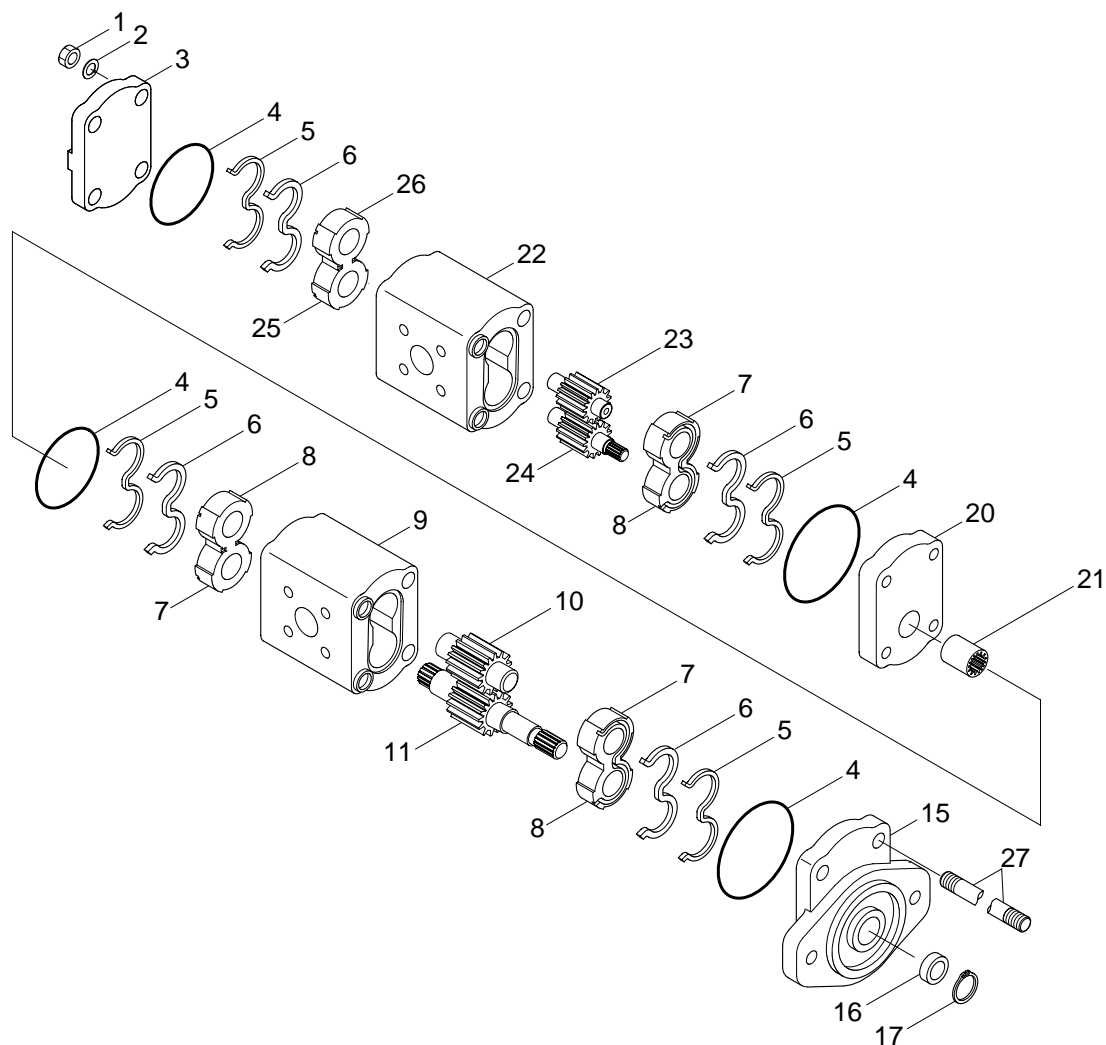


GROUP 4 DISASSEMBLY AND ASSEMBLY

1. MAIN PUMP

1) STRUCTURE



- 1 Nut
- 2 Spring washer
- 3 End cover
- 4 O-ring
- 5 Back up seal
- 6 Bush seal
- 7 Bushing
- 8 Bushing

- 9 Front body
- 10 Driven gear
- 11 Driveshaft and gear
- 15 Flange
- 16 Shaft seal
- 17 Circlip
- 20 Spacer plate
- 21 Splined coupling

- 22 Rear body
- 23 Driven gear
- 24 Driveshaft and gear
- 25 Bushing
- 26 Bushing
- 27 Stud

2) GENERAL INSTRUCTION

(1) Cleanliness

- ① Cleanliness is the primary means of assuring satisfactory hydraulic pump life. Components such as flanges and covers are best cleaned in soap and hot water, then air dried. Gears should be washed in solvent, air dried, and oiled immediately.

▲ Certain cleaning solvents are flammable. Do not allow sources of ignition in the area when using cleaning solvents.

- ② Protect all exposed surfaces and open cavities from damage and foreign material.

*** Gear journals and gear faces are super finished. Take care not to touch these surfaces after oil and solvent have been removed.**

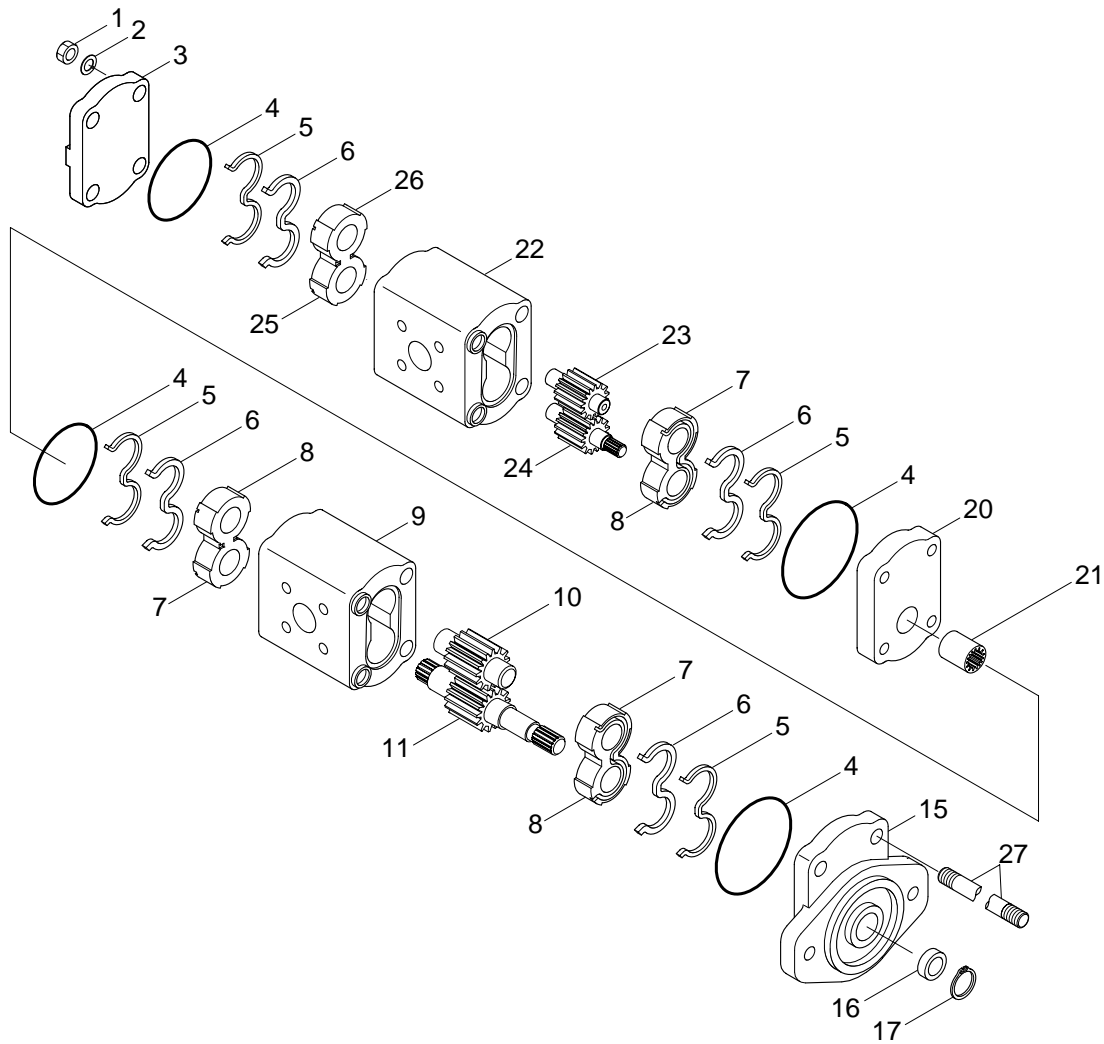
(2) Lubrication of moving parts

During assembly, all running surfaces(Bushing and spacer plate) must be lightly lubricated with a clean oil or aerosol lubricant.

(3) Tools required for assembly

- ① Torque wrench(0~20kgf · m, 0~150lbf · ft)
- ② Open end wrenches
- ③ Seal installation tools(Inner and outer)
- ④ Shaft bullet(Seal protector)
- ⑤ Installation plate

3) DISASSEMBLY

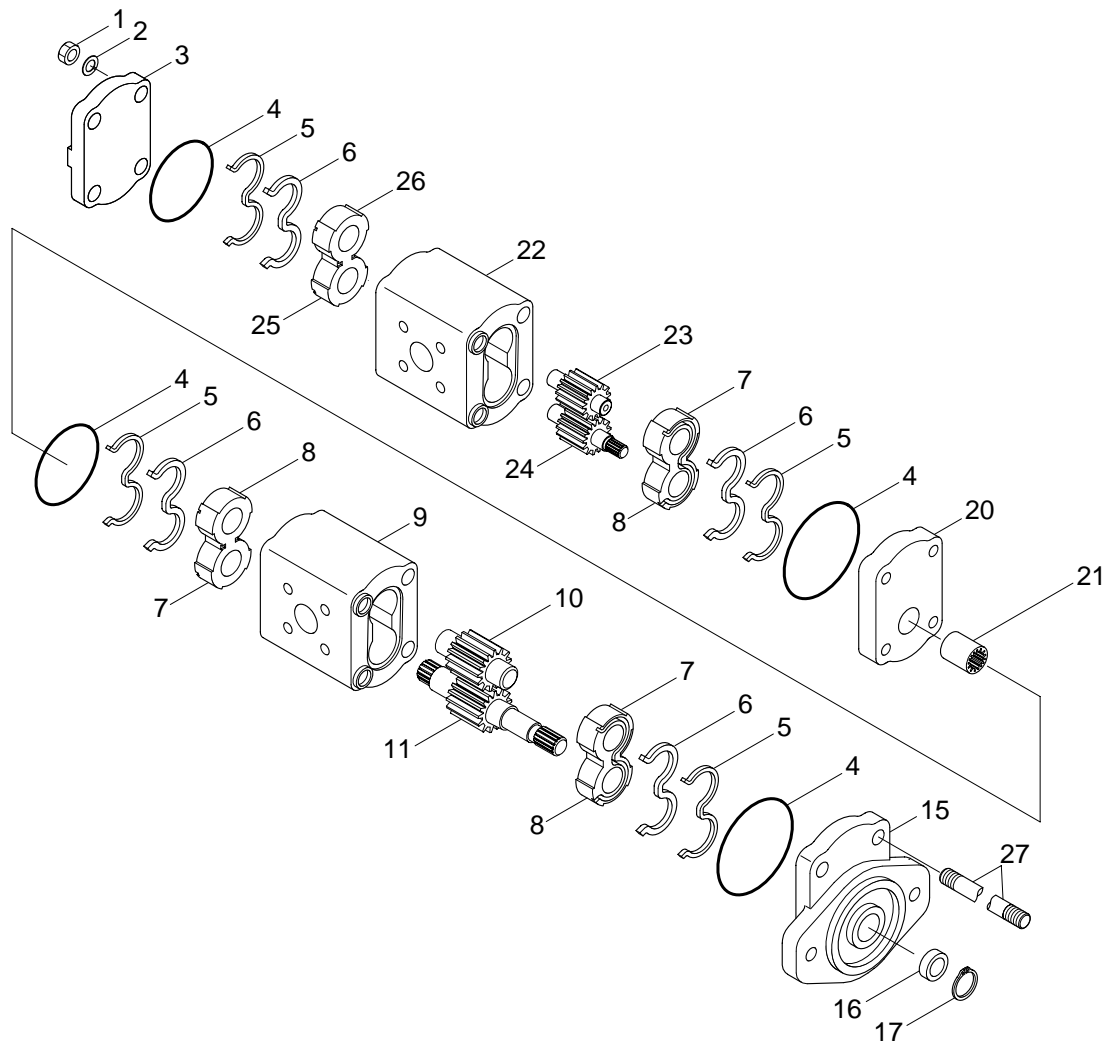


※ Prior to starting work ensure that the pump and the working area are thoroughly clean and free from sources of contamination.

- (1) Mark end cover(3), center body(22), front body(9) and mounting flange(15) to ensure correct assembly.
- (2) Remove the 4 stud bolts(27) serrated washers(2), nut(1) clamping the units together, separate the pumps by removing the rear unit from the location dowels in the center body - use a soft faced hammer.
- (3) Remove splined coupling(21).
- (4) Disassemble rear pump by removing the end cover(3) from the body(22), free cover front location spigot using a soft faced hammer.
- (5) Remove drive shaft(24) from its bore by pushing it out from the connection hole in the rear face, this will also remove bushing(7, 8).

※ Note position of gear and bushing for correct reassembly.

DISASSEMBLY



- (6) Remove driven gear(23) and lower bushing(25, 26).
- (7) Discard O-ring(4) from end cover, seal element(5) and seal energizer(6) from bushing.
- (8) Disassemble front pump by separating flange(15) from its location spigot in body(9) - use soft faced hammer.
- (9) Remove circlip(17) and shaft seal(16) take care to ensure that the seal recess is not damaged as this could result in leakage.
- (10) Grasp drive shaft(11) and remove it with bushing(7, 8), finally remove driven gear(10) and lower bushing(7, 8).
- ※ Note their positions for correct assembly.
- (11) Remove and discard O-ring(4) in flange recess and seal element(5) and seal energizer(6) from bushing.
- (12) Clean off all loctite sealant from flange/body and end cover/body interfaces.

4) INSPECTION AND REPAIR

(1) Assessment

Each component should be thoroughly cleaned, carefully examined and assessed for suitability of re-use. Below is a guide for inspecting the various components.

(2) Body

- ① Inspect the body bore cut-in where gears wipe into the body.
- ② The body can only be re-used if the **cut-in** is bright and polished in appearance and the depth does not exceed 0.8mm(0.03in).
- ③ The body should be replaced if the surface is scored, has a matt appearance or shows signs that the tip of the gears have dug in and torn away the surface material.
- ④ The body should be inspected to ensure that there is no superficial damage which may adversely effect performance or sealing. Pay particular attention to the port threads and body O-ring seal recesses.

(3) Mounting flange and end cover

- ① The inner surfaces should be inspected to ensure that there is no unusual wear or scoring in the regions where the body O-rings and bush seals contact, which result in external leakage.
- ② Check the shaft seal recess for scoring or damage that could result in oil leakage around the outer diameter of the shaft seal. Replacement shaft seals can be refitted with Loctite hydraulic sealant to overcome slight damage in this area.

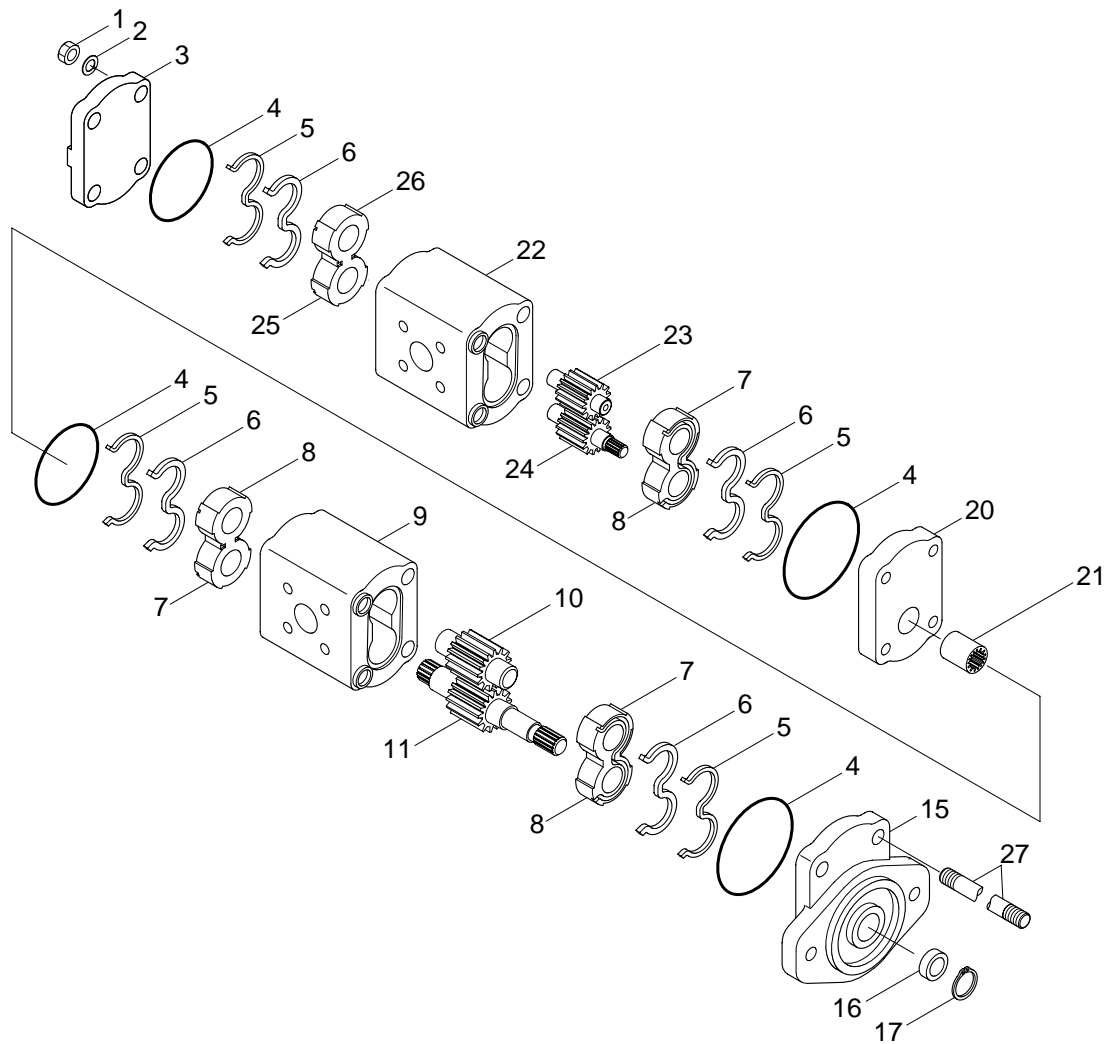
(4) Bushings

- ① The side faces which abut the gears should be perfectly flat showing no sign of scoring. Characteristically there are bright polished areas on this surface caused by loading against the gear side faces, which is often more pronounced on the low pressure side. These should be replaced if there is any general scoring or fine scoring with a matt appearance or tearing of the surface material. Often there is a witness where the tips of the opposing gears have wiped an overlap reassembling a half moon shape. There must be no noticeable wear step as it is critical that the bushing side face is completely flat to the gear side face.
- ② The bushing bearing liners are acceptable providing that they are not scored or show other damage. The general outside area of the bushing should not show any prominent signs of wear.

(5) Gears

- ① The gear side faces should be examined for bruising or scoring. Often operation on contaminated fluid shows scoring between the root of the gear and the journal undercut, which leaves a wear step. If a wear step can be felt, coincidental with the root diameter, by drawing a sharp pointed tool across the surface from the journal undercut outwards towards the tip of the gear, then the gear is unserviceable.
- ② The gear teeth should then be carefully examined to ensure that there are no signs of bruising or pitting.
- ③ The journal bearing surfaces should be completely free from scoring or bruising. The surface should appear highly polished and smooth to touch.
- ④ Examine the area where the shaft seal lips run on the drive shaft, this shows up as a polished ring or rings. If a noticeable groove can be felt or there is scoring the shaft should be replaced.
- ⑤ Provided the drive shaft is not damaged from the drive-coupling and the gears have not been harmed as described above, then the gears can be re-used. If, however, the gears are damaged they must be replaced as a matched set.
- ⑥ As a matter of good practice, when pumps have been disassembled, all the seals should be replaced. It is most important that only the genuine seals are used.

5) ASSEMBLY



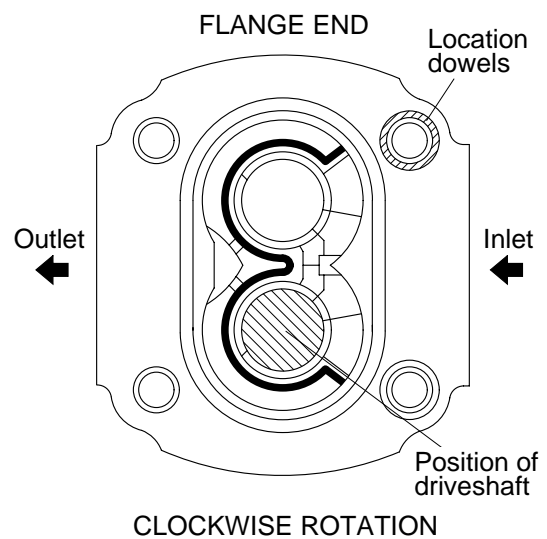
- ※ Prior to assembly all parts must be perfectly clean and lubricated with clean hydraulic oil.
- ※ Renew all seals using clean hydraulic oil as a lubricant.

(1) Front pump

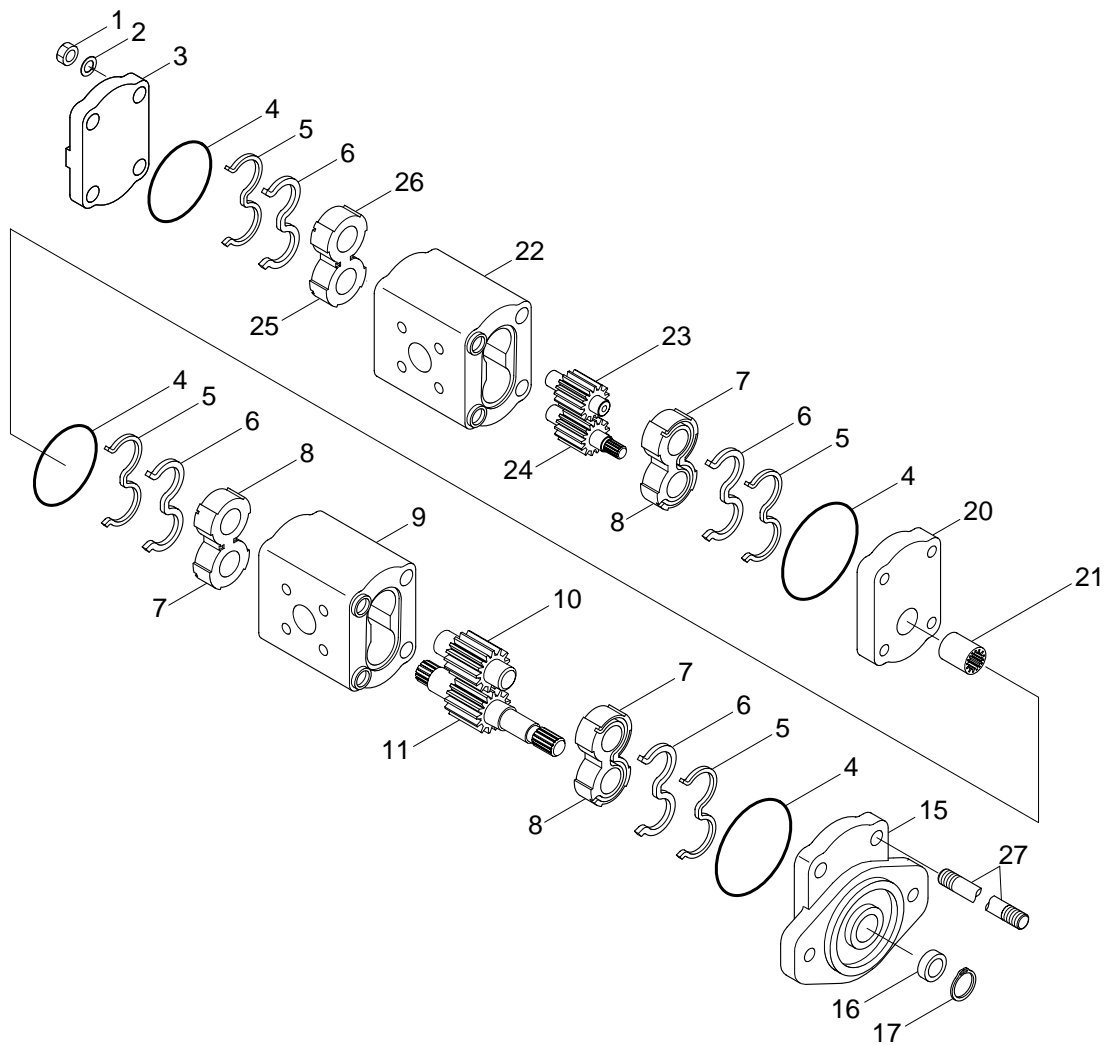
- ① Fit inner shaft seal(16) into the recess in the mounting flange, with the garter spring facing into the pump, refit circlip(2) into its groove.

Fit outer shaft seal with garter spring facing uppermost. Coat lips of seals with a high melting point grease.

- ※ If the seal recess has been scored, then seal outside diameter can be coated with loctite hydraulic sealant to prevent leakage.



ASSEMBLY

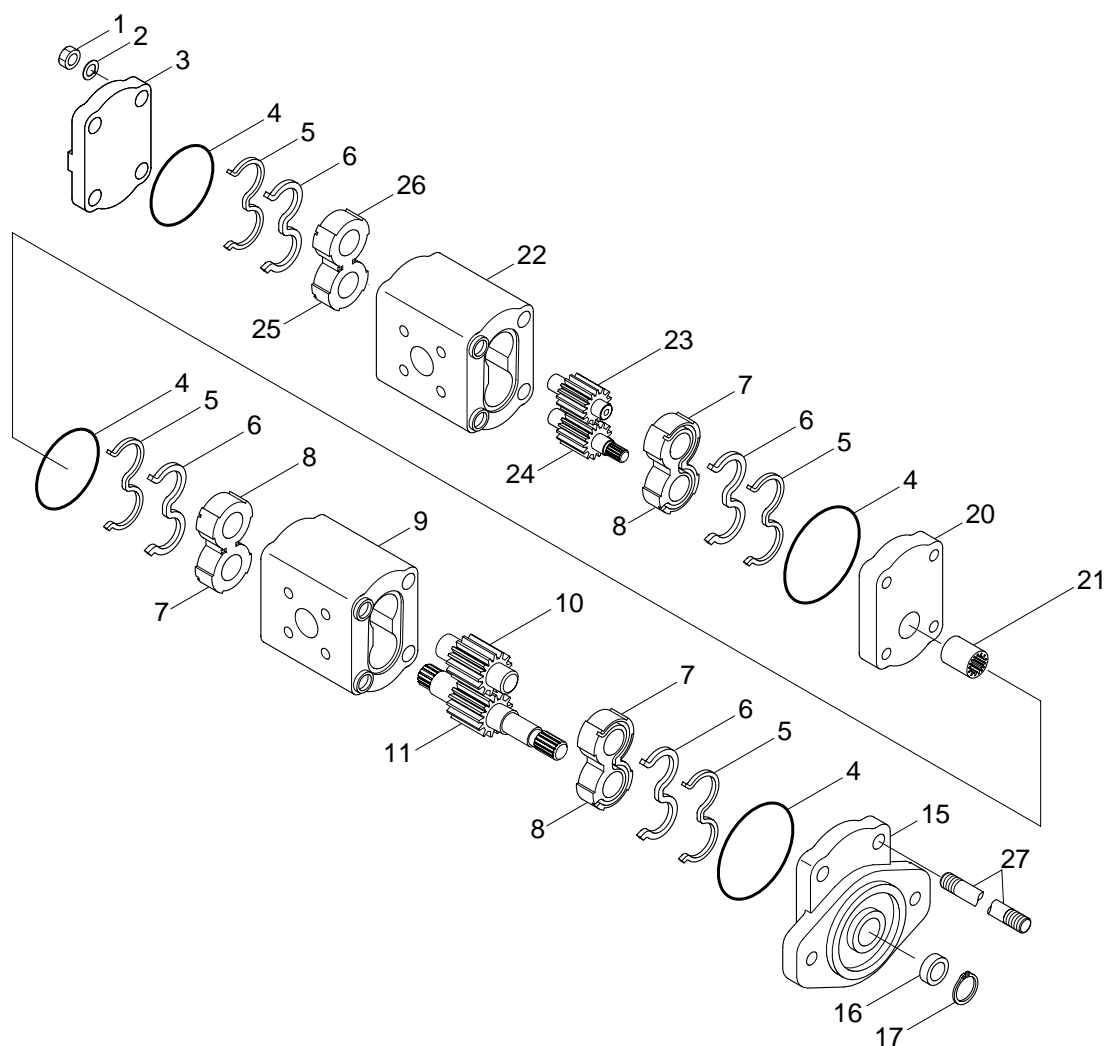


- ② Stand pump body on its rear face, fit seal element(5) and seal energizer(6) to the groove in the bushing(7, 8). Carefully feed the bushing into the body bores. Ensure that the seals remain in position and that the two small holes through the bushing are to the low pressure side of the unit, i.e. side with large 4 bolt port pattern.
- ③ Insert drive shaft(11) and driven gear(10) into their original bores.
- ④ Replace top bushing with small holes to low pressure side of the unit, fit seal element(5) and seal energizer(6) to grooves in balance plate.
- ⑤ Fit O-ring(4) to groove in mounting flange and apply a small amount of loctite sealant to the body lower face, i.e. outboard of oval spigot. This sealant is to prevent moisture entering this area preventing corrosion.
- ⑥ Carefully feed mounting flange over the drive shaft, ensure flange is in its original position-4mm hole in rear face of flange must be to the low pressure side of the unit. Tap flange on to its location spigot with a soft faced hammer.

(2) Rear pump

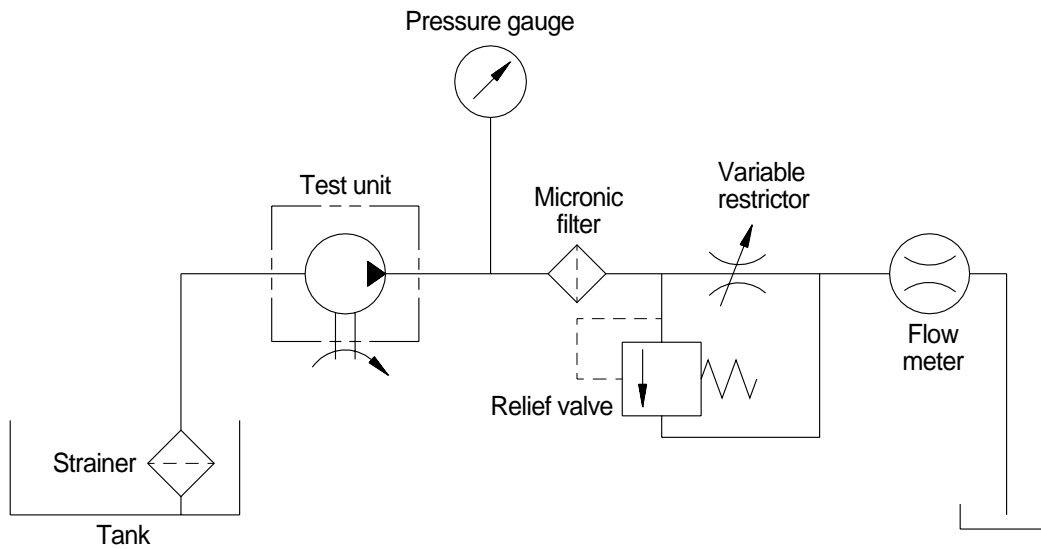
- ① Support front pump on the mounting flange and connection passages in the rear face, replace splined coupling(21).

ASSEMBLY



- ② Fit rear pump body to front pump ensuring that it locates on the dowels and the through holes line up.
- ③ Fit seal element(5) and seal energizer(6) to grooves in bushing(7, 8) and carefully feed into body bores. Ensure seals remain in position and that the two small holes through the bushing are to the low pressure side, i.e. the side without a port.
- ④ Fit drive gear(24) ensuring that it locates in the splined coupling(21), fit driven gear(23).
- ⑤ Replace upper bushing in its original position, i.e. with 2 small holes to low pressure side, fit seal element(5) and seal energizer(6) to groove in plate.
- ⑥ Fit O-ring(4) to groove in end cover, apply a small amount of loctite sealant to lower face of body, i.e. outboard of oval spigot.
- ⑦ Studs(27) to be screwed into cover(3). Prior to fitting flange(16) washers(2) and nuts(1).
 • Tightening torque : 4.7~5.2kgf · m(34~38lbf · ft)
- ⑧ Pour a small amount of clean hydraulic oil into ports and check that the unit rotates without undue force. If excessive force it required then seals in balance plates are possibly trapped and the unit should be disassembled and reassembled correctly.

6) RUNNING-IN



- (1) A unit which has been reassembled with either new gears, bushings or body, must be carefully run-in before it is subjected to full working conditions.
- (2) Ideally this should be done on a test rig(See figure) where pressure can be gradually applied and any wipings from the body cut-in arrested by filters.
- (3) It is recommended that the unit is run-in at 1500rpm, initially, at zero pressure for one minute then in stages with the pressure increased by 35kgf/cm^2 (500psi) every minute, until maximum rated pressure has been attained. Frequently check the system temperature, ensuring that it does not exceed the maximum permissible figure of 80°C . If the temperature exceeds the system or unit specification the test must be delayed and operated off-load until acceptable temperatures are obtained.

2. MAIN CONTROL VALVE

1) GENERAL PRECAUTION

(1) General instructions

Valves are often used in hazardous environments, therefore care should be taken to frequently inspect the product for damage due to improper use, corrosion or normal wear. Repairs should be made immediately if needed.

(2) Correct procedure to remove the valve from the machine

- ① Ensure that all the pipes and hoses are marked before removal to ensure correct replacement.
- ② Disconnect all pipes, hoses, fittings, control handles and linkages that might be attached to the machine. Fit protective caps to hose ends to prevent dirt ingress while the valve is off the machine. Always plug supply and return lines to prevent syphoning from the hydraulic oil tank.

Remove the valve from the machine, **plug all ports**, and thoroughly clean the valve exterior, after which the port plugs can be removed.

(3) All work must be performed in a clean area

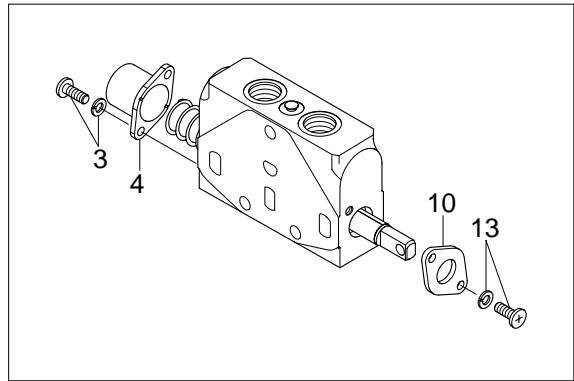
When disassembling control valves ensure that all parts are clearly identified so that they can be reassembled in the correct order. The spools and bodies are manufactured as matched pieces to control internal leakage. It is essential that when a spool is removed from a valve body for servicing work, that it is reassembled into the same body.

Whenever the spool seal retaining plates are removed, to change action or handles, it is recommended that the spool seals are always renewed.

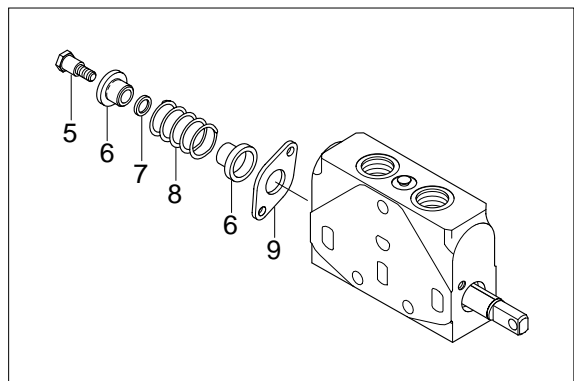
2) DISASSEMBLY

(1) Disassemble of spool seal

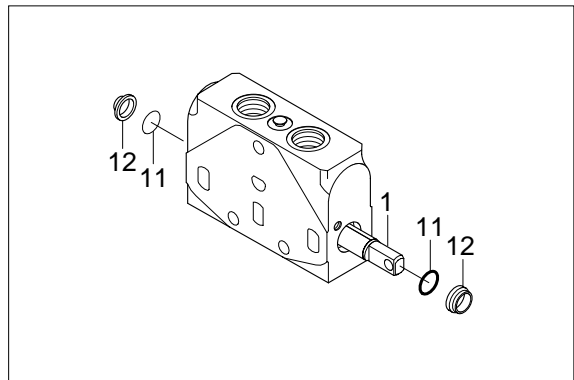
- ① Loosen and remove screws and washers(3, 13). Remove seal retainer(10) and end cap(4).



- ② Prevent spool rotating. Remove shoulder screw(5). Disassemble spring seats(6), spacer(7), spring(8), and seal retainer(9).

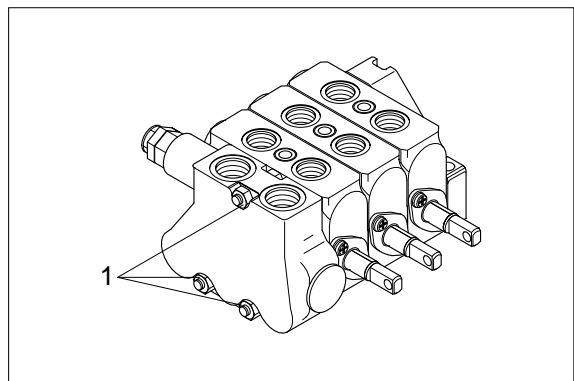


- ③ Remove spool(1). Remove and discard O-rings(11) and wiper seals(12).

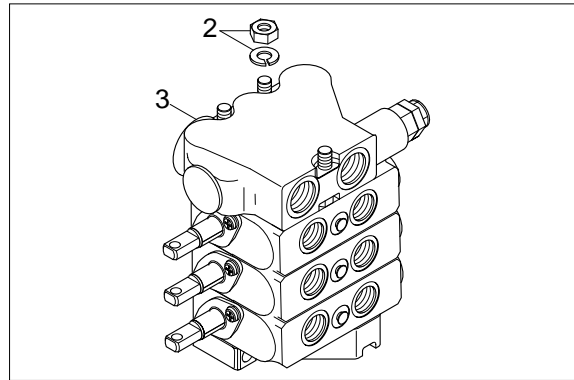


(2) Disassemble of intersection seal

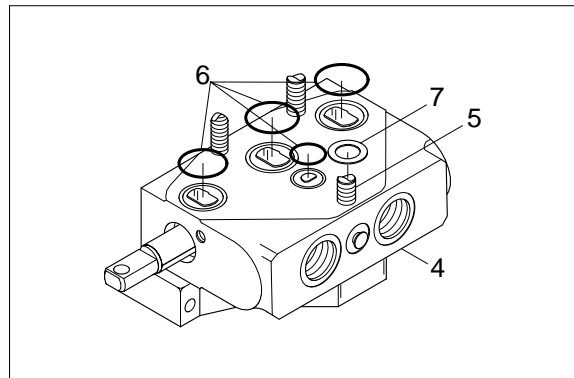
- ① Operate each spool in turn to release any trapped pressure. Loosen tie rod nuts(1) at the inlet cover end of the valve assembly.



- ② Position the valve assembly upright on its outlet cover. Remove tie rod nuts and washers(2). Remove inlet cover(3). Identify each section to note the order of assembly.

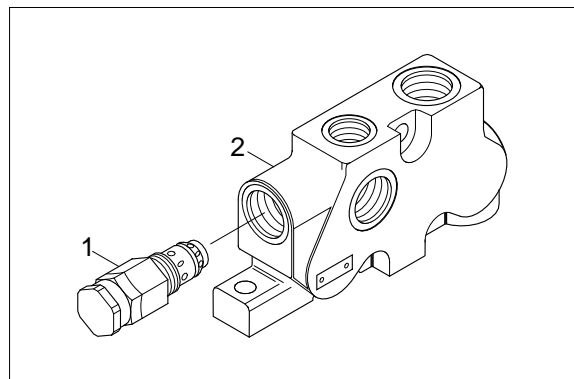


- ③ Remove all the sections(4) from the tie rods(5). Discard all intersection seals(6) and shims(7). Inspect all seal grooves and faces for deterioration or damage and ensure all are clean.

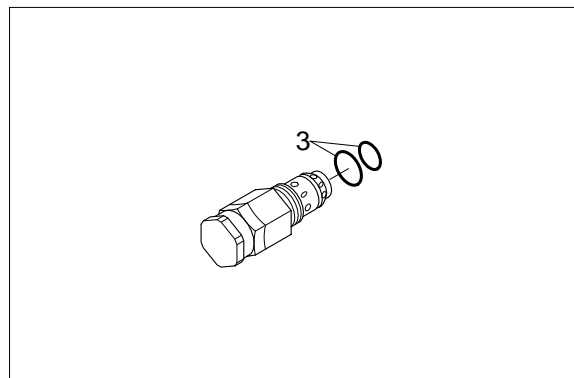


(3) Disassemble of main relief valve

- ① Remove relief valve assembly(1) from the housing(2).



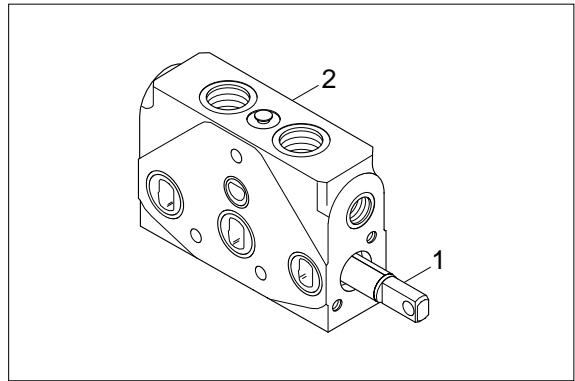
- ② Remove and discard O-rings(3).



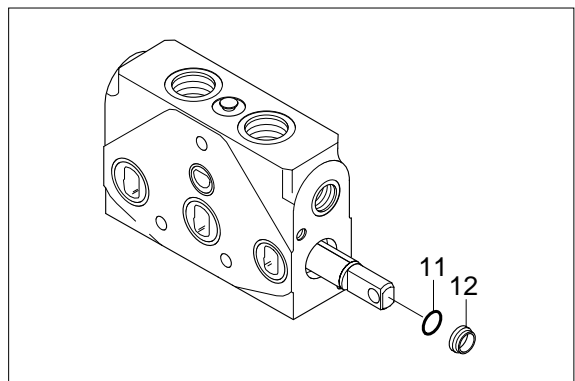
3) REASSEMBLY

(1) Assemble of spool seal

- ① Clean and lubricate spool(1). Insert spool into the housing(2) and set spool in its approximate neutral position.

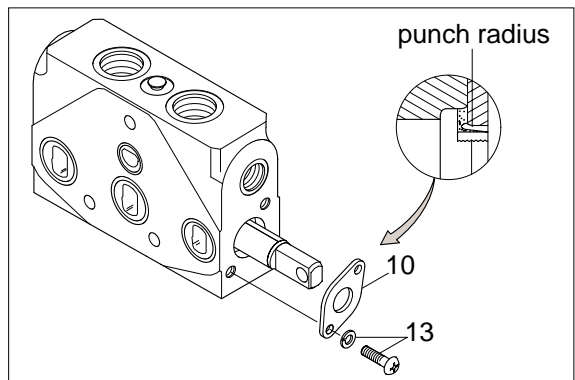


- ② From the service kit fit new O-ring(11) and wiper seal(12).



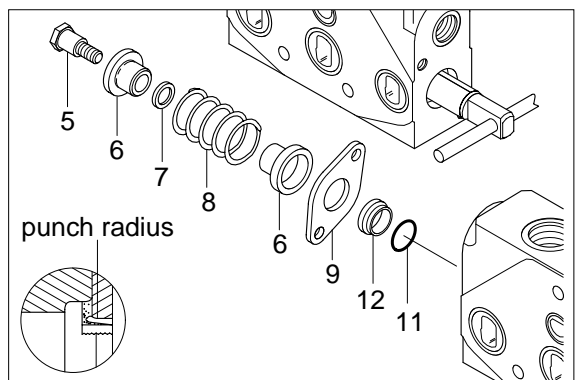
- ③ Refit seal retainer(10) with punch radius innermost to housing(2). Refit screws and washers(13).

- Tightening torque : 0.5~0.8kgf · m
(4~6lbf · ft)

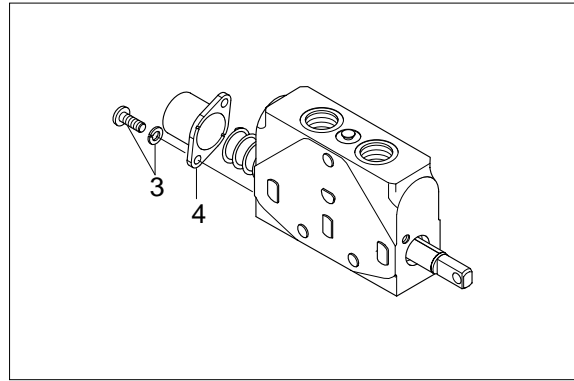


- ④ From the service kit fit new O-ring(11) and wiper seal(12). Assemble(9) with punch radius innermost to housing. Assemble(6), (8) and (7). Prevent the spool rotating and refit shoulder screw(5).

- Tightening torque : 0.5~0.8kgf · m
(4~6lbf · ft)

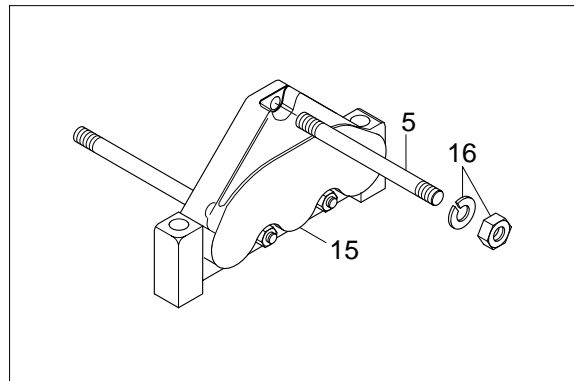


- ⑤ Refit end cap(4). Refit screws and washers(3).
- Tightening torque : 0.5~0.8kgf · m
(4~6lbf · ft)

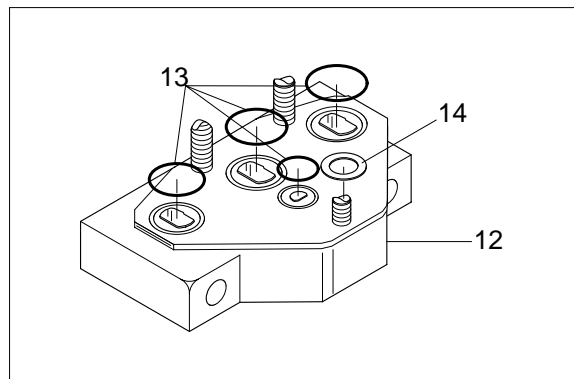


(2) Assemble of intersection seal

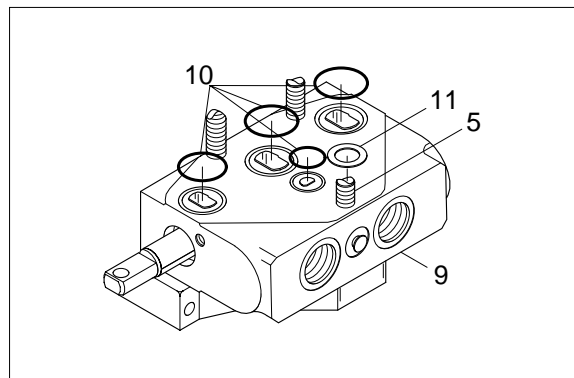
- ① Assemble tie rods(5), nuts and washers(16) and refit to the outlet cover(15).



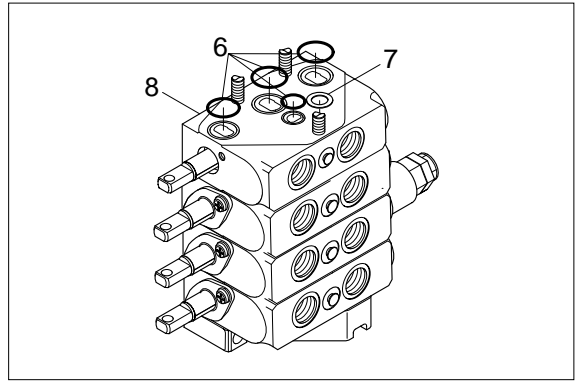
- ② Position the assembly upright on its outlet cover(12). Ensure all parts are clean. From the service kit fit new intersection seals(13) and shim(14).



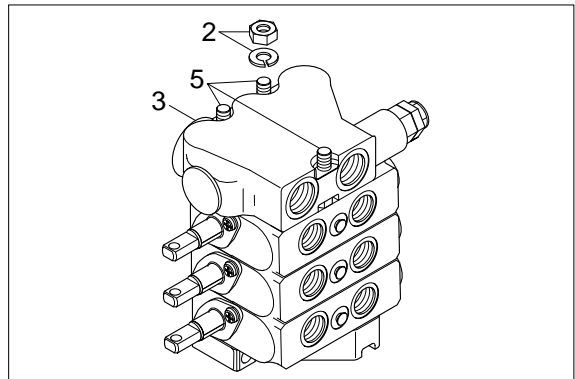
- ③ Assemble in the correct order the next section(9) over the tie rods(5). Ensure all parts are clean. From the service kit, fit new intersection seals(10) and shim(11). Repeat until all the sections have been assembled.



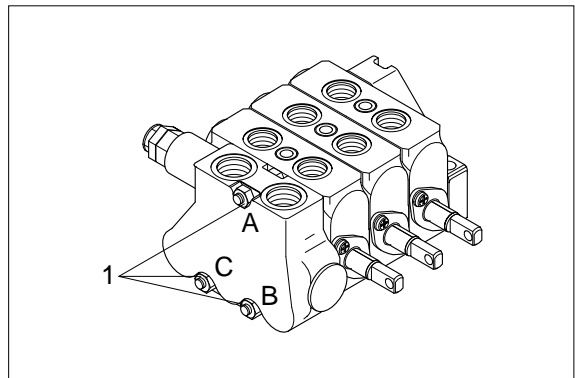
- ④ Ensure all seal grooves and connection areas are clean. From the service kit fit new intersection seals(6) and shim(7) to the final assembled section(8).



- ⑤ Assemble the inlet cover(3) over the tie rods(5) and the assembled sections. Refit tie rod nuts and washers(2) to the tie rods(5).

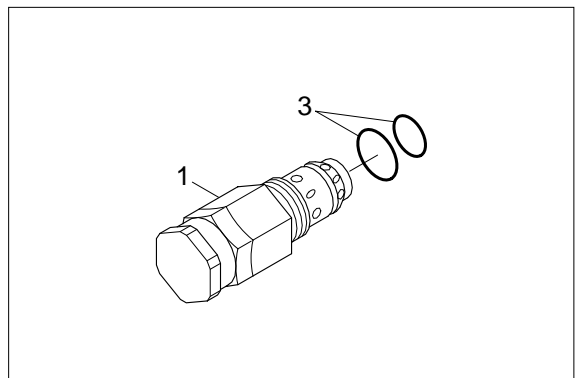


- ⑥ Position the valve assembly on to its feet. Ensure valve is sitting flat. Evenly torque tighten the tie rod nuts to $2.7\sim 2.9\text{kgf} \cdot \text{m}$ ($19\sim 21\text{lbf} \cdot \text{ft}$), using the following sequence, A, B, C and A again.
- Tightening torque : $2.7\sim 2.9\text{kgf} \cdot \text{m}$ ($19\sim 21\text{lbf} \cdot \text{ft}$)



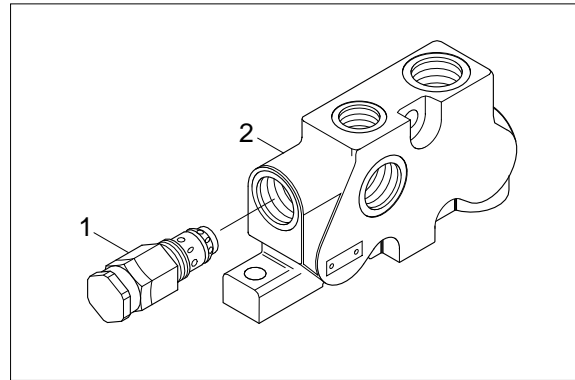
(3) Assemble of main relief valve

- ① Ensure all threads and sealing areas are clean and free from damage. Fit new O-rings(3), to the relief valve assembly(1).



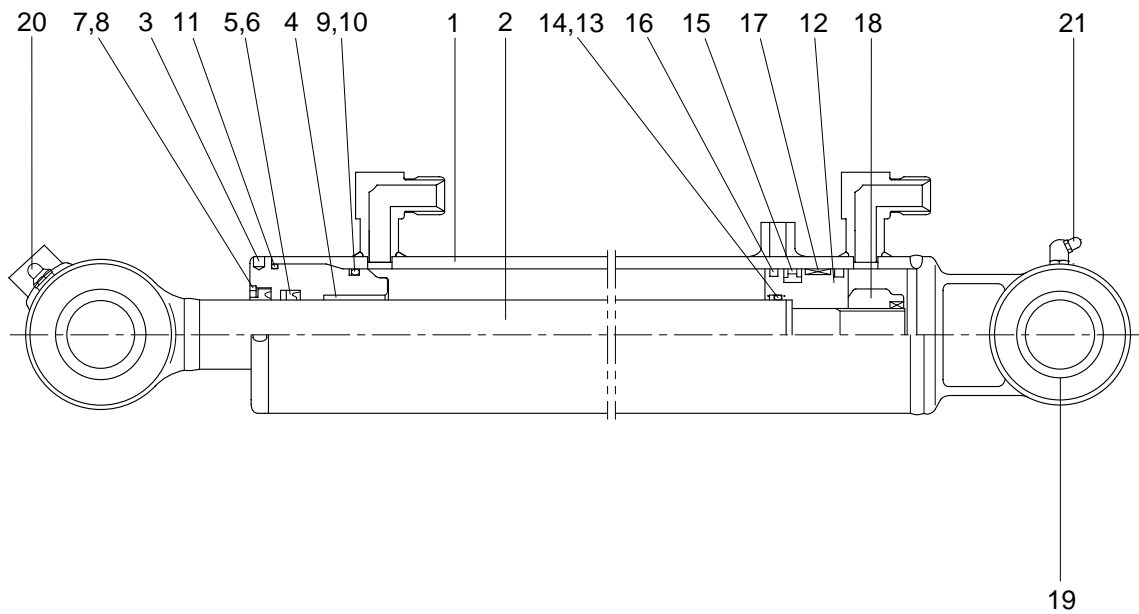
② Refit the relief valve assembly(1), to the housing(2).

- Tightening torque : 2.0~2.4kgf · m
(15~18lbf · ft)



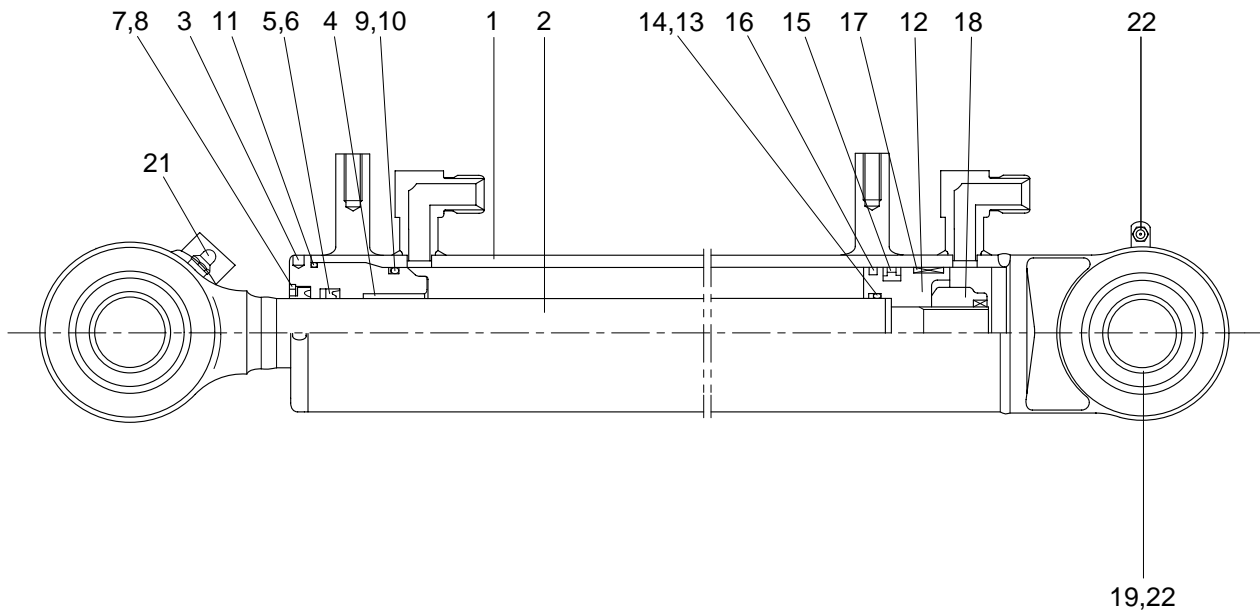
3. CYLINDER

1) LIFT CYLINDER



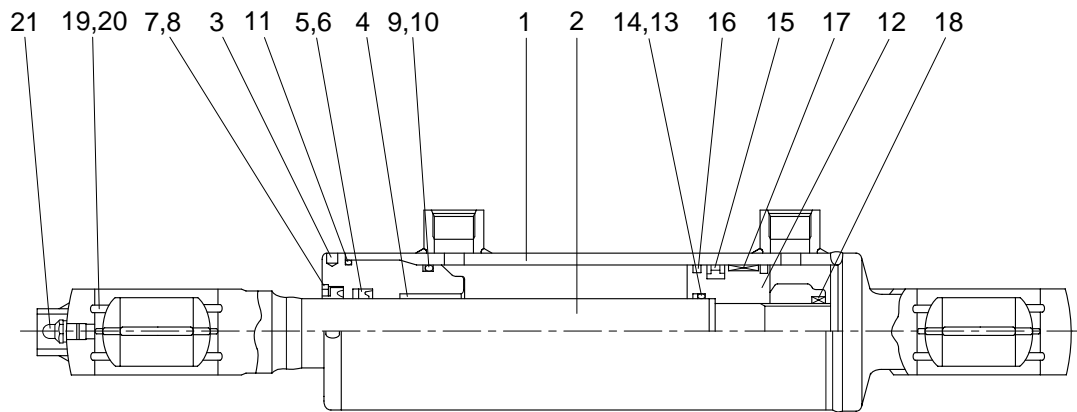
1	Tube assy	8	Snap ring	15	Piston seal
2	Rod assy	9	O-ring	16	Dust ring
3	Gland	10	Back up ring	17	Wear ring
4	Bushing	11	O-ring	18	Nylon nut
5	Rod seal	12	Piston	19	Bushing
6	Back up ring	13	O-ring	20	Grease nipple
7	Dust wiper	14	Back up ring	21	Grease nipple

2) ANGLE CYLINDER



1	Tube assy	9	O-ring	17	Wear ring
2	Rod assy	10	Back up ring	18	Nylon nut
3	Gland	11	O-ring	19	Spherical bearing
4	Bushing	12	Piston	20	Retainer ring
5	Rod seal	13	O-ring	21	Grease nipple
6	Back up ring	14	Back up ring	22	Grease nipple
7	Dust wiper	15	Piston seal		
8	Snap ring	16	Dust ring		

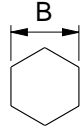
3) TILT CYLINDER



- | | | | | | |
|---|--------------|----|--------------|----|-------------------|
| 1 | Tube assy | 9 | O-ring | 17 | Wear ring |
| 2 | Rod assy | 10 | Back up ring | 18 | Nylon nut |
| 3 | Gland | 11 | O-ring | 19 | Spherical bearing |
| 4 | Bushing | 12 | Piston | 20 | Retainer ring |
| 5 | Rod seal | 13 | O-ring | 21 | Grease nipple |
| 6 | Back up ring | 14 | Back up ring | | |
| 7 | Dust wiper | 15 | Piston seal | | |
| 8 | Snap ring | 16 | Dust ring | | |

4) TOOLS AND TIGHTENING TORQUE

(1) Tools

Tool name	Remark	
Spanner	46	
(-) Driver	Small and large sizes	
Torque wrench	Capable of tightening with the specified torques	
Steel bar	For gland	

(2) Tightening torque

Part name		Item	Size	Torque	
				kgf · m	lbf · ft
Gland	Lift cylinder	3	M80 × 2.0 × 80	70 ± 7	506 ± 51
	Angle cylinder				
	Tilt cylinder				
Nylon nut	Lift cylinder	18	M30 × 2.0	82 ± 8	593 ± 58
	Angle cylinder				
	Tilt cylinder				

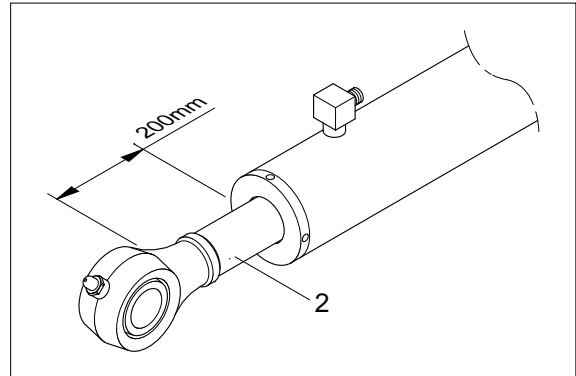
5) DISASSEMBLY

(1) Remove cylinder head and piston rod

① Hold the clevis section of the tube in a vise.

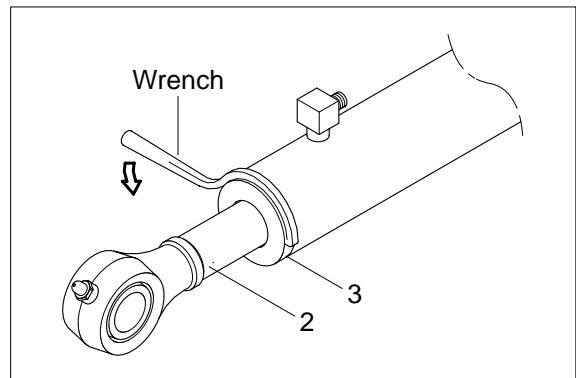
※ Use mouth pieces so as not to damage the machined surface of the cylinder tube. Do not make use of the outside piping as a locking means.

② Pull out piston rod(2) about 200mm (7.1 in). Because the piston rod is rather heavy, finish extending it with air pressure after the oil draining operation.



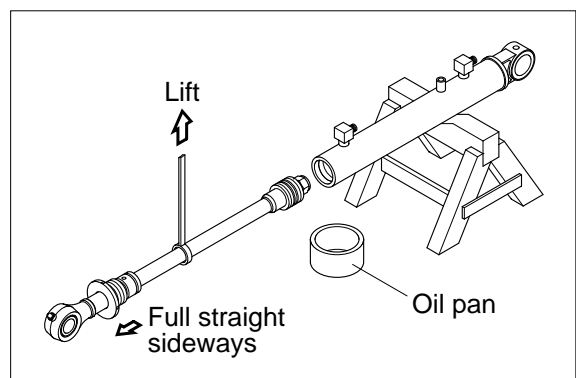
③ Loosen and remove the gland(3).

※ Cover the extracted piston rod(2) with rag to prevent it from being accidentally damaged during operation.



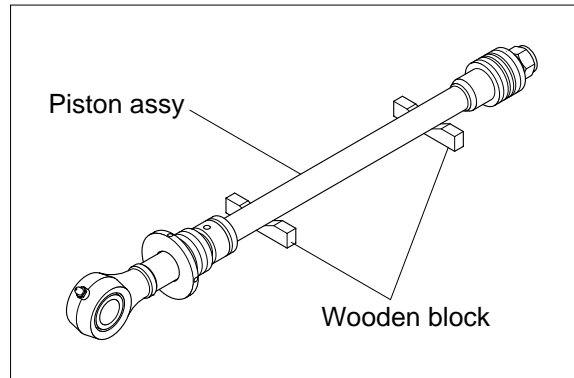
④ Draw out gland(3) and piston rod (2) assembly together from cylinder tube(1).

※ Since the piston rod assembly is heavy in this case, lift the tip of the piston rod(2) with a crane or some means and draw it out. However, when piston rod(2) has been drawn out to approximately two thirds of its length, lift it in its center to draw it completely.



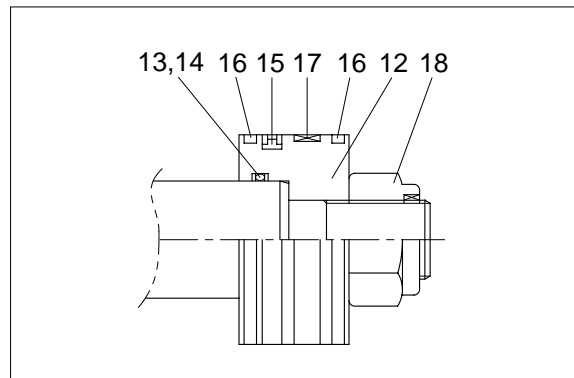
- ※ Note that the plated surface of piston rod(2) is to be lifted. For this reason, do not use a wire sling and others that may damage it, but use a strong cloth belt or a rope.

- ⑤ Place the removed piston rod assembly on a wooden V-block that is set level.
- ※ Cover a V-block with soft rag.

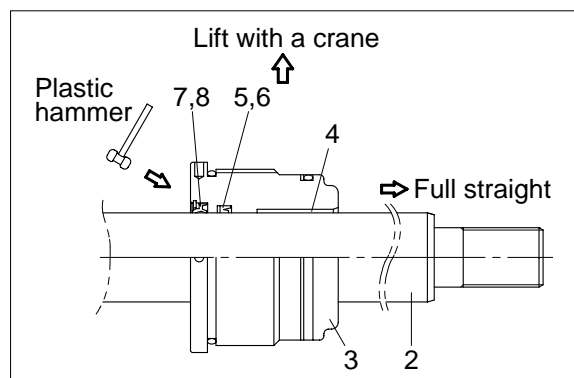


(2) Remove piston and gland assembly

- ① Remove the nylon nut(18).
- ② Remove piston assembly(12), and O-ring(13), back up ring(14).

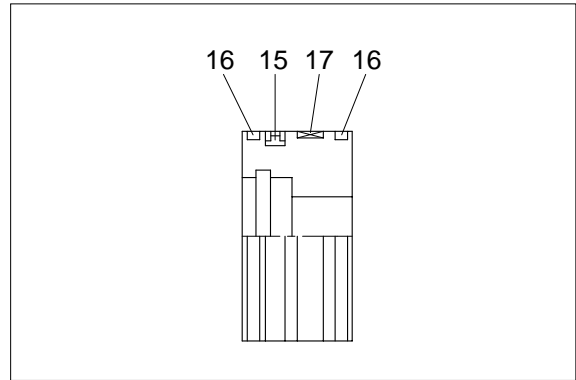


- ③ Remove the gland(3) assembly from piston rod(2).
 - ※ If it is too heavy to move, move it by striking the flanged part of gland(3) with a plastic hammer.
 - ※ Pull it straight with cylinder head assembly lifted with a crane.
- Exercise care so as not to damage the lip of rod bushing(4) and packing(5, 6, 7, 8) by the threads of piston rod(2).



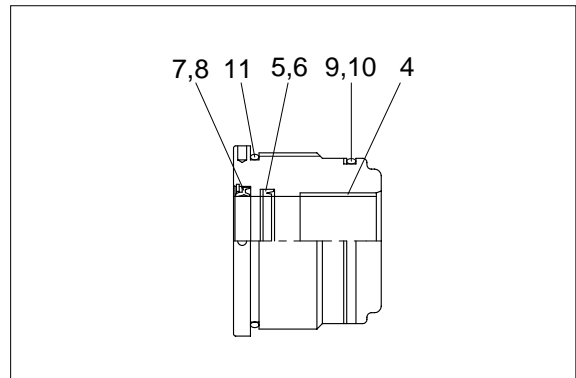
(3) Disassemble the piston assembly

- ① Remove wear ring(17), dust ring(16) and piston seal(15).
- ※ Exercise care in this operation not to damage the grooves.



(4) Disassemble gland assembly

- ① Remove back up ring(10) and O-ring(9).
 - ② Remove O-ring(11).
 - ③ Remove snap ring(8) and dust wiper(7).
 - ④ Remove back up ring(6) and rod seal(5).
- ※ Exercise care in this operation not to damage the grooves.
- ※ Do not remove seal and ring, if does not damaged.

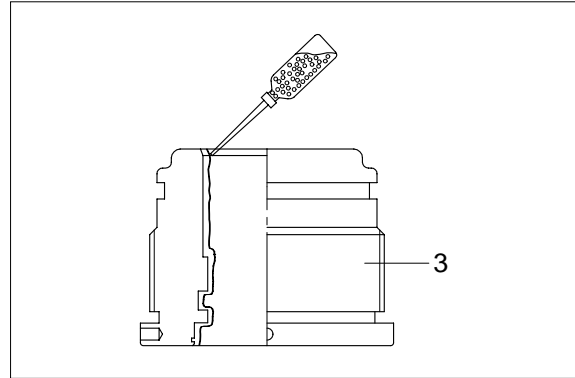


6) ASSEMBLY

(1) Assemble gland assembly

※ Check for scratches or rough surfaces if found smooth with an oil stone.

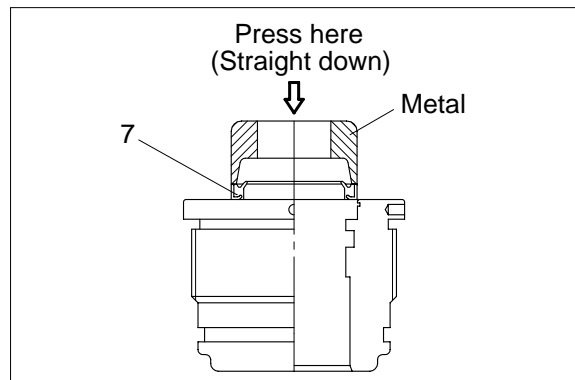
- ① Coat the inner face of gland(3) with hydraulic oil.



- ② Coat dust wiper(7) with grease and fit dust wiper(7) to the bottom of the hole of dust wiper.

At this time, press a pad metal to the metal ring of dust seal.

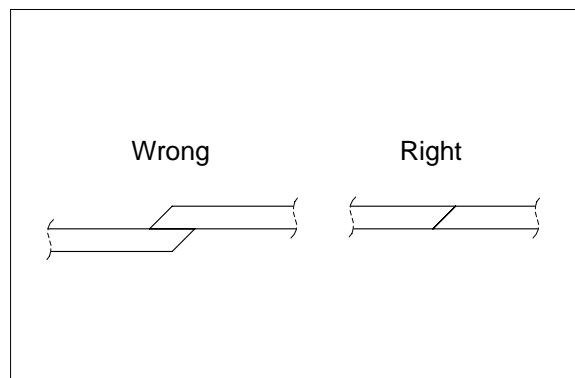
- ③ Fit snap ring(8) to the stop face.



- ④ Fit back up ring(6) and rod seal(5) to corresponding grooves, in that order.

※ Coat each packing with hydraulic oil before fitting it.

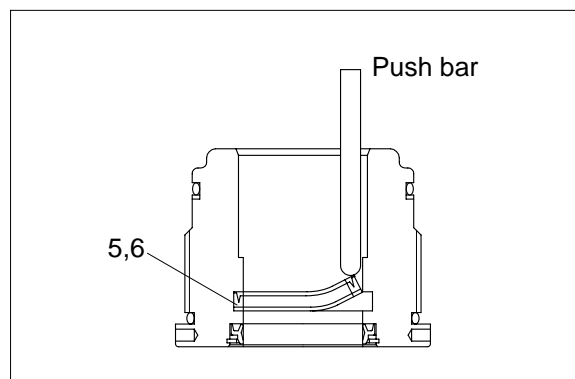
※ Insert the backup ring until outside of it is inserted into groove.



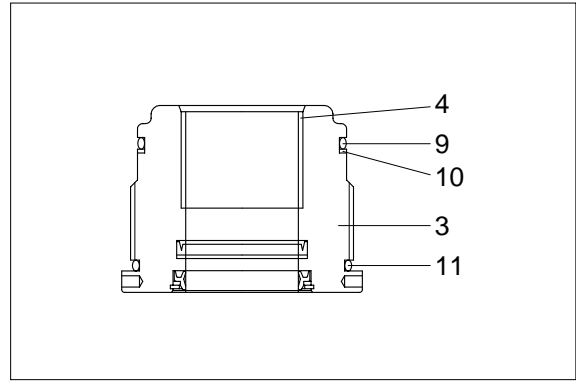
※ Rod seal(5) has its own fitting direction.

Therefore, confirm it before fitting them.

※ Fitting rod seal(5) up side down may damage its lip. Therefore check the correct direction that is shown in fig.

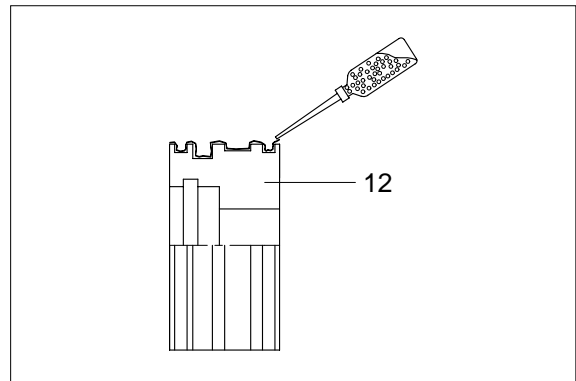


- ⑤ Fit back up ring(10) to gland(3).
- ※ Put the backup ring in the warm water of 30~50°C.
- ⑥ Fit O-ring(9) to gland(3).
- ⑦ Fit O-ring(11) to gland(3).

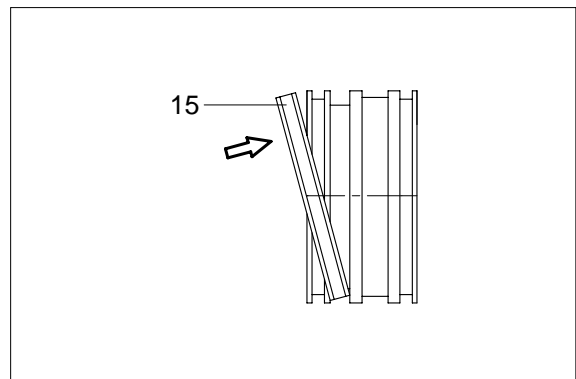


(2) Assemble piston assembly

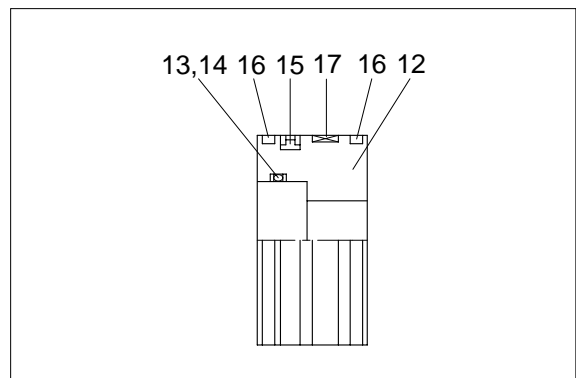
- ※ Check for scratches or rough surfaces.
If found smooth with an oil stone.
- ① Coat the outer face of piston(12) with hydraulic oil.



- ② Fit piston seal(15) to piston.
- ※ Put the piston seal in the warm water of 60~100°C for more than 5 minutes.
- ※ After assembling the piston seal, press its outer diameter to fit in.

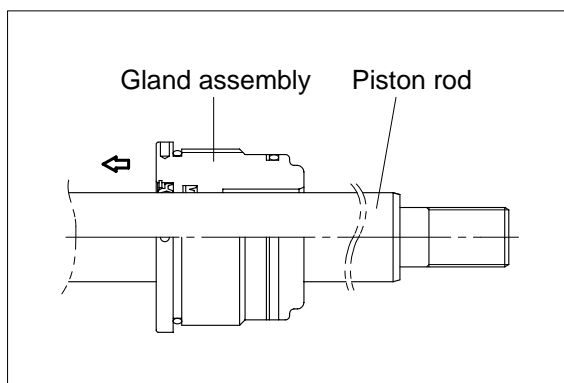


- ③ Fit wear ring(17) to piston(12).
- ④ Fit O-ring(13) to piston(12).

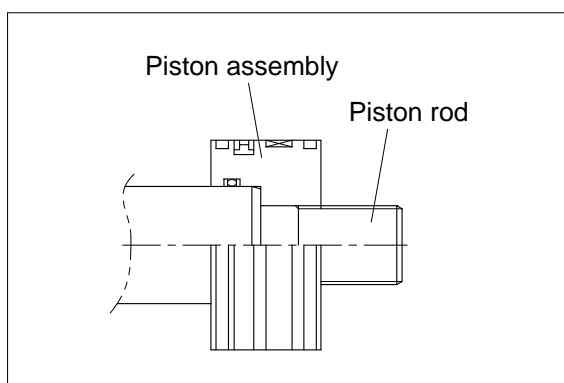


(3) Install piston and gland assembly

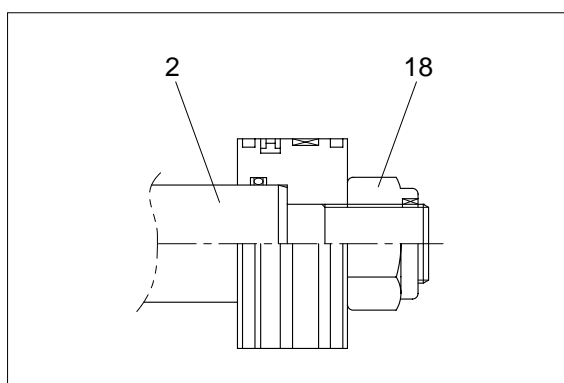
- ① Fix the piston rod assembly to the work bench.
- ② Apply hydraulic oil to the outer surface of piston rod(2), the inner surface of piston and gland.
- ③ Insert gland assembly to piston rod(2).



- ④ Fit piston assembly to piston rod.



- ⑤ Tighten nylon nut(18) to piston rod(2).
 - Tightening torque : $82 \pm 8 \text{ kgf} \cdot \text{m}$
($593 \pm 58 \text{ lbf} \cdot \text{ft}$)



(4) Overall assemble

- ① Place a V-block on a rigid work bench.
Mount the cylinder tube assembly(1) on it and fix the assembly by passing a bar through the clevis pin hole to lock the assembly.
- ② Insert the piston rod assembly in to the cylinder tube assembly, while lifting and moving the piston rod assembly with a crane.
- ※ Be careful not to damage piston seal by thread of cylinder tube.
- ③ Match the bolts holes in the cylinder head flange to the tapped holes in the cylinder tube assembly and tighten socket bolts to a specified torque.
- ※ Refer to the table of tightening torque.

