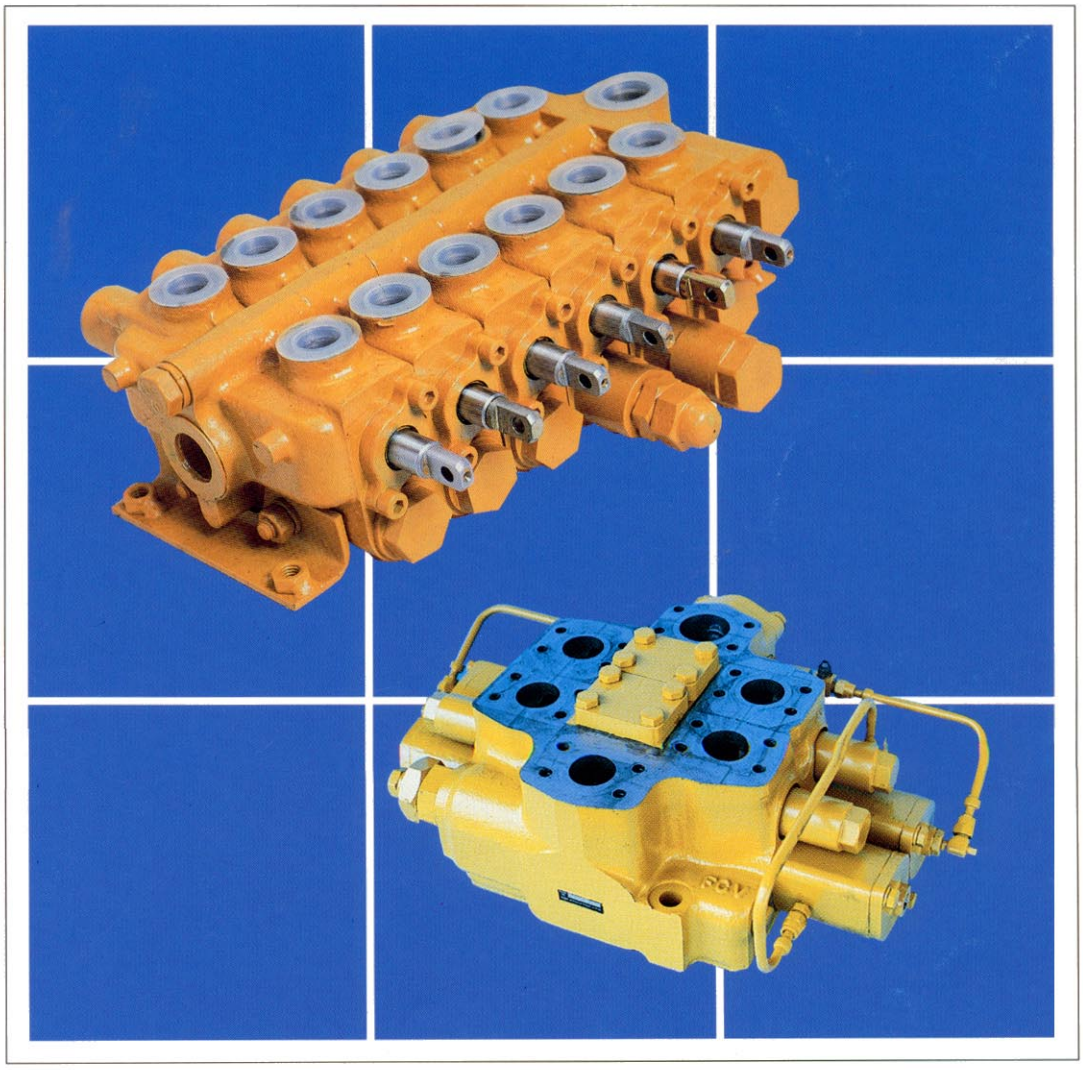
FORM NO. SEBG4200

SHOP MANUAL

GUIDANCE FOR REUSABLE PARTS

HYDRAULIC CONTROL VALVES



GUIDANCE FOR REUSABLE PARTS

KOMATSU

INDEX

GUIDANCE FOR REUSABLE PARTS
INDEX

INTRODUCTION

This Guidance for Reusable Parts ptovides basic knowledge and explanation of the causes of damage needed when disassembling, assembling or repairing hydraulic control valves.

It includes photgraphs of various types of damage so that judgement can be made visually as to whether a part can be used again or not.

Hydraulic control valves are widely used for the control of the transmission, steering, and work equipment. However, this Guidance for Reusable Parts has been prepared mainly with examples of the control valve for the work equipment on bulldozers, hydraulic excavators, and wheel loaders. It is difficult to make 100% judgement by visual checks or by feeling when confirming the quality of control valves, because they are parts demanding high precision. Bench tests may have to be carried out to check the operation or to test the amount of leakage. Therefore, to use the most effective method, it is desirable to make judgements according to know-how built up from experience over a long period of time with troubleshooting and disassembly work.

This Guidance is desirable to be utilized well by those who are engaged in troubleshooting and servicing on construction machines. Consequently, the servicing cost reduction can be obtained through proper reuse or replacement of parts, and proper preventive actions of failures can be taken after correct determination of failure causes.

The repair and rebuilding of hydraulic control valves should be carried out at a "centralized maintenance shop", or "authorized shop" of equivalent level possessing the necessary techniques and equipment for repair, in particular for hydraulic equipment authorized by Komatsu.

OUTLINE OF HYDRAULIC CONTROL VALVE

Outline of Function and Formal Classification

Control valves have the role of controlling the movement of hydraulic cylinders.

In order to control the movement of hydraulic cylinders, they control the pressure, direction, and amount of the oil sent from the hydraulic pump.

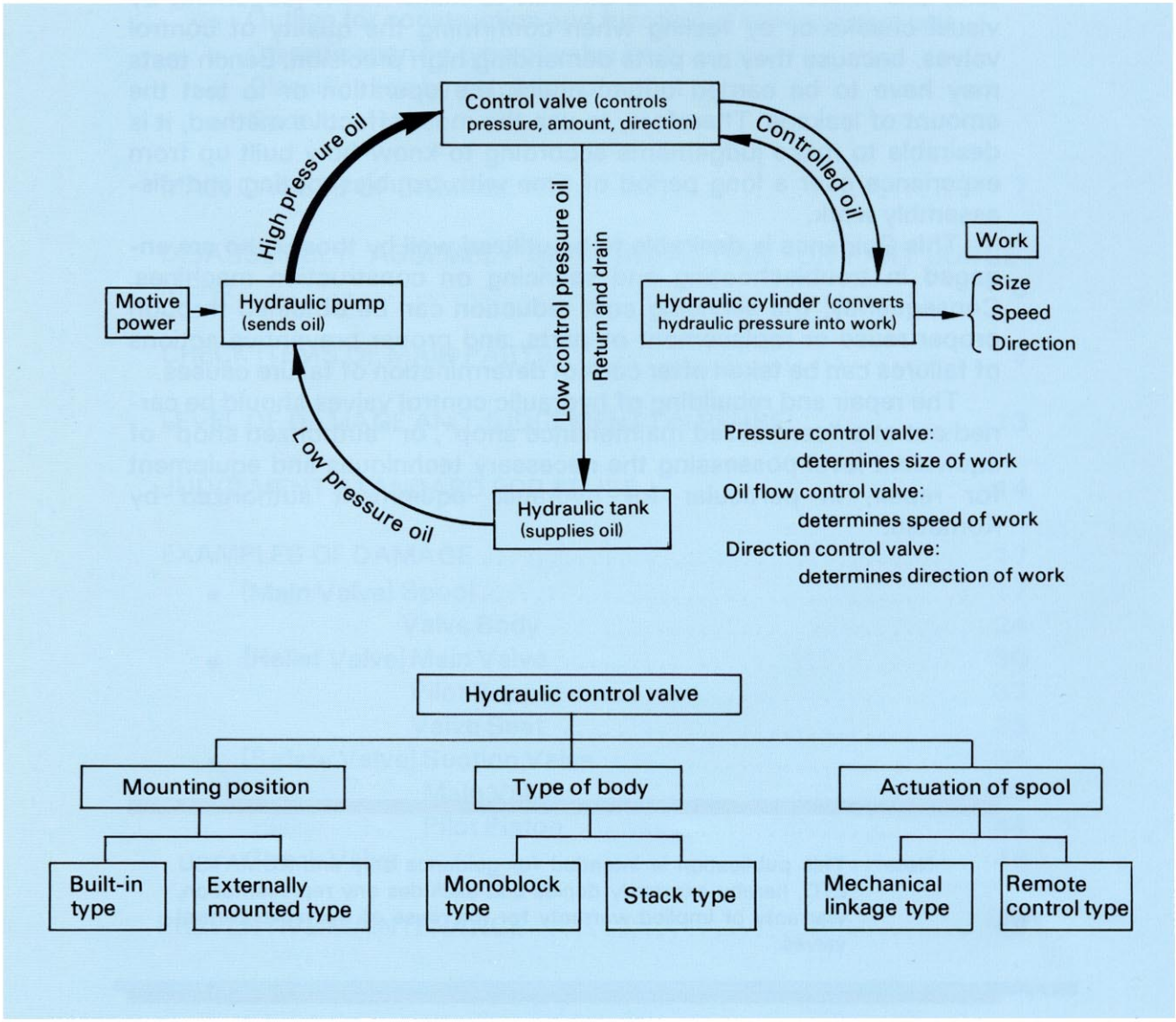
To do this, the control valve consists of five types of valves: the main valve (direction selector valve), main relief valve, safety valve, check valve, and suction valve.

There are two methods for installing the control valve. One type is built into the hydraulic tank, and the other is installed externally. Medium and large-size machines have built-in control valves, while small machines have externally mounted control valves.

In addition, the built-in valves are what is called a monoblock type, and generally have one or two spools in the main valve. If there are three or more spools, they are made into sets of 2-spool type valves and 1-spool type valves.

Externally mounted valves are what is called a stack type.

With this type, several main valve spools can be assembled inside one body.



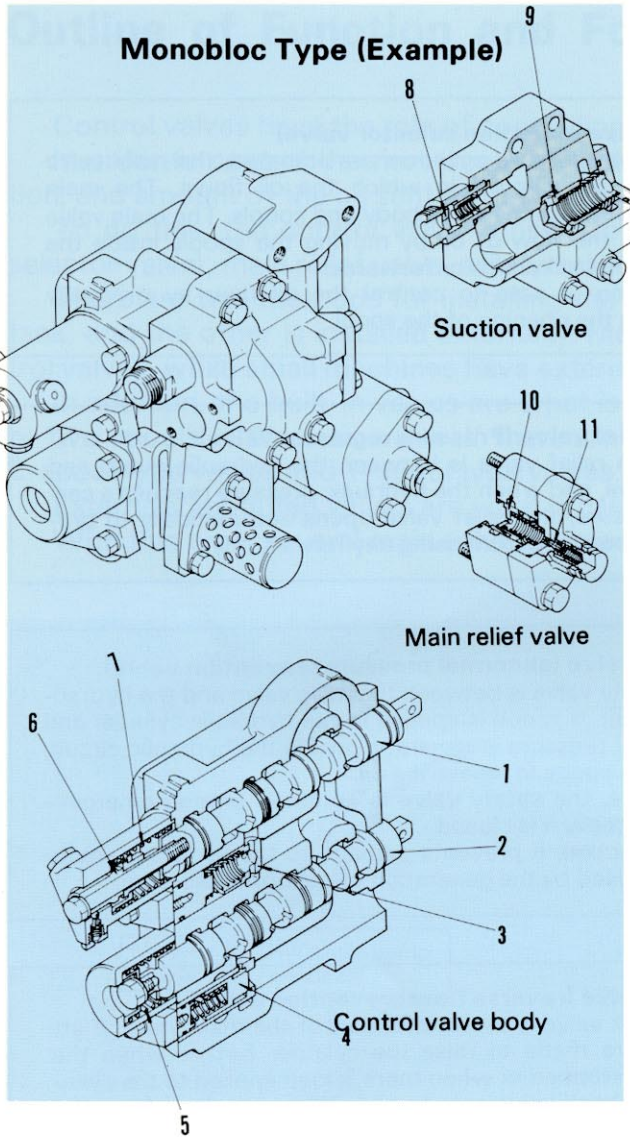
Outline for Construction and Function of Control Valve Unit

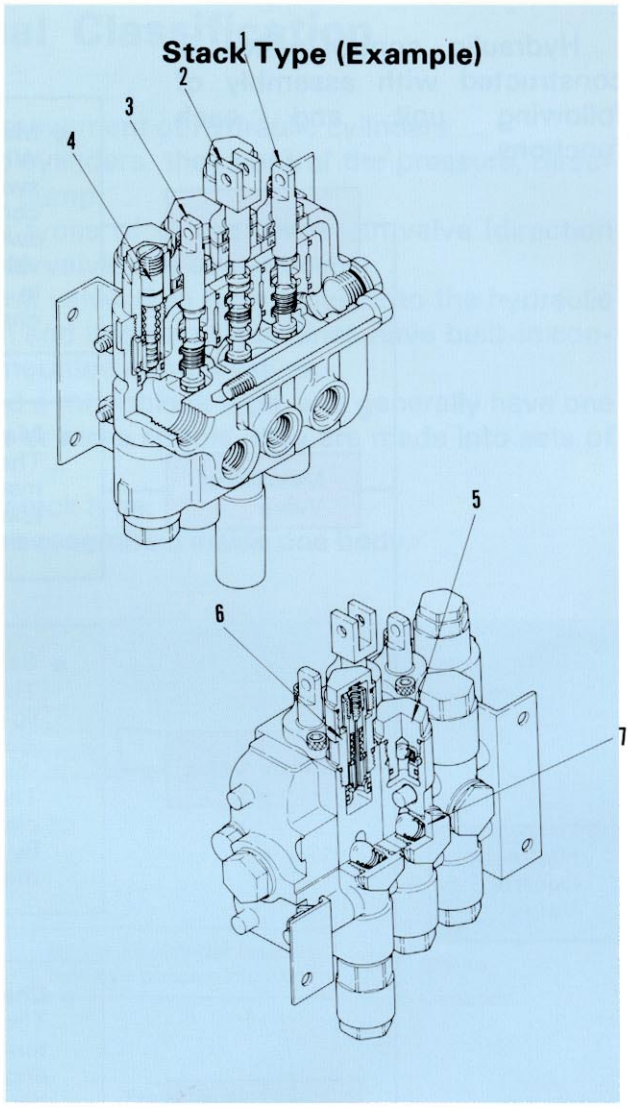
Hydraulic control valve is constructed with assembly of following unit and each functions.

Hydraulic Control Valve

- Main Valve
  - **Main valve (direction selector valve)**
    When the hydraulic cylinders are actuated, the main valve switches the circuits in which the oil flows. The main components are the valve body and spools. The main valve switches the flow of oil by moving the spools inside the valve body backwards or forwards.
    In addition, it acts to control the oil flow by gradually changing the opening of the spool.
- Main Relief Valve
  - **Main relief valve (Pressure regulator valve)**
    The main relief valve is between the hydraulic pump and main valve, and when the hydraulic pressure reaches a certain pressure, the relief valve opens automatically to prevent the pressure from rising any further.
- Safety Valve
  - **Safety valve (abnormal pressure prevention valve)**
    The safety valve is between the main valve and the hydraulic cylinder. If shock is applied to the hydraulic cylinder and abnormal pressure is generated inside the hydraulic circuit, the valve opens to relieve the oil.
    Therefore, the safety valve is actuated only in emergencies; normally it is closed.
    By this action, it prevents damage to the hydraulic equipment caused by the generation of abnormal pressure.
- Load Check Valve
  - **Check valve (reverse flow prevention valve)**
    The check valve is at the inlet port of the main valve. If attempts are made to raise the cylinder further when the engine is stopped or when there is load applied to the cylinder, the check valve acts to allow the oil to flow from the pump to the cylinder, but prevents it from flowing from the cylinder back to the pump or to the tank.
    In other words, it allows the oil to flow freely in one direction, and acts to prevent it from flowing in the opposite direction.
- Suction Valve
  - **Suction valve (vacuum prevention valve)**
    The suction valve is between the main valve and the hydraulic cylinder. It acts to allow oil to flow from the tank cylinder and to prevent the oil from flowing from the cylinder to the tank. With dozer shovels, when the bucket is lowered, oil is sent to the head end of the hydraulic cylinder, but if the lowering speed of the bucket is fast, the flow of oil from the pump is insufficient, and this creates a vacuum inside the cylinder.
    When this happens, the suction valve opens and sucks in oil from the tank to compensate for the lack of oil, thereby preventing any vacuum from forming. One the other hand, when the pressure inside the circuit rises, the valve closes and prevents the oil form flowing to the tank.

Classification by Type of Body





With the monoblock type, the valve is a one-piece casting, so the valve had high rigidity and there is little problem of oil leakage. However, castings are complicated, and their weak point is that they cannot deal with a large variety of circuits. In addition, even if only one part of the valve is damaged, the whole valve body must be replaced. With the monoblock type, to reduce the complexity of the casting, the passages in the casting are made simple, and to cover this, passages are provided inside the spool. However, it is impossible to make large passages inside the spool, so there is increased pressure loss and deformation of the spool under high pressure, causing problems such as sticking.

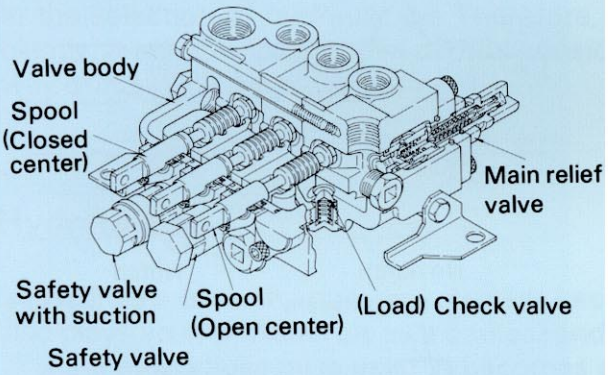
With the stack type, each section is bolted on to form the control valve. In this way, it is possible to select freely the number of spools and functions of the valve. However, the sections are bolted together, so there is the risk of deformation of the valve body, even though the deformation may be small. Therefore, the sections must be assembled together with a fixed tightening touque. If the tightening touque is too large, there will be slight deformation, which may cause the spool to stick. On the other hand, if the tightening torque is too small, there is the problem of leakage of oil from the places where the sections join when the circuit is under high pressure.

[Safety Valve]

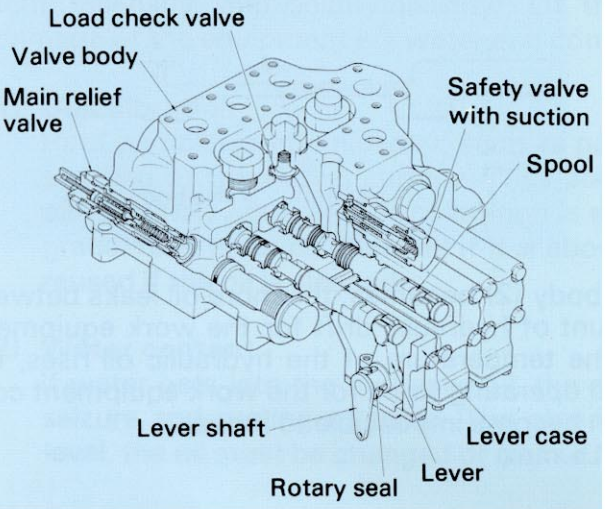
Classification by Actuation of Spool

Mechanical Linkage Type (Example)

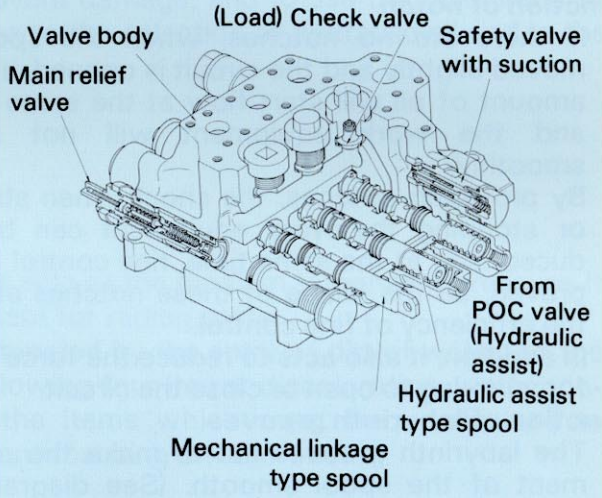
Mechanical linkage type 1



Mechanical linkage type 2



Remote Control Type (Example)



Most control valves used in construction equipment are manually-operated control valves. This means that the operator moves the valve spool directly, so there is no delay in movement, and the operator can control the machine as he wishes.

On the other hand, with the valves controlling large oil flows used on large machines, the operating force is large, so the operator becomes fatigued.

In addition, the vibration coming from the machine and the vibration caused by the flow of oil is also transmitted through the valve to the operator, so the feeling for the operator is not good.

Hydraulic, electrical, or air power is used to operate the control valve spool, and this reduces the operating force for the control levers in the operator's compartment.

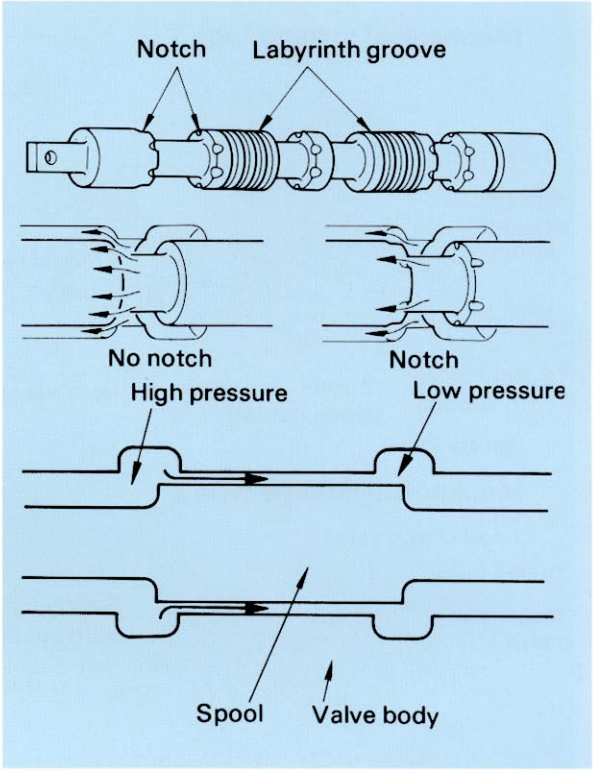
In large machines, where a large capacity is demanded, the control valves must also be large. As a result, movement of the spool demands a large force. With the mechanical linkage type, the operating force for the control levers in the oprerator's compartment becomes large, so the remote control type is used insted.

About Spool

The control valve switches the circuits for the oil flow when the hydraulic equipment is operated. Generally speaking, these valves are called "control valves", but they may also be called "selector valves" or "derectional control valves". When the spool is not operated, springs are used to keep the spool in the neutral position.

Spool

The spool has notches and grooves as shown in the diagram on the right.



Function of notch

- If there are no notches, when the spool is moved slightly and the circuit is opened, a large amount of oil will start flow at the same time, and the work equipment will not move smoothly.
- By providing notches, the shock when starting or stopping the work equipment can be reduced, and at the same time, fine control is improved, so the shape of these notches affects the efficiency of fine control.
- In addition, it also acts to reduce the force (flow force) trying to open or close the circuit.

Function of labyrinth grooves

- The labyrinth grooves act to make the movement of the spool smooth. (See diagram on right) However, the following problems will cause the movement of the spool to become heavy.
  1) When there is dirt caught in the spool
  2) When the valve is deformed

Clearance between spool and body

- The larger the clearance between spool (1) and body (2) becomes, the more oil leaks between the valve body and spool, causing a large amount of hydraulic drift for the work equipment. However, if the clearance is too small, when the temperature of the hydraulic oil rises, the clearance disappears completely. As a result, the operating force for the work equipment control lever becomes larger, and the spool may even become impossible to move.
  Generally speaking, this clearance is 0.005 - 0.015 mm.

MEMO

Hydraulic lock and dirt lock

Hydraulic lock

As the pressuer used for hydraulic pressure is increased, the spools of the main valve start to stick. As a result, the spool cannot be operated by hand, or the operating force becomes extremely large. This is called hydraulic lock.

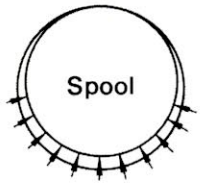
The following are probable caused of hydraulic lock. The high pressure oil is shut off from the other ports by the contact surface between the valve body and spool, but it enters the slight clearance at this contact surface.

When this happens, if the clearance at the contact surface becomes uneven, or dirt gets stuck, the pressure around circumference of the spool will become different.

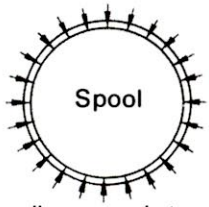
The spool will then be pushed to the side where the pressure is lowest (as shown in the figure on the right), and as a result, the spool will stick to the valve body.

To prevent this hydraulic lock, labyrinth grooves are cut into the spool so that the oil in the clearances at the contact surface passes through the groove and applies the same pressure around the circumference of the spool, thereby preventing the spool from sticking.

In addition to the problems caused by hydraulic lock, sticking of the spool may be caused by dirt getting caught in the spool (this is called dirt lock), deformation of the valve body, or by excessive rise in the oil temperature.



If there are no grooves, a difference in the pressure around the spool circumference is created, and the spool is pushed in the direction where the pressure is lowest. This causes the control levers to become heavy.



The oil pressure is transmitted along the grooves, so the pressure around the spool circumference is the same. The spool does not contact the valve body, so it moves smoothly.

MAIN CAUSES OF DAMAGE

About 70% of damage to hydraulic equipment is caused by problems in maintenance and in the selection of hydraulic oil. Therefore, to prevent damage, and to use the machine efficiently, it is important to give careful consideration to the selection of hydraulic oil and to the way of handling the machine.

Hydraulic oil

Hydraulic oil is an important element because it acts as the medium to transmit pressure. It also plays an important role as a coolant and lubricant for sliding parts.

As the hydraulic oil is used, it becomes contaminated by the entry of dirt of water, so the condition of the oil is generally checked by the following four items: discoloration, water content, viscosity, and acidity(alklinity). Of these, the items which most frequently lead to damage of the equipment are water and contaminants causing discoloration.

1) Discoloration

Hard particles(contaminants), such as particles of worn metal, sand or dirt, cause wear or scuffing of the sliding surface. They also advance the change to acidity of the hydraulic oil. Generally speaking, discoloration is expressed by NAS grade. The oil should be within grade 10;it must be changed if it is above grade 12. Grade 11 and grade 12 can often be reused if the oil is cleaned.

2) Water content

If water gets into the hydraulic oil, the oil does not lubricate properly. This leads to wear, seizure and rusting of parts. The standard for water content is within 0.2%;above this level, the oil must be changed or cleaned.

3) Cavitation

If air gets into the oil, it creates bubbles. When these bubbles burst, there is sudden high pressure at that point, which causes noise or vibration. In particular, around the delivery port of the pump, this causes damage by erosion.

4) Rise in oil temperature

If the oil is allowed to rise above the specified temperature, the viscosity will be reduced and the delivery amount will drop because of internal leakage. In addition, the oil film wil be lost, thereby causing wear and seizure, and it will also advance the change to acidity of the hydraulic oil.

DISASSEMBLY, ASSEMBLY AND PRECAUTION FOR PART JUDGEMENT

Disassembly, Assembly and Precaution for Part Judgement

Each part hydraulic control valve is constructed with parts worked high precisely as the same as hydraulic pump.

Entry of dirt, dents, burrs, scratches, catching of the O-ring , and abnormal tightening torque during disassembly and assembly operations can cause oil leakage, scuffing and seizure during operation. This lowers the output and has other adverse effects on performance.

★ See the Shop Manual for details of tightening torques and methods of adjustment during assembly operations.

Therefore, it is important to exercise extreme care not to damage performance and quality of control valve when making judgements about the reuse of parts.

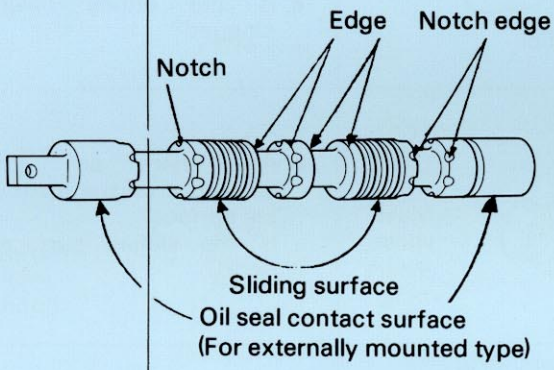
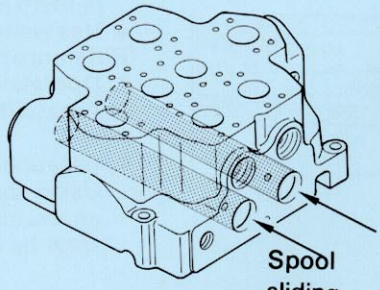
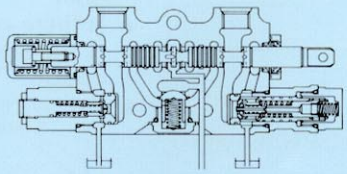
When making judgements about the reuse of parts, it is important to consider daily maintenance and operating conditions to find out exactly why that kind of damage was caused. In this Guidance Manual, there are photographs of damage ranked A, B or C. These photographs should be used together with the know-how derived from experience to make judgements about reuse of the part.

Check points when judging parts

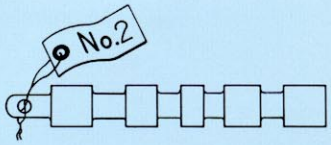
To make accurate judgement on damaged parts, it is necessary to wash and clean the parts first and then to pay careful attention to the following check points.

If there is any malfunction or drop in the perfomance of a control valve, check the discoloration of the hydraulic oil and use the results as reference when looking for the cause of the problem.

CHECK ITEMS OF MAIN PARTS

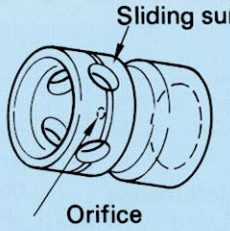
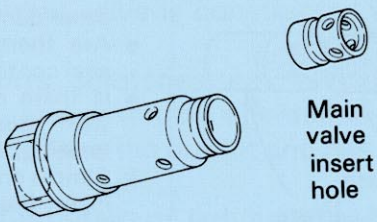
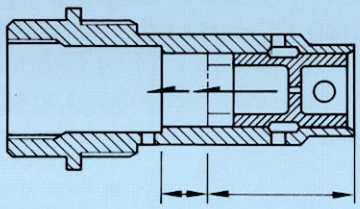
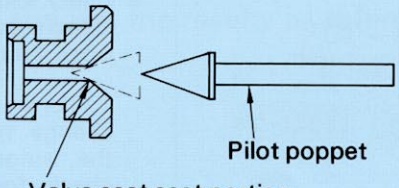
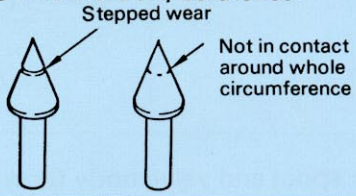
No.	Part Name	Check Portion	Check Point
1	Spool		● Are there any grazes, scratches, dents, or other damage on the sliding surface? Is the sliding contact good? ● Are there any burrs, dents, or other damage at the spool edge? ● Are there any dents on the oil seal contact surface? ● Is there any place on the spool with discoloration caused by heat? Is there any bending? ★ Simple check for bending Insert the spool in the valve body and check the ease of sliding to measure the precision.
2	Valve body		● Are there any grazes, scratches or other damage to the spool sliding surface(inside wall of hole)? External view of body, etc. ● Is there any damage to the chassis mount? ● Are there any missing parts or damage at the piping mount, plug mounts, and auxiliary valve mounts.? ● Are there any dents or damage at the O-ring mount surface?
3	Spool valve body Assembly		● Check sliding of spool Is there any catching? Does it move smoothly? Turn the spool 180° to change the position and check the smoothness of sliding to check for any bending of the spool.

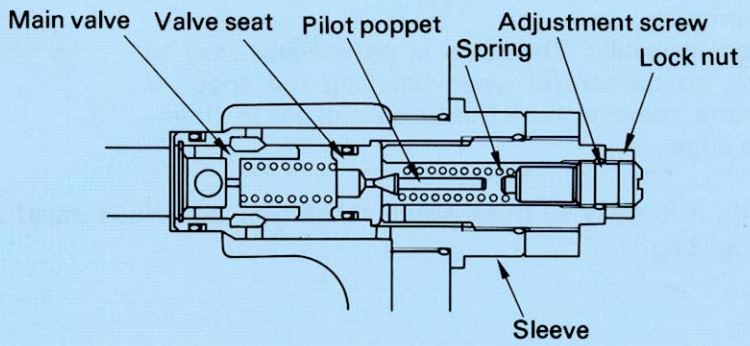
★ The spool and valve body form a set, so they cannot be replaced individually.
If the spool is removed from the body, fit tags to indicate the relationship between the spool and valve body to prevent mistakes when assembling.
Handle the spool carefully. The edge is particularly easy to dent or scratch, so be careful when handling the spool. If there are any burrs, remove these but be careful not to chamfer or round the edge.



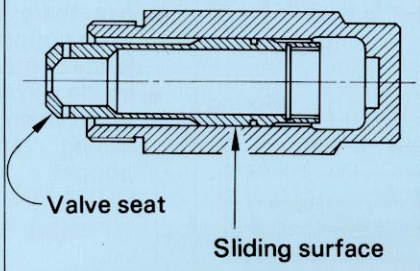
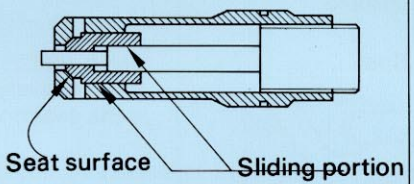
When checking, it is easy to miss small scratches, so check carefully. Use a magnifying glass or bright light.

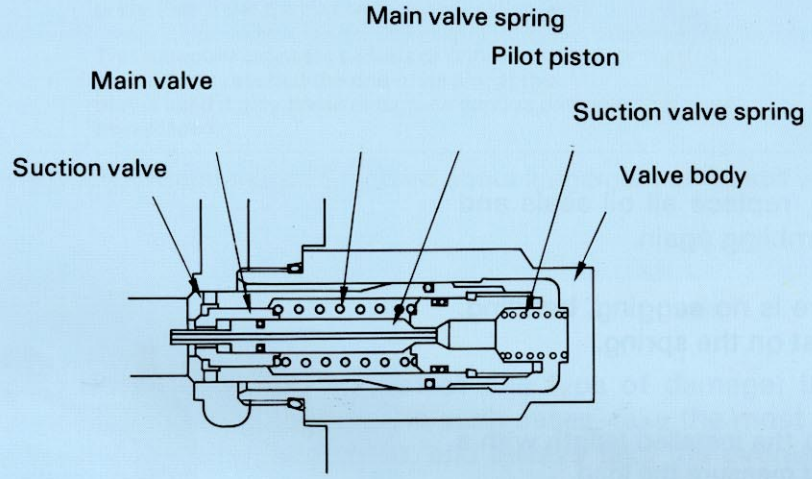
Main relief Valve

No.	Part Name	Check Portion	Check Point
1	Main valve		● Check for grazes, scratches or dents on the sliding surface Is the contact of the sliding surface good? Is there any heat discoloration? ● Is the orifice balance hole clogged?
2	Sleeve		● Are there any grazes or scratches on the main valve sliding surface? Is the sliding surface contact good?
3	Main valve sleeve Assembly		● Check the sliding smoothness of the main valve. Does it move smoothly? Is there any catching? ● Has wear progressed? [Reference] A: Operating range of main valve B: Area with no wear on valve seat mount portion Application of feeling Using the inside diameter at B as an example, judge the amount of wear by the play.
4	Pilot poppet and valve seat		● Contact between poppet and valve seat Has wear progressed on both parts? Poppet: ● Is there any stepped wear? ● Is the contact of the seat surface good? ● Are there any scratches? 

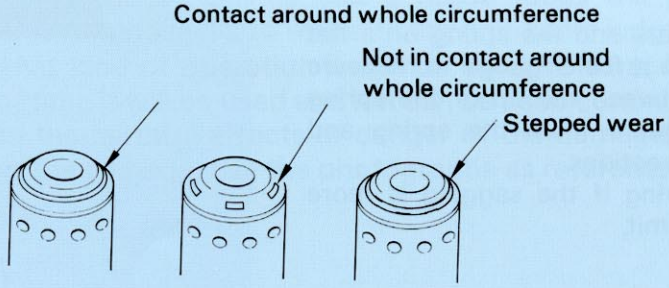


Safety valve (with suction)

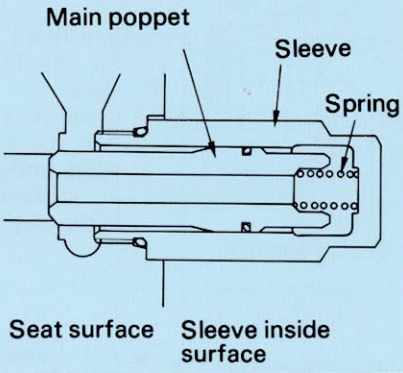
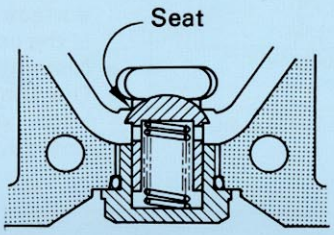
No.	Part Name	Check Portion	Check Point
1	Suction valve & valve body		● Are there any scratches or dents on the suction valve seat surface? Is the seat contact good? ● Are there any scratches on the valve body and suction valve sliding surface? Is the sliding smooth?
2	Suction valve Main valve Pilot piston		● Are there any scratches on the suction valve and main valve seat surface? Is the contact good? ● Main valve sliding portion Do the suction valve side and pilot piston side both slide smoothly?



Contact of valve seat surface



Suction Valve Check Valve

No.	Part Name	Check Portion	Check Point
1	Main poppet sleeve		• Are there any scratches on the main poppet seat surface? Is the contact good? • Inside surface of sleeve Insert main poppet and check the sliding smoothness of the poppet.
2	Check valve		Valve seat Are there any scratches or dents? Is the seat contact good?

Other

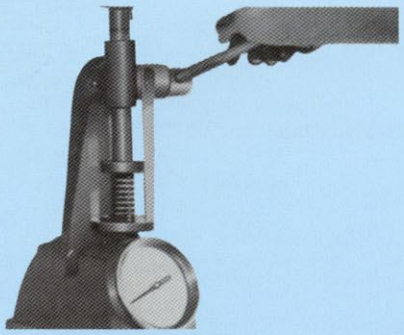
Wear parts

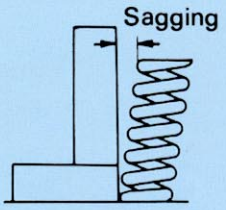
As a basic rule, replace all oil seals and O-rings when assembling again.

Spring

Check that there is no sagging, bending, deterioration, or rust on the spring.

- **Installed load**
  Set the spring to the installed length with a spring tester, and measure the load.
  Replace the spring if the installed load is below the repair limit.
  See the Shop Manual for the details of the installed length and installed load.
- **Sagging**
  Place a set square and the spring on a flat surface, and use a feeler gauge to measure the distance between the tip of the spring and the set square. Turn the spring and measure in all directions.
  Replace the spring if the sagging is more than the repair limit.





LEVEL OF DAMAGE AND JUDGEMENT ON REUSE

The level of damage for hydraulic control valves is categorized into three stages: A,B,C. judgement about reuse of parts is made according to these categories.

Category	Level of damage	Remedy
A	This category indicates slight or minor damage which creates no problem for the performance of the machine. There is no risk of this damage causing secondary damage.	Can be used as it is
B	This category indicates medium damage which at present is no problem to the performance of the machine, but there is a risk of secondary damage, so replacement is preferable if the part is used for heavy duty work.	Repair and reuse
C	This category indicates serious or critical damage, or that the part has reached the end of its life. If this part is used it may break and cause serious damage, so it must be replaced.	Can not be reused

★ Refer to Shop Manual Maintenance Standard about judgement of normal wear.

Damage to parts does not simply consist of one type of damage; it often consists of several types of damage occurring together. In such cases, take the most dangerous form of damage as a guide when making judgement, and always take the overall safety of the machine into consideration.

If the level of damage is ranked between category A and category B as shown in the photographs, the damage should be ranked at the more dangerous category, that is, category B.

This judgement frequently depends on the user's needs (does the part still have the demanded residual life?), so it is impossible to make an unconditional judgement. However, it is necessary to consider what kind of operation it will be used in, what level of capacity it must display, what length of time it will be used and if it can be used continuously.

Therefore, judgement on the harmful effects or danger of the damage must be based on experience, so when ranking the damage, use the photographs as reference.

JUDGEMENT STANDARD FOR REUSE

Main Valve

Part Name	Check Portion	Judgement		
		A	B	C
Spool	Outside diameter sliding surface Others	• No scratches or dents on the sliding surface • Slight scrapes, but cannot be felt by the tip of the fingernail • No burrs or dents on the machined edges • Good contact • No heat discoloration • Slides smoothly when inserted into valve body (no bending) • No scratches on oil seal contact surface	• Slight scratches on sliding surface (fingernail catches slightly) Or fine cloudy scratches can be seen ★ Slight uneven contact or partial contact • Slides smoothly when inserted into valve body	• Deep scratches forming stripes, or dents or scratches can be seen. • Marked surface roughness • Limited contact or marked uneven contact • Does not slide smoothly when inserted into valve body • Others Heat discoloration or bending Deep scratches in oil seal contact surface
Valve body	Inside diameter sliding surface Others	• No grazes or scratches on sliding surface • Spool slides smoothly when inserted • Others No cracks, marked heat discoloration, damage to outside	• Fine scrapes caused by sliding ★ Slight uneven contact or partial contact • Slight smoothly when spool is inserted	• Deep scratches forming stripes, or scuffing, or marked scratches can be seen. • Marked surface roughness • Marked uneven contact or limited contact • Others Marked scratches or damage, and heat discoloration

1) Judge the wear by the results of leakage tests on the actual machine or in bench tests.
2) To correct the scratches on the spool for category B damage, use a fine oil stone (a smooth bar type oil stone without any roughness should be used) to remove the burrs at the damage parts. Finish carefully and be sure not to polish below the base surface.

For cloudy fine scratches, use sandpaper # 600 – 800, and correct as shown in Fig. 2.

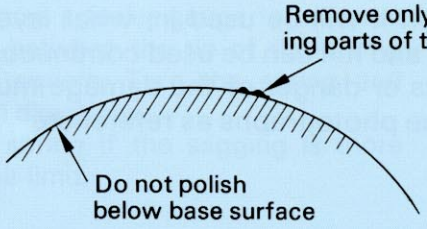


Fig. 1

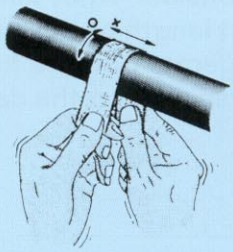
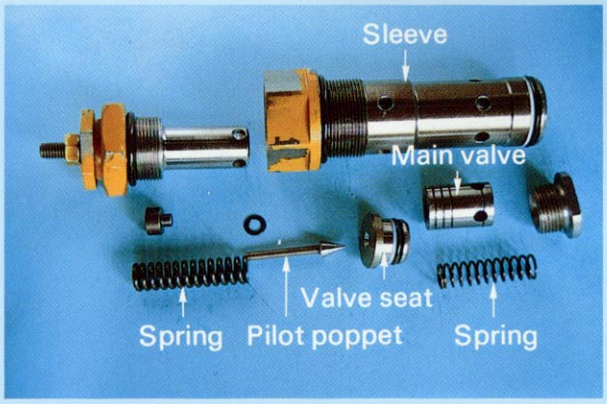


Fig. 2

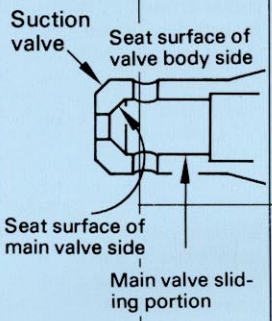
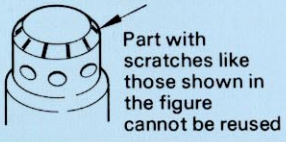
Main Relief Valve

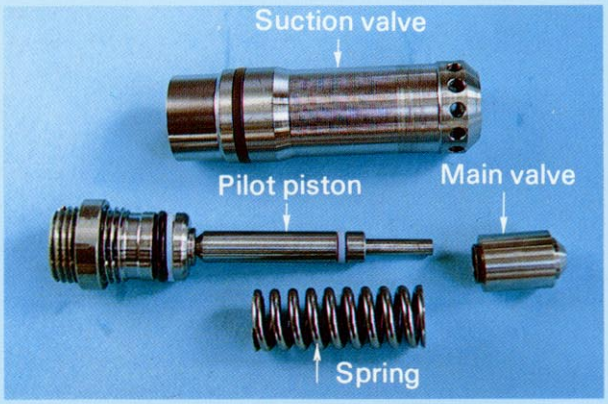
Part Name	Check Portion	Judgement		
		A	B	C
Main valve	Outside diameter (Sliding surface)	• No grazes, scratches or dents • Uniform contact • No heat discoloration • Moves smoothly when inserted in sleeve • No wear	• Cloudy scratches, shallow scratches that can be felt with the tip of the fingernail, but only light • Light uneven contact or partial contact • Moves smoothly when inserted in sleeve (No applicable judgement for wear)	• Marked grazes, scratches or dents • Strong partial or uneven contact • Catches or does not move smoothly when inserted in sleeve • Wear can be seen
Sleeve	Inside diameter (Sliding surface)	• No grazes or scratches • Good sliding surface contact • Valve moves smoothly • No wear can be seen	• Light grazes • Light uneven contact • Valve moves smothly (No applicable judgement for wear)	• Marked grazes, scratches or dents • Strong partial or uneven contact • Valve catches or does not move smoothly • Wear can be seen
1) For cloudy scratches or light grazes of the main valve in category B, correct in the same way as for damage to the spool. 2) When correcting slight defective correct of the main valve and sleeve in category B, correct in the same way as for the spool and valve body.				
Pilot poppet & valve seat	Seat portion	• No scratches on seat surface • Good contact (Uniform line showing contact mark around whole circumference) • No wear can be seen	Not applicable	• Scratches on seat surface • Poor contact • Wear can be seen



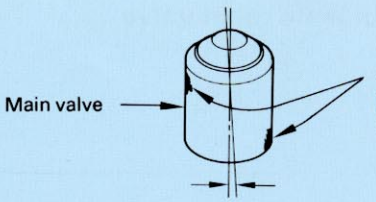
Parts of main relief valve

Safety valve (with suction)

Part Name	Check Portion	Judgement A	Judgement B	Judgement C
Suction valve / Seat surface of valve body side / Seat surface of main valve side / Main valve sliding portion 	Valve seat surface	• No scratches or dents on valve seat surface • Good contact	Light scratches on seat surface or light uneven contact or partial contact; possible to correct by lapping together with mating part	• Deep scratches or dents in seat surface; impossible to correct by lapping 
		• No scratches • Main valve moves smoothly	• Grazes, but possible to correct by lapping together with main valve • Main valve moves smoothly	• Marked scratches • Catching; main valve does not move smoothly
Main valve	Valve seat surface	• No scratches or dents • Good contact	Not applicable	• Scratches and dents • Poor contact
	Outside diameter sliding surface	• No scratches • Moves smoothly when inserted in suction valve	• Light grazes, or cloudy scratches; possible to correct by polishing lightly with sandpaper #600 – 800 • Slides smothly when inserted in suction valve	• Many scratches • Does not slide smoothly • Catching • Angled contact
Valve body	Inside diameter (Sliding surface of suction valve)	• No scratches	• Light grazes; possible to correct by polishing with sandpaper #400	• Deep grazes or scuffing
Pilot piston	Main valve sliding portion	• No grazes or scuffing • Good contact	• Fine grazes; possible to correct by polishing lightly with sandpaper #600	• Marked grazes or scuffing • Angled contact
★ If the pilot piston is evaluated as category C, evaluate its matching main valve also as C.				



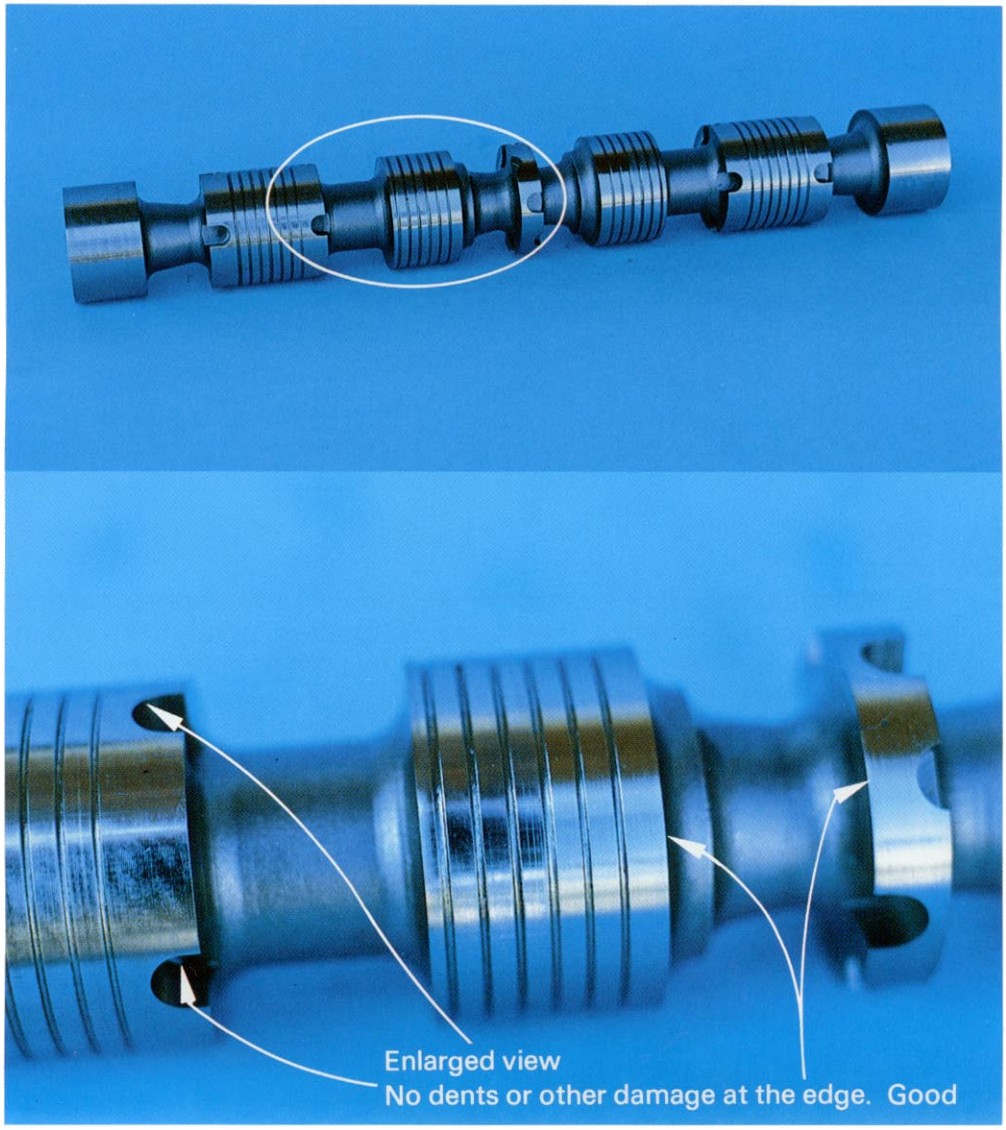
Parts of safety valve (with suction)



EXAMPLES OF DAMAGE

[Main Valve]

Spool: Sliding Surface



Category: A

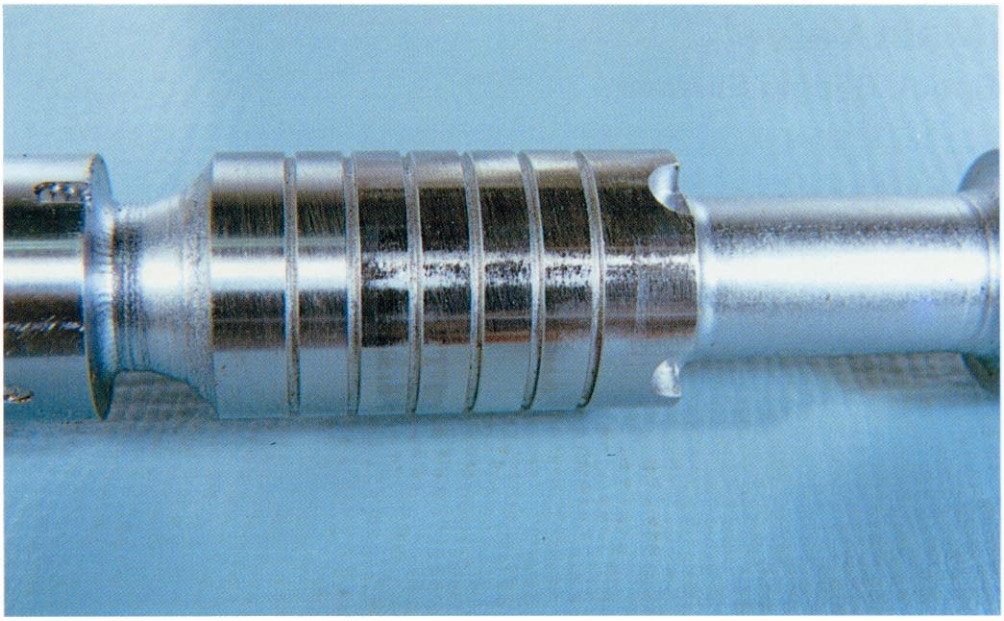
Condition

- There is a good contact over almost all of the sliding surface, and there are no scratches. There are no dents or other damage at the edge, and the condition is good.

Cause

- Normal

Spool: Sliding Surface



Category: A
Condition
- The sliding surface has a mirror finish showing even contact around the whole circumference. There are no grazes, scratches, and no traces of lock. There are also no traces of contamination by oil. It is in good working condition.

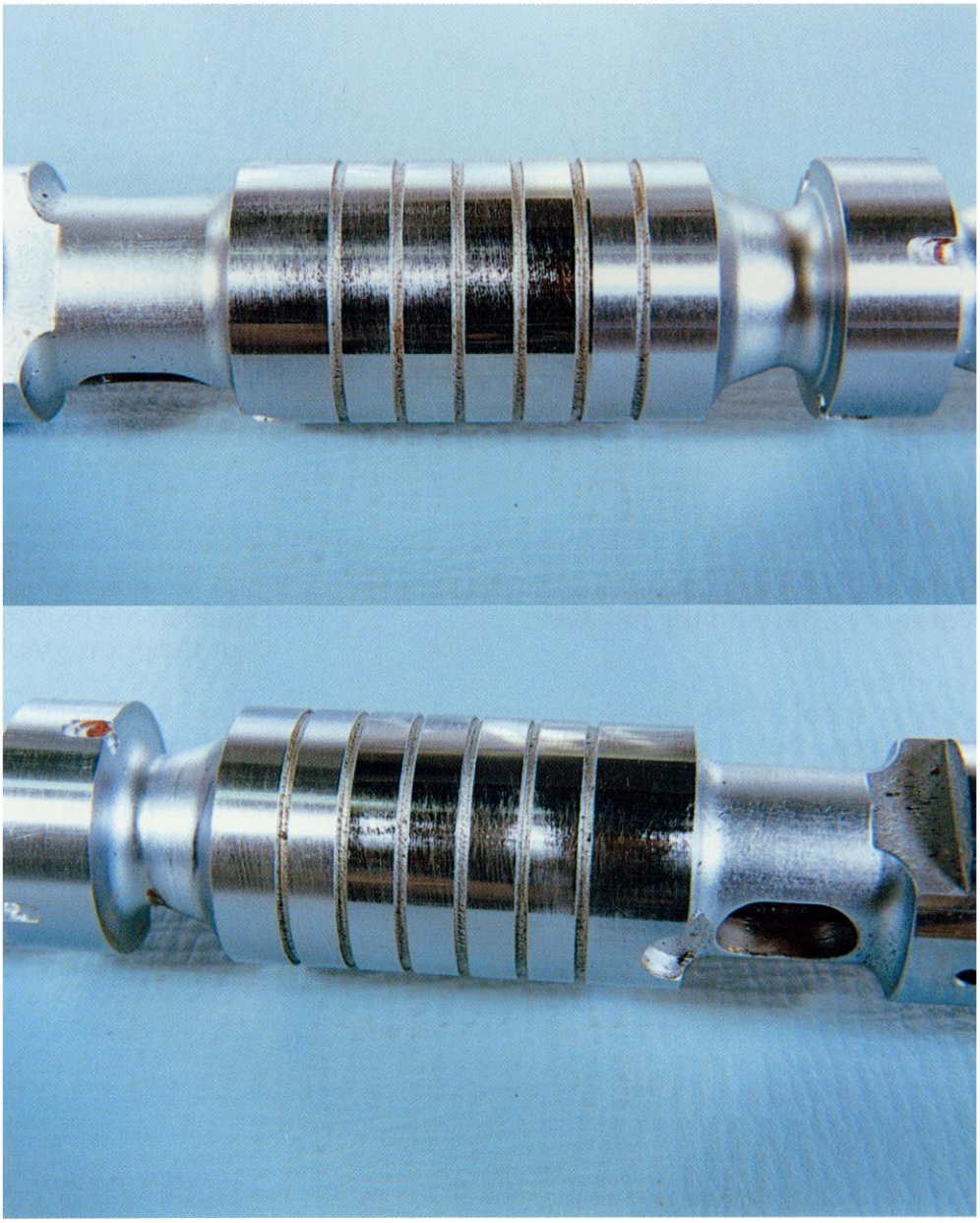
Cause
- Normal

Category: B
Condition
- The sliding surface has extremely small grazes that can be felt by the fingertip or fingernail.

Cause
- Contamination of oil, catching of wear particles.

Remedy
- Correct carefully with sandpaper #600 – 800. See P14.

Spool: Sliding Surface



Category: A

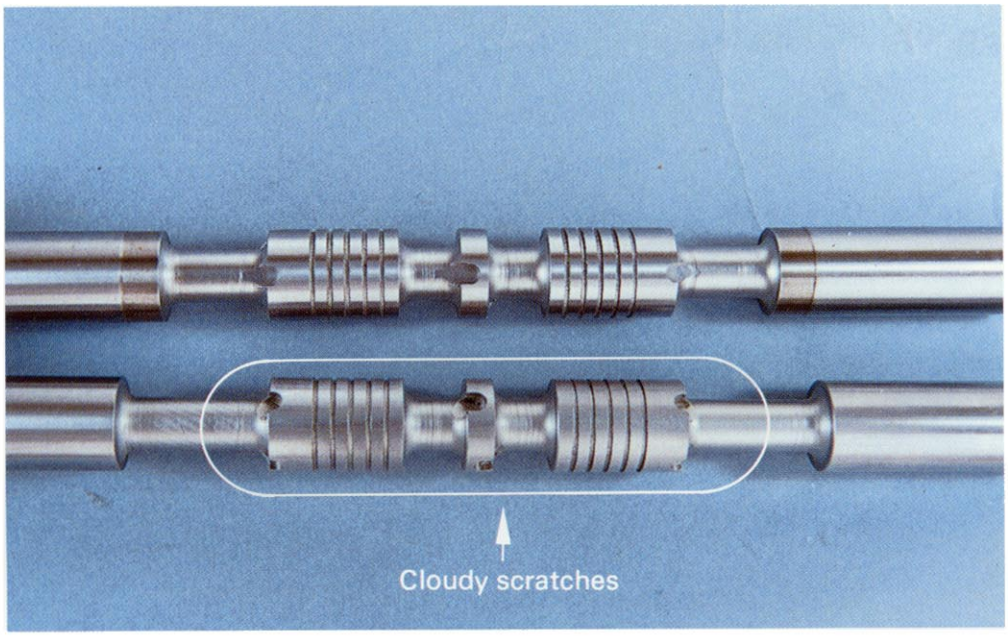
Condition

- The sliding surface has a mirror finish showing even contact around the whole circumference. There are no grazes, scratches, and no traces of lock. There are also no traces of contamination by oil. It is in good working condition.

Cause

- Normal

Spool: Sliding Surface



Category: A . . . . . The spool at the top of the photograph
Category: Refer to the following . . . . . The spool at the bottom of the photograph

Condition

- The spool at the top of the photograph shows luster on the sliding surface, but there are no grazes. This is in normal operating condition.
- The spool at the bottom of the photograph has no luster on the sliding surface, but there are fine cloudy scratches over the whole surface.

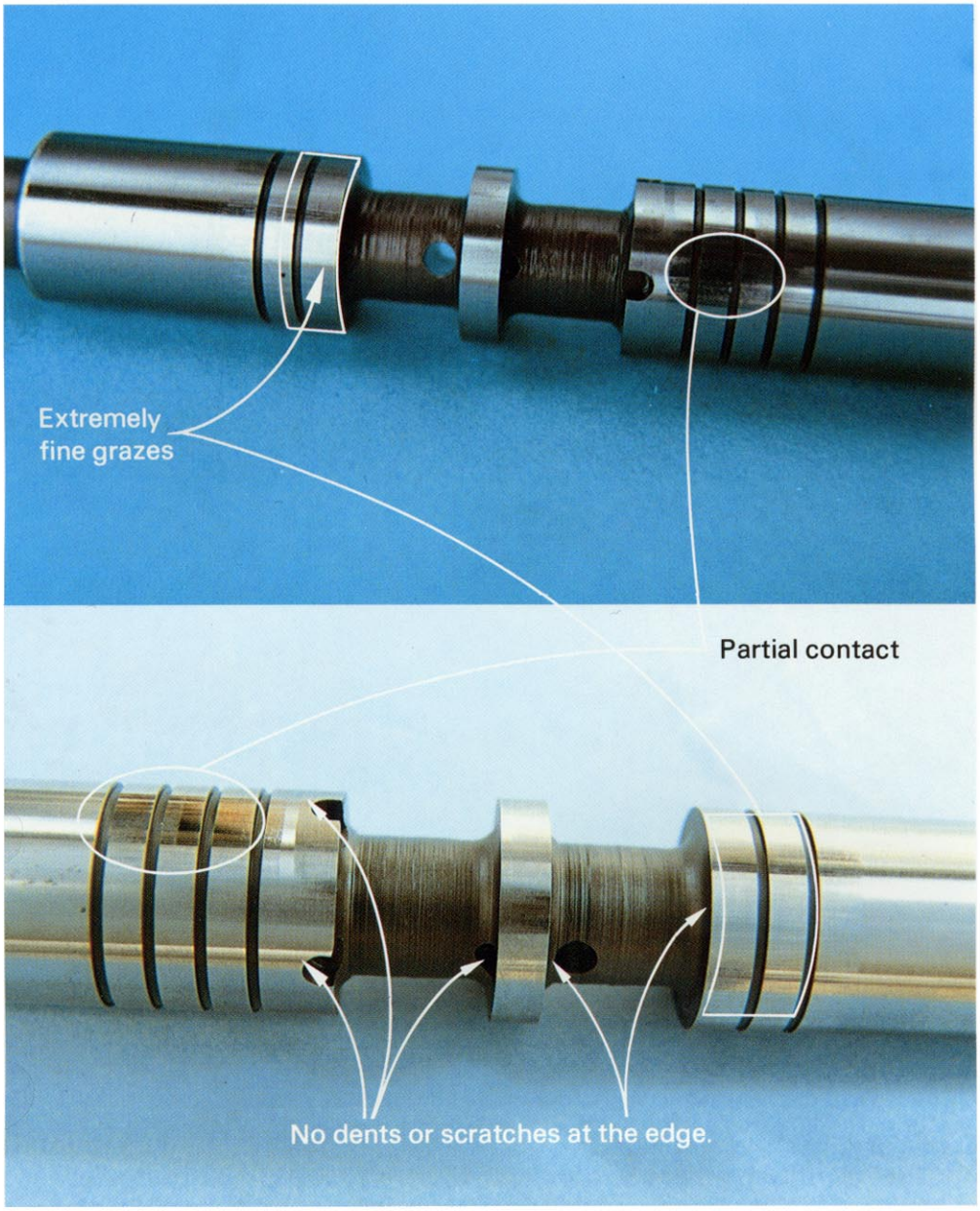
Cause of problem with lower spool

- This is probably caused by use of extremely contaminated oil. If it continues to be used in this condition, there will probably be accelerated wear.

Category and remedy to take with lower spool

- Check the inside of the wall surface of the valve body for scratches or surface roughness, and check for sliding resistance when the spool is inserted to judge if correction is possible.

Spool: Sliding Surface



Category: B

Condition

- Both the top and bottom photographs show partial contact of the sliding surface and extremely light grazes. There are no dents or scratches at the edge.

Cause

- This was probably caused by dirt getting caught in and causing slight dirt lock.

Remedy

- Correct by polishing the damaged parts several times with sandpaper #800.

Spool: Sliding Surface

Category:

Test on the machine or carry out bench test to check for oil leakage and to check the operating force. If there is no abnormality, place in category **B**. If there is abnormality, place in category **C**.

Condition

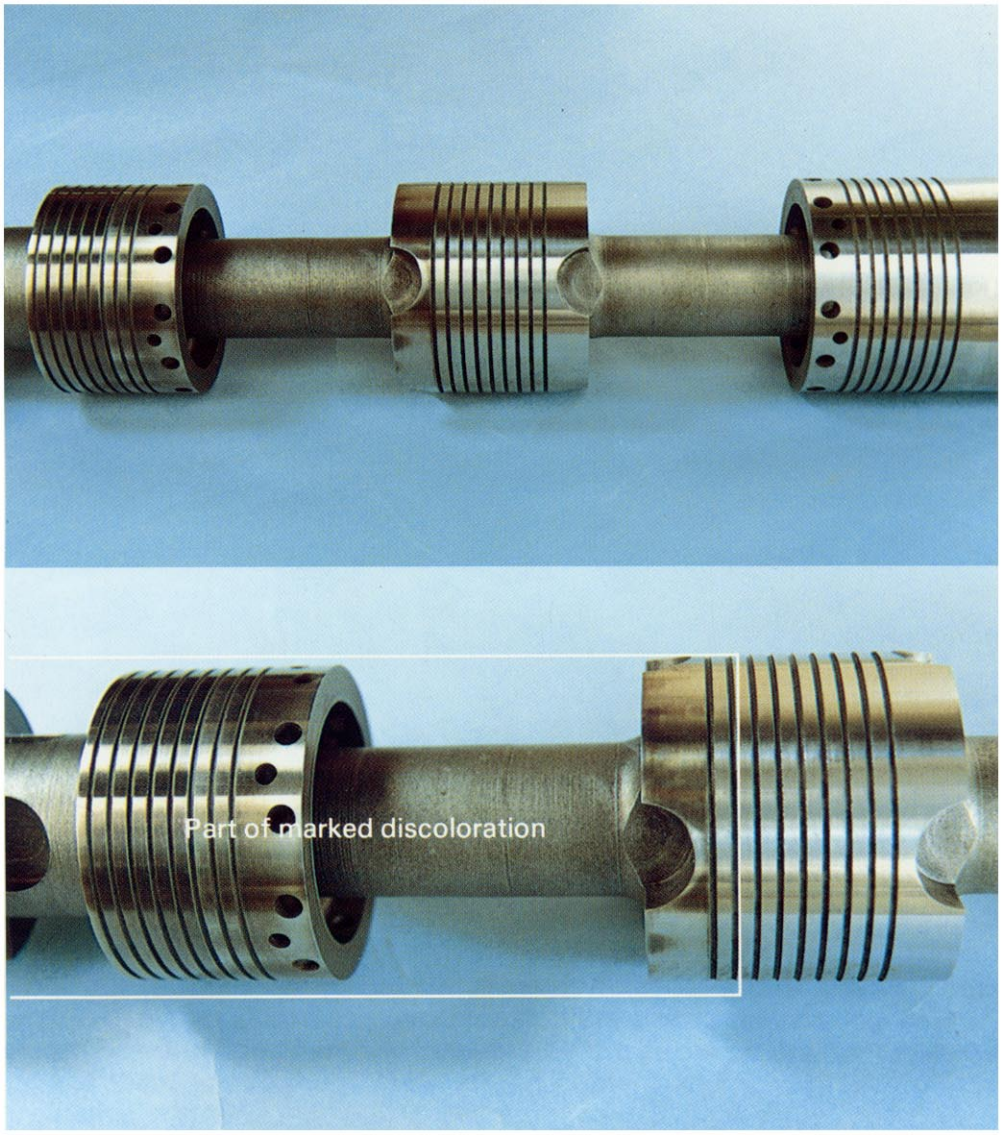
- There is a black gleam on the sliding surface caused by strong uneven contact (small width of contact), but there are no grazes.

  [Note] With strong contact, the contact width is usually narrow.

Cause

- There is no trace of dirt or foreign material getting caught or of contamination of oil, so the cause is probably repeated hydraulic lock.

Spool: Whole



Category:

Test on the machine or carry out bench test to check for oil leakage and to check the operating force. If there is no abnormality, place in category **B**. If there is abnormality, place in category **C**.

Condition

- There are almost no scratches, but there is marked heat discoloration.

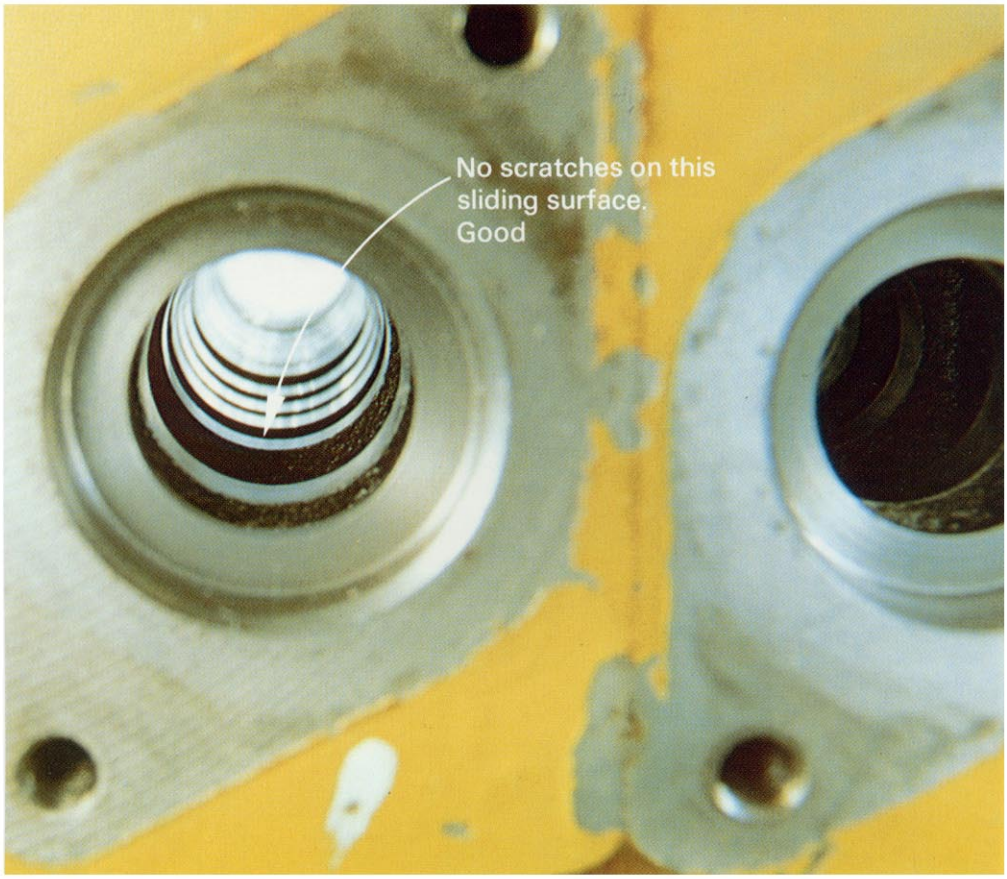
Cause

- The oil has been burnt by overheating of the hydraulic oil.
  The overheating of the hydraulic oil was probably caused by use of oil of the incorrect viscosity or by problems in the hydraulic system, such as failure of the oil cooler or damage to the pump.

Remedy

- If there is no bending of the spool caused by heat effect or wear on the valve body side, correct by polishing the burnt surface of the spool.

Valve Body: Spool Sliding Surface (Inside Wall)



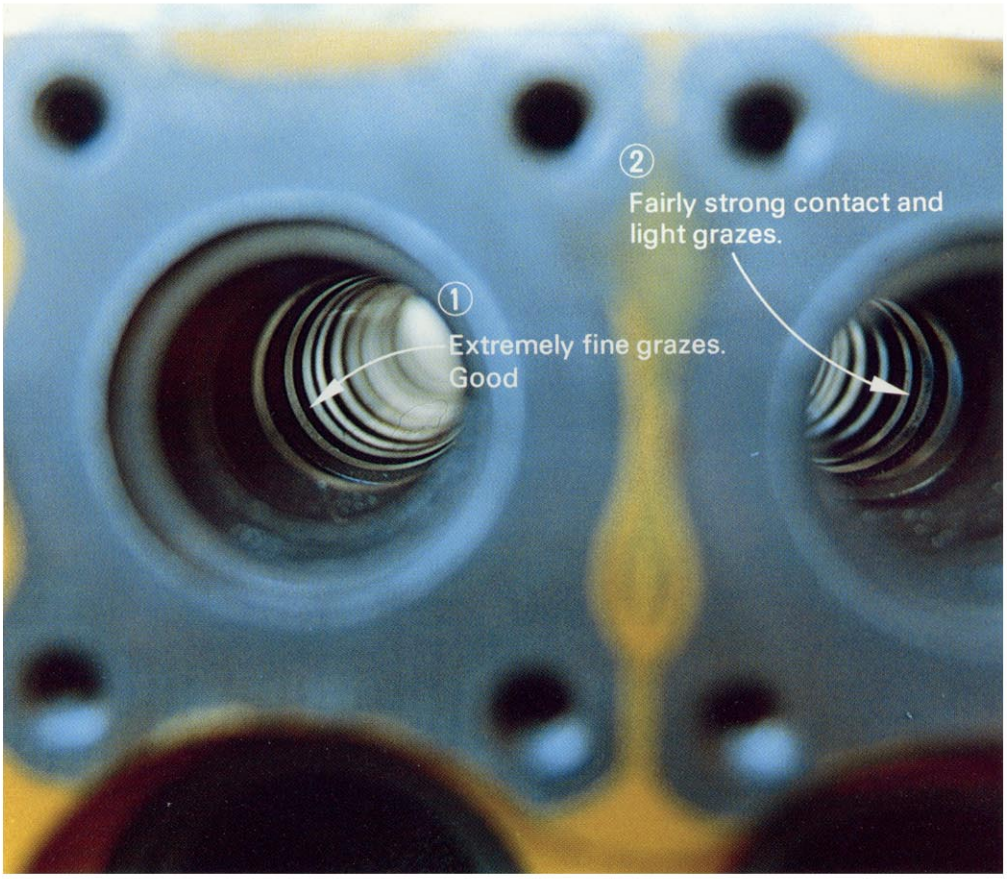
Category: A
Condition

- There are no scratches on the part marked by the arrow of the spool sliding surface and no condition of strong contact. Good.

Cause

- Normal

Valve Body: Spool Sliding Surface (Inside Wall)



Category: ① A; ② B

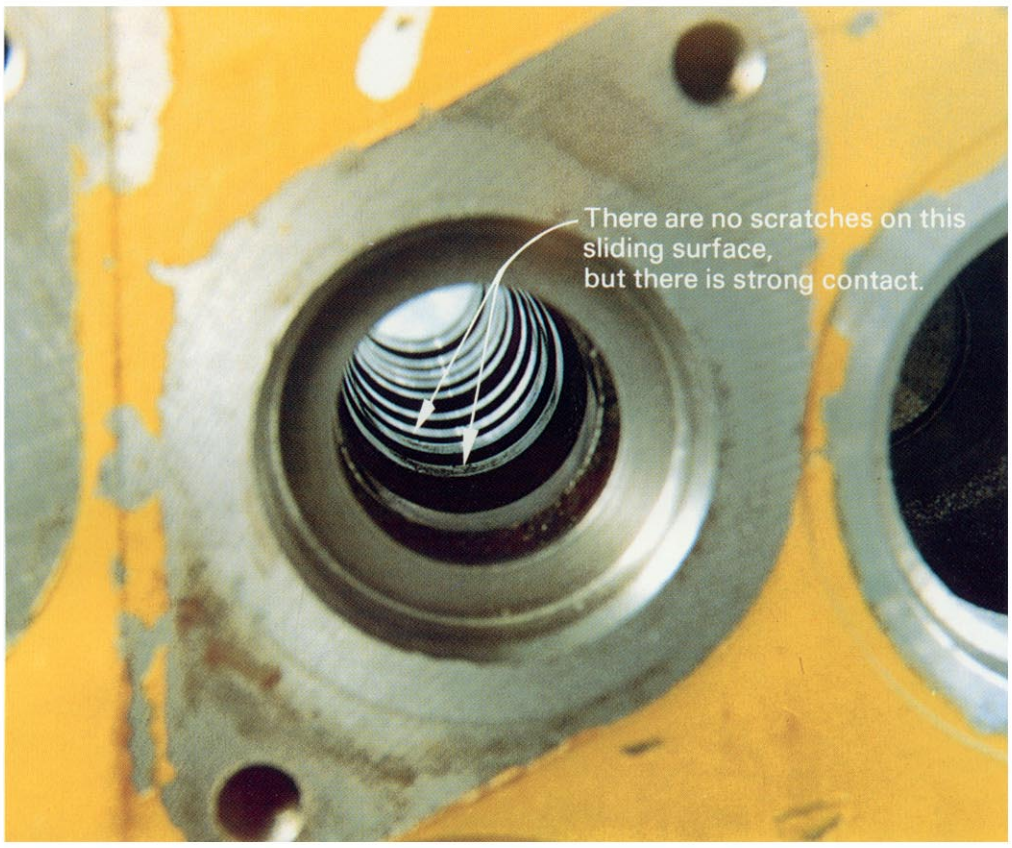
Condition

- ① The condition of the part marked by the arrow on the left is good, but there are extremely fine grazes on the sliding surface.
- ② The condition of the part marked by the arrow on the right is good, but there are sighs of fairly strong contact and light grazes on the sliding surface.

Cause

- The fairly strong contact of ② is often seen, and this is normal. Refer to next page.

Valve Body: Spool SlidingSurface (Inside Wall)



Category: B
Condition

- There is strong contact at the two places on the spool sliding surface marked by arrows, but there are no scratches.

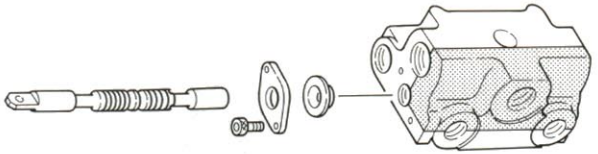
Cause

- The strong contact at places is probably caused by jets of dirty oil or the dirt getting caught and leading to uneven wear of the sliding surface.
  Other causes: Locking of the spool, bending of spool.

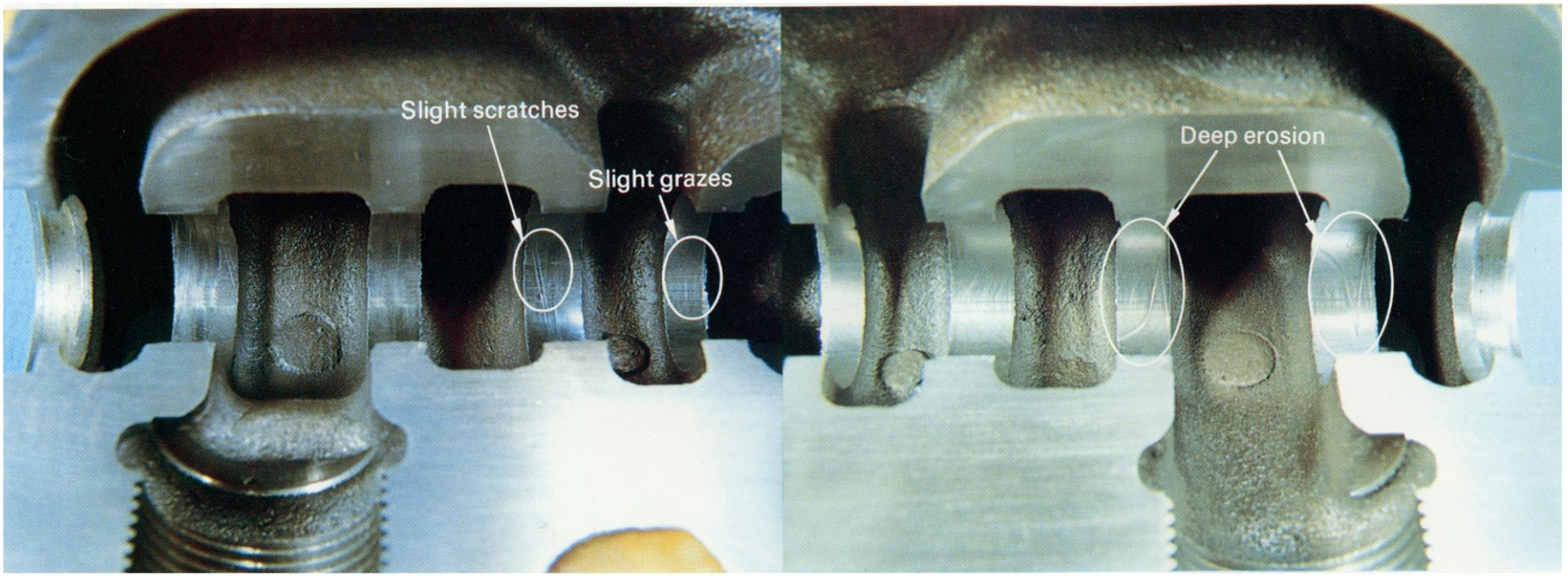
★ Judge if correction is possible by lapping from the condition of the contact and the degree of wear.
If the contact is even for the whole body, lapping is not needed.

[Reference]

The shaded area in the diagram below was cut away and the photograph was taken of the damage to the spool sliding surface.



Valve Body: Spool Sliding Surface (Bore Inside Wall)



Category: C

Note: If it is assumed that there are no deep erosion, place in category **B**.

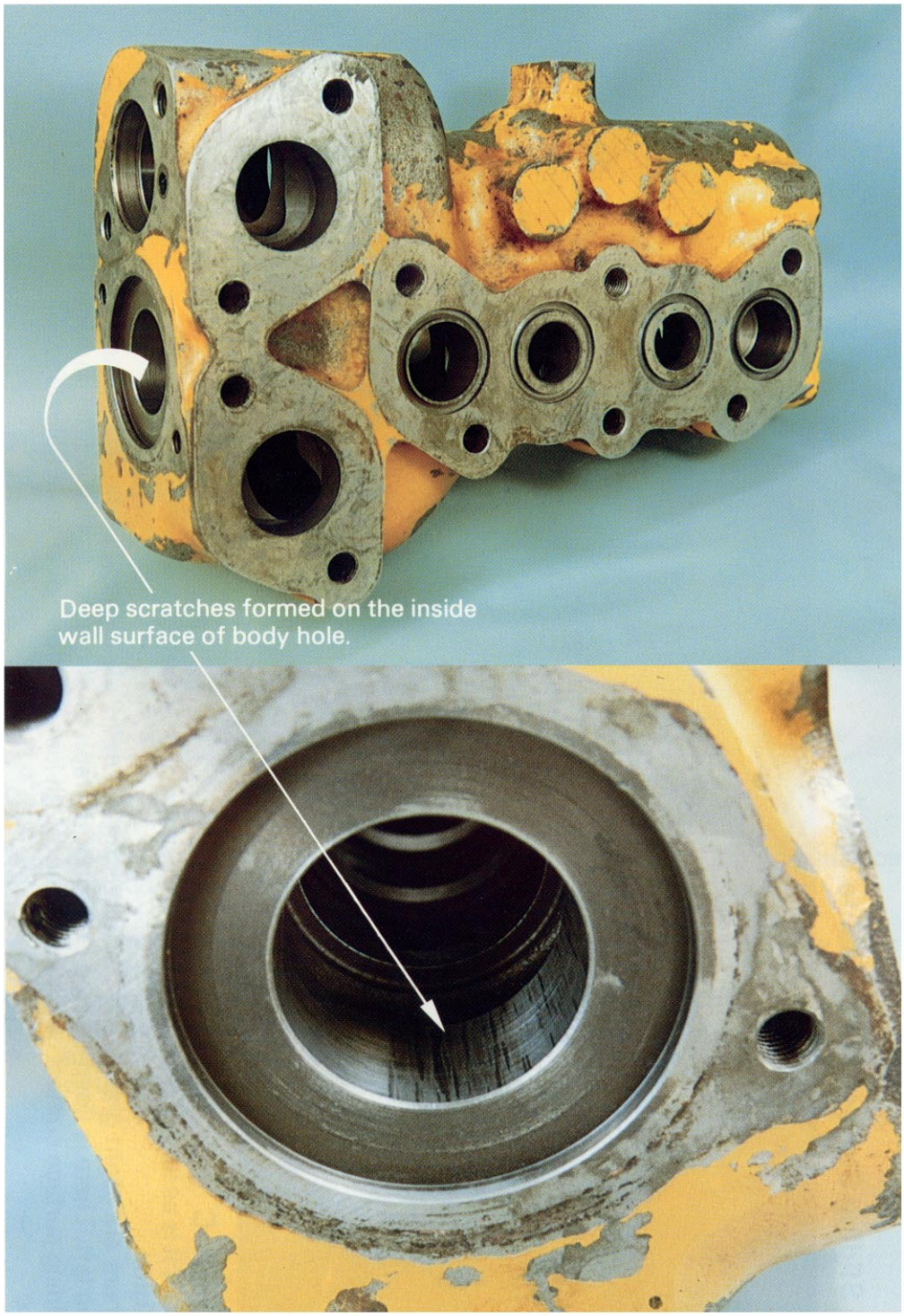
Condition

- There are slight grazes and scratches on the spool sliding wall surface in photograph on the left. There is deep erosion in the photograph on the right, so this is fatal damage. The sliding surface contact condition is good with luster uniform over the whole body.

Cause

- The deep erosion was probably caused by fine material getting caught, accompanied by careless disassembly (probably by forced turning of the spool when removing it).

Valve Body: Spool Sliding Inside Wall Surface



Category: C

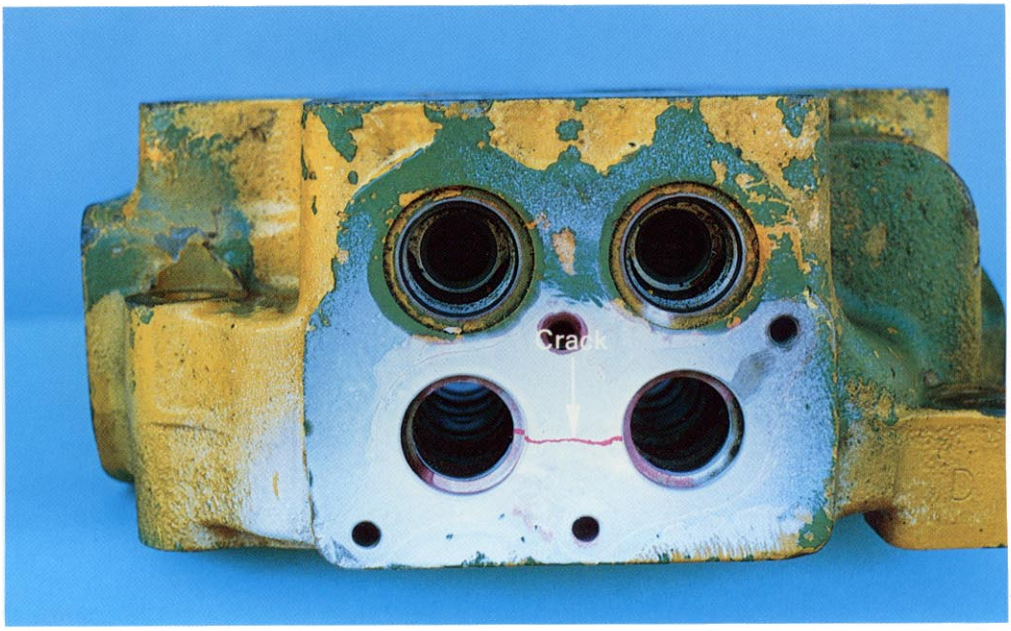
Condition

- There are deep scratches forming stripes on the inside wall surface where the spool slides, and these scratches extend in completely to the end. (This portion cannot be seen in the photograph.)

Cause

- The cause is probably inproper maintenance of the hydraulic oil leading to accelerated contamination and catching foreign material in the sliding surface, or the catching of broken pieces coming from damage to other hydraulic equipment.

Valve Body: Appearance

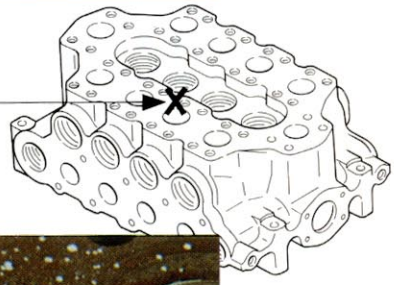


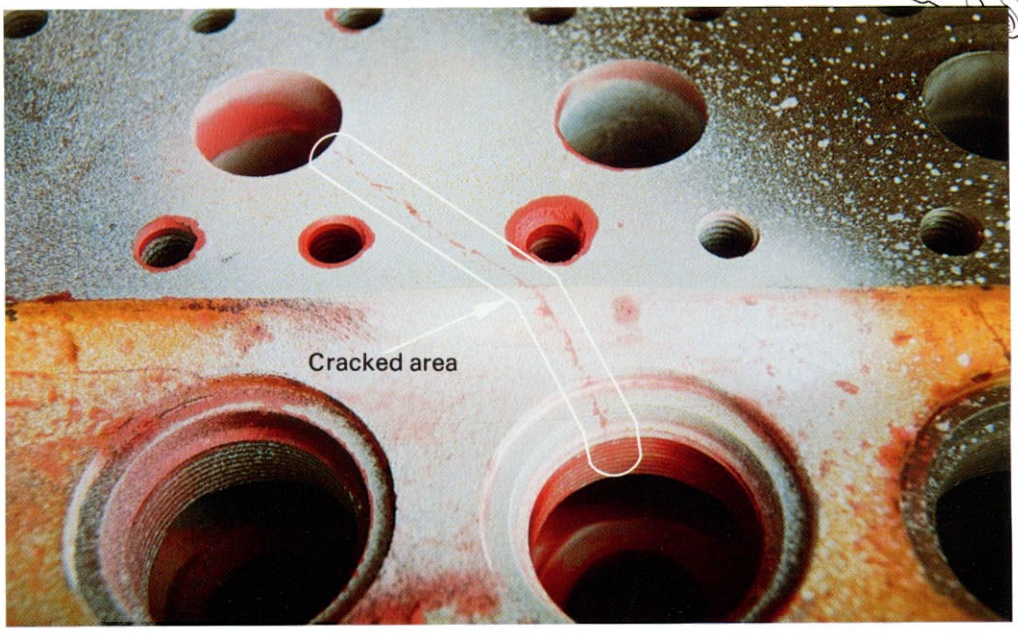
Category: C
Condition

- Crack

Cause

- This was probably caused by the generation of abnormal pressure or by defects in the casting.





Category: C
Condition

- Cracks in valve body
- The cracks extend from the plug screw hole of the check valve to the piping pressure pick-up port. (The area around opening can be checked with the naked eye with some effort, but it is extremely fine and it is causing oil leakage, so we used a color check to show it more clearly.)

Cause

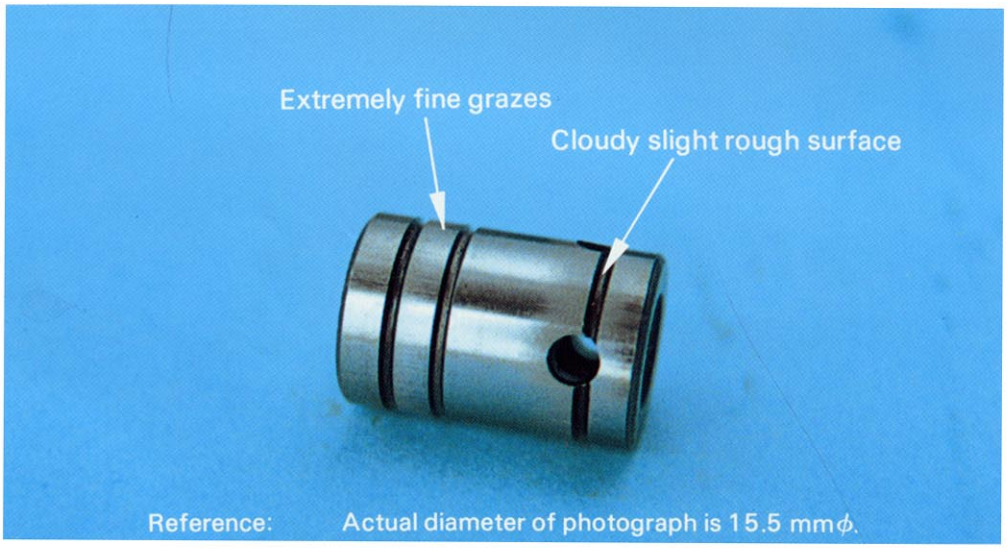
- The cause is probably abnormal pressure or defect in the material such as the air pockets in the casting.

[Relief Valve]

Main Valve: Sliding Surface

Category: A
Condition
- The contact left by sliding does not extend to the middle, but there are almost no grazes, so the condition is good.

Cause
- Normal



Category: B
Condition
- There are extremely fine grazes on the sliding surface and cloudy areas on the surface probably caused by the catching of dirt in the oil.

Cause
- Contamination of hydraulic oil

Remedy
- Check for damage to the sleeve. If the judgement is category A or B, carry out lapping for both parts. Apply a small amount of lapping compound and polish carefully, or slide the two parts together with chromium oxide.

[Relief Valve]

Main Valve: Sliding Surface

Category: B
Condition
- The color is black, showing the initial stage of rusting, but this has not extended to corrosion. There are no grazes, scratches or other damage.

Cause
- The machine was out of use for a long period, and during that time the water in the hydraulic oil collected in the corners of the oil pool in the sleeve and caused rusting to start. (This discoloration is a typical symptom of the initial stages of rusting.)

Remedy
- As shown in the example in the photograph above, the part can continue to be used if the discoloration is only about half.

Reference
Area where water is thought to have collected.

Category: C
Condition
- There are clear scratch marks on the sliding surface and marked roughness can be felt with the fingertips. The scratches are sharp and comparatively deep.

Cause
- Broken particles from damaged related hydraulic equipment getting caught.

[Relief Valve]

Main Valve: Sliding Surface

The upper and lower photographs are both of the same part. The actual size is 19.5ϕ, but it is enlarged in this photograph.

Category: C

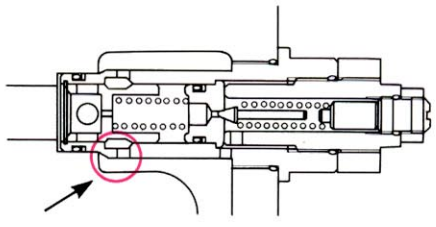
Condition

- At the right port side of the photograph, broken pieces getting caught have caused grazes (which catch the fingernail), and there are traces of seizure on parts of the sliding area. In the central part, there is cloudy surface roughness caused by jets of contaminated oil.

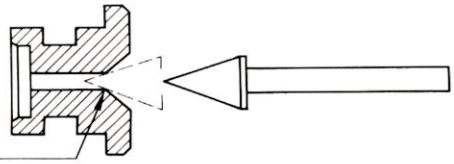
Cause

- The cause is probably improper maintenance of the hydraulic oil leading to accelerated contamination and catching foreign material in the sliding surface, or the catching of broken pieces coming from damage to other hydraulic equipment.

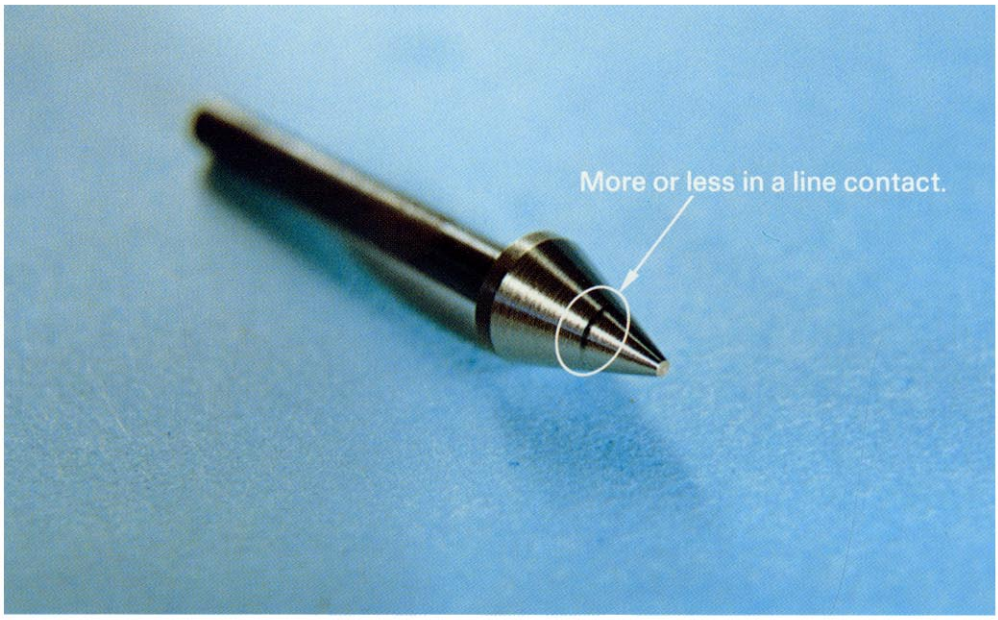
★ Action to take for broken hydraulic parts: the equipment must be cleaned thoroughly by flushing the hydraulic circuit.



[Relief Valve]



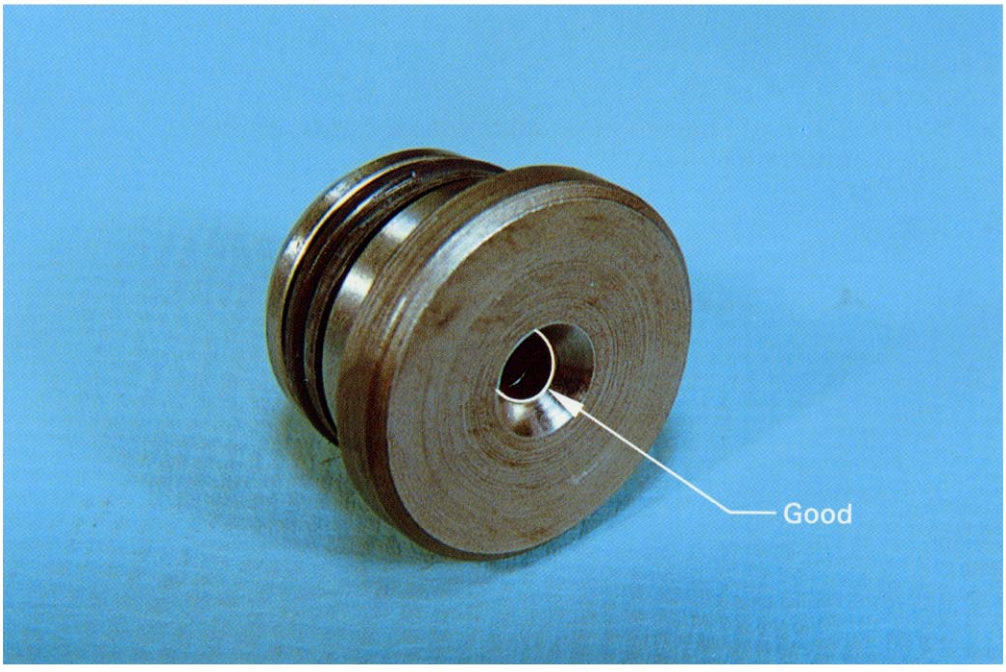
Pilot Poppet: Seat Portion



Category: A
Condition
- There is some wear, but the contact is uniform and more or less in a line around the whole circumference, so the condition is good.

Cause
- Normal

Valve Seat: Seat Portion

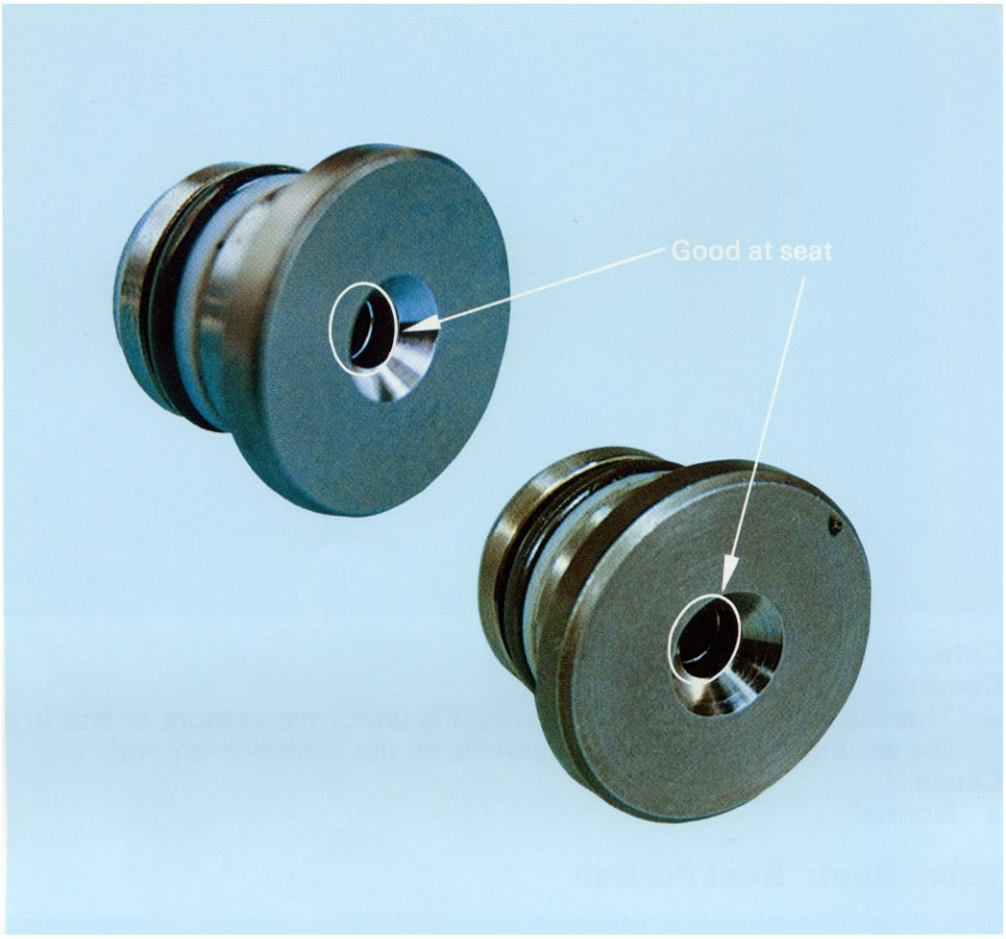


Category: A
Condition
- There is no wear, damage, or dents at the seat, and the contact is in a stripe, so the condition is good.

Cause
- Normal

[Relief Valve]

Valve Seat: Seat Portion



Category: A
Condition
- Both valve seats have almost no damage, dents, or wear. Good condition

Cause
- Normal

[Relief Valve]

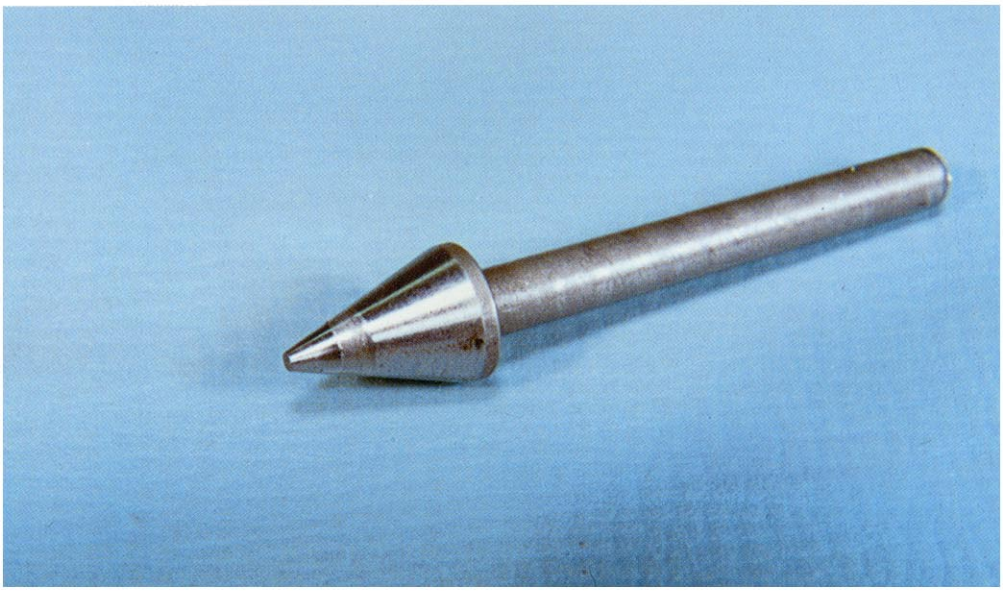
Pilot Poppet: Seat Portion

Category: A
Condition

- There is belt-shaped contact of the seat, showing that there has been wobble of the poppet, but there are no dents or damage, and there is no wear.

Cause

- This is probably caused by hydraulic chattering which has caused defective following of the spring, or the spring is deteriorated.
  Note: Check the spring.



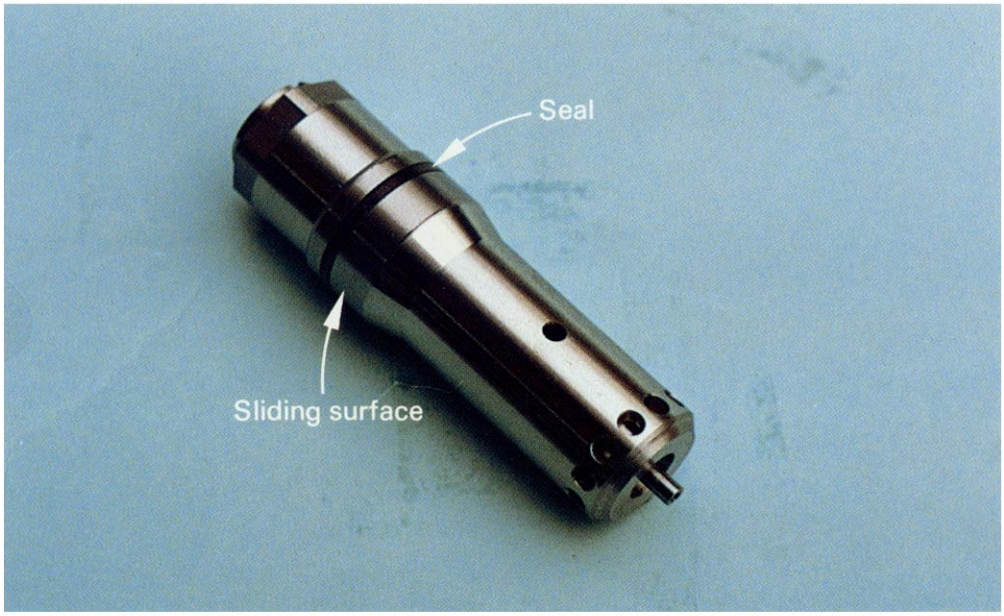
Category: C
Condition

- There is belt-shaped contact of the seat, there is no luster and abnormal wear can be seen.

Cause

- Dirt in the oil has got caught, and there has been vibration and wobble the poppet caused by excessive chattering.
  Note: The wear of the valve seat has probably progressed more than the wear of the poppet, so replace both parts.

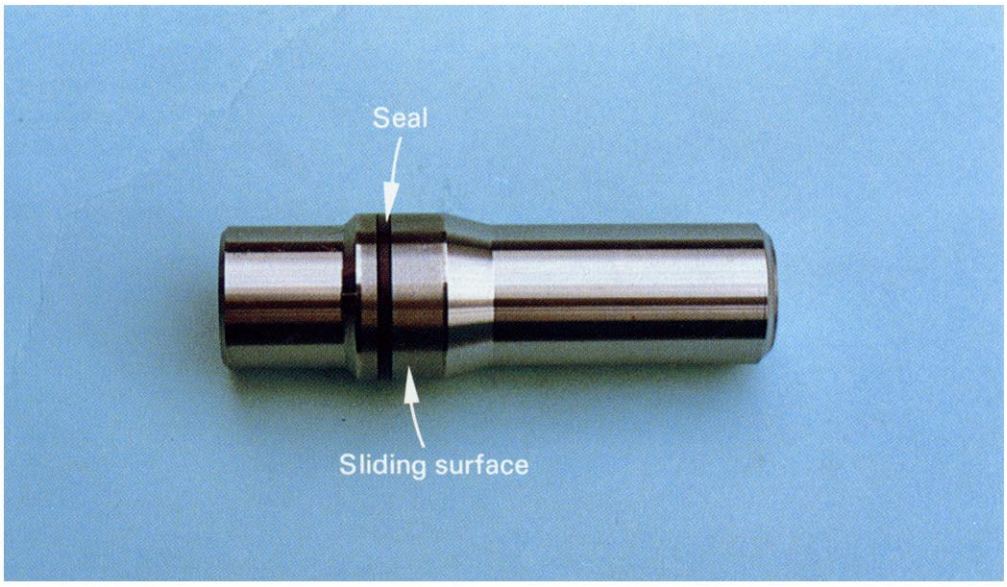
Safety Valve & Suction Valve: Sliding Surface



Category: A
Condition
- There are no scratch on the sliding surface and no damage of the seal. Extremely good.

Cause
- Normal

Suction Valve: Sliding Surface

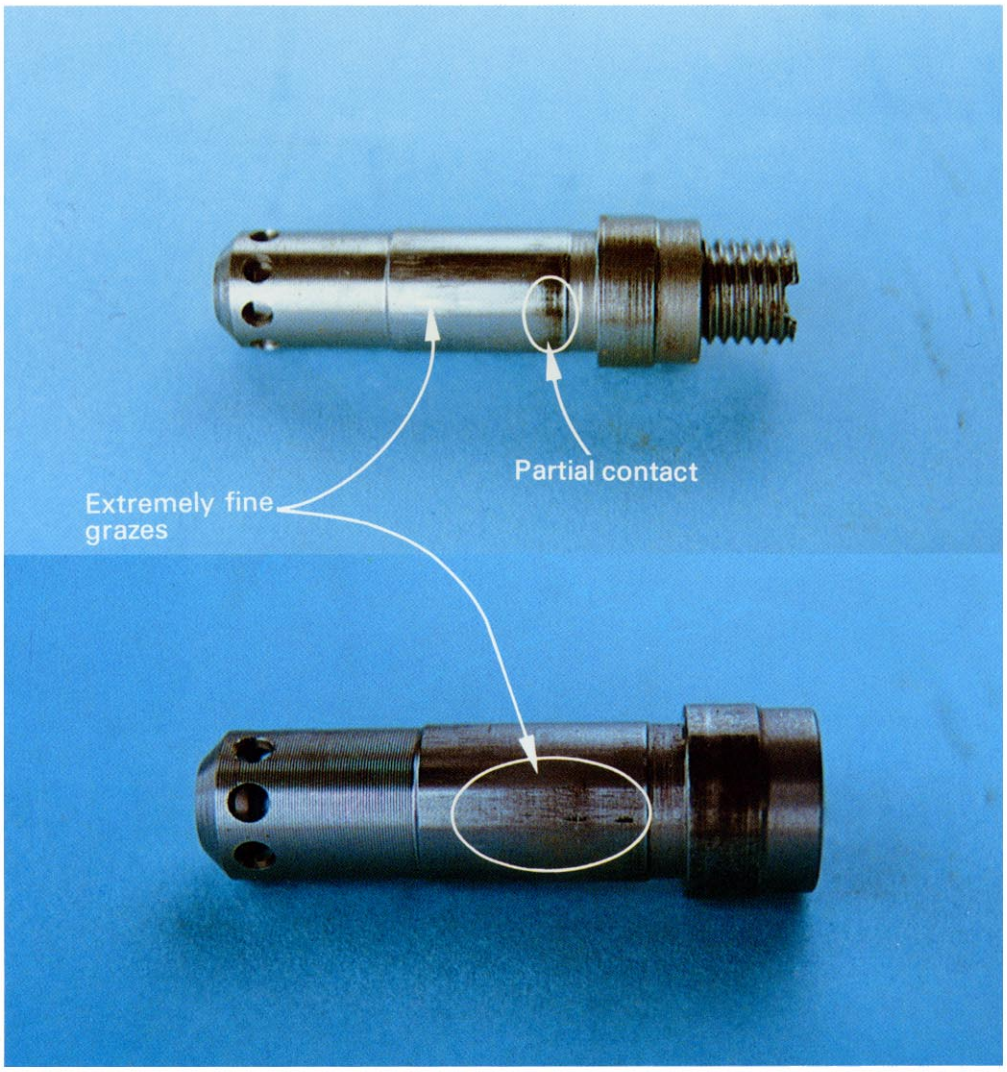


Category: A
Condition
- There are no scratch on the sliding surface and no damage of the seal. Extremely good.

Cause
- Normal

[Safety Valve]

Suction Valve: Sliding Surface



Category:

If the leakage is within the allowable value about the actual machine, place in category **B**. If the leakage is over the allowable value, place in category **C**.

Condition

- There is strong sliding contact in places at the sliding end face of the suction valve in the upper photograph, and with both the upper and lower parts there are small grazes that can be felt with the fingernail.

Cause

- The oil is contaminated, or worn particles have been caught.

Remedy

- Use sandpaper #800 to polish the defective parts several times to correct. Check for damage to the inside wall of the valve body. If it is light, slide the two parts together to carry out lapping.

[Safety Valve]

Suction Valve: Slilding Surface

Category: C

Condition

- There are scuffing scratches on the sliding surface, and the surface is extremely rough.

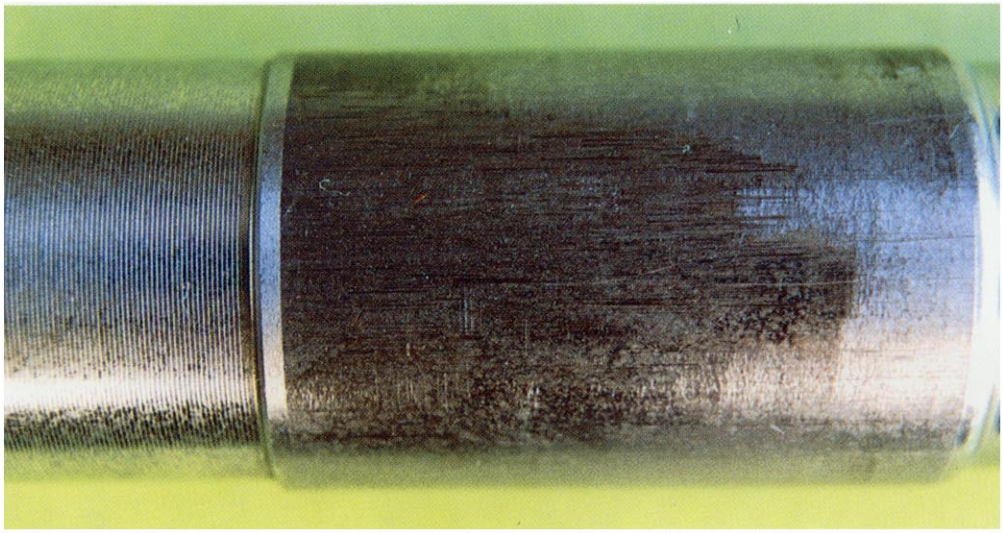
Cause

- The cause is probably catching of broken pieces coming from damage to related hydraulic equipment or dirt in the hydraulic oil.

  Note: Replace the valve body also.

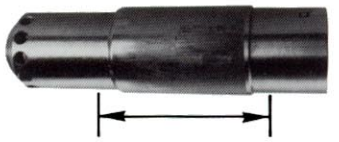
[Safety Valve]

Suction Valve: Sliding Surface

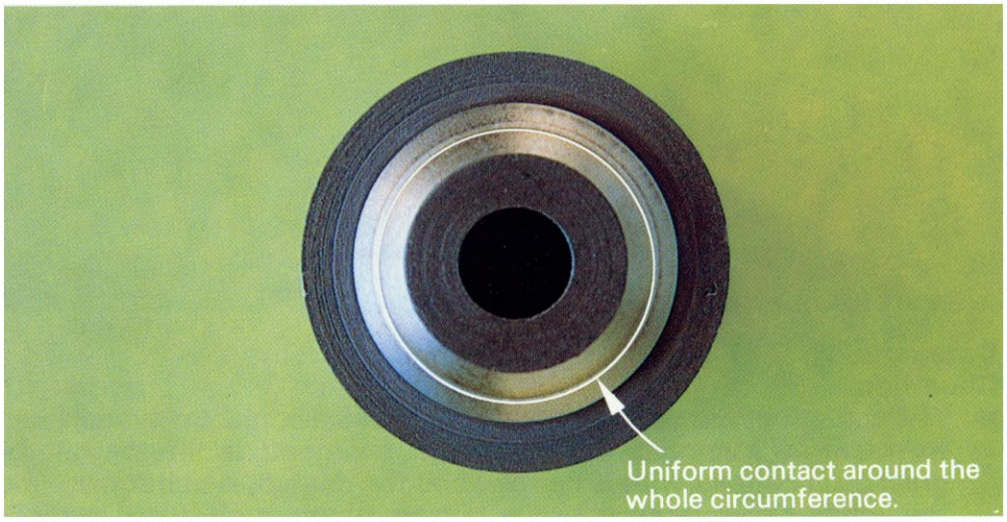


Category: C
Condition
- Generation of distinct scratches

Cause
- Foreign material getting caught



Suction Valve: Valve Seat



Category: A
Condition
- The contact is uniform in a line around the whole circumference of the seat surface and there are no progressive scratch and wear so the condition is good.

Cause
- Normal

[Safety Valve]

Suction Valve: Valve Seat Portion

Category: A

Condition

- The contact of the valve seat shows the initial contact condition, and there are no scratches, so the condition is good. In the top photograph, the contact with is narrow, and the contact is uniform around the whole circumference. In the bottom photograph, there is slight deviation of the contact, but this is extremely small, so the condition is good.

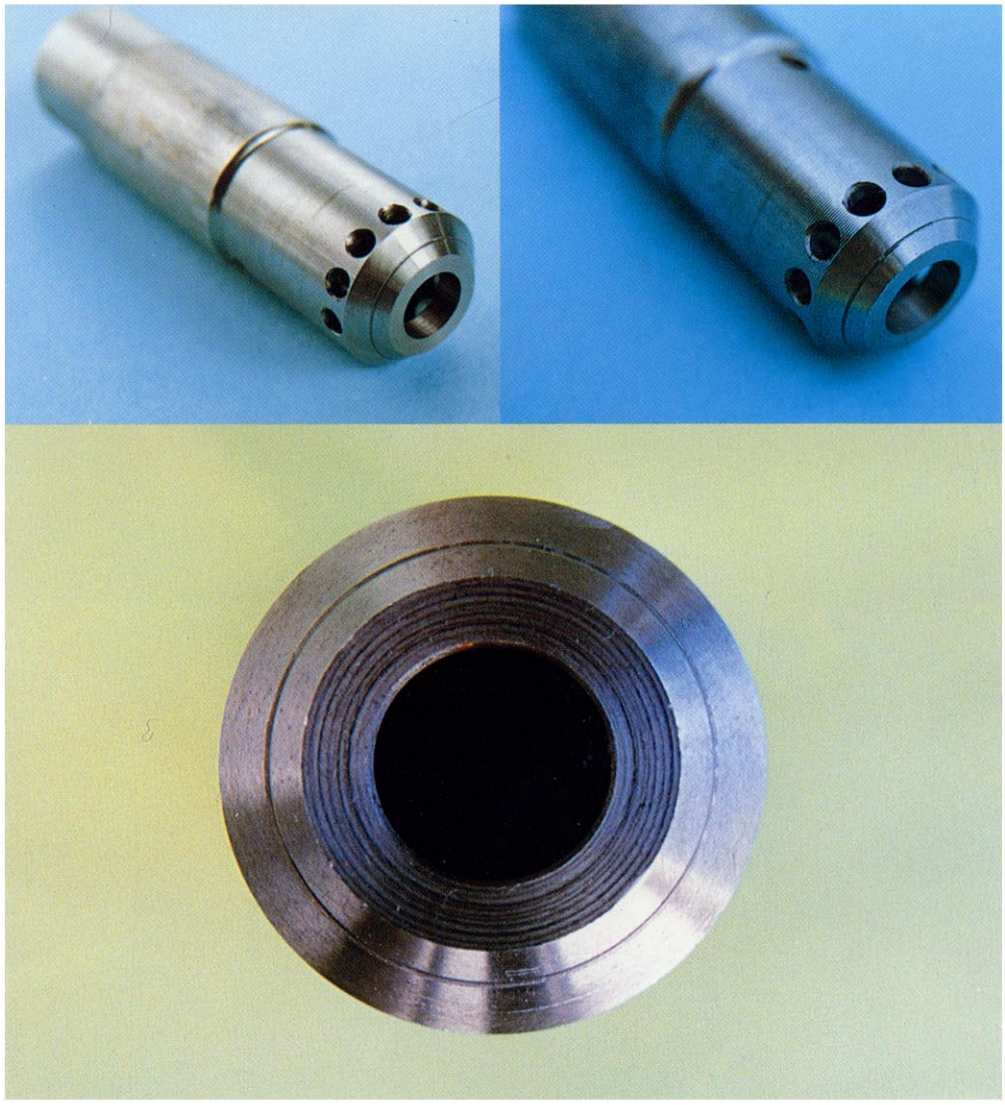
Cause

- In the bottom photograph, foreign material getting caught in the seat probably caused a temporary change in the position of the seat.

★ For Safety's sake, check the valve chamber seat also.

[Safety Valve]

Suction Valve: Valve Seat Portion



Category: A

For no leakage, place in category **A**.
For leakage, place in category **B**. Apply lapping together with valve body side.

Condition

- There is marked stepped wear on the seat surface (can be felt by the fingernail), but the wear is uniform, and there are no scratches, so the condition is good.

Cause

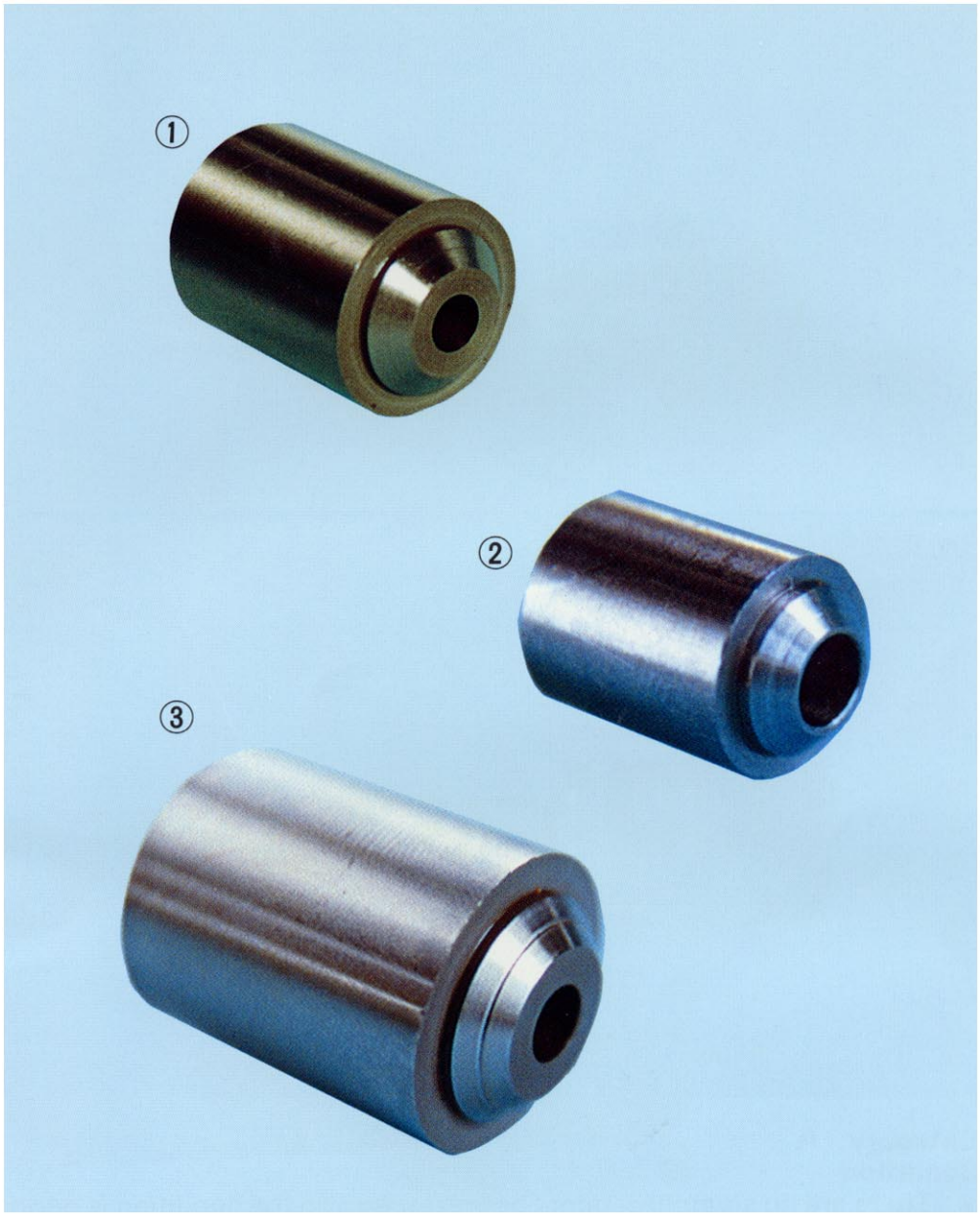
- This is normal wear.

Safety Valve
Suction Valve: Valve Seat Portion

Category: C
Condition
- The seat surface is corroded by rust.

Cause
- This has probably been caused by improper storage after the control valve assembly was removed.

Safety Valve
Main Valve: Sliding Surface and Seat Surface



Category: ① A; ② B

- Slide together with the suction valve to carry out lapping.
  Judge category ③ after test on the machine or carry out bench tests to judge.
  For no leakage **B**.
  For leakage **C**.

Condition

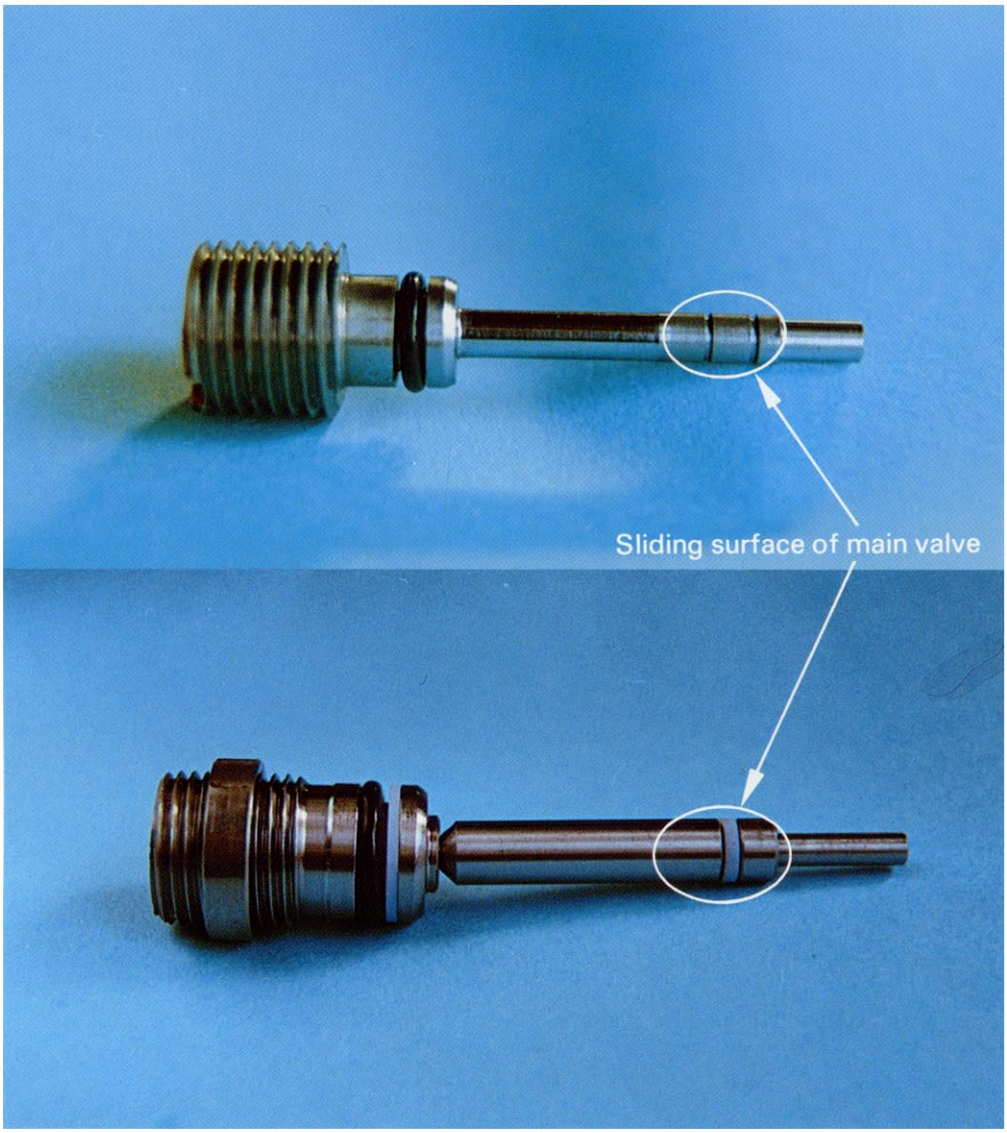
- There are no scratches on the sliding surface of any of main valves ①, ②, or ③, so the condition is good.
  The condition of the valve seat contact surface is as follows.
  ① Extremely thin contact, showing initial contact condition
  ② Contact width is extended, and contact is slightly defective, but wear is light.
  ③ Contact is uniform around whole circumference, so condition is good, but stepped wear is progressing.

Cause

- The defective contact of the seat surface in ② is probably caused by an abnormality in the suction valve.

[Safety Valve]

Pilot Piston: Main Valve Sliding Portion



Category: A

Condition

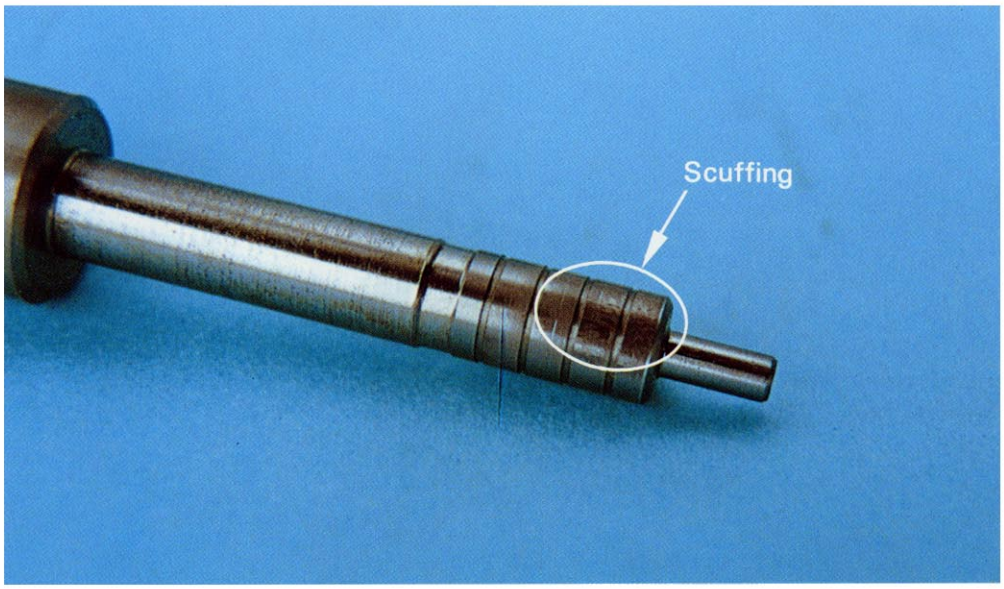
- There are no scratches, dents or grazes, and so the condition is good.

Cause

- Normal

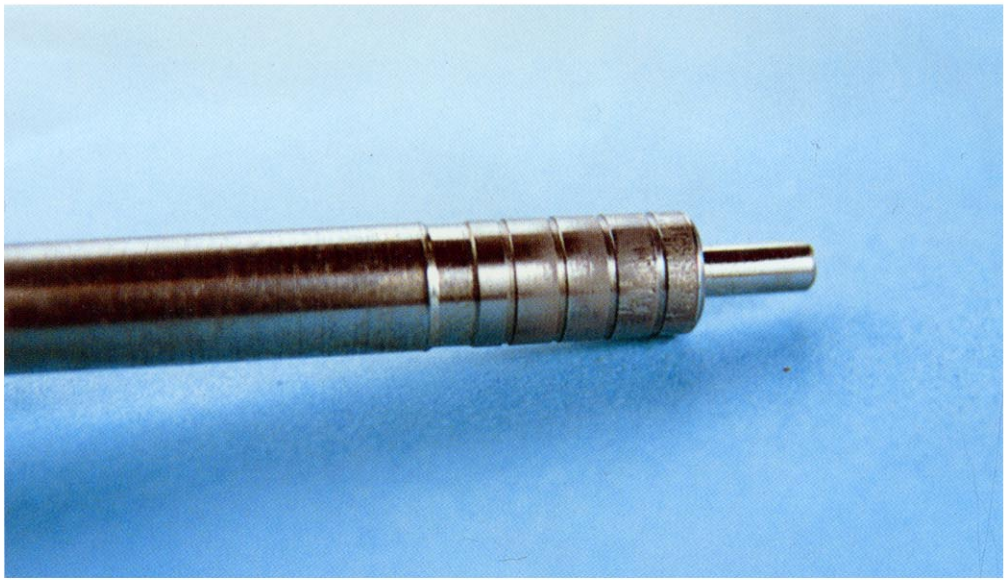
[Safegy valve]

Pilot Piston: Main Valve Sliding Portion



Category: C
Condition
- There is marked scuffing on the sliding area of the main valve.

Cause
- Broken pieces coming from damage to related hydraulic equipment have got caught.



Category: C
Condition
- Same as above photograph

Cause
- Same as above.

★ Replace together with opposite main valve

Check Valve: Valve Seat

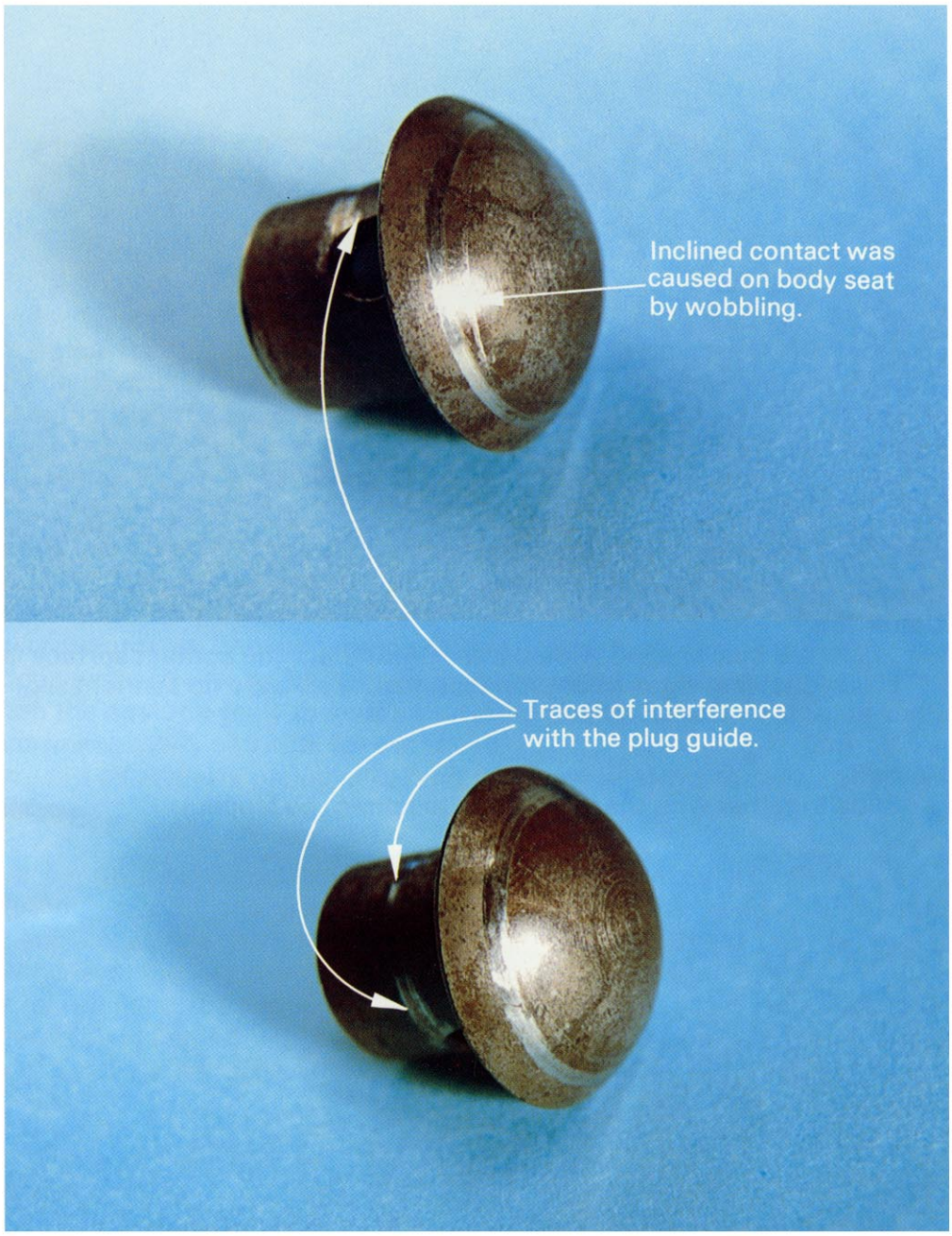
Category: A
Condition
- The valve seat surface contact is more or less uniform, and there is no wear or scratches, so the condition is good.

Cause
- Normal

Category: A
Condition
- The valve seat contact shows the initial contact condition, with no strong contact. The contact is uniform around the whole circumference, and there are no dents or damage, so the condition is good.

Cause
- Normal

Check Valve: Valve Seat



Category:

- If there is no abnormality on the seat surface of the valve body, place in category **B**.
  If there is any abnormality, such as deep scratches, on the mating part, place in category **C**.

Condition

- The valve contact shows traces of wobbling, and there are traces of interference with the plug guide, but no scratches can be seen.

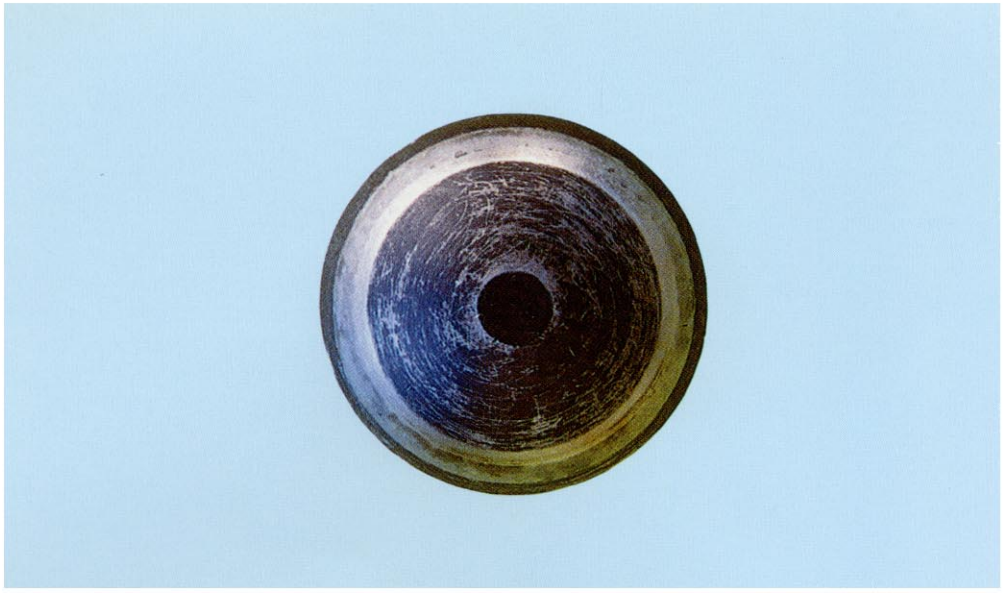
Cause

- This is probably caused by abnormal pressure in the cylinder circuit and by dirt getting caught.

Remedy

- There is probably damage to the valve chamber seat.
  Check the spring and valve body seat surface, and if there is no abnormality, lap the two parts together to correct.

Check Valve: Valve Seat



Category: B
Condition
- There is a belt-shaped wide contact width, but the contact surface is black, showing signs of improper contact. There are no scratches.

Cause
- Normal

Remedy
- Slide together with the valve body to correct by lapping.

Category: C
Condition
- There is uniform belt-shaped wide spherical surface contact, and granular dents around the whole circumference. There are signs of hitting the mating seat face too hard.

Cause
- The granular dents are probably caused by broken pieces or foreign material in the hydraulic oil being caught, or there is damage to the valve body seat.

★ Check carefully for any sinking (erosion) in the valve body seat surface.
If there is any abnormality, replace the body also.

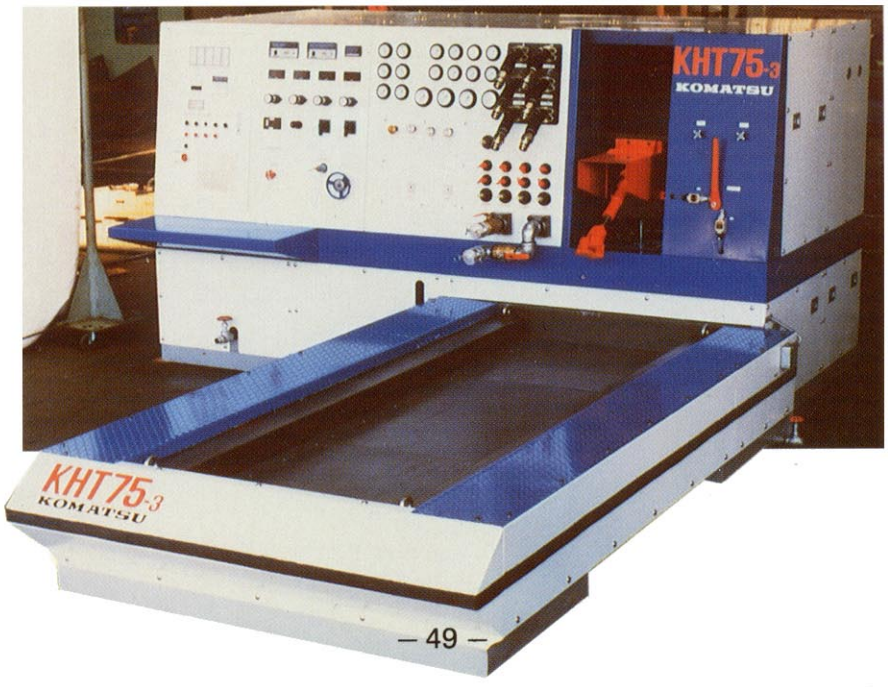
PREVENTIVE MAINTENANCE

To prevent failures in the machine before they occur, and to allow the machine to demonstration its function 100% it is necessary always to know the condition of the machine, in particular to be aware of abnormal noise, particles of worn metal in the lubricating oil, and the level of the lubricating oil. In addition, by carring out maintenance correctly as listed in the operation manual, most damage can be prevented, but be particulary sure to have the user carry out the following points properly.

- Always use genuine Komatsu lubricating oil, keep to the prescribed change intervals, and use lubricating oil to correspond with changes in the ambient temperature.
- Always warm up the engine thoroughly. Avoid as far as possible applying sudden excessive loads, accelerating suddenly or stopping suddenly.
- When the operator feels there is some abnormality, he should stop using the machine immediately and look for the cause.
- Carry out oil analysis periodically, and make every effort to prevent failure in the machine.

Have periodic operation troubleshooting carried out by the distributor, and if there is thought to be any drop in the function, use unit exchanger for the hydraulic equipment. Leave the decision as to whether the equipment can be reused to a repair shop with the test stand shown in the diagram below.

We recommend the Komatsu multi-purpose hydraulic test stand for troubleshooting and rebuilding of hydraulic equipment in construction equipment, and confirmation of quality after repair.



FORM NO. SEBG4200

KOMATSU

Printed in Japan