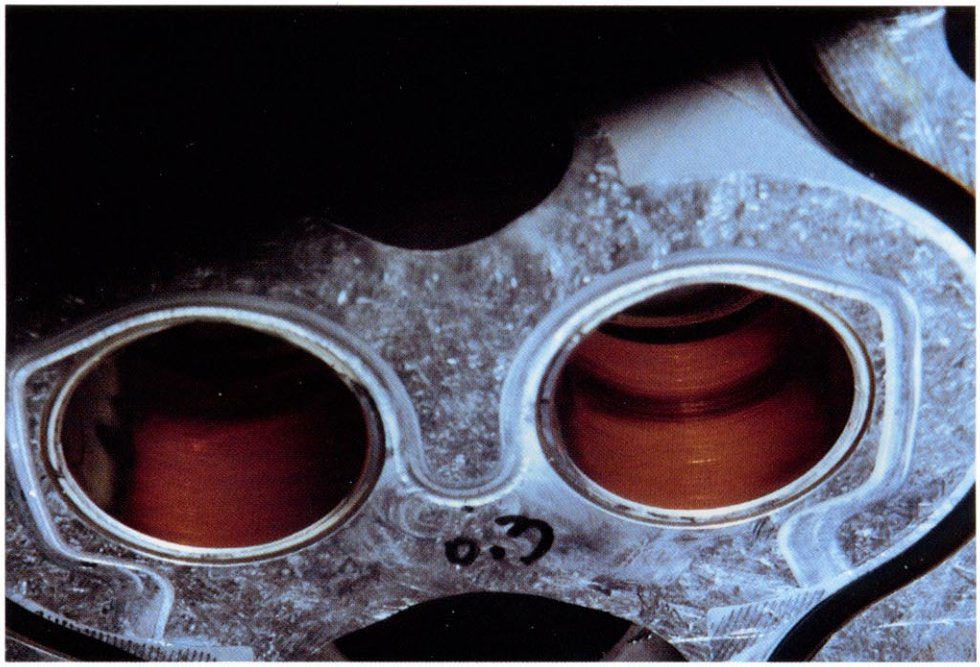
Example of SA type

USE AGAIN

Failure Sign
- Very slight wear

Cause
- Normal wear

33



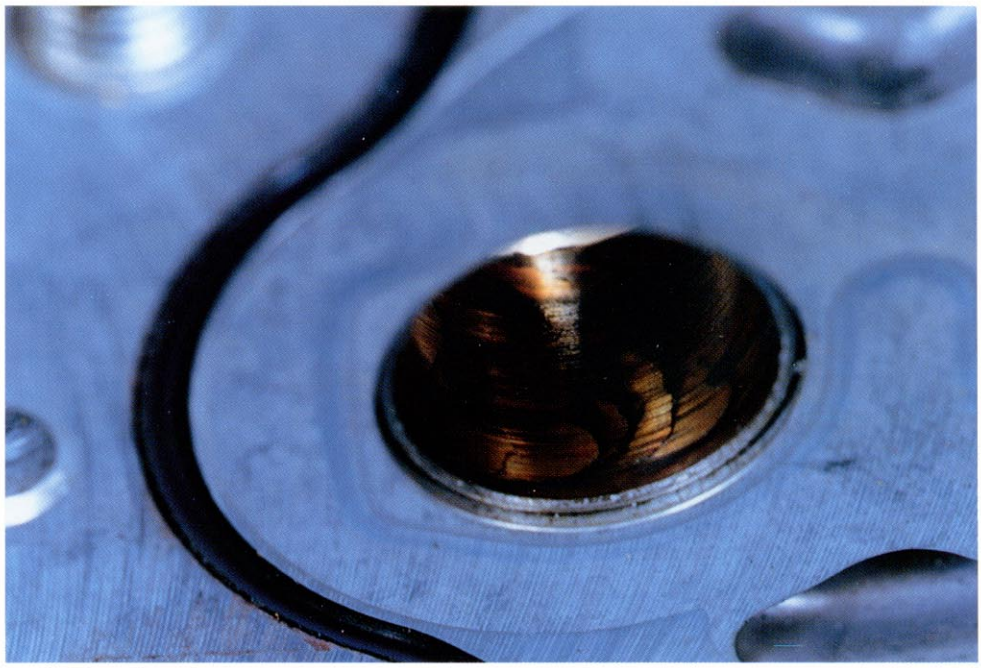
Example of SA type

DO NOT USE AGAIN

Failure Sign
- Wear

Cause
- Dust in hydraulic oil

34



Example of SA type

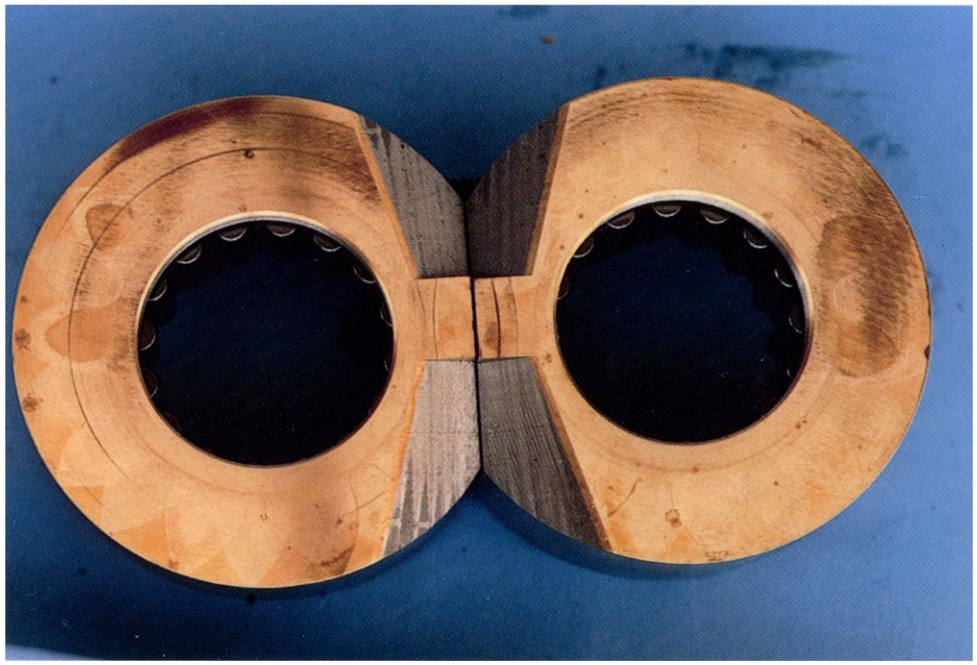
DO NOT USE AGAIN

Failure Sign
- Wear and discoloration

Cause
- Dust in hydraulic oil

Bushings

35



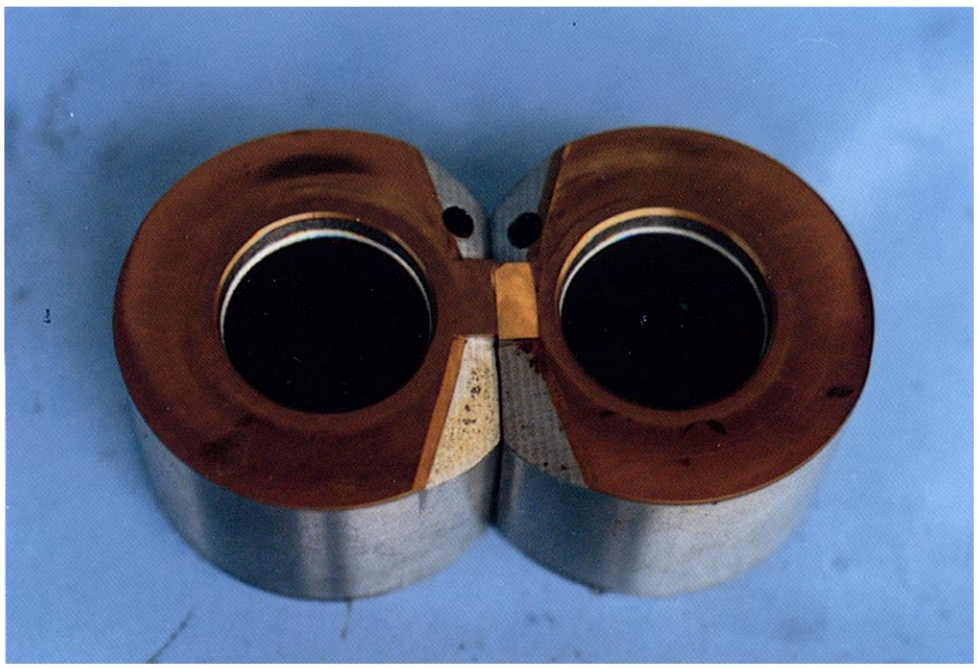
Example of PA type

USE AGAIN

Failure Sign
- Very slight wear and scratches

Cause
- Wear . . . . . Normal wear
- Scratches . . . Dust in hydraulic oil

36



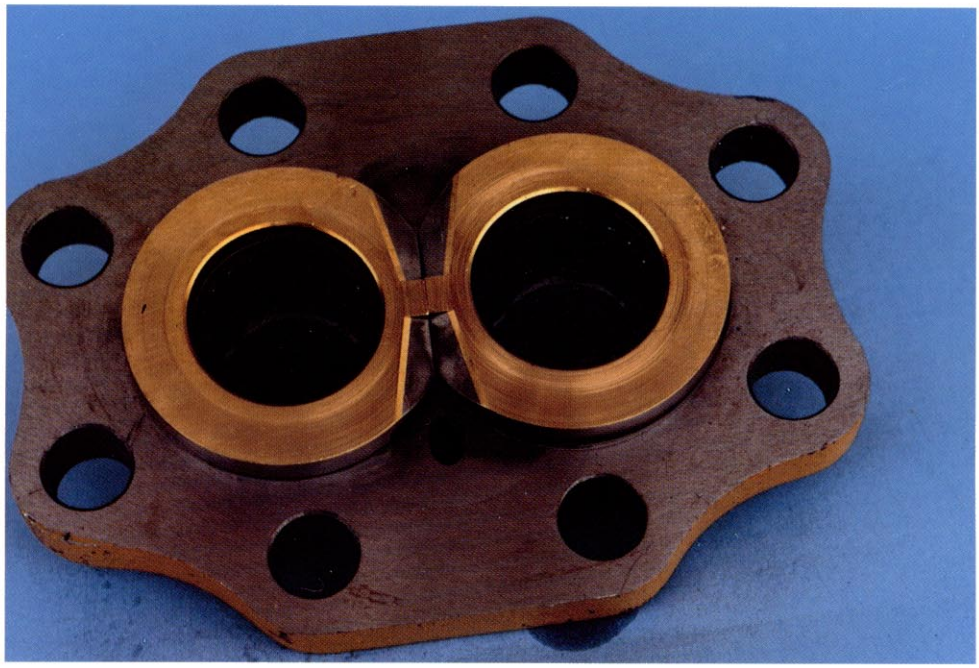
Example of KA type

USE AGAIN

Failure Sign
- Very slight wear

Cause
- Dust in hydraulic oil

37



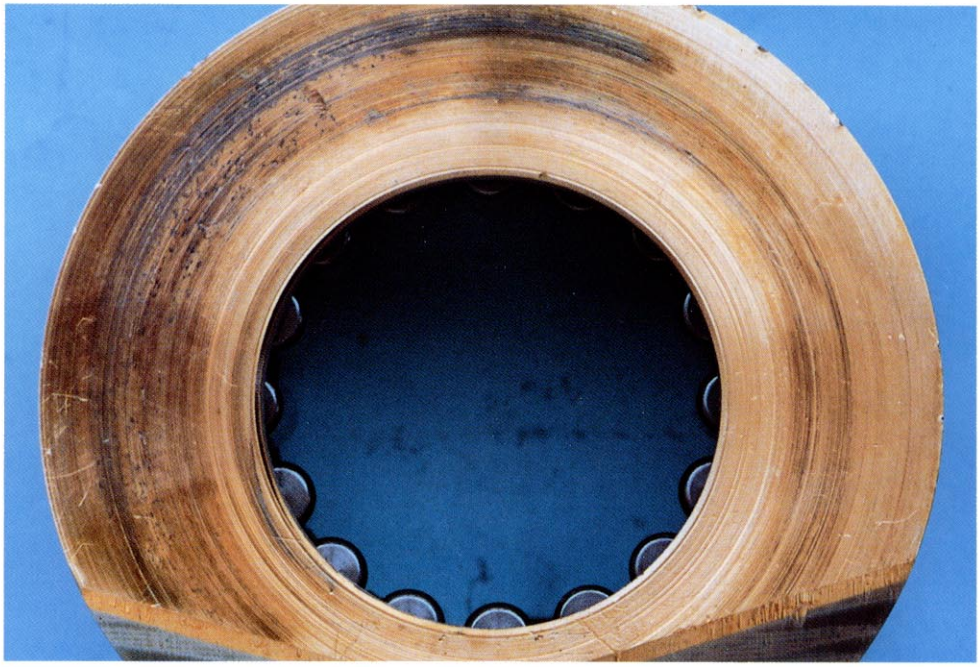
Example of FA type

USE AGAIN
(for low pressure)

Failure Sign
- Slight wear

Cause
- Normal wear

38



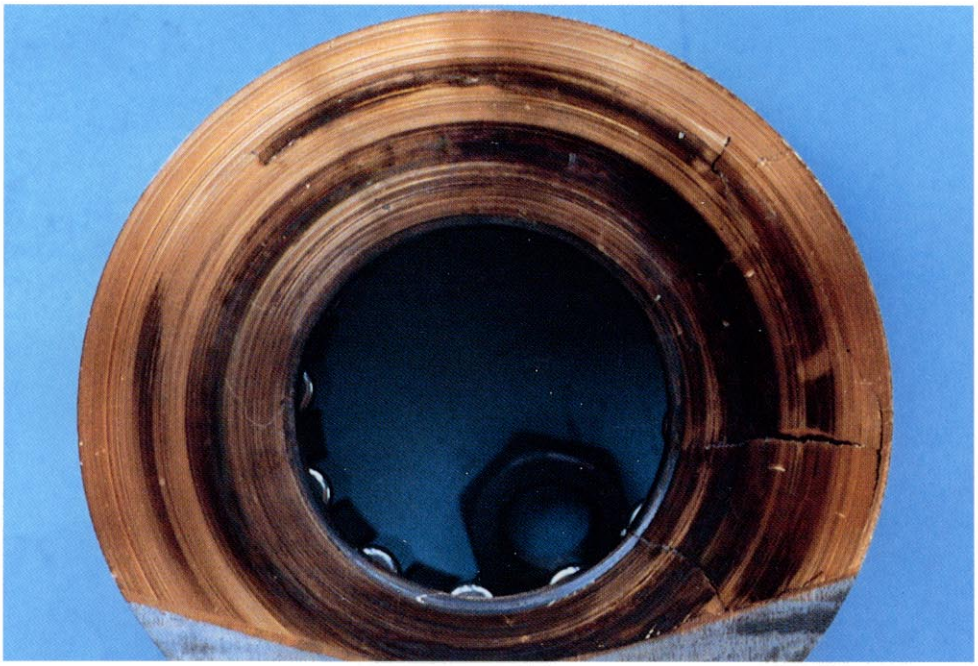
Example of PA type

USE AFTER RECONDITIONING

Failure Sign
- Wear

Cause
- Dust in hydraulic oil

39



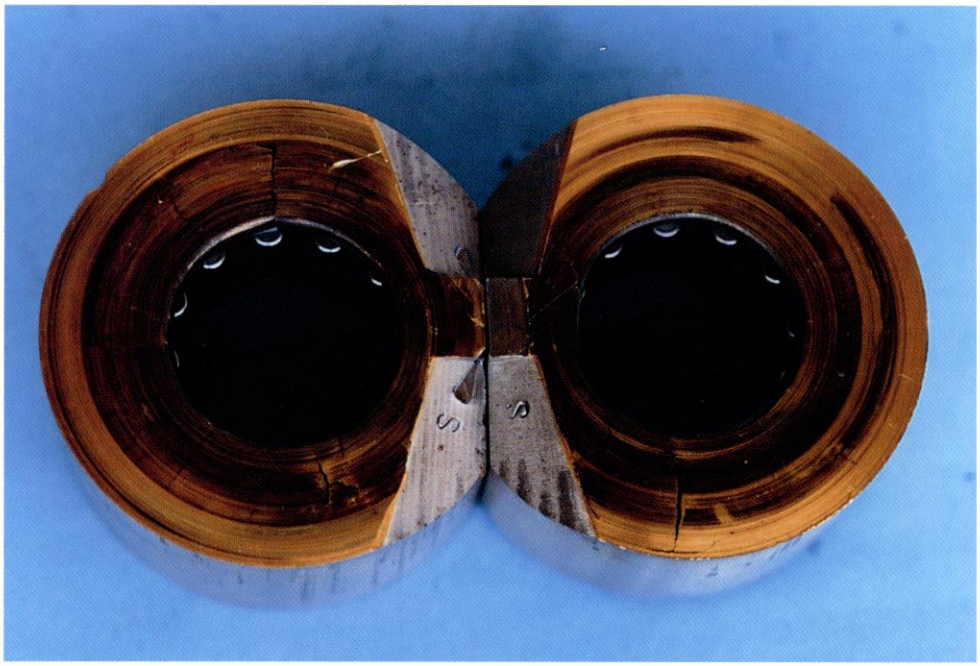
Example of PA type

DO NOT USE AGAIN

Failure Sign
- Cracks, discoloration, and deep scratches

Cause
- Partial rise of temperature caused by poor contact due to wear resulting from dust in the hydraulic oil

40



Example of PA type

DO NOT USE AGAIN

Failure Sign
- Cracks, discoloration, and deep scratches

Cause
- Partial rise of temperature caused by poor contact due to wear resulting from dust in the hydraulic oil

Side Plates

41

Example of SA type

USE AGAIN

Failure Sign
- Very slight wear

Cause
- Normal wear

42

Example of SA type

USE AGAIN

Failure Sign
- Very slight wear

Cause
- Normal wear

43

Example of SA type

DO NOT USE AGAIN

Failure Sign
- Wear (Left top) and Scratches (Right)

Cause
- Dust in hydraulic oil

44

Example of SA type

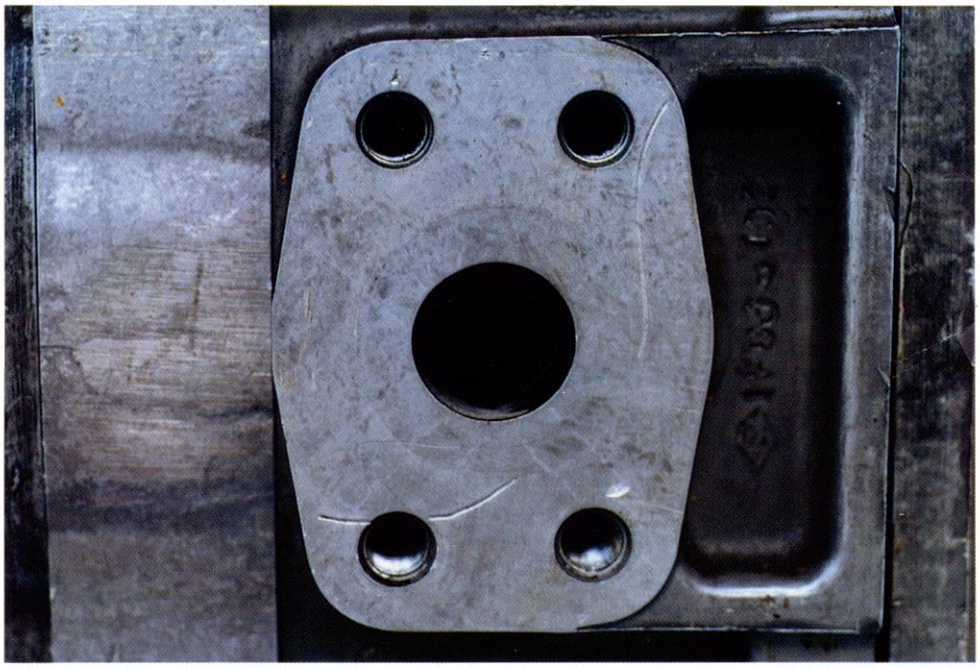
DO NOT USE AGAIN

Failure Sign
- Wear (Right top) and scratches (Center)

Cause
- Dust in hydraulic oil

Pump Case Bracket

45



Example of SA type

USE AFTER RECONDITIONING
(only if parallel grinding within 1mm is possible)

Failure Sign
- Hit marks on contact face of O-ring

Cause
- External matter

STRUCTURE AND FUNCTION

Functions

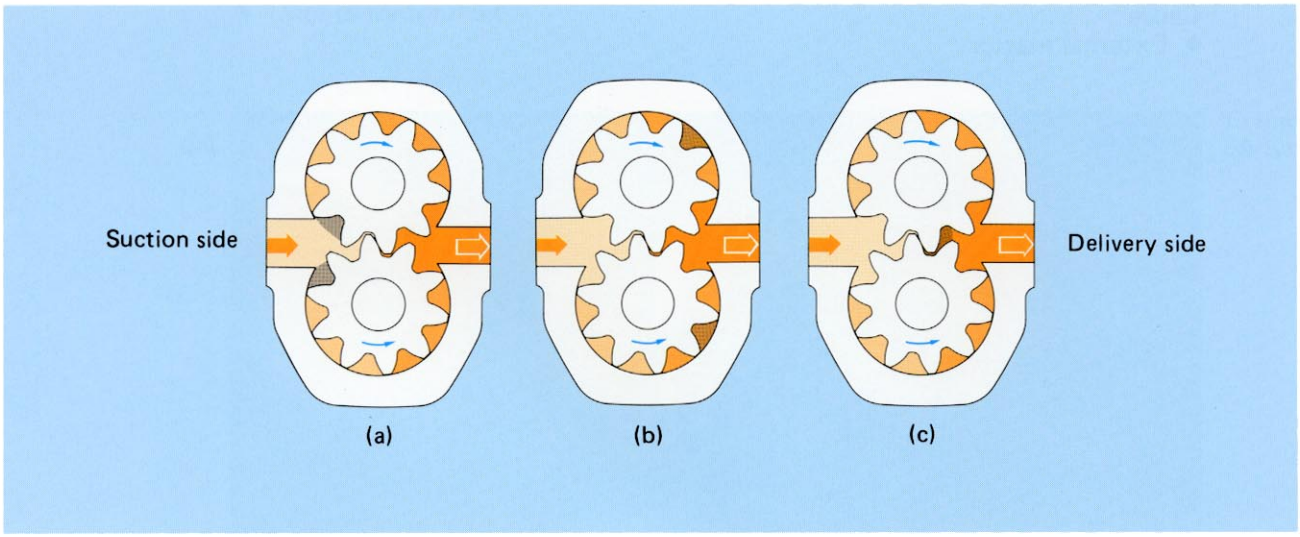
The hydraulic pump receives mechanical energy from the engine and converts it into fluid energy.

Fluid energy is classified into velocity energy, pressure energy, and potential energy, and among these pressure energy is used in hydraulic devices. The hydraulic pump transfers energy by using the static pressure of a fluid. Since the delivery of the pump is determined by the moving speed of the volume enclosed with the fixed walls, a high pressure can be easily obtained and the delivery does not change much when the load changes. Therefore, the pump generates a flow of oil, but does not generate the pressure by itself. The pressure is caused by the resistance (load) which hinders the flow of the oil, that is, if there is no resistance, no pressure is generated.

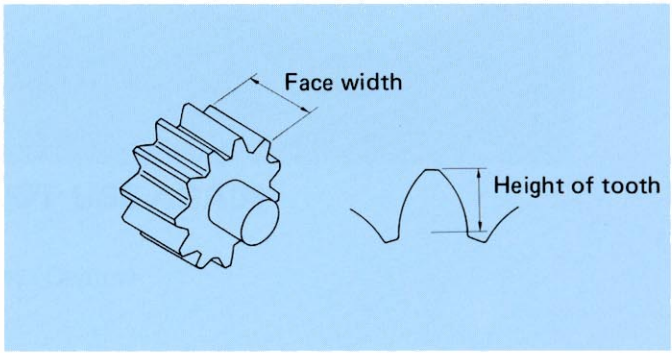
Hydraulic pumps are classified by structure into rotary pumps and reciprocating pumps, and by function into the fixed delivery type and variable delivery type. The external gear pump in the rotary pump of the fixed delivery type will be explained below.

Mechanism for sending the oil

The oil sucked through the suction opening (Fig. a) is enclosed between the outside wall and gear, moves as the gear rotates (Fig. b), then is delivered through the delivery opening (Fig. c).

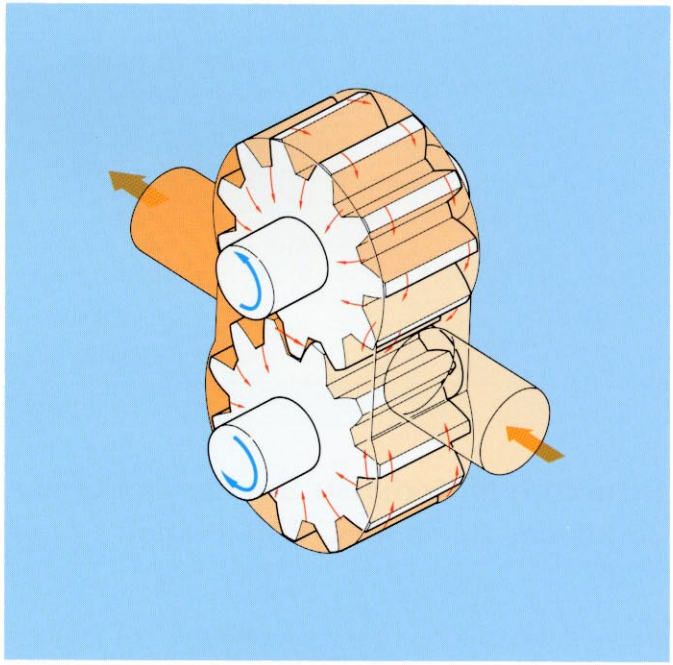


Since the two gears are in mesh, the oil on the delivery side will not move to the suction side (except for the small amount of oil enclosed between the tooth crest and the bottom land). Since the gear continuously sends oil, the oil is pushed out of the delivery opening and the delivery increases as the gear speed increases. The amount of oil delivered by every turn of the gears is approximately proportional to (height of tooth)^2 x (face width) x (number of teeth).



Internal oil leakage

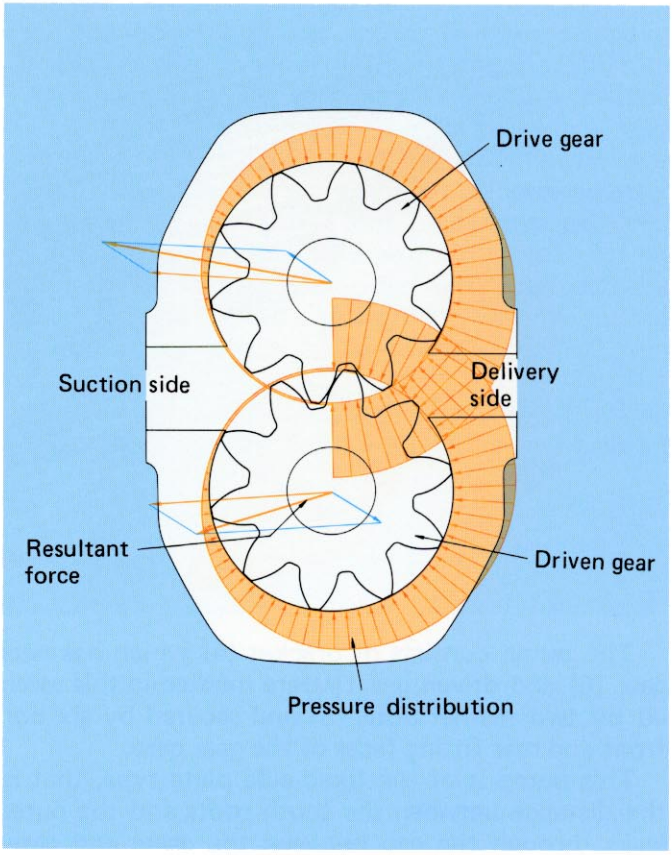
If there is a gap, oil flows from a higher pressure side to a lower pressure side. Since gaps are made between the gears and the case or between the gears and side plates to prevent seizure and scuffing, oil leaks through those gaps, and the leaking oil lubricates the parts. This state of the pump is shown in the figure at right. Thus, in the pump, the oil continuously flows from the delivery side where the pressure is higher to the suction side, and the delivery of the pump is reduced by the amount of that leakage. If the gaps are enlarged because of wear or if the viscosity of the oil decreases after its temperature is raised, or if an oil with a low viscosity is used, the oil leakage will increase further, and the rate of delivery will decline correspondingly.



Forces applied to the gears

Oil pressure is applied to the periphery of the gears toward their centers. This pressure is highest at the delivery side and gradually lowers along the periphery of the gears toward the suction side. This state of the pressure is shown in the figure at right. In addition to the above pressure, each of the meshed teeth receives pressure from the other. The gears are pressed toward the suction side by these forces, and they are supported by the bearings. As a result, the gaps between the tooth tops and the case are reduced and they contact each other in some types of pumps.

Therefore, if the delivery pressure is too high and if a large force is applied to the gears and the bearings, the life of the bearings will be shortened and the tooth tops will scuff the pump case. The delivery pressure must be controlled so that it will not increase too much.



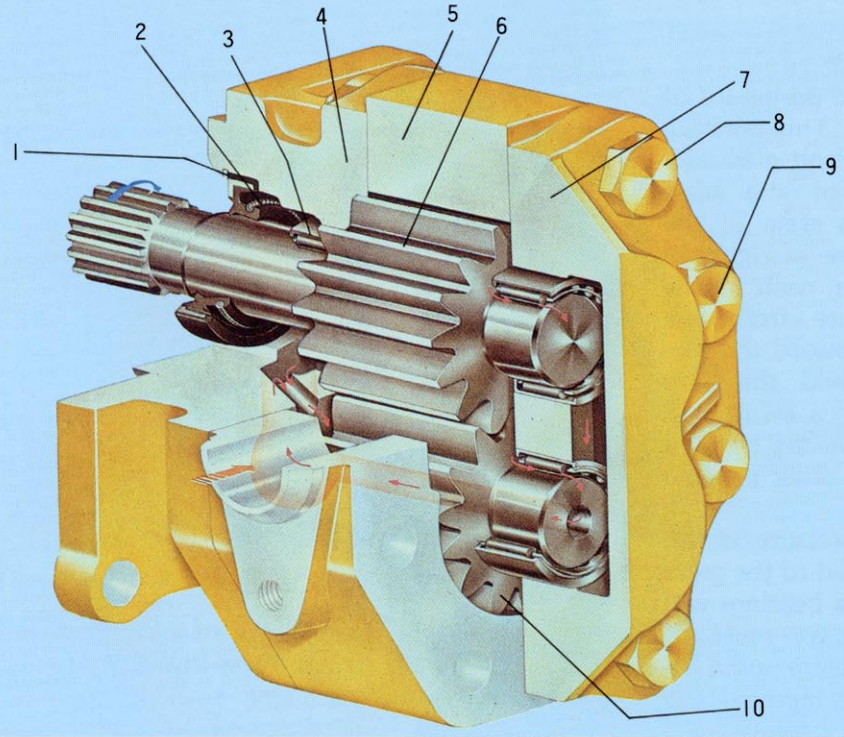
Types of Komatsu Standards Pumps

The gear pumps used for the hydraulic work equipment and steering devices are divided into five types (based on the maximum possible continuous use pressure), and the pumps of each type are further divided in terms of delivery rate.

30-kgf/cm^2 pump	Also called "FAL/FAR". Mainly used for transmission devices.
125-kgf/cm^2 pump	Also called "GAL/GAR". Fixed side plate type: has been used for work equipment. Recently, PAL/PAR pumps are often used for this purpose.
140-kgf/cm^2 pump	Also called "PAL/PAR". Balanced side plate type: used for work equipment.
175-kgf/cm^2 pump	Also called "KAL/KAR". Balanced side plate type: similar to "PAL/PAR" used for work equipment.
210-kgf/cm^2 pump	Also called "SAL/SAR". Balanced and movable side plate type: used for work equipment.

Structure of Komatsu Standards Pumps

30-kgf/cm^2 Pump (FAL/FAR Pump)

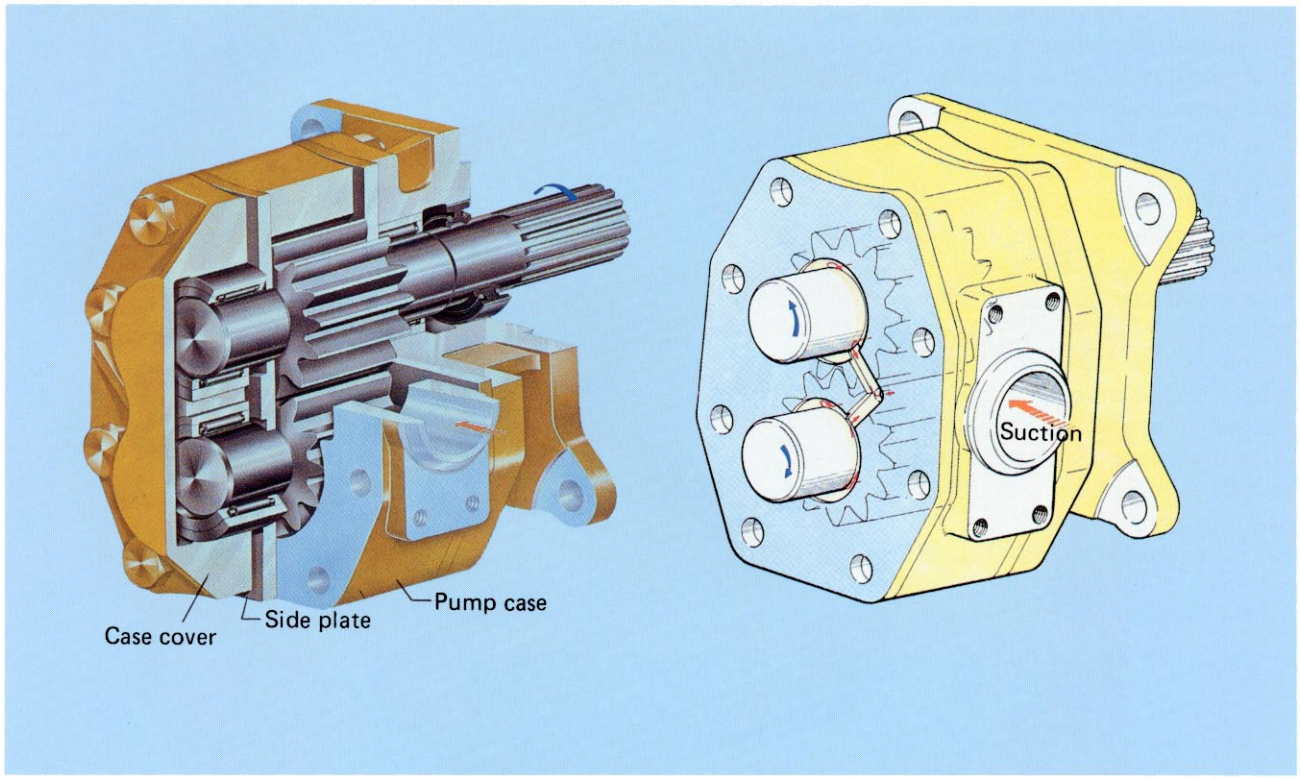


1. Snap ring
2. Oil seal
3. Needle bearing
4. Bracket
5. Gear case
6. Drive gear
7. Case
8. Reamer bolt
9. Bolt
10. Driven gear

The pump consists of bracket (4) which has needle bearings (3), case (7), and gear case (5); drive gear (6) and driven gear (10) are meshed in this assembly. The bracket, case, and gear case are positioned by two reamer bolts (8) and secured by six bolts (9). In addition, liquid gasket is applied to the front and rear fitting faces of the gear case.

This pump is of the fixed side plate type, that is the case is also used as the side plates. Therefore, the distance between the tooth roots and the outer races of the bearings is short, thus the oil easily leaks through the gap between the gears and case. The leaking oil flows through the bearings and outside to the suction side as shown by the arrows in the figure. The oil leaking toward the RH cover does not directly return to the suction side, but flows through the centers of the gears to the left side, then returns to the suction side.

125-kgf/cm² Pump (GAL/GAR Pump)



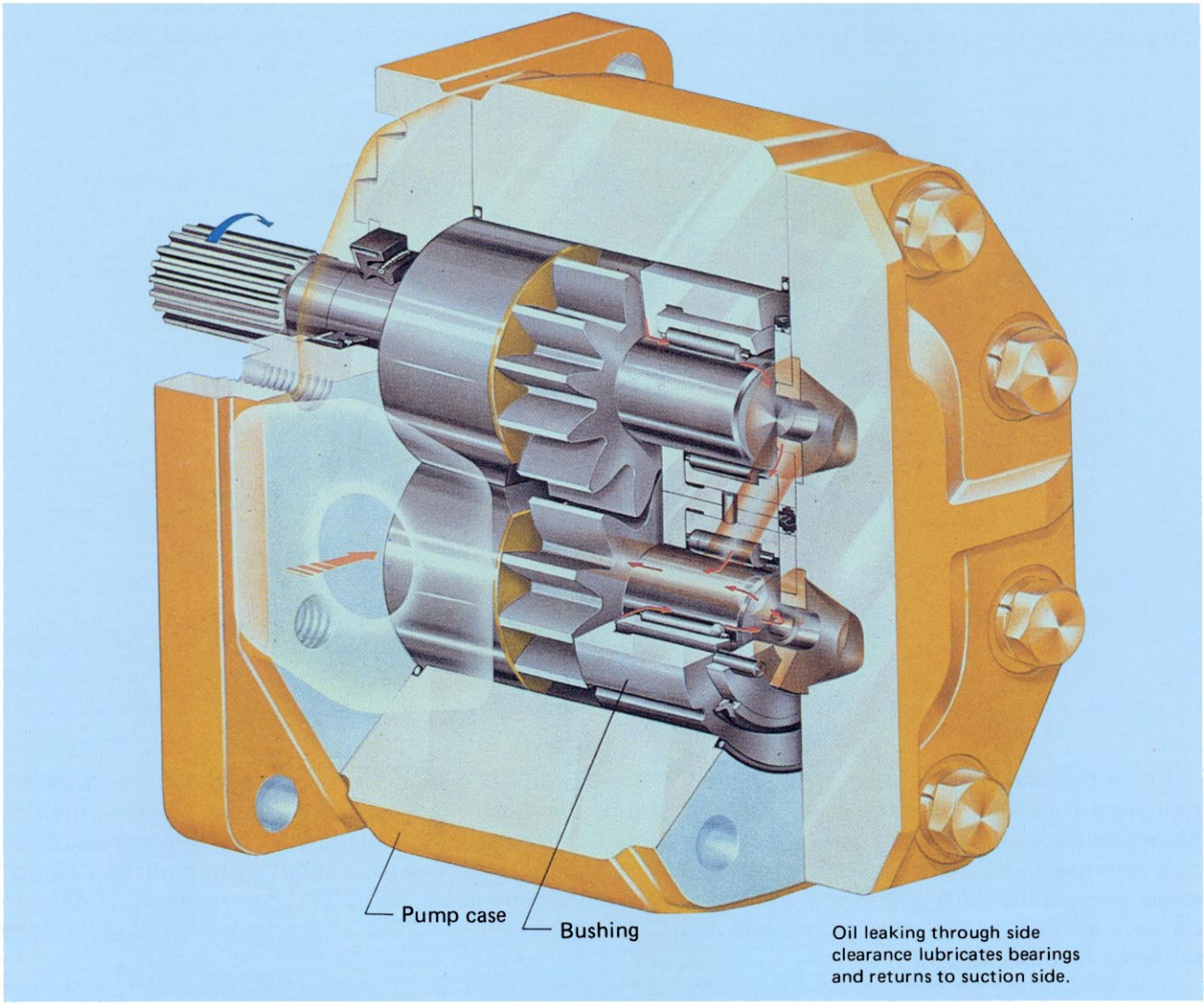
Since the side plate is used as the cover of the side of the case and since the case and the cover are tightened together, the difference in thicknesses of the case and the gears is the gap between the side plate and the gears, and this gap cannot be adjusted. Since there are variations in the thicknesses of the case and gears and there is a slight radial runout in the bearings, this gap cannot be minimized so much as to prevent the side plate and the gears from contacting each other. This gap is about 1/100 mm on each side of a small-sized pump and about 4/100 mm on each side of a large-sized pump, and the oil flows through this gap.

The lead bronze is sintered on the surface of the side plate which contacts the gears to prevent wear and scuffing, but the oil leakage increases if the gap between the side plate and gears is increased after long use. Since the case is made of cast iron, it may get scuffed if the tooth tops are pressed against it.

Therefore, the gap between the tooth tops and case on the suction side is set larger than that on the delivery side so that the tooth tops and the case do not contact each other when the gears are pressed by the oil pressure toward the suction side. For example, this gap on the delivery side of an assembled small-sized pump is about 3/100 mm and that of a large-sized pump is about 5/100 mm, but those on the other side are about three times as large.

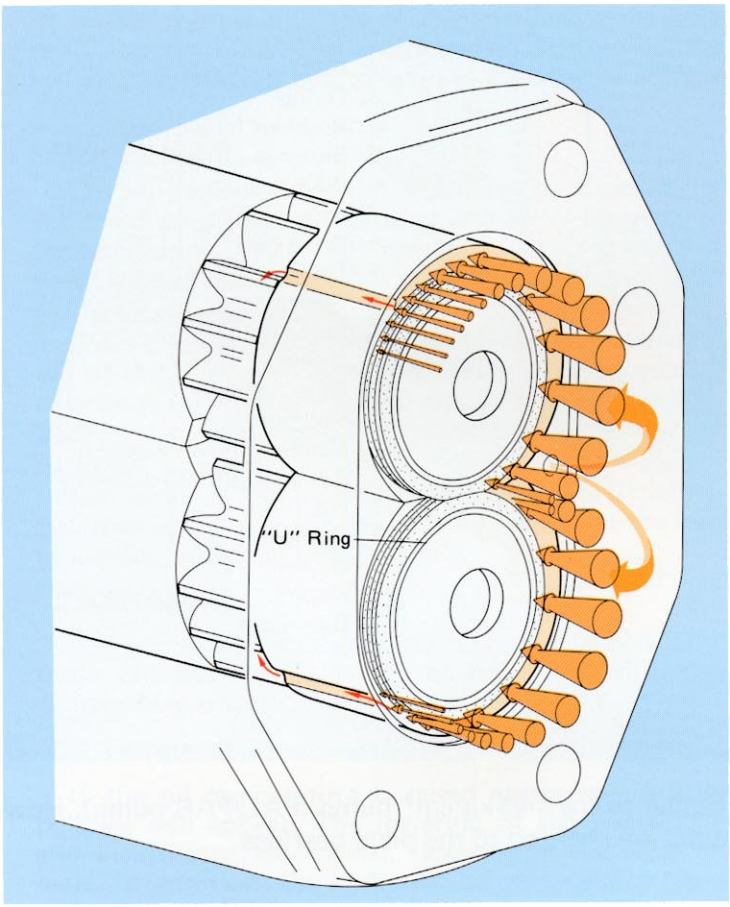
The oil leaking through the gap between the gears and side plate flows along the shafts to the back side of the side plate, then through the grooves on the side plate to the suction side. This oil lubricates the bearing on the back side of the side plate.

140-kgf/cm² Pump (PAL/PAR Pump)

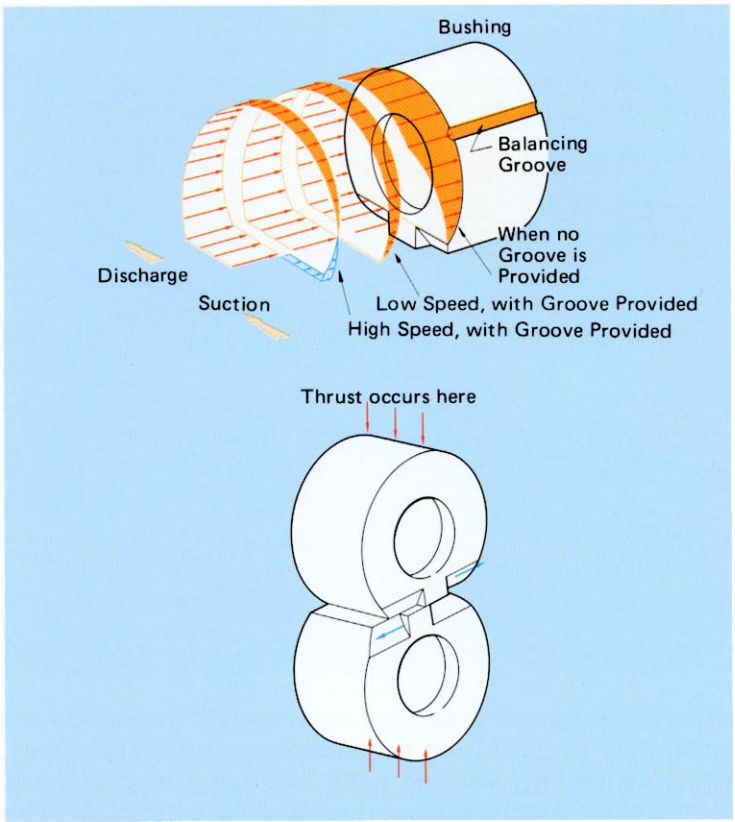


The bushings which are used as the side plate are fitted to the case and can be moved in the axial direction of the gears. Since the back side of the bushings are connected to the delivery side through the small hole, the bushings are pressed by the delivery pressure against the side faces of the gears. Therefore, there is very little oil leakage along the side faces of the gears. In addition, since the bushings are constantly pressed by the oil pressure against the gears, the gap between them is not increased even if the bushings are worn after long use, thus the oil leakage does not increase.

Since the case is made of an aluminum alloy, it will not be scuffed so much by the tooth tops, and the bearings and the case can easily be aligned because of their structure. Thus the gap between the case and the tooth tops is minimized. Being different from the 125-kgf/cm² pump, the gap between the gears and the case is even all round. This gap on each side of a small-sized pump is about 3/100 mm and that on a large-sized pump is about 8/100 mm. For this reason, if the delivery pressure is raised and the gears are pressed toward the suction side, the tooth tops will lightly contact the case. There are closed relief grooves on the delivery side and suction side. When the gap is increased, the oil is sucked from the suction side through the groove on the suction side to prevent a vacuum.



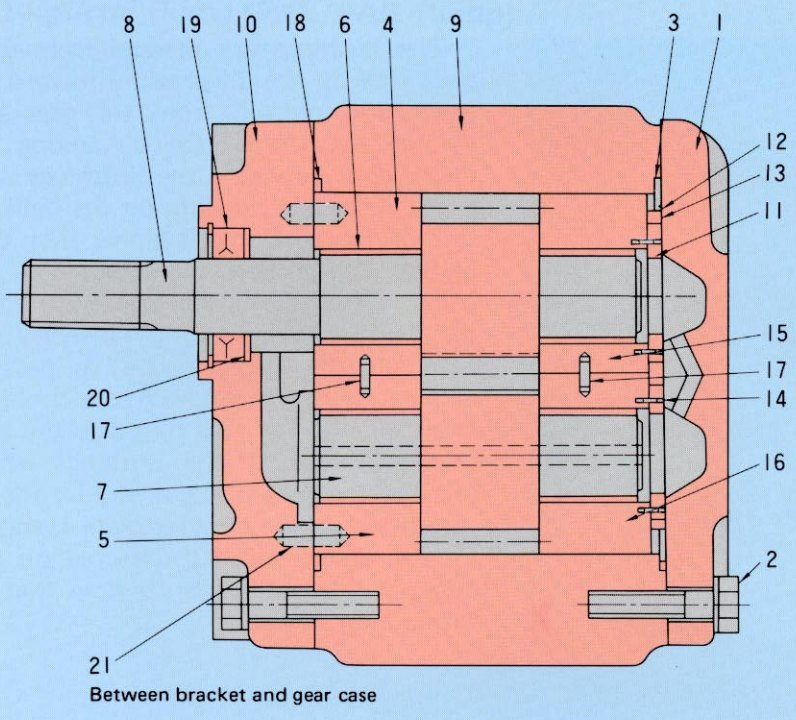
The bushings are pressed from their back side by the oil pressure toward the gears, and pressed from the gear side by the pressure of the oil among the teeth and between the bushings and gears. Since the pressure on the delivery side of the gear side is higher than that on the suction side, the pressure on the back side of the bushings is adjusted so that it will be higher on the delivery side than on the suction side to prevent uneven wear and to keep the bushings from falling. For this purpose, the area on back side of the bushings which receives the pressure is divied by the U-ring fitted to the circular plate as shown in the figure so that the area on the delivery side will be larger than that on the suction side.



If the pump rotates at a high speed, the pressure on the suction side will lower and the pressure distribution on the periphery of the gears will change as shown in the figure. Thus, as the speed changes, the pressure distribution will change and the pressing force on the gear side will also change. If the pressing forces on the gear side and back side are not balanced, the bushings may wear one-sidedly or fall down. In this pump, the delivery pressure is transferred through the pressure balancing groove as shown in the figure so that the pressure distribution will not change largely.

The pin on the fitting faces of the bushings is set as shown in the figure so that the bushings will fit properly into the case.

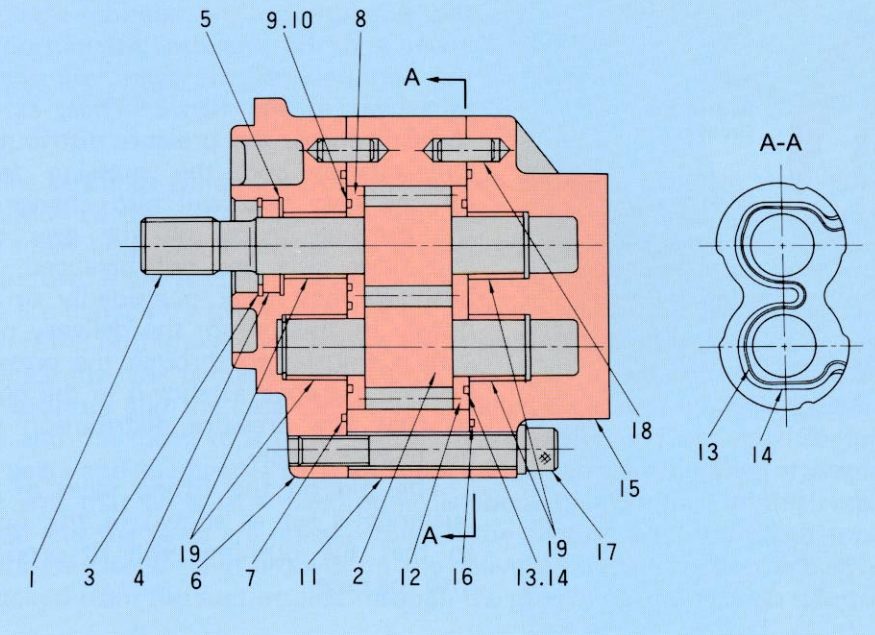
175-kgf/cm² Pump (KAL/KAR Pump)



1. Cover
2. Bolt
3. O-ring
4. Bushings (drive) assembly
5. Bushings (driven) assembly
6. Plain bearing
7. Driven gear
8. Drive gear
9. Case
10. Bracket
11. Seal plate
12. U-ring
13. Backup ring
14. Roll pin
15. Bushings (drive) assembly
16. Bushings (driven) assembly
17. Pin
18. O-ring
19. Oil seal
20. Plate
21. Dowel pin

This pump has a balanced side plate type similar to the 140-kg/cm² pump (PAL/PAR pump). However, the needle bearings in the 140-kg/cm² pump are changed to the plain bearings.

210-kgf/cm² Pump (SAL/SAR Pump)



1. Drive gear
2. Driven gear
3. Snap ring
4. Oil seal
5. Plate
6. Bracket
7. O-ring
8. Side plate
9. Backup ring
10. Seal ring
11. Case
12. Side plate
13. Backup ring
14. Seal ring
15. Cover
16. O-ring
17. Bolt
18. Pin
19. Plain bearing

This pump has been developed based on a series of pumps which has been widely praised by the users. This pump features compactness, fewer number of parts, and a higher pressure of 210-kg/cm². The bracket and covers are made of die casting aluminum, and the plain bearings are press-fitted. The movable side plate is made of a special copper alloy, and its surface is treated for a better fit. This pump is a pump of hydrobalanced type which has very little torque loss and high resistance to wear. Since the flanges and splines of this pump are based on SAE, it has a higher degree of interchangeability with the pumps of other companies.

FAILURES AND THEIR CAUSES

It is said that about 70% of the troubles in the hydraulic devices are caused by the hydraulic oil chosen and the quality of maintenance work. Therefore, carefully select and handle the hydraulic oil to prevent troubles and to operate the machine efficiently.

1. Hydraulic Oil

The hydraulic oil is what transfers the pressure. It also works as the lubricating oil and coolant for the sliding parts. Since dust and water may mix with the hydraulic oil as it is used, the particle contamination level, water content, viscosity, and total acid (alkali) number should be monitored. Particles and water are especially frequent causes of damage to the devices.

1) Particle Contamination Level

Solid particles (contaminants) such as metal wear power and gritty dirt cause the wear and scuffing of the sliding surfaces and hasten the oxidation of the oil. Generally, the contamination level is expressed by NAS grade, and the control standard is Class 10 or better. Oil which is in Class 12 or above must be replaced. The oil in Class 11-12 may be reused several times by cleaning it.

2) Water Content

The water in the hydraulic oil causes insufficient lubrication, and that causes the wear, seizure, and rust of the parts. The control standard of the water content is 0.2%. If more water is contained in the oil, replace or clean the oil.

2. Cavitation

If air is mixed in the oil, bubbles will appear and the pressure will increase in the areas where those bubbles burst, leading to noise and vibration. The periphery of the delivery opening is damaged by erosion.

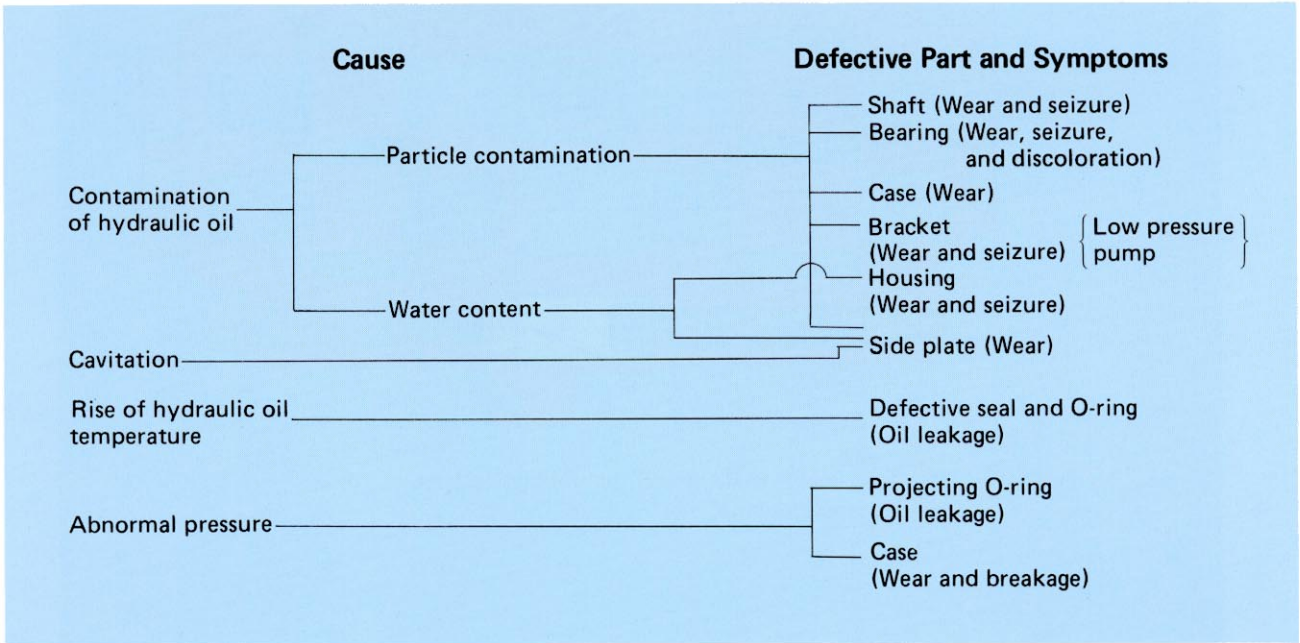
3. Oil Temperature

If the oil temperature is raised above specification, the viscosity of the oil will decrease and bubbles will appear. The lowering of the viscosity of the oil causes a reduction in the delivery and insufficient lubrication, resulting in the wear and seizure of the parts and damage to the oil seals. In addition, the hydraulic oil will oxidize rapidly. The bubbles will reduce the delivery rate and cause cavitation.

4. Abnormal Pressure

If an abnormal pressure is generated because of a malfunction of the main relief valve or if the machine is operated with the hydraulic pressure above specification, the O-rings will project and the inside of the case which the tooth tops contact will suffer abnormal wear.

5. Flow Chart of Causes of Troubles and thir Symptoms



PREVENTIVE MAINTENANCE

To prevent machine breakdowns before they have a chance to happen and to keep the machine operating at 100% of its capacity, it is necessary to be constantly aware of the state of the machine. Such problems as insufficient oil pressure, fluctuating oil pressure, abnormal noise, large vibration, and high oil temperature often occur in the hydraulic pump, and many troubles of the pump are caused by dust getting into the hydraulic oil. In other words, most troubles can be prevented if the maintenance work described in the Operation and Maintenance Manual is carried out diligently. In addition, you should strictly observe the following two rules:

1. Always use Komatsu genuine oil filters and specified hydraulic oil and replace them at the specified intervals.
2. Always add oil up to the specified level.

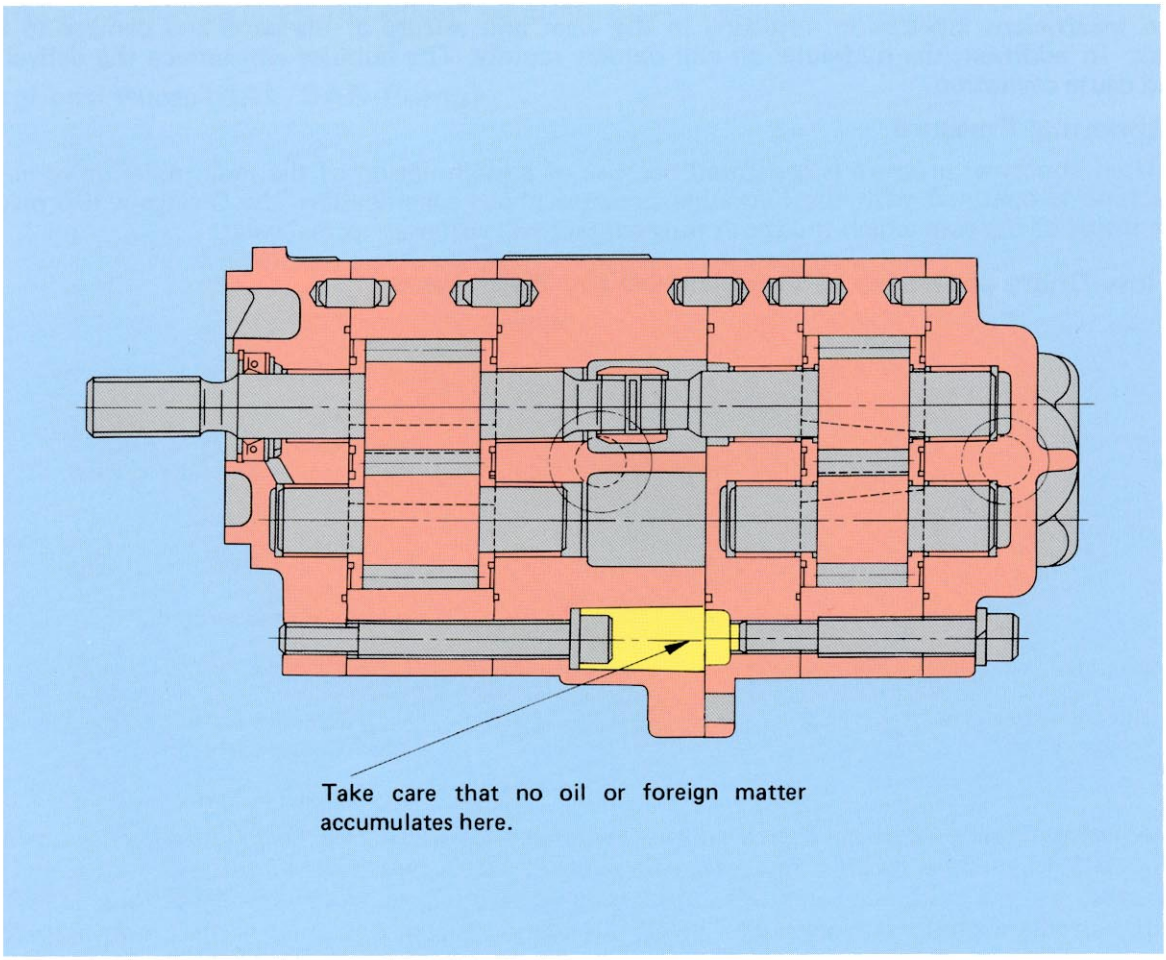
Prevention of Reccurence

If the hydraulic pump breaks down, find out the cause of the trouble and take a complete countermeasure. Wash the hydraulic devices and piping to prevent the same trouble from occurring again.

Precautions for Assembling a Pump

When assembling a hydraulic pump (2-spool or 3-spool), take care that no oil or foreign matter accumulates in the connecting sections.

★ If oil accumulates in those sections, the oil will ooze out when the oil temperature rises, and that may be mistaken for oil leakage.



FORM NO. SEBG4130

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