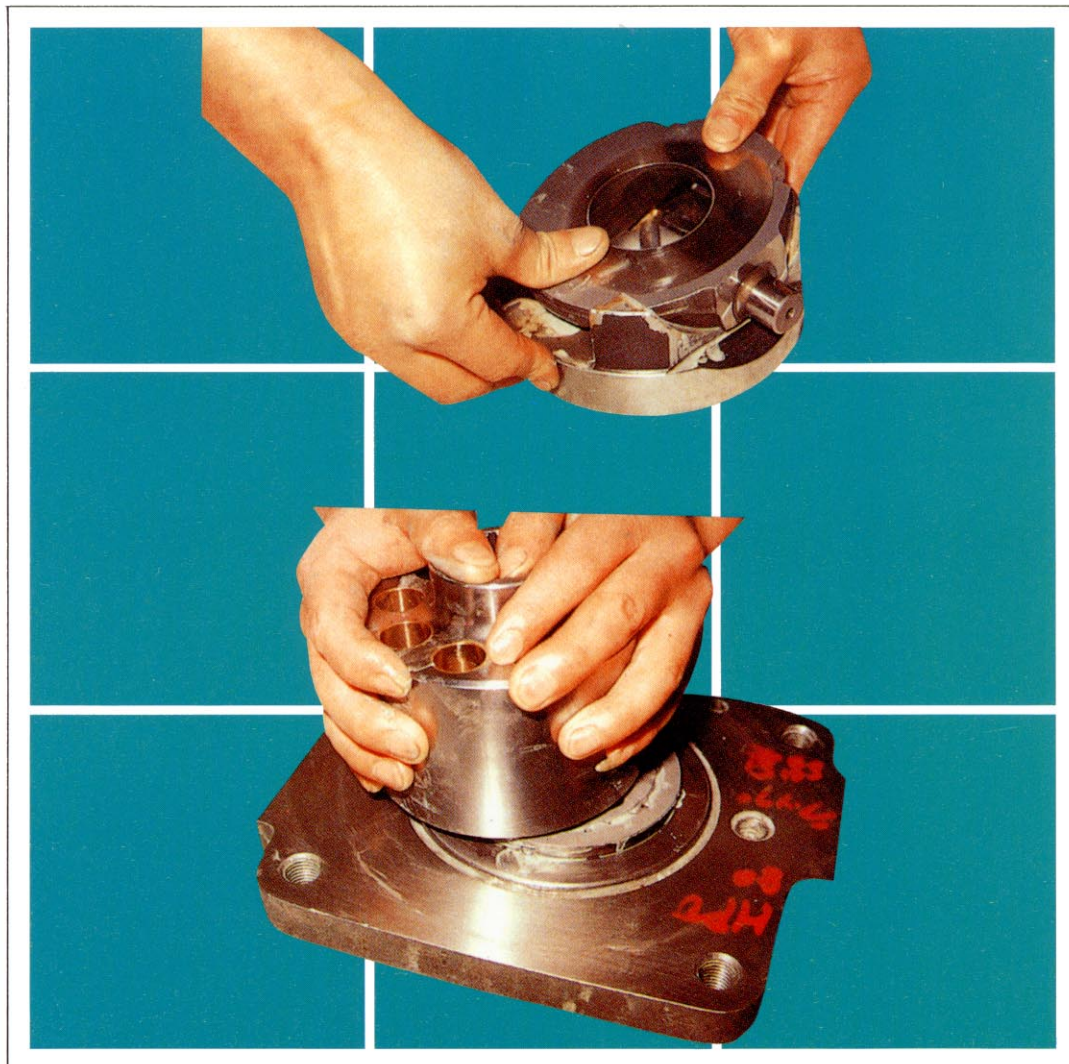




**GUIDANCE
FOR
REUSABLE PARTS**

**PPM/HST PAIR SUPPLY
PARTS LAPPING SKILL**



GUIDANCE FOR REUSABLE PARTS
KOMATSU

INDEX

INTRODUCTION	1
REBUILT PORTIONS BY LAPPING	2
BASIC PROCEDURE FOR LAPPING	6
• Necessary Materials	7
• Procedure for Co-Lapping	
Spherical Surface	8
• Jig for Judgement of Contact	
for Spherical Surface	10
• Procedure for Judging Contact	
of Spherical Surface	11
• Judgement Standard for Contact	
of Spherical Surface	13
• Procedure for Co-Lapping	
Cylindrical Surfaces	14
• Procedure for Judging Contact	
of Cylindrical Surface	16
• Judgement Standard for contact	
of Cylindrical Surface	20
• Procedure for Lapping Flat Surface	
(Example for reference)	23
• Procedure of Correcting Contact	
and Flatness of HST Parts	25

INTRODUCTION

Some of the inner parts for PPM (piston pump motor) and HST (hydrostatic transmission) mounted on Komatsu machines are supplied as sets (pairs). These parts are lapped together at the plant to produce correct contact. For this reason, if one of the pair of parts is replaced with a new part, it is necessary to produce the proper contact between the two parts in the new combination.

To aid in this, this manual introduces the procedures for co-lapping to produce proper contact for the parts, the procedures for judging the contact, and the judgement standards. This manual also includes methods for single lapping of flat surfaces.

Producing the proper contact by lapping, and judgement of the contact requires accumulated experience together with skill and practice. Therefore, until a worker becomes accustomed to the work, judgement about contact must be carried out repeatedly and particularly carefully to learn the necessary skills. In addition, for final quality assurance, always carry out bench tests to check the performance.

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 PPM and HST.

REBUILT PORTIONS BY LAPPING

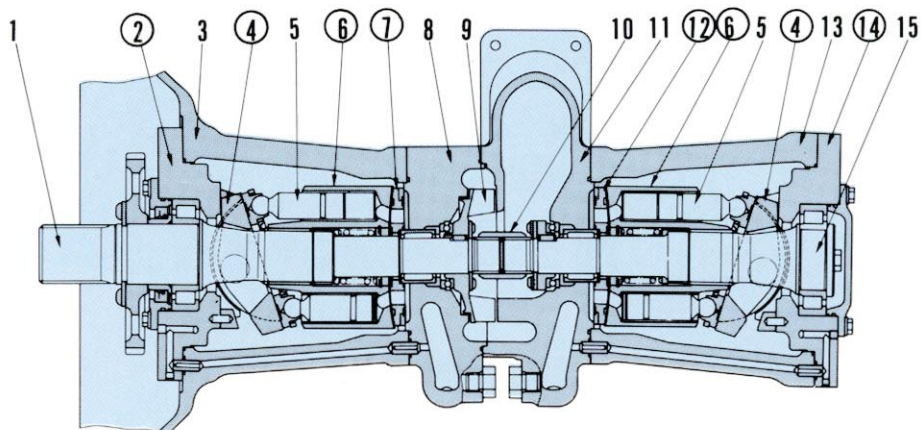
Method of lapping introduced in this manual is applied to all sliding portion of PPM/HST. The portions are as following.

No.	Portion	Category of sliding surface	Applicable PPM/HST model	Method of lapping
1	Between valve plate and cylinder block	Spherical surface	HPV (including HPF), Swash plate variable (fixed) pump	Co-lapping
2	Between cradle and rocker cam	Cylindrical surface	HPV, Swash plate variable pump	Co-lapping
3	Between cradle and rocker cam (Swash plate)	Cylindrical surface	HST, Swash plate variable pump motor	Co-lapping
4	Between end cap and valve plate	Cylindrical surface	KMV, Bent axis variable motor	Co-lapping
5	Between valve plate and cylinder block	Flat surface	KMF-1, KMF-2, Bent axis motor KPW, KPV, Bent axis pump	Single lapping (Using lapping surface plate)
6	Between cradle and piston shoes	Flat surface	HPV Swash plate variable pump	Single lapping (Using lapping surface plate)
7	Between valve plate and cylinder block Between valve plate and end cap	Flat surface	HST	Single lapping (Using lapping surface plate)

HPV Series (Swash plate variable pump)

Example of HPV 160 + 160

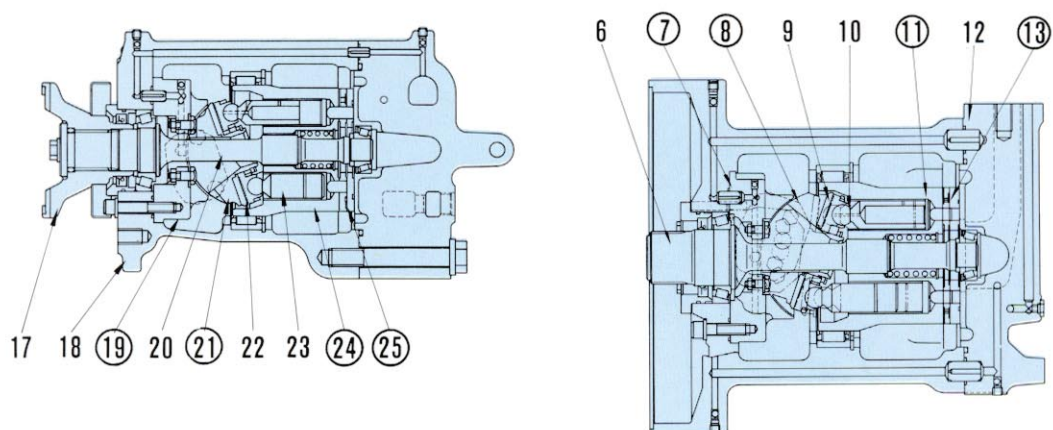
This pump is installed on PC300, 400 (LC)-3.



- Between cradle (2), (14) and rocker cam (4), cylindrical surface.
- Between cylinder block (6) and valve plate (7), (12) spherical surface.

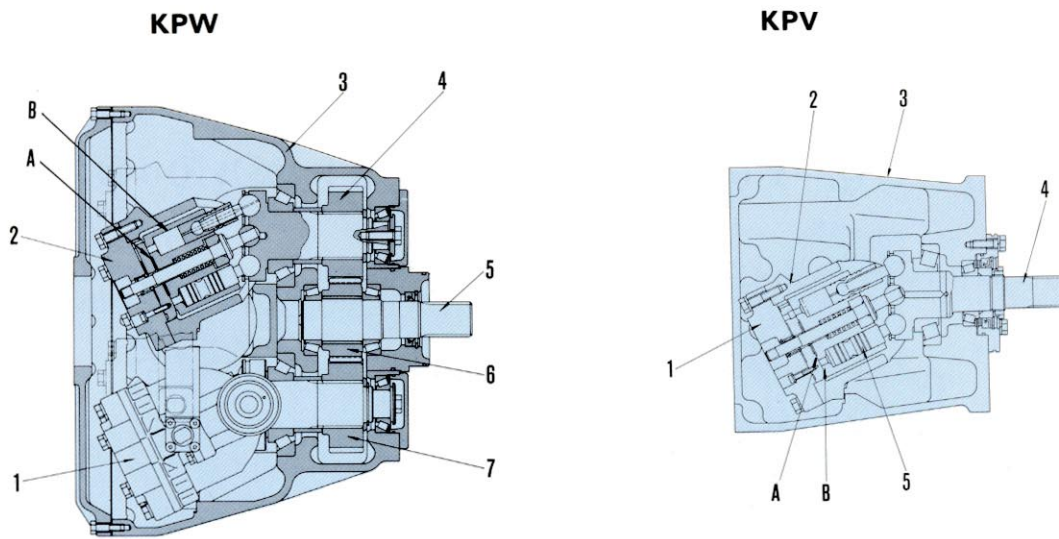
HST (Swash plate variable pump motor)

Installed on D66 S



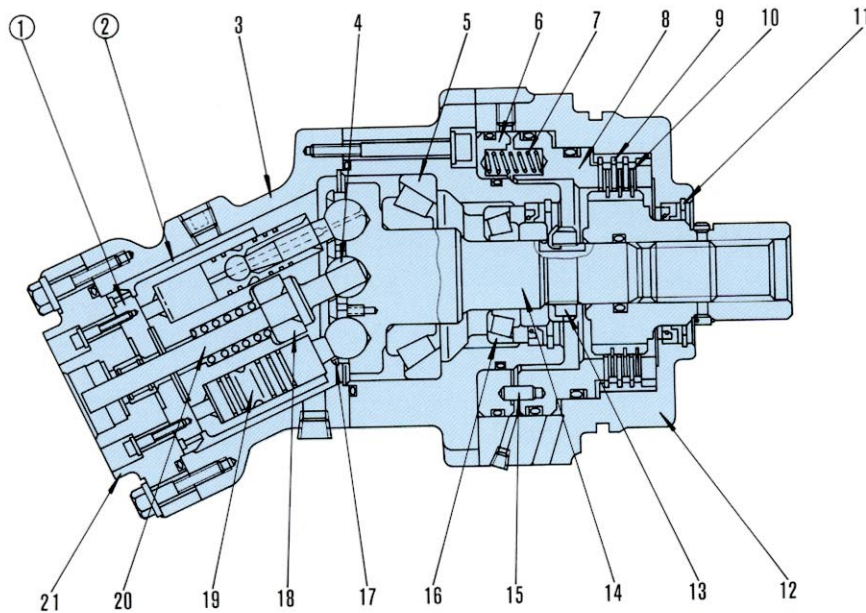
- Between cradle (19, 7) and rocker cam (21, 8), cylindrical surface.
- Between cylinder block (24), (11) and valve plates (25), (13), flat surface.

KPW, KPV Series (Bent axis pump)



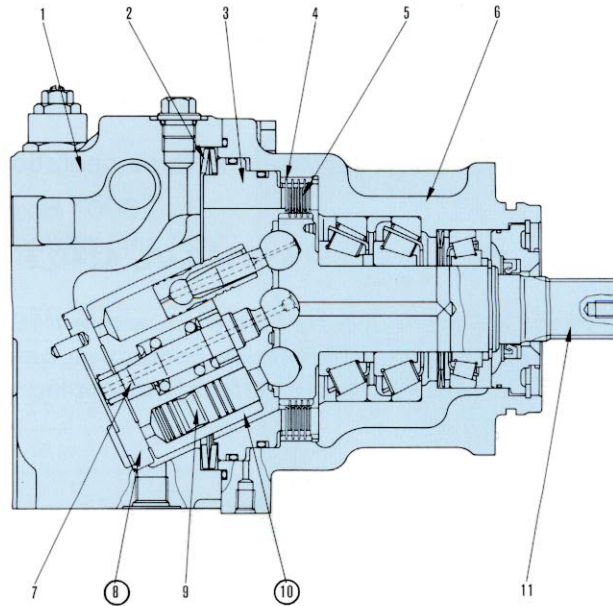
- Between valve plate A (installed on end cover (2)) and cylinder block B, flat surface.

KMF-1 Series (Brake valve add-on or separately installed type, bent axis motor)



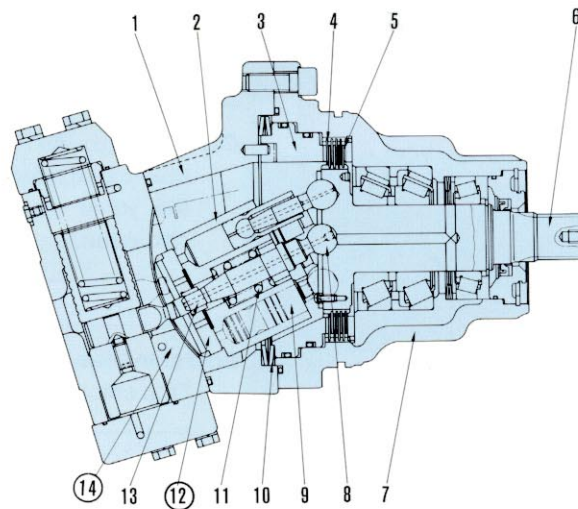
- Between valve plate (1) and cylinder block (2), flat surface.

KMF-2 Series (Brake valve built-in type, bent axis motor)



- Between valve plate (8) and cylinder block (10), flat surface.

KMV Series (Bent axis variable motor)



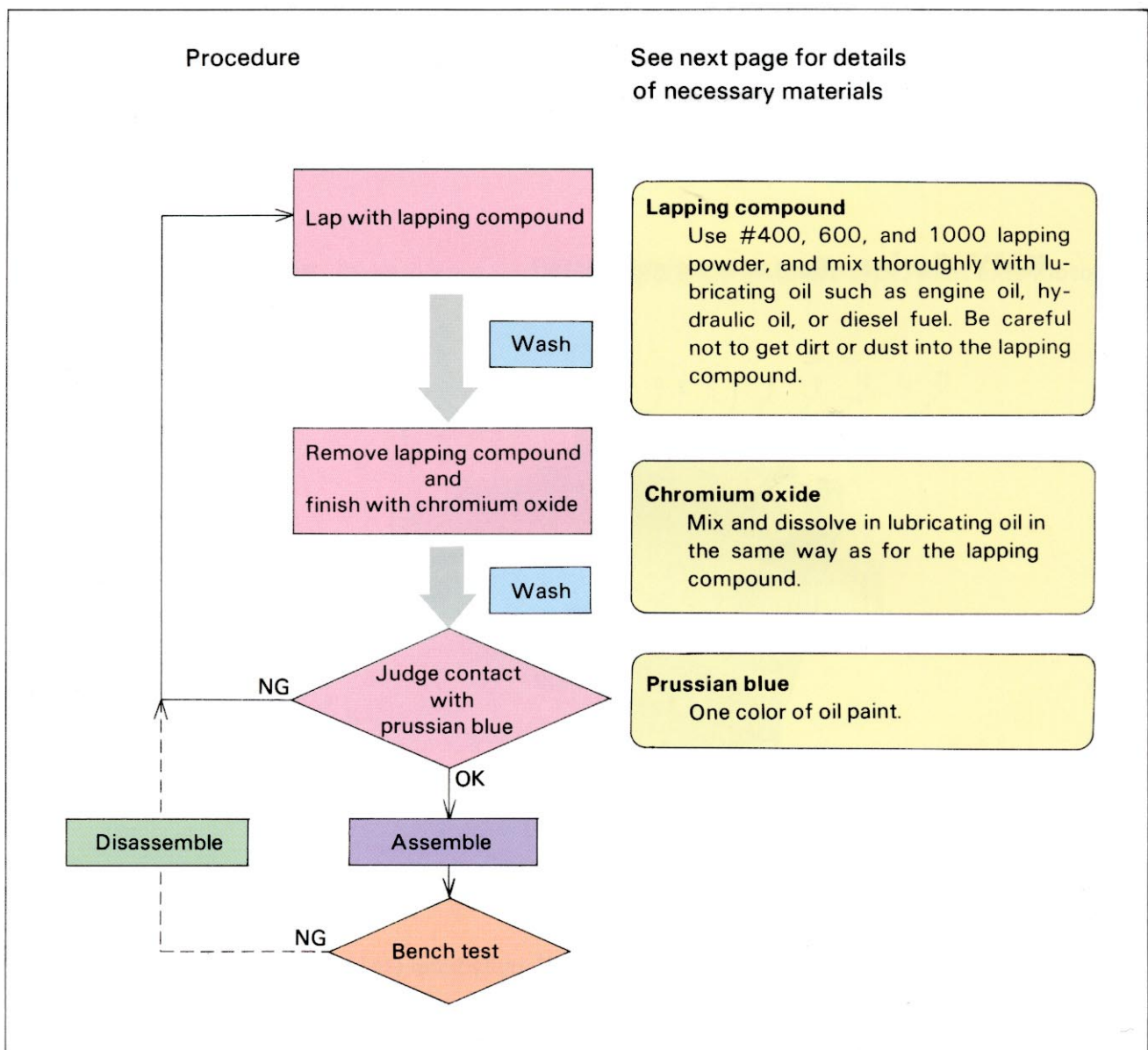
- Between valve plate (12) and end cap (14), cylindrical surface.

BASIC PROCEDURE FOR LAPPING

Wash the parts thoroughly, and be particularly careful to remove all dirt or dust from the lapping surface. Carry out the operation in a dust-free room, in the same way as for disassembly and assembly of the PPM and HST.

The lapping operation can be broadly divided into the three operations given below. However, before starting work, carry out the following.

- Refer to GUIDANCE FOR REUSABLE PARTS SEBG4120-01, 4140 and 4160 to judge whether the parts can be used again.
- Check that there are no burrs. If any are found, remove them with a #1000 oilstone.
- Check the contact condition, and if there is excessive contact on one side, finish the hard part (valve plate or rocker cam) with an oilstone before carrying out lapping.



Necessary Materials (see photographs)

1. Lapping powder

Use #400, 600 and 1000.
(The larger the number, the finer the powder.)

#	Powder mean size (μ)
400	44 – 37
600	31 – 26
1000	18 – 14.5

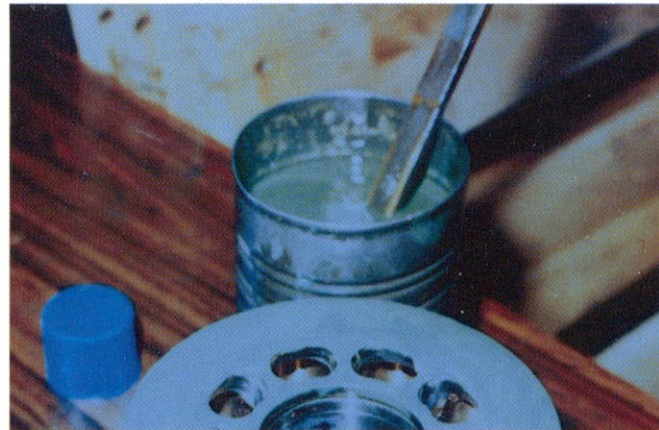
- ★ Mix the powder thoroughly in lubricating oil, and use it dissolved.



2. Chromium oxide

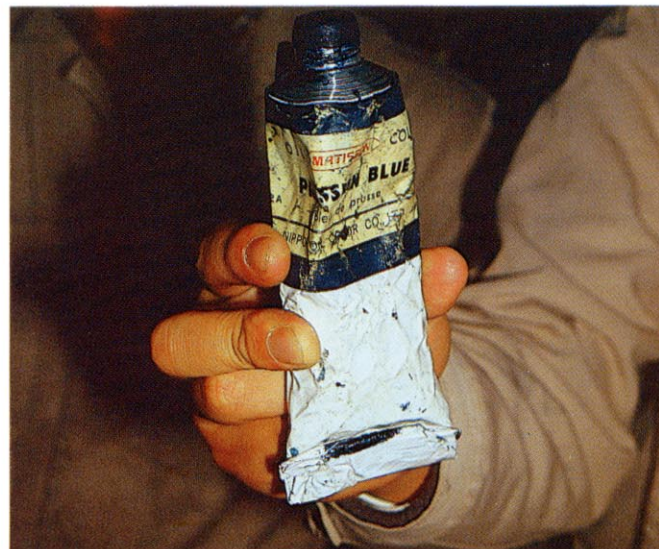
This removes the lapping powder that has got into the metal surface, and at the same time carries out final polishing (mirror polishing).

- ★ The photograph shows chromium oxide dissolved in lubricating oil.



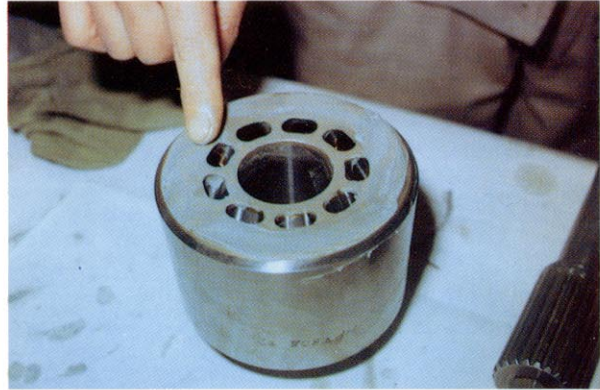
3. Prussian blue

Ordinary oil paint
(Bleu de Prusse)



Procedure for Co-Lapping Spherical Surfaces (Example for HPV Series)

1. Coat the whole sliding surface of the cylinder block evenly with lapping powder.



2. In the same way, coat the sliding surface of the valve plate with lapping powder.

- ★ Align the valve plate with the dowel pin, fit it on top of the end cap, and secure it in position.



3. Fit the cylinder block on the valve plate, and rub the two parts together for two or three minutes.

- ★ When doing this, keep the cylinder block pressed lightly against the valve plate, and move the cylinder block in a large circular motion on top of the valve plate.



4. Wipe off the lapping powder with a cloth, then wash the parts thoroughly, and put lubricating oil on both sides of a piece of paper.

- ★ Any lubricating oil, such as engine oil or hydraulic oil, can be used as the lubricating oil. However, check that there is no dirt or dust in the oil.



5. Fit the piece of paper between the two sliding surfaces, press the cylinder block lightly against the valve plate, and rotate the cylinder block in the same place for two or three minutes to remove the lapping powder from the sliding surface.

★ The motion for the cylinder block is simple rotation, not the large circular motion in Step 3.

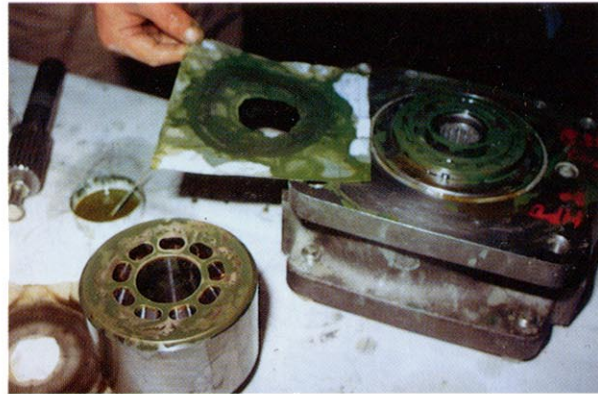


6. Wash again thoroughly, put oil on both sides of a piece of paper, then coat both sides of the paper with chromium oxide (green).



7. Repeat the same procedure as in Step 5. This step removes the lapping powder and carries out final finishing of the sliding surface.

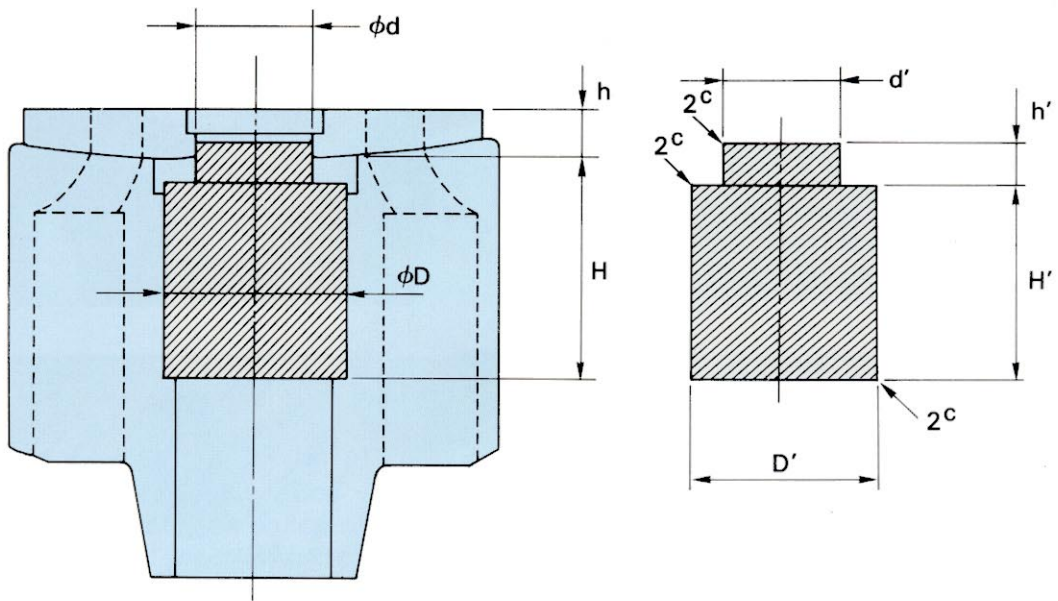
★ Do not continue this procedure for too long, it will cause the corners to droop.



8. Wash the sliding surface thoroughly. (Right: Before lapping; Left: After lapping)



Jig for Judgement of Contact for Spherical Surface



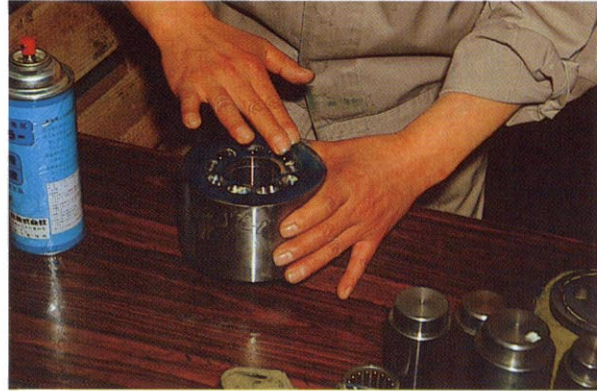
(mm)

Symbol	D'	d'	H'	h'
Dimension	$D - 0.5$	$d - 0.5$	$H - 5.0$	h

Measure the actual dimension (D , d , H , and h) and make a centering jig for judging the contact between the valve plate and cylinder block on the HPV series according to the dimensions given in the table.

Procedure for Judging Contact of Spherical Surface (Example for HPV Series)

1. Coat the sliding surface of the cylinder block thinly and evenly with prussian blue paint.

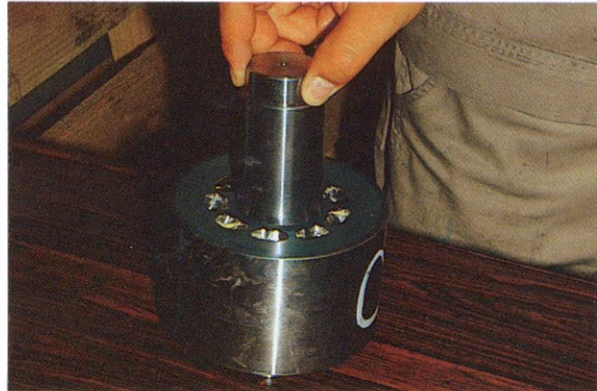


2. The photograph shows the cylinder block painted as thinly and evenly as possible with paint.

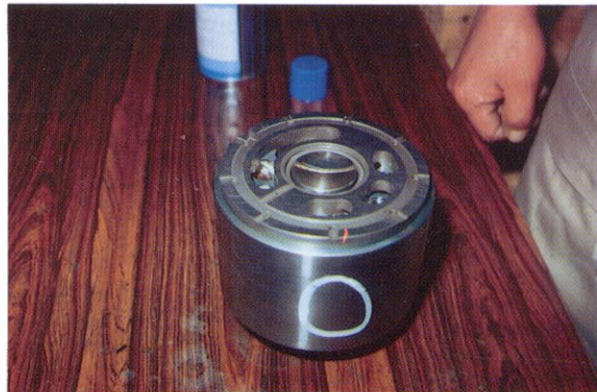
- ★ The paint must be coated thinly and evenly. There must be neither too much nor too little paint, nor must there be any variation in the amount. Therefore, use your experience to judge the most suitable amount and method of coating with paint.



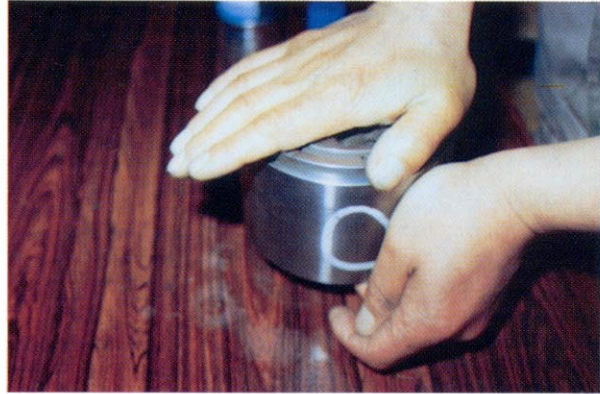
3. Insert the centering jig.



4. Set the valve plate on top quickly before the paint has time to dry.



5. Push down on the valve plate with a force of 4 – 5 kg, and move the valve plate backwards and forwards 90° two or three times.



6. Remove the valve plate.



7. Set the valve plate on the work stand with the sliding surface facing up. Then stick mending tape to the whole surface and push down on the tape to press it against the surface.

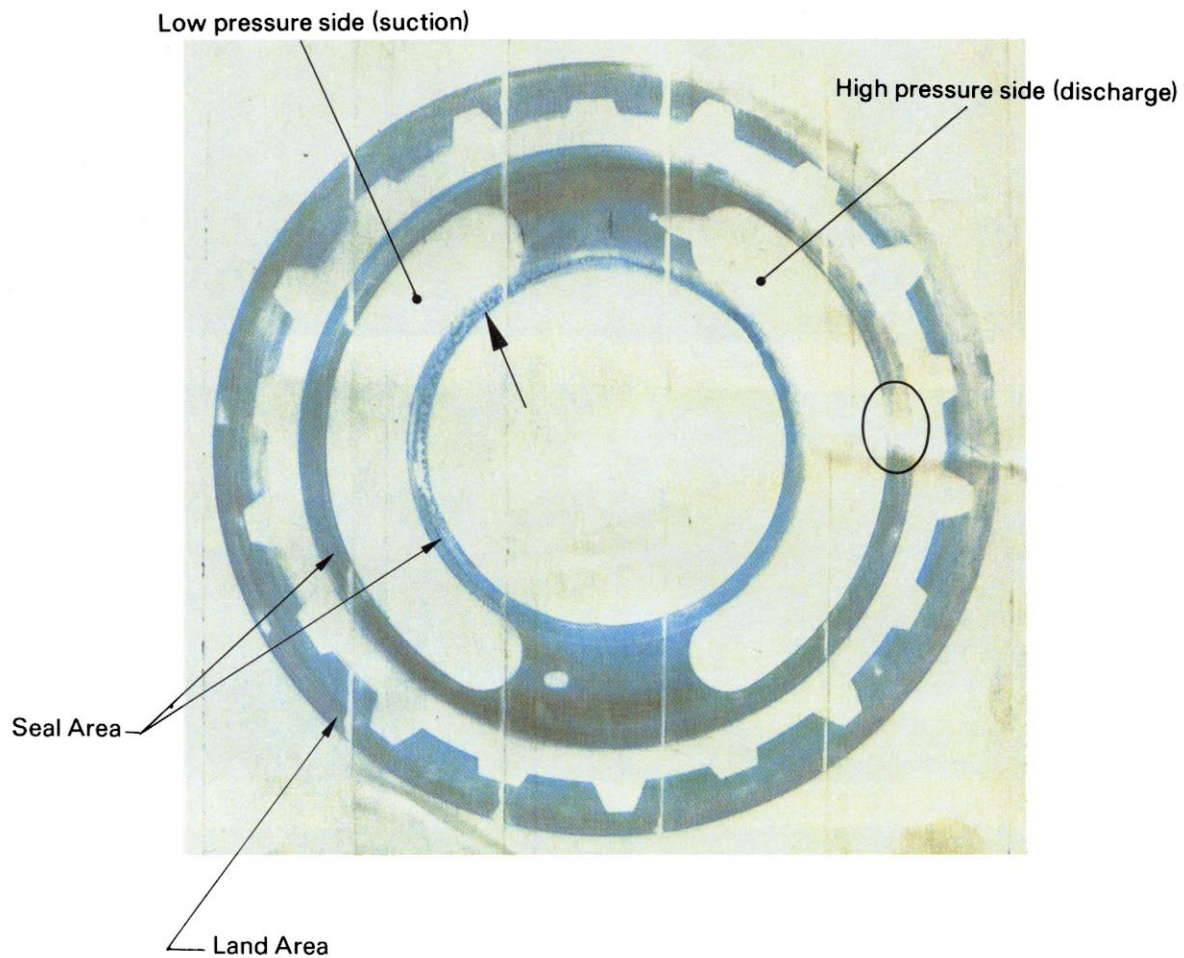


8. The photograph on the right shows mending tape stuck to the whole surface. Remove this tape and stick it to white paper so that judgement can be made about the contact.



Judgement Standard for Contact of Spherical Surface

Contact between cylinder block and valve plate of HPV Series



- Seal Area
 - Contact area must be more than **80%**
 - There must be **no break** in the contact for the whole circumference on the high pressure side
- Land Area
 - Contact area must be more than **60%**

Judgement sample

The judgement is "Fail".

Reason

- The contact covers an area of approx. 80%, but there is a break at the area marked ○.
- In addition, there is oil at the part marked by the arrow, so it is probably impossible to make an accurate judgement of contact. Remove all the oil and try again.

Procedure for Co-Lapping Cylindrical Surfaces (Example of cradle and rocker cam on HPV Series)

1. Coat the sliding surface of the cradle evenly with lapping powder.



2. Coat the sliding surface of the rocker cam also evenly with lapping powder.

- ★ Check the lubrication hole in the cradle and the lubrication groove in the rocker cam.
- ★ The hole and groove are on the high pressure side.



3. Align the sliding surfaces, set the rocker cam on top of the cradle, and rub together for two or three minutes.

- ★ Then, aligning the sliding surfaces, set so that the lubrication hole in the cradle matches the lubrication groove in the rocker arm.



4. Wipe off the lapping powder with a cloth and wash the parts. Then drop lubricating oil on the sliding surface of the cradle and rocker cam.



5. Rub both sliding surfaces with paper to remove both the oil and the lapping powder.



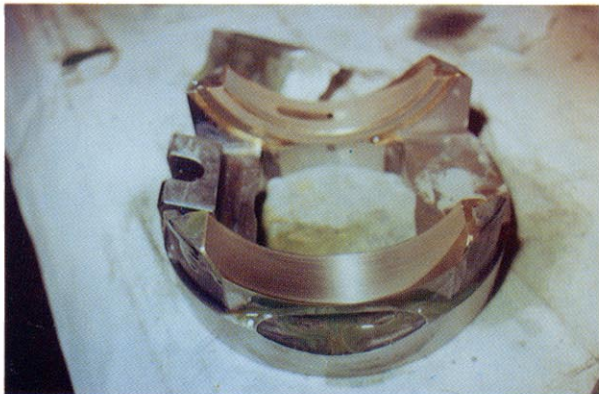
6. Put a suitable amount of chromium oxide (green) on a piece of paper, and remove the oil.



7. Repeat the same procedure as in Step 5.
This step removes the lapping powder and carries out final finishing of the sliding surface.



8. Wash the sliding surface thoroughly.
This completes the lapping.



Procedure for judging Contact of Cylindrical Surface (Example for HPV series)

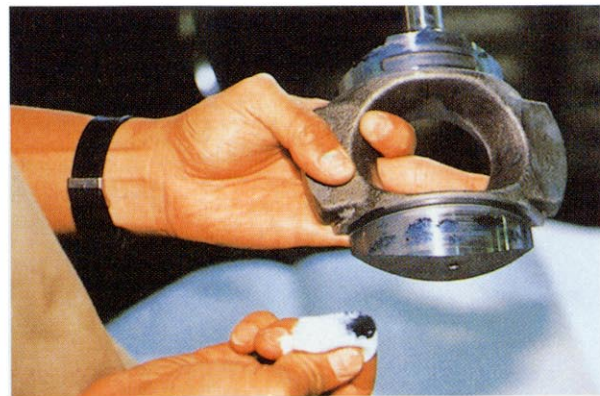
1. Wash the sliding surface of the rocker cam thoroughly with spray detergent.



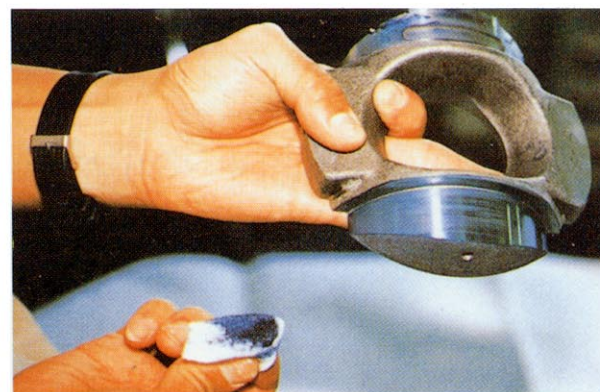
2. Wash the cradle thoroughly in the same way as in Step 1.



3. Put prussion blue paint on the cylindrical surface of the rocker cam patting with cloth.

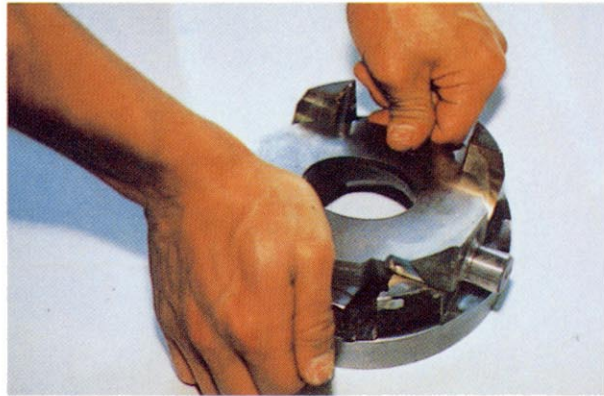


4. Coat the surface with the blue paint thin and evenly.

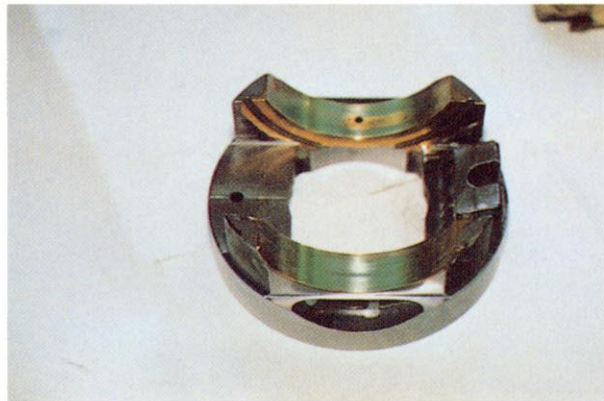


5. Align the rocker cam on the cradle and slide the cam two or three times pressing down with 8 to 10 kgs.

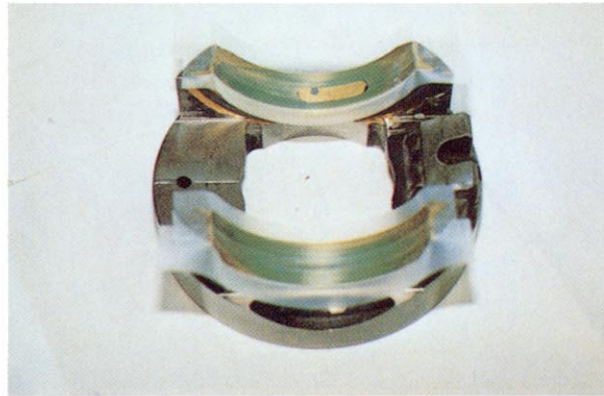
★ Check the lubrication groove in the cam is aligned on the hole side of the cradle.



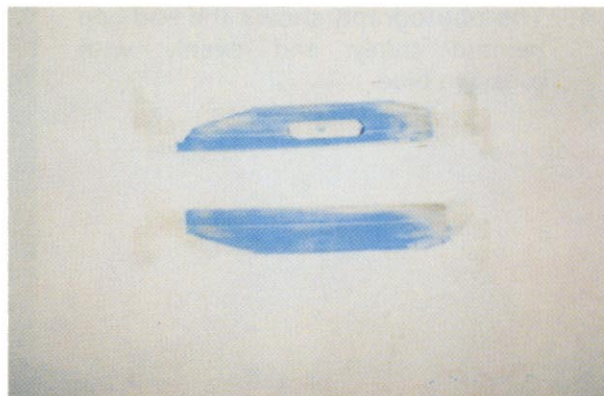
6. The blue paint is transferred from the cam to the cradle shown in this picture.



7. Stick mending tape on the cylindrical surface and press it thoroughly.

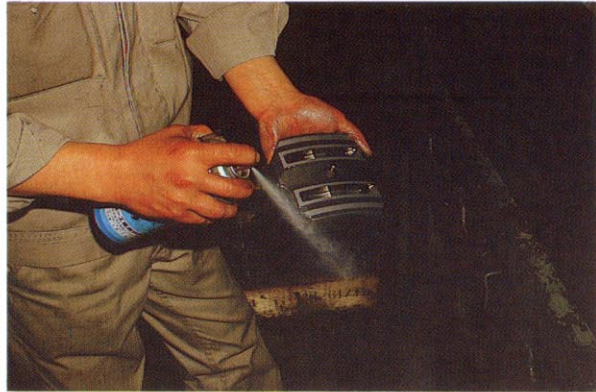


8. Remove the tape and stick it to white paper so that judgement can be made about the contact.

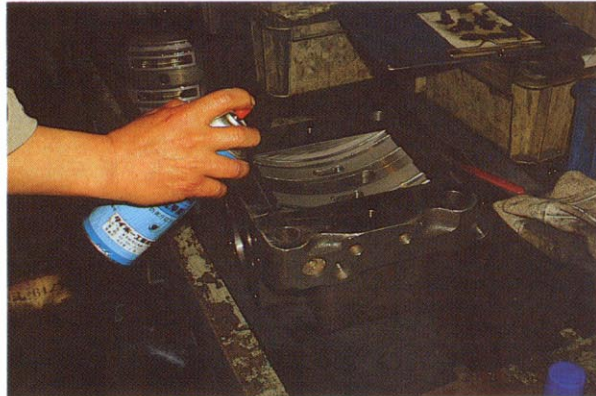


Procedure for judging Contact of Cylindrical Surface (Example KMV)

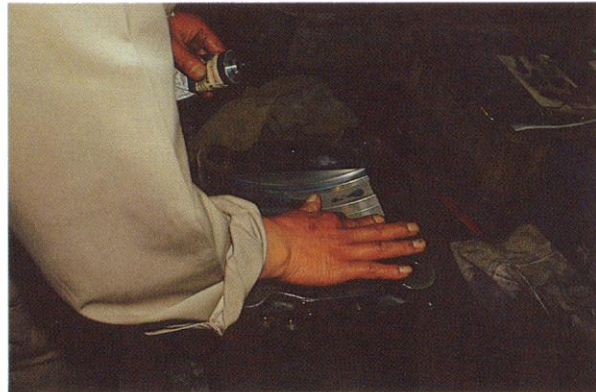
1. Wash the sliding surface of the valve plate thoroughly with spray detergent.



2. Wash the end cap thoroughly in the same way as in Step 1.



3. Coat the sliding surface of the end cap thinly and evenly with prussian blue paint.



4. The photograph shows the end cap painted thinly and evenly with prussian blue.

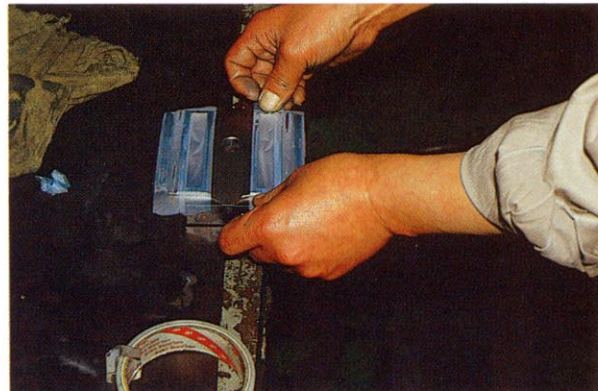


5. Align the sliding surfaces and set the valve plate on top of the end cap. Push down on the whole area of the valve plate by hand, and move the valve plate backwards and forwards two or three times, making the valve plate protrudes about 1/4 from the end surface of the end cover.

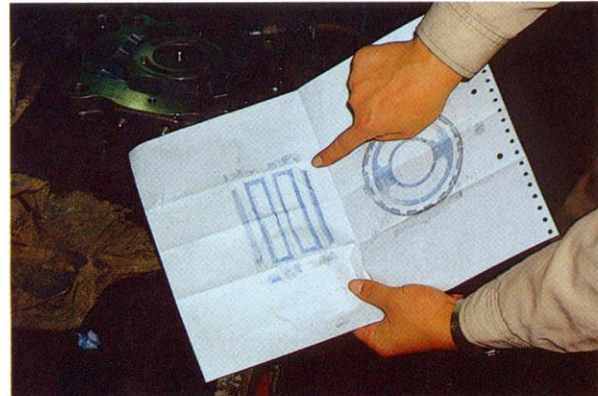
★ Push down with a force of 8 – 10 kg. Try pushing down on scales to get the feeling of 8 – 10 kg.



6. Stick mending tape to the sliding surface of the valve plate and push down on the tape to press it against the surface.

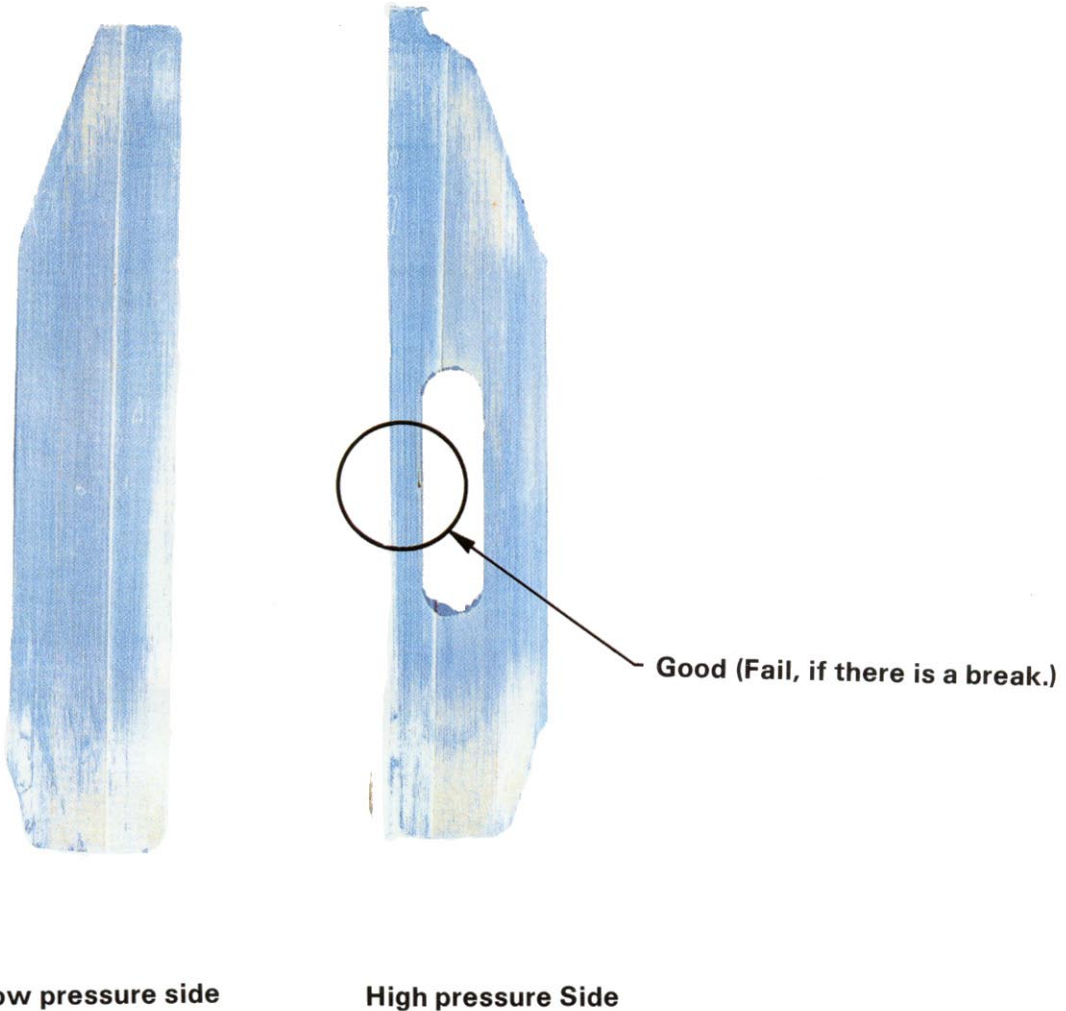


7. Remove the mending tape from the valve plate and stick it to white paper so that judgement can be made about the contact.



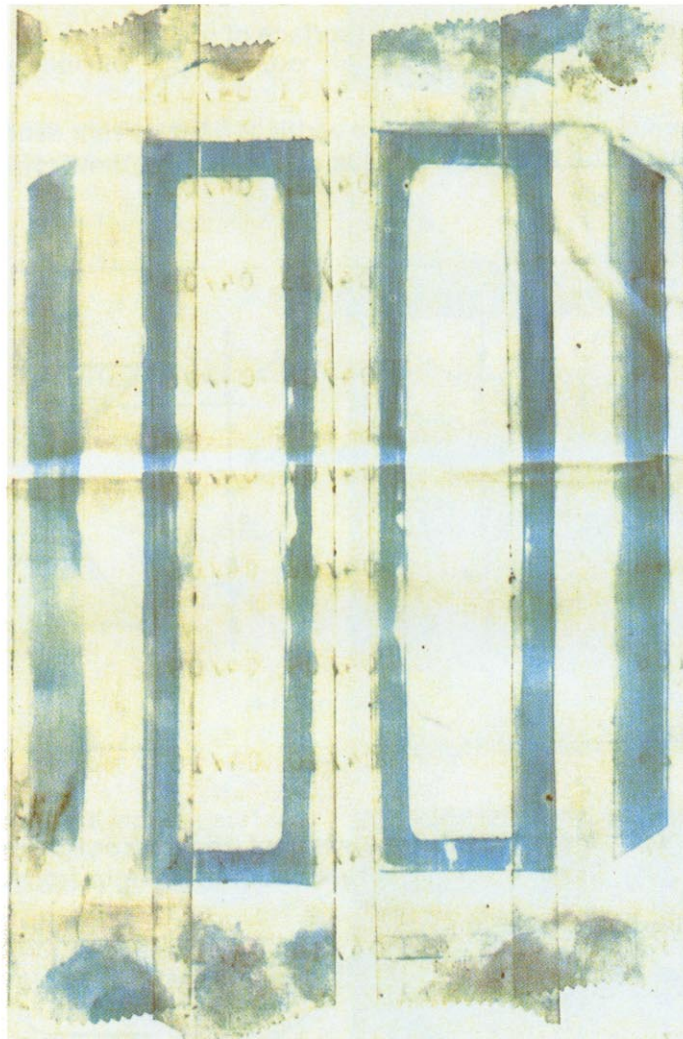
Judgement Standard for Contact of Cylindrical Surface

1. Contact between cradle and rocker arm on HPV Series



- To pass, the contact must fulfil the following conditions.
- Area of contact (area stained by prussian blue) must be
 - (1) At least **80%**and, in particular, with the contact at the high pressure side,
 - (2) There must be **no break**

2. Contact between end cover and valve plate on KMV Series



Same as Item 1 above.

- With the KMV, the high pressure side and low pressure side are interchanged, so it is important that there is no break in contact in the area marked



Judgement sample

- Judgement is "Pass".

Reason

- There is no break in the contact in the



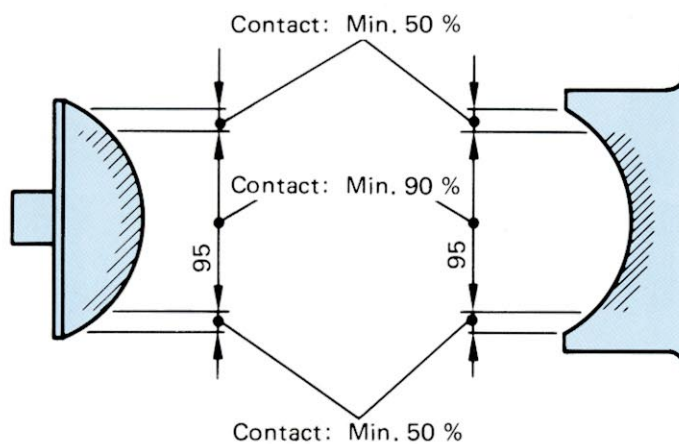
area.

3. Judgement standard for contact of HST

Check contact between cradle and cylindrical surface of rocker cam.

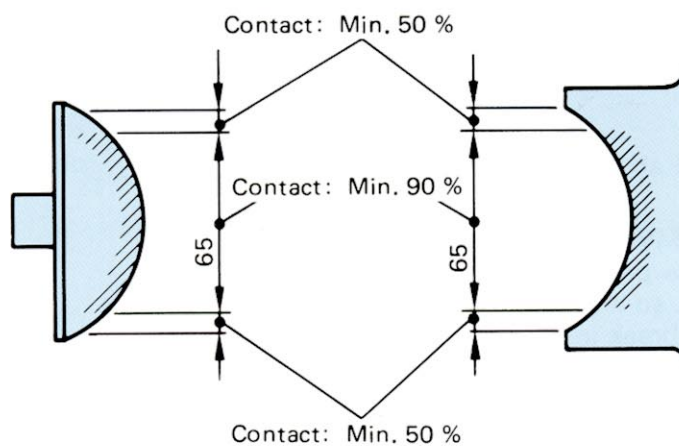
1) For motor

- Contact must be over 90% inside a width of 95 mm from center (center part).
- Contact must be over 50% outside a width of 95 mm from center (outside part).



2) For pump

- Contact must be over 90% inside a width of 65 mm from center (center part).
- Contact must be over 50% outside a width of 65 mm from center (outside part).



- ★ It is not permitted if there is no contact in the center, and only contact on the outside.
- ★ In case of wrong contact, correct contact.

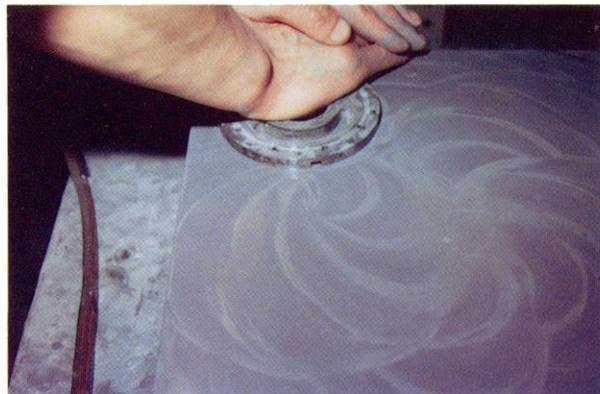
Procedure for Lapping Flat Surfaces (Example for reference)

1. Check the contact, and if there is excessive contact on one side, polish with an oilstone.

- ★ Be careful not to rub off too much.
- ★ If there is no place with excessive contact, go on immediately to Step 2.

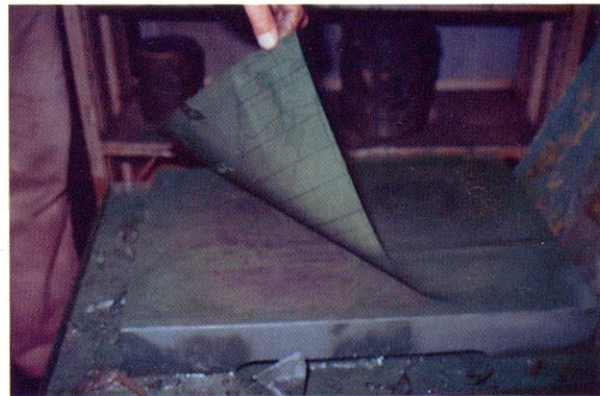


2. Carry out lapping on a lapping surface plate.



3. Spread paper on the lapping surface plate, and coat the whole surface with chromium oxide (green).

- ★ When using the same lapping surface plate as in Step 2, clean the surface thoroughly first.



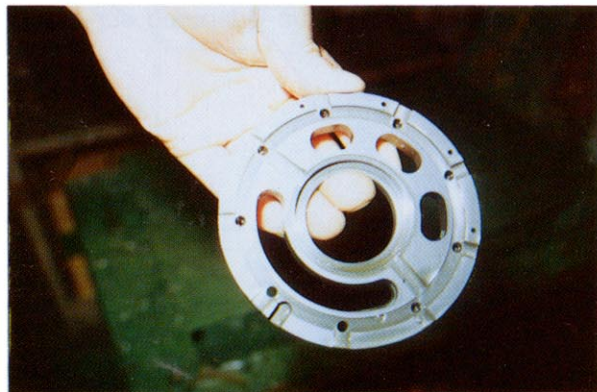
4. Wash the flat surface thoroughly.



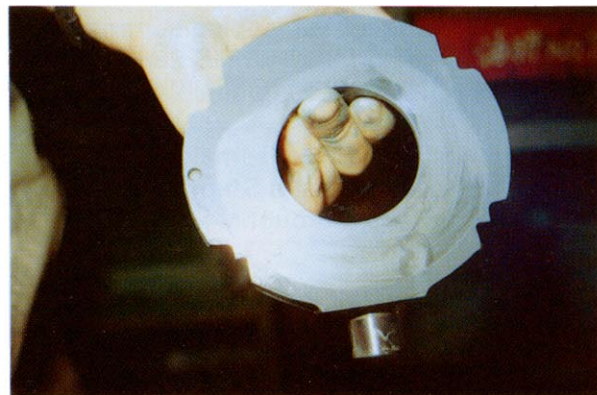
5. Carry out final finishing on the surface plate prepared in Step 3.



6. Wash the flat surface thoroughly. The photograph shows the flat surface of a finished valve plate.



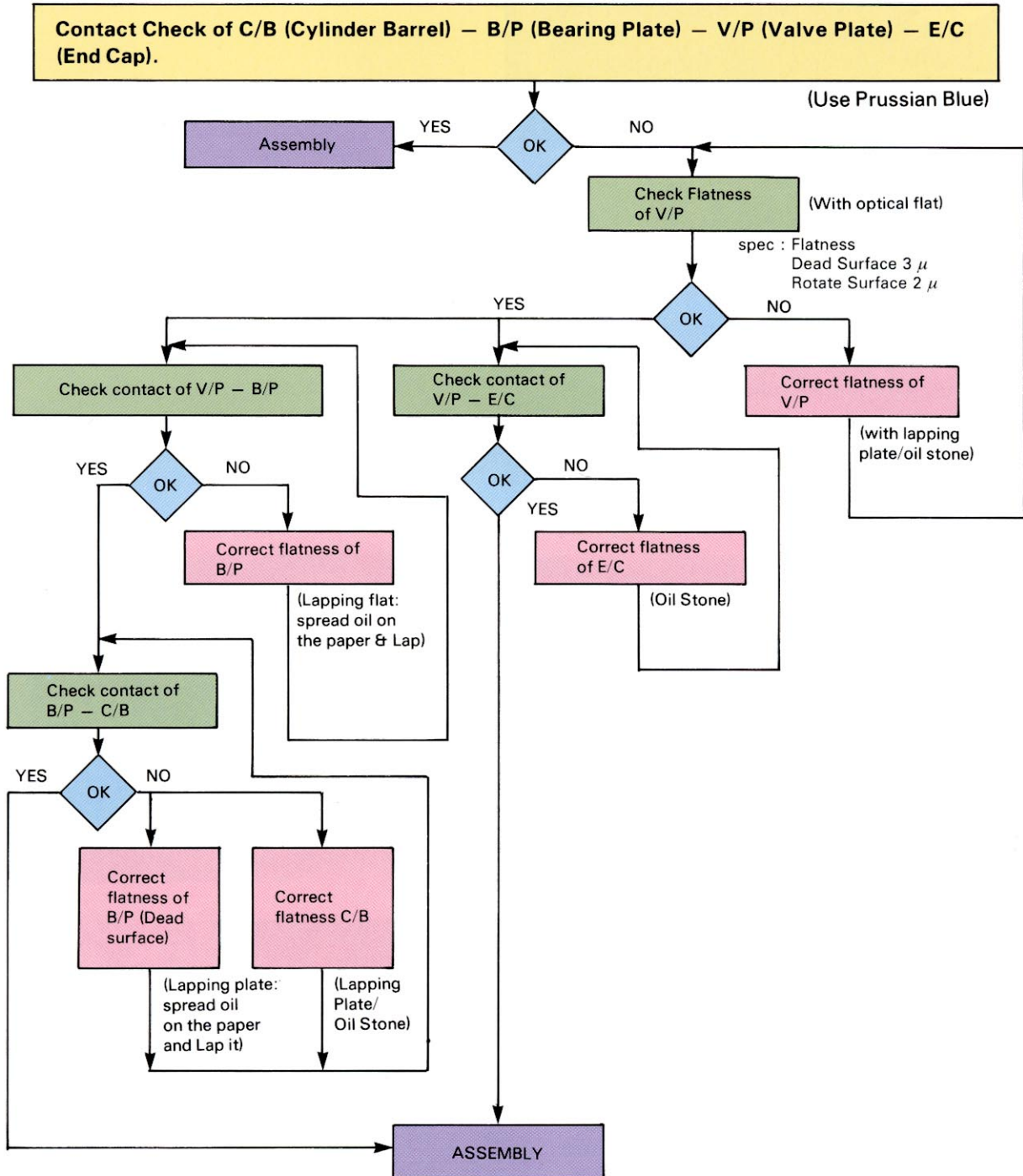
- **Rocker cam**
Carry out lapping in the same way as for the valve plate. The photograph shows the flat surface of a finished rocker cam.



Procedure of Correcting Contact/Flatness of HST Parts

Judgement Standard for Contact

1. Contact area must be more than 80% at seal areas and 60% at non-seal area. (Land Area).
 2. There must be no break in the contact for the whole circumference on seal area.
- ★ See the 13 page for your reference.



How to Check and Correct Flat Surfaces

This example is shown how to correct and check the flatnesses of the vital parts surfaces of piston pumps and motors.

Applicable To:

- HST:
- Both surfaces of valve plate
 - Valve plate fitting surface of end cap
 - Bearing plate fitting surface of cylinder barrel
 - Both surfaces of thrust plates.

- Excavator:
- Fitting surface to end cap of valve plate
 - Valve plate fitting surface of end cap
 - Shoe sliding surface of rocker cam.

1. When contact between the parts is bad, lap the surface of the parts on the lapping flat.

Press the part by hand with force of 4 – 6 lbs.

Slide the part on the lapping flat making the rotation as shown below.



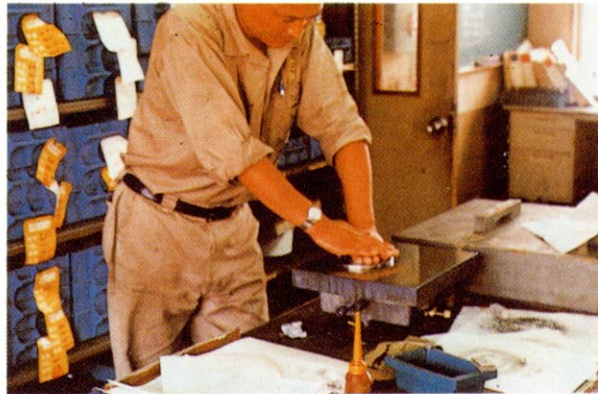
2. Wash the part with solvent detergent. After washing, go on to the "finish" lapping.

- Put paper on the same lapping flat.
- Using acid crome (or 3000 grid compound) lap the part on the paper.
[Same way as mentioned on the front page.]

After the "finish" lapping and washing, put new paper on the contact checking flat (or lapping flat) Remove the acid crome on the surface of the part by sliding the part on the flat.



3. To check contact between the part and contact checking flat, press the part on the flat by hand the same way mentioned on the front page.



4. Check contact by looking at the surface carefully, shining points or areas are higher on the surface.



5. Rub the higher points or areas with oil stone.
(Grid is around 1000)



6. Clean the surface with cleaning solvent use clean cloth or paper.



7. Deer skin is recommended to remove the acid creme thoroughly.



8. Clean the optical flat with cleaning solvent.

Use clean cloth or paper.



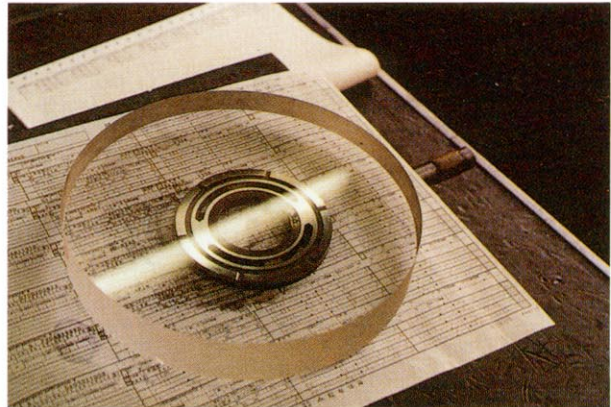
9. Wipe the optical flat with deer skin.
(Do not use the same deer skin used
to remove the acid crome.)



10. Place the optical flat on the part.

Count the number of bands.
 $0.3 \mu\text{m}/\text{band}$

Press the optical flat by a finger. To
check which is the lower part.



[Note] Regarding how to use optical flat in detail, please study the operation
manual of the optical flat.

This completes our explanation of know-
how in the plant. To repeat once more, prac-
tice and skill are essential for lapping
operations.

After finishing the lapping, always carry
out final confirmation of the quality with
bench tests.

