SECTION 6 HYDRAULIC SYSTEM

SECTION 6 HYDRAULIC SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. HYDRAULIC SYSTEM OUTLINE

The hydraulic system consists of a variable displacement pump, a control valve (MCV), lift cylinders and tilt cylinders. Refer to below followings. The oil is supplied from the tank at the left side of the frame. The hydraulic return filter is installed inside in the hydraulic tank. For the high-pressure piping, the o-ring fitting method (ORFS) that provides high sealing performance is employed to improve hydraulic system serviceability.

1) VARIABLE DISPLACEMENT PUMP

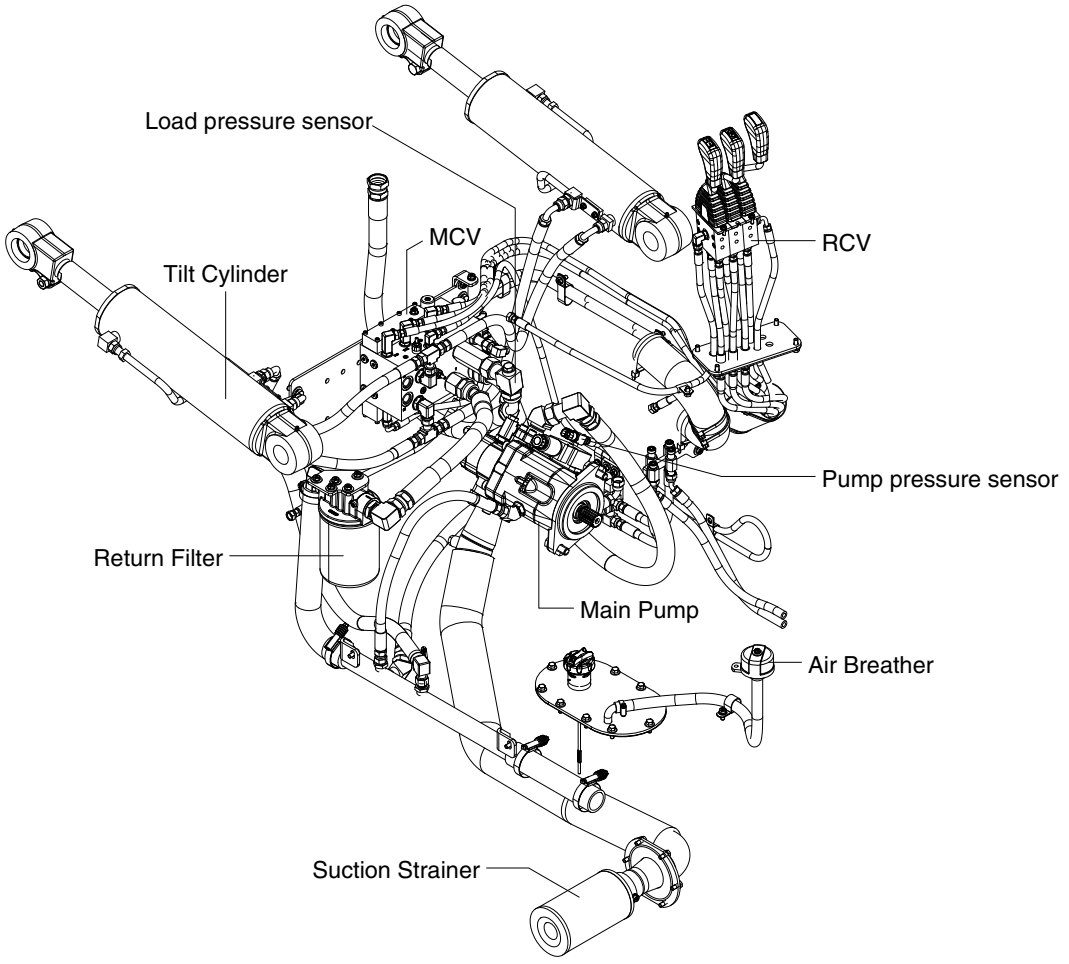
· Lift cylinder ,Tilt cylinder, Steering cylinder, Auxiliary function cylinder

2) MCV

· Built in priority valve and shuttle valve, Lift function, Tilt function, Auxiliary function (Sideshift etc.), RCV

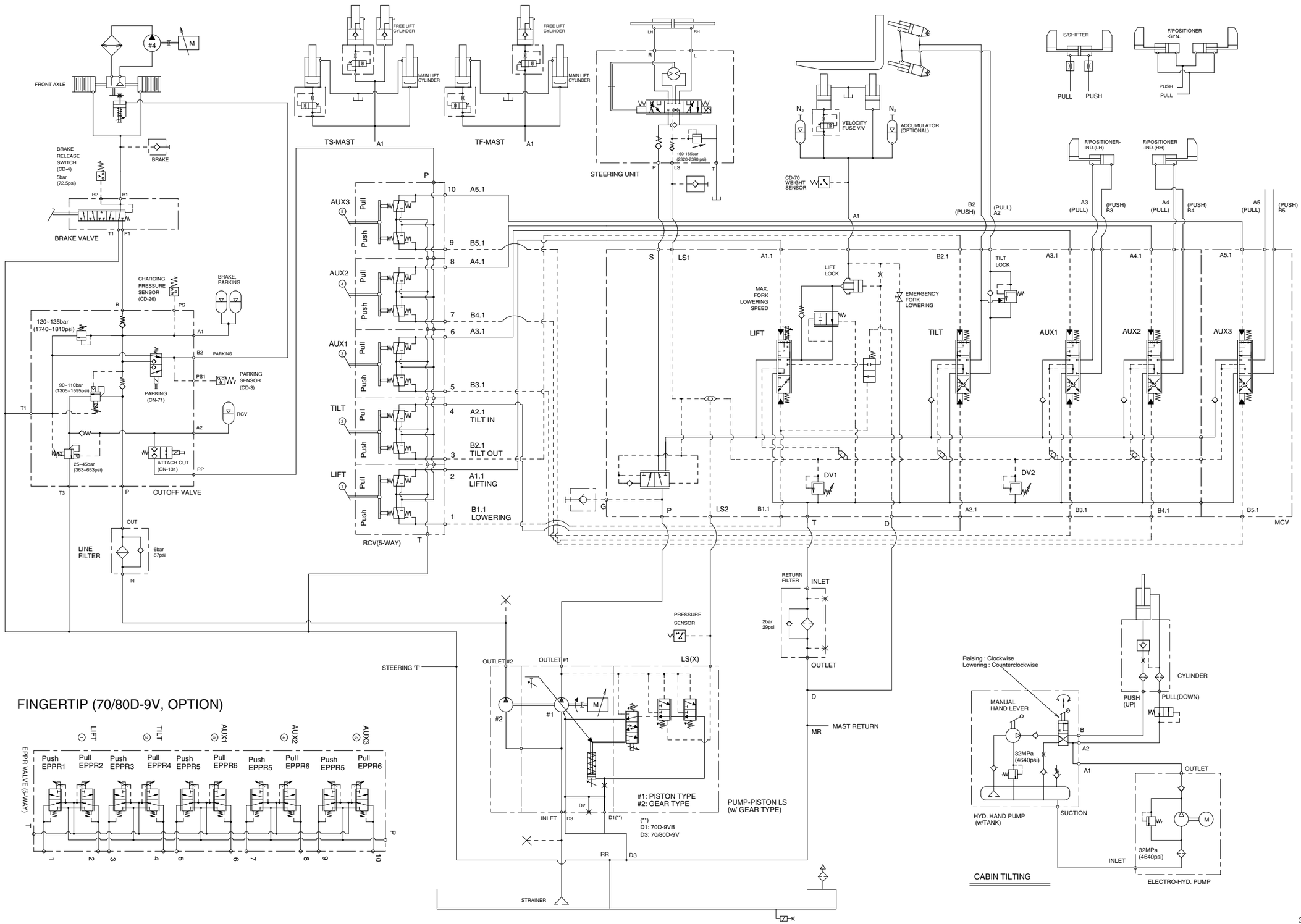
3) HYDRAULIC OIL TANK

· Return filter, Suction strainer, Air breather, Drain plug-magnetic



70D9V6HS01

2. HYDRAULIC CIRCUIT

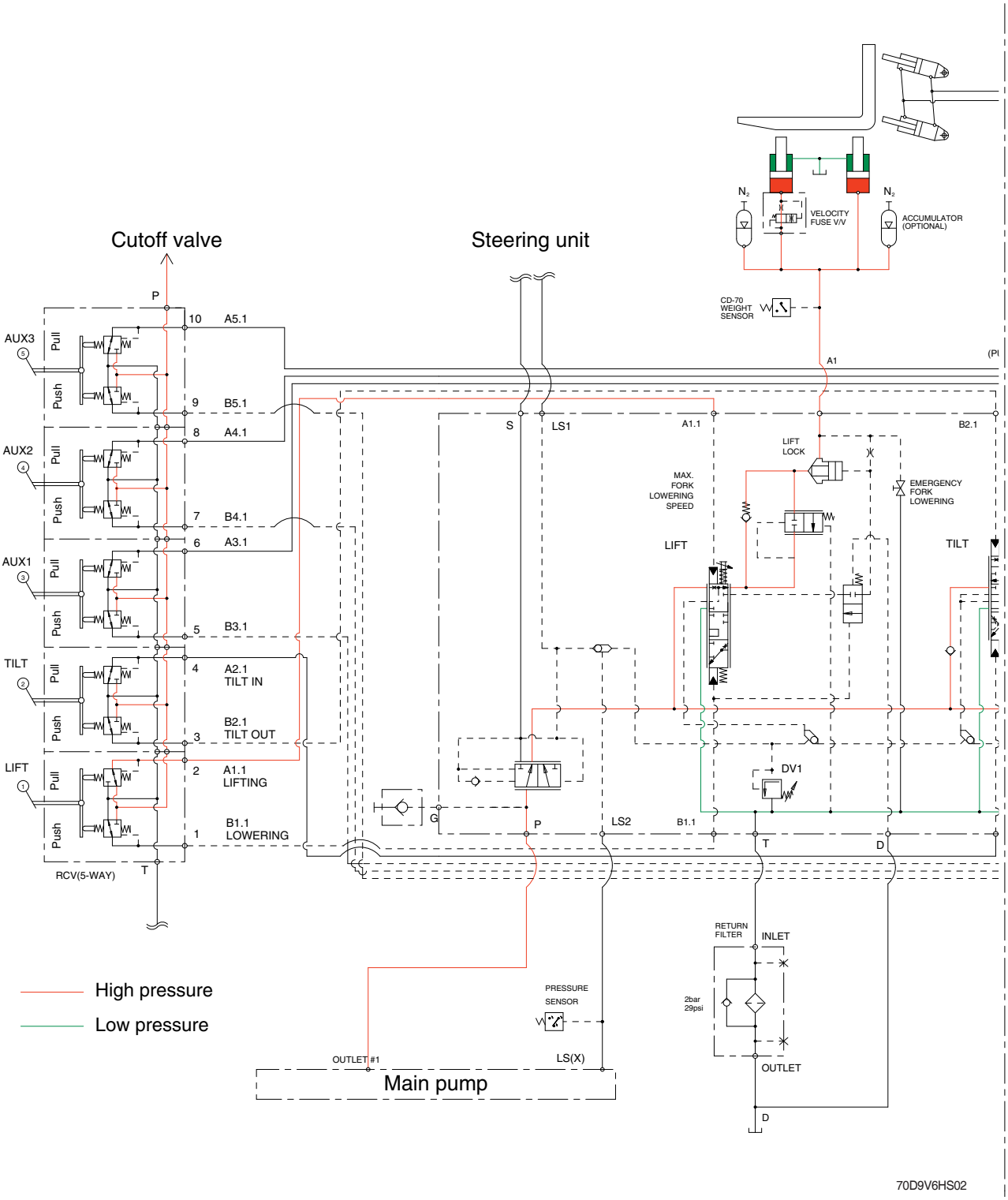


FINGERTIP (70/80D-9V, OPTION)

3YFJ-00100-05

3. WORK EQUIPMENT HYDRAULIC CIRCUIT

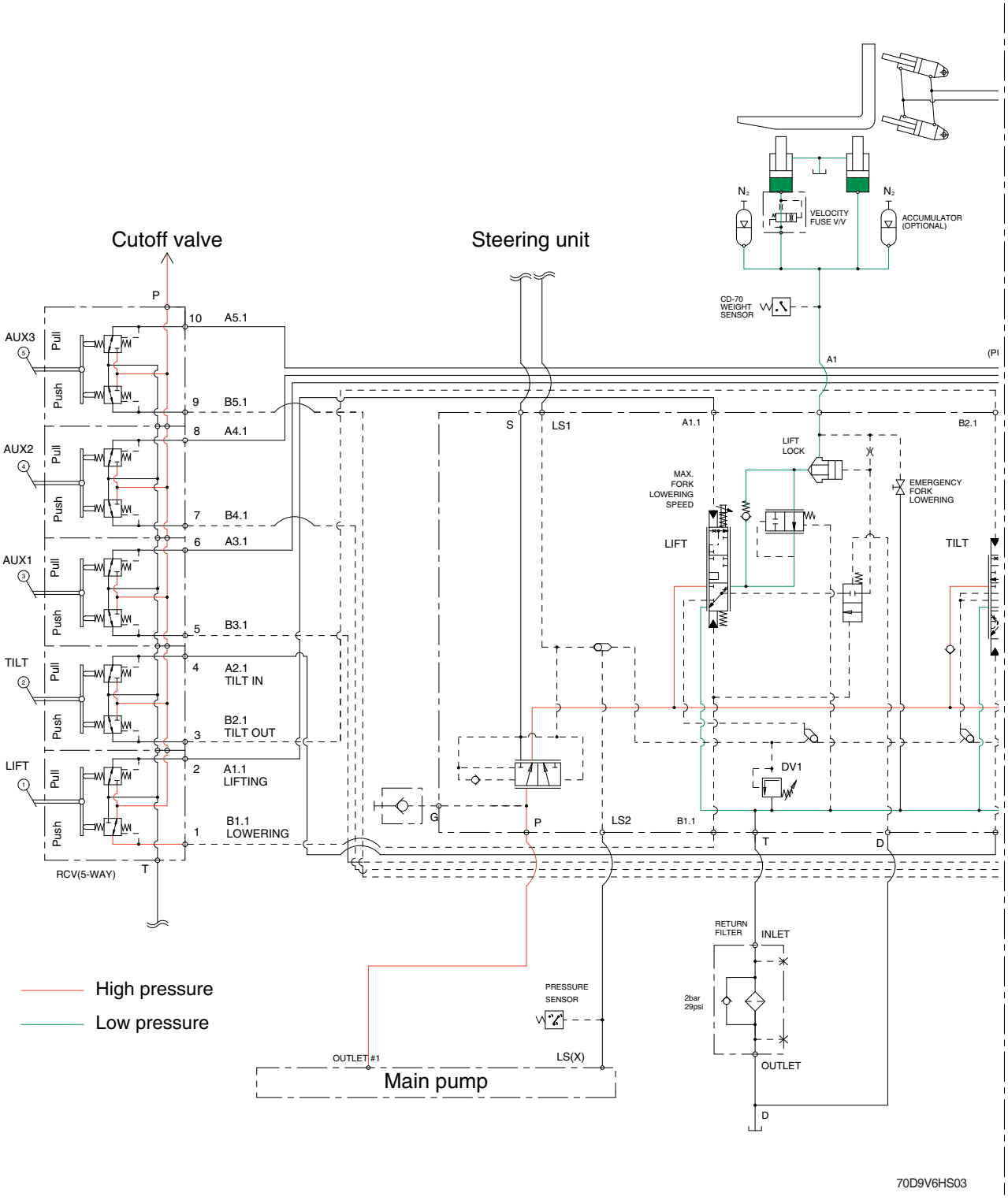
1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION



When the lift control lever is pulled back, the spool in the first block is moves to lift position. The oil from the main pump flows into main control valve through the priority valve. Then goes to the large chamber of lift cylinder by pushing the load check valve of the spool and lift lock valve.
The oil from the small chamber of lift cylinder returns to hydraulic oil tank at the same time. When this happens, the forks go up.

※ The circuit diagram may differ from the equipment, so please check before a repair.

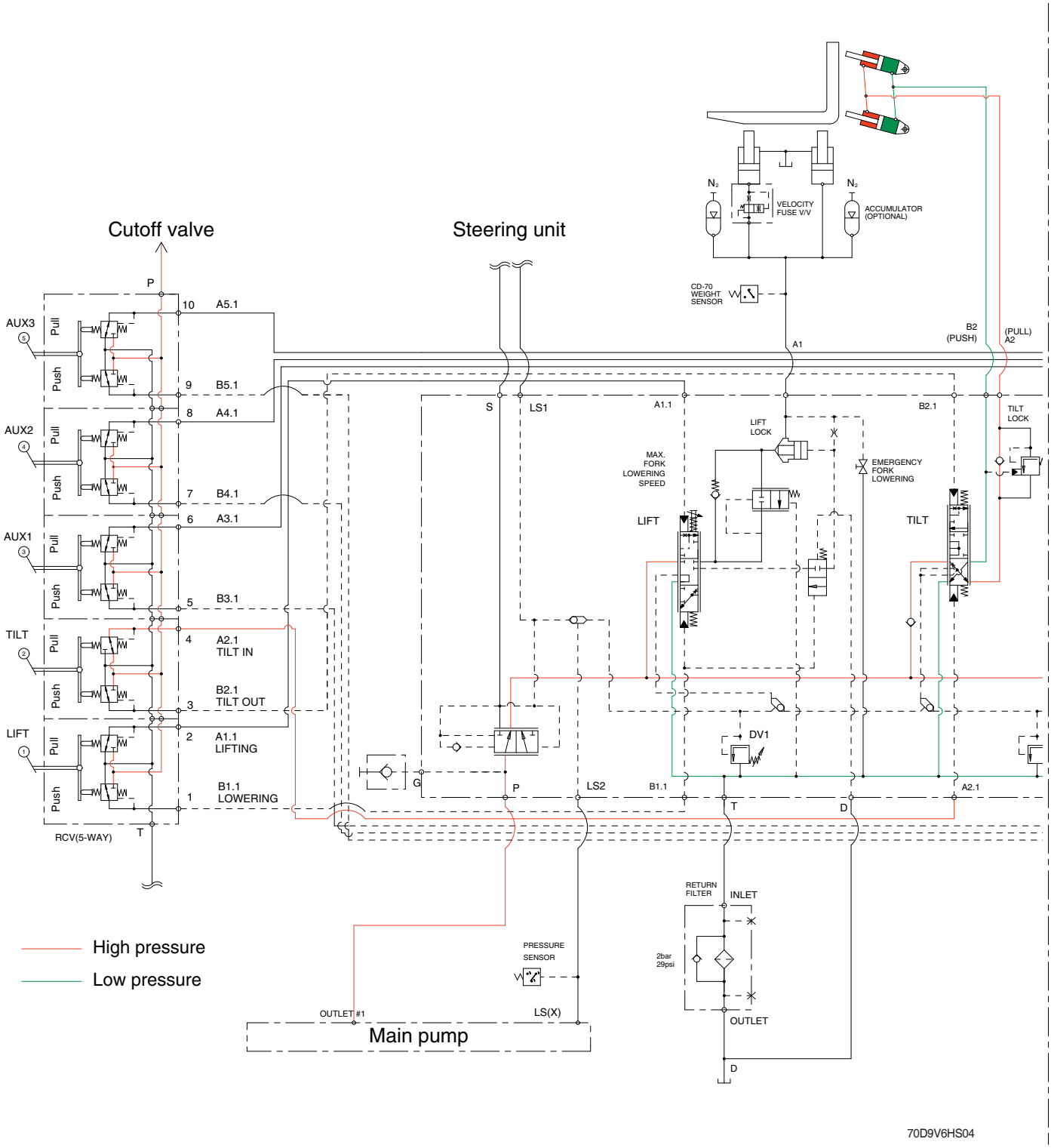
2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION



When the lift control is pushed forward, the spool in the first block is moved to lower position.
The work port and the small chamber and the large chamber are connected to the return passage, so the forks will be lowered due to its own weight.

※ The circuit diagram may differ from the equipment, so please check before a repair.

3) WHEN THE TILT CONTROL LEVER IS IN THE BACKWARD POSITION



When the tilt control lever is pulled back, the spool in the second block is moved to tilt backward position.

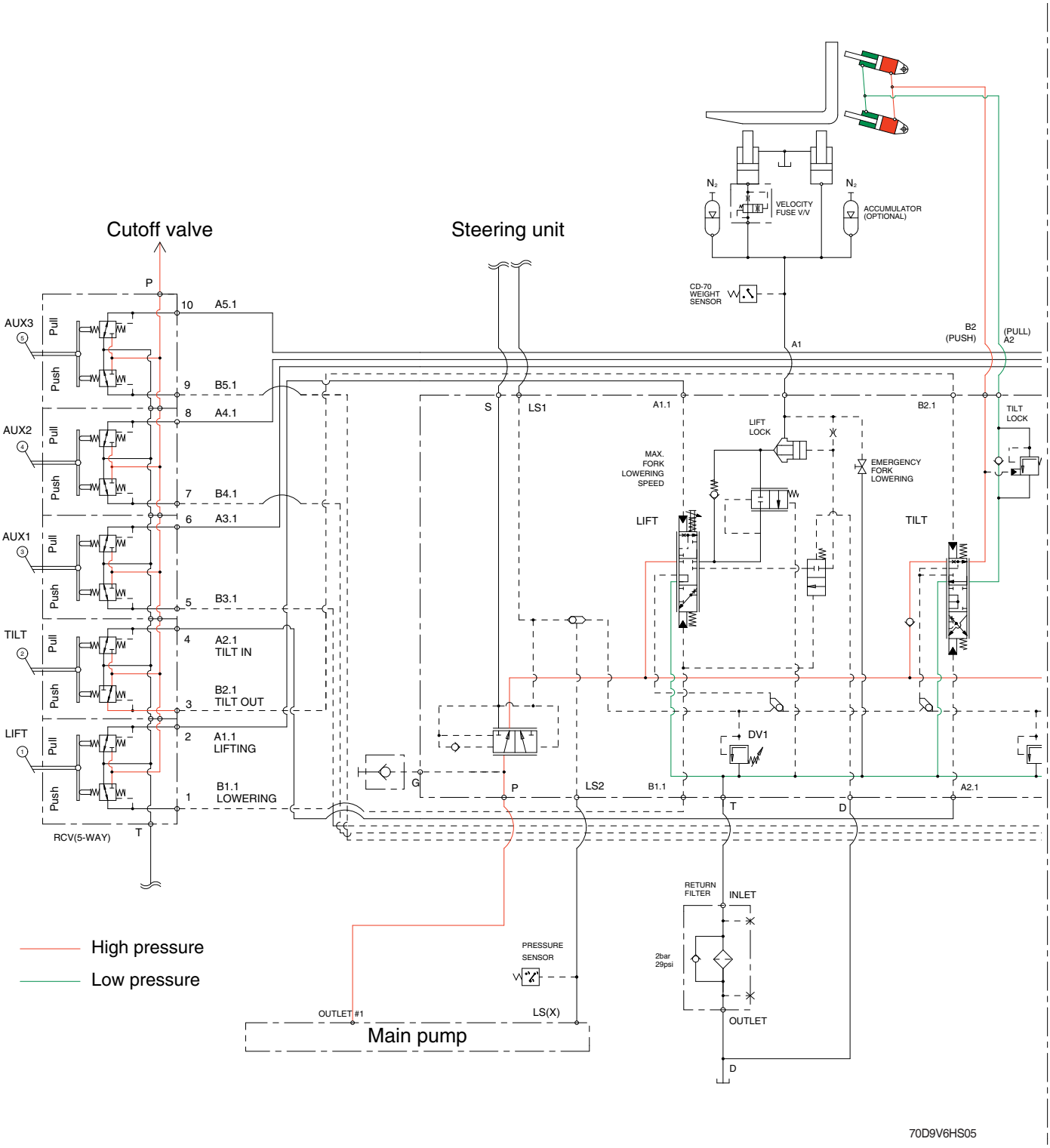
The oil from the main pump flows into main control valve through the priority valve. Then goes to the small chamber of tilt cylinder by pushing the load check valve of the spool and tilt lock valve.

The oil at the large chamber of tilt cylinder returns to hydraulic oil tank through the hydraulic oil cooler and return filter at the same time.

When this happens, the mast tilt backward.

※ The circuit diagram may differ from the equipment, so please check before a repair.

4) WHEN THE TILT CONTROL LEVER IS IN THE FORWARD POSITION



When the tilt control lever is pushed forward, the spool in the second block is moved to tilt forward position.

The oil from the main pump flows into main control valve through the priority valve. Then goes to the large chamber of tilt cylinder by pushing the load check valve of the spool and tilt lock valve.

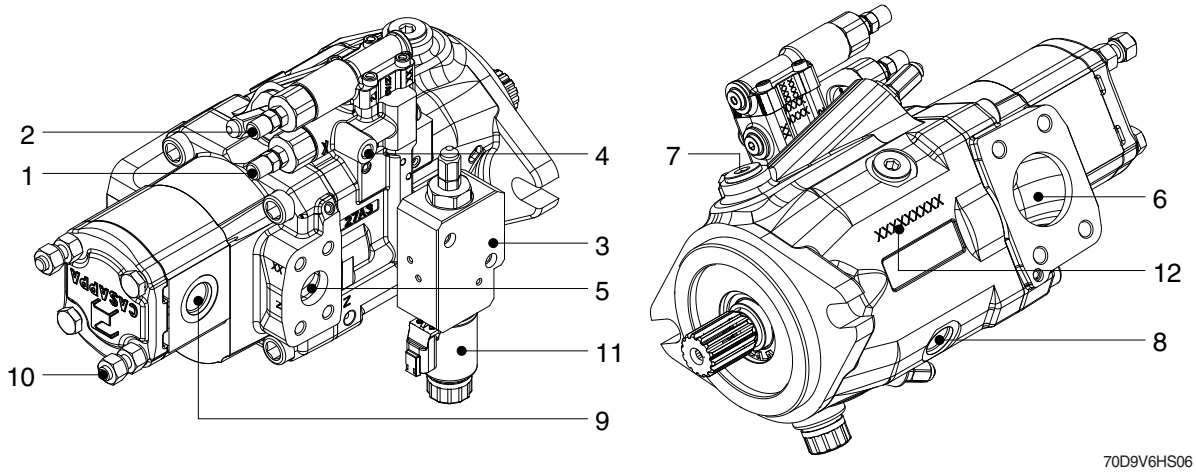
The oil at the small chamber of tilt cylinder returns to hydraulic oil tank through the hydraulic oil cooler and return filter at the same time.

When this happens, the mast tilt forward.

※ The circuit diagram may differ from the equipment, so please check before a repair.

4. MAIN PUMP

1) STRUCTURE



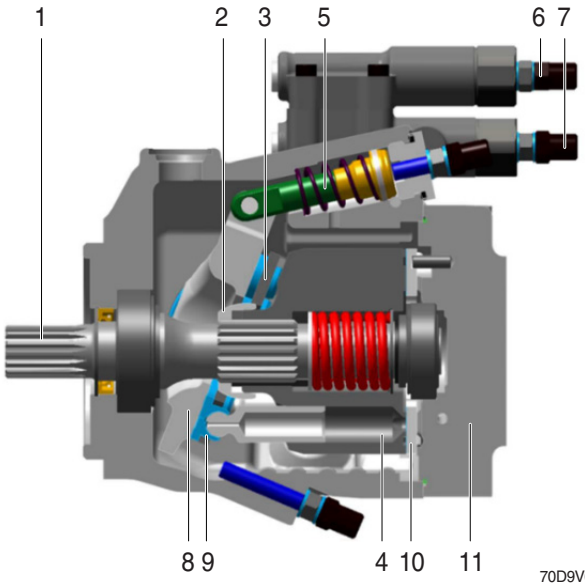
1	Flow compensator	5	Pressure port (out) B	9	Pressure port (Outlet)
2	Pressure compensator	6	Suction port (in) S	10	Stud bolt and nut
3	DEC valve	7	Drain port D1	11	12V coil (CN-155)
4	Load sense (LS) port X	8	Drain port D3	12	Label

Index	Function	Port	Thread (quantity)	Tightening torque	
				kgf·m	lbf·ft
Piston pump	Suction	IN (S)	M12 (4 EA)	3.1	22.4
	Dischrage	OUT (B)	M10 (4 EA)	3.1	22.4
	LS	X	BSPP PF 1/8	1.5	10.9
	Drain	D1, D3	7/8-14UNF	3.1	22.4
	Plug and nut (M8)	Limiter (Displacement, pressure)		1.5	10.9
		Flow regulator		1.5	10.9
		DEC Valve		1.5	10.9
	Mount bolt	DEC Valve	M6 (2 EA)	1.5	10.9
		Flow regulator, pressure limiter	M6×60 (4 EA)	1.5	10.9
		Cover	M14×45 (4 EA)	13.2	95.5
	Coil valve DEC	-	-	0.6	4.4
Gear pump	Dischrage	Outlet	7/8-14UNF	7.2	52
	Mount bolt	Stud bolt	M10×120 (2 EA)	4.6	33.3
		Rear cover	M10×85 (2 EA)	4.6	33.3

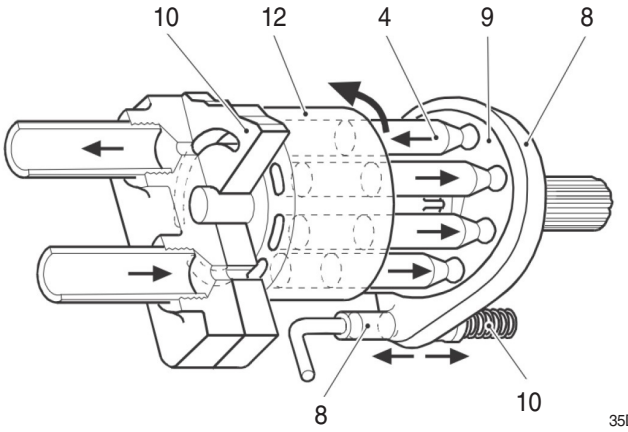
※ Drain port : D1 - 70D-9VB, D3 - 70/80D-9V

2) OPERATION

(1) General



70D9V6HS61



35D9VB6HS62

1 Drive shaft
2 Sleeve (retaining ball)
3 Slider
4 Piston
5 Regualting piston
6 Pressure compensator
(adusting screw, max. Pressure)
7 Flow compensator
(adjusting screw, stand-by pressure)
8 Swash plate
9 Regualting plate
10 Valve palte (distributor plate)
11 Connection plate
12 Cyclinder rotor
13 Return spring

These pumps are the variable axial piston pump type and are controlled with load signals from the flow demand for each respective function. They pump oil with 9 pistons (4) that are located in a cylindrical cylinder block (cylinder rotor). The pistons (4) are tubular sleeves with a ball-shaped top. There are T-shaped sliders (3) on the piston top. The sliders are fixed in the swash plate (8).

The swash plate secures the piston tops so that the pistons run straight in the cylinder bores. The swash plate is forced against the regulating plate by a ball-shaped sleeve (2) on the pump shaft. The cylinder rotor (12), pistons (4), sliders (3) and swash plate (8) rotate with the pump shaft.

The sliders (3) slide against the regulating plate (9). On the other side of the cylinder rotor, there is a valve plate (10) which controls oil to and from the cylinder rotor. The regulating plate (9) angles in relation to the pump's shaft with a regulating piston (5) to change the pump's capacity. A return spring (13) acts against the regulating piston (5). The pressure regulator (7) limits max. pressure and min. pressure (stand-by pressure).

The pressure regulator (7) limits max. pressure and min. pressure (stand-by pressure).

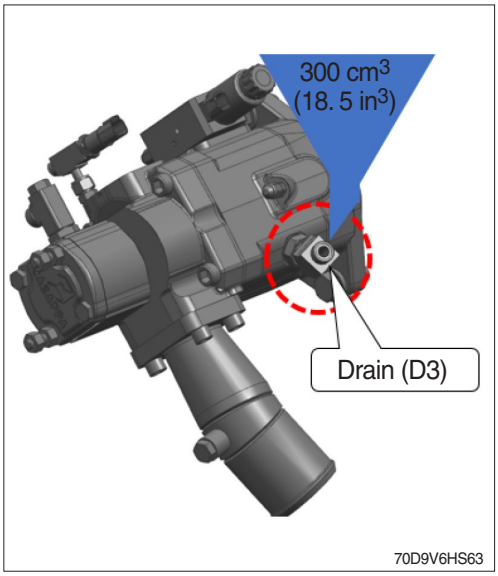
When the shaft turns, the cylinder rotor (12) will rotate. The angle of the regulating plate (9) results in the pistons being pulled in and out of the cylinder rotor by the sliders. The pistons' (4) stroke is changed by changing the angle of the yoke.

When the pistons are pulled out of the cylinder rotor (12), the cylinder and the space in the piston are filled with oil (suction phase). The oil is sucked through the outlets in the valve plate (1).

When the pistons are pressed in, the oil is forced out at the bottom, through the valve plate (10). A small amount of oil is forced through the piston head and lubricates the slider and yoke. The yoke does not rotate, which means that the pistons always suck and respectively force oil in a certain part of the revolution. This makes it possible to simplify the design of the valve plate, and valves can be avoided.

The regulating piston, which controls the angle of the yoke and thus the pump performance, is affected by load signals from the hydraulic system's valves. The pump also has its own supply which means that the pump always pumps a small amount, a so-called "stand-by pressure".

※ Axial piston variable pumps may not be started until they are filled with oil. A pump of this construction relies on the oil it is pumping to provide lubrication for its moving parts. Never lubricate the sliding parts in the pump casing and do not operate the pump in a dry state. It will be damaged immediately. Fill the pump case to the highest case drain or vent port. Use clean filtered fluid.



3) CHECKS AND ADJUSTMENTS

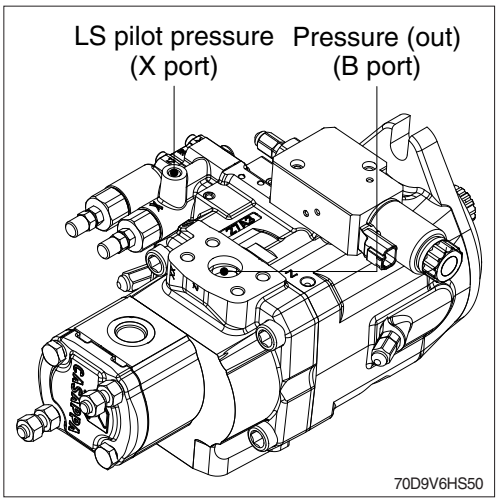
(1) Margin pressure check

The margin pressure is the difference between the pressure at the B-Port and X-Port. If the margin pressure is not within the range shown in the below table, the flow of hydraulic oil out of the variable displacement pump will be either too low or too high.

⚠ Do not operate the hydraulic functions while checking the margin pressure. Serious injury to personnel and damage to the lift truck can result if hydraulic functions are operated.

① Install pressure gauges on port B and port X respectively. See the illustration for location.
② Start the engine and keep the forklift at idle for 5 minutes.
③ Check the pressure on the gauge compared to that listed in the under table.
④ If the margin pressure is not within the range specified in the below table, go to "The flow compensator adjustment section".

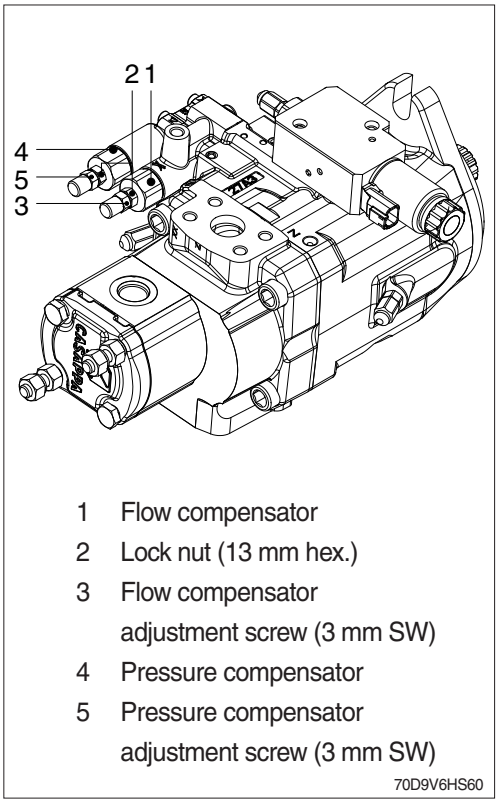
Gague B-X	bar	psi
	25 ± 1	363 ± 14.5



(2) Flow compensator adjustment

① Insert an hexagonal wrench (3 mm) into flow compensator adjustment screw. Hold hexagonal wrench in flow compensator screw and turn locknut (13 mm) counterclockwise all the way.
② Turn the flow compensator adjustment screw to adjust the B port pressure.
- Clockwise to increase the B port pressure by 16 bar (232 psi) per turn.
- Counterclockwise to decrease the B Port pressure by 16 bar (232 psi) per turn.

③ Check the margin pressure as described in the margin pressure checks. If margin pressure is not correct, perform Step 1 and Step 2 until correct margin pressure is reached.
④ Tighten the locknut to 1.5 kgf·m (10.9 lbf·ft).



1 Flow compensator
2 Lock nut (13 mm hex.)
3 Flow compensator adjustment screw (3 mm SW)
4 Pressure compensator
5 Pressure compensator adjustment screw (3 mm SW)

(3) Pressure compensator adjustment

① Mark or measure the screw locations of the flow and pressure compensators.

※ **Be sure to count and note the number of turns on the lock nut.**

Pressure compensator	bar	psi
	250	3625

② Using an hexagonal wrench (3 mm), hold the flow compensator adjustment screw and turn the lock nut (13 mm) counterclockwise all the way.

③ Turn the flow compensator adjustment screw clockwise until it stops.

- Clockwise to increase the B port pressure by 52 bar (754 psi) per turn.
- Counterclockwise to decrease the B Port pressure by 52 bar (75 psi) per turn.

④ Start forklift truck engine and let it idle. Do not operate the hydraulic functions. Measure the pressure at the B port of the pump. If pressure does not match what is shown in the above table, adjust the pressure compensator as follows.

a. Turn pressure compensator adjustment screw clockwise to increase pressure by 52 bar (754 psi) per turn.

b. Turn pressure compensator adjustment screw counter clockwise to decrease pressure by 52 bar (754 psi) per turn.

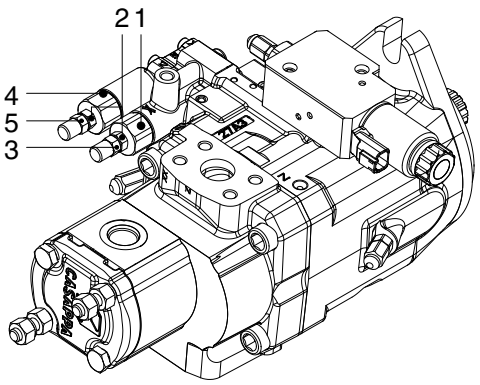
c. Put the pressure compensator adjustment screw back to its original position by turning the adjustment screw counter clockwise by the number of turns noted earlier.

d. Tighten locknut on pressure compensator adjustment screw to 1.5 kgf·m (10.9 lbf·ft).

e. Put the flow compensator adjustment screw back to its original position by turning the adjustment screw counter clockwise by the number of turns noted earlier.

f. Check the margin pressures as described in the margin pressure checks.

g. If margin pressure is correct, tighten the flow compensator lock nut to 1.5 kgf·m (10.9 lbf·ft). If margin pressure is not correct, adjust margin pressure as outlined in the margin pressure checks.

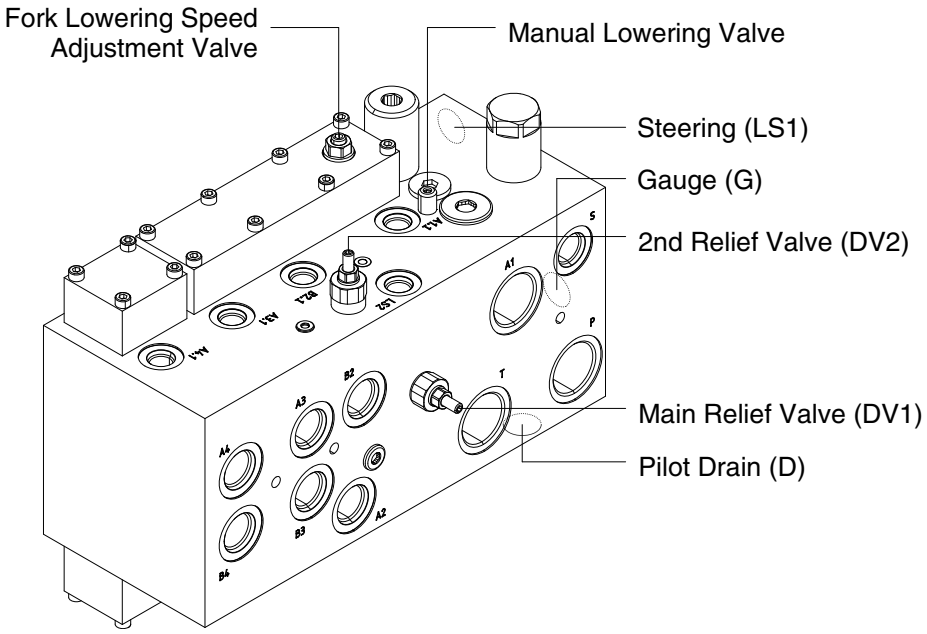


1 Flow compensator
2 Locknut (13 mm hex.)
3 Flow compensator adjustment screw (3 mm SW)
4 Pressure compensator
5 Pressure compensator adjustment screw (3 mm SW)

70D9V6HS60

5. MAIN CONTROL VALVE

1) STRUCTURE (4 SPOOL)



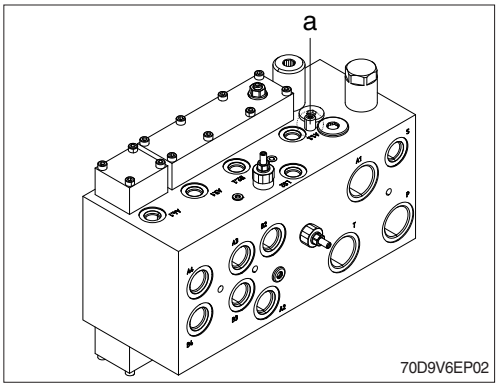
70D9V6HS07A

Port	Port name	Port size	Tightening torque	
			kgf·m	lbf·ft
A1	Lift / Lower	BSPP PF 1	19.0	177
A2, B2	Tilt rod / head	7/8-14 UNF	9.5	51.6
A-, B-	Aux 1, Aux 2			
P	Inlet	BSPP PF 1	19.0	177
T	Outlet			
a-.-, b-.-	RCV Lever	9/16-18 UNF	3.0	22.4
G / LS2 / D / LS1, S	Gauge / Pilot / Drain / Steering			
-	Main relief valve (DV1)	-	0.27	1.95
	2nd relief valve (DV2)			
	Manual lowering valve			
	Fork lowering speed ajdustment valve	M8		

2) FUNCTION

(1) Emergency fork lowering

In case that the mast can not be lowered due to a problem in the controller, activate the emergency lowering valve on the MCV assembly by rotating the valve (a).



⚠ Manual override features are intended for emergency use, not for continuous-duty operation.

① Rasing the cabin.

② Use the L-wrench (3 mm) to slowly undo the screw for the emergency lowering feature in an anti-clockwise direction until lowering begins.

※ **Do not undo the screw more than 1.5 turns.**

※ **If lowering still does not begin, there is a mechanical block. Do not under any circumstances continue to unscrew the emergency lowering feature.**

③ After lowering is complete, the screw must be screwed back in again

※ **Screw locking is essential to prevent fork lifting (or lowering) slow (or malfunction) due to valve opening.**

※ **Do not exceed a tightening torque of maximum 0.25 ~ 0.3 kgf·m (1.8 ~ 2.2 lbf·ft).**

⚠ When operating the emergency lowering valve in order to lower the mast inevitably, always make certain that any person should not stand or pass under the mast, the fork and platform so as to avoid from unexpected accident such as severe personal injury or death.

(2) **Cutoff solenoid for hydraulic blocking**

This device is a mast interlock that prevents the hydraulic functions of the RCV from being activated unless the driver is seated. In addition, it is a key lowering interlock device that prevents the fork from descending even when the ignition key is turned off. This safety function is defined in ISO 3691-1 and should not be arbitrarily disabled in the RCV.

(3) Relief valve

① Main relief valve (DV1)

The main relief valve limits the maximum pressure for the lift and tilt functions. If the lift or tilt function is operated simultaneously with the auxiliary function, the maximum pressure of the lift or tilt function is limited by the 2nd relief valve pressure setting. Typically the main relief valve would not require any field adjustment. If adjustment is necessary, refer to next page for main relief valve test and adjustment.

② 2nd relief valve (DV2)

The secondary relief valve limits the maximum pressure of the auxiliary function and is set lower than the main relief valve. Secondary relief valves may require pressure adjustment depending on the type of attachment.

※ If pressure adjustment is required, it is recommended to adjust within 90% of the main relief valve set pressure (e.g. 210 × 0.9=190 bar). If the main relief valve is too close to the set pressure, a problem of inter-circuit interference may occur. Refer next page for relief valve test and adjustment for adjustment instructions. As for the auxiliary function, up to 2 fingertip control methods and up to 3 manual control methods are provided as options.

3) RELIEF VALVE PRESSURE TEST AND ADJUSTMENT

(1) Test specification

- Engine speed : high idle rpm
- Oil temperature : 50 ± 5 ℃ (122 ± 9 ℉)
- MCV relief set pressure
  - Main : 210 ± 3 bar (3045 ± 43 psi)
    ★185 ± 3 bar (2680 ± 43 psi) / ★ : EU, AN corporate sales equipment
  - 2nd : 140 ± 3 bar (2030 ± 43 psi)
- Tools : spanner 10 mm, hex. wrench 3 mm

⚠ In general, the main relief valve (DV1) should not be adjusted for boosting applications in the field. Increasing the main relief valve pressure above the specified set pressure can damage the equipment.

⚠ Inspect the relief valve in a safe and clean environment.

⚠ Make sure that there is no other person around the equipment during operation and testing.

⚠ Even after turning off the engine, hydraulic oil may remain in the hydraulic system. To prevent personal injury, lower the fork completely down to the ground. (The mast chain has to be released loosely so that the fork is completely lowered.)

⚠ Before disassembling, tightening, removing, or adjusting piping components (hoses, fittings, plugs, etc.), be sure to turn off the engine. Completely remove the pressure inside the circuit by moving the MCV control lever two or three times in the forward and backward direction. Also opening the hydraulic tank cap and remove the pressure. (If the hydraulic tank breather filter is clogged, the pressure in the tank may remain.)

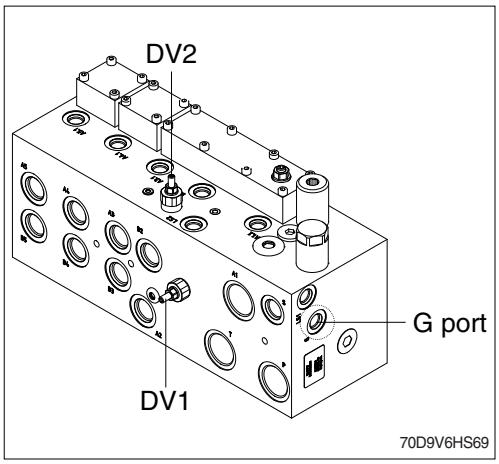
⚠ **Hot hydraulic oil can cause serious burns to skin. Do not touch hydraulic components or oil during test. Make sure hydraulic oil has cooled to safe temperature before installing or removing test equipment.**

⚠ **Hydraulic oil under pressure can be injected into skin. Lower forks to ground and relieve all circuit pressure before removing test plugs from valve.**

① Operate hydraulic system until the oil temperature is within test specification. See Hydraulic WarmUp Procedure.
② Lower the fork to the ground, stop the engine, and apply the parking brake switch.
③ Rasing the cabin.
④ Connect a pressure gauge to the “G” pressure check port on the MCV.
⑤ Operate engine at test specifications.
⑥ Pull the lift lever to raise the fork all the way and hold it.
⑦ Check pressure gauge reading. Compare the readings and specifications.
⑧ Loosen the MCV relief valve locknut (10 mm) and turn the adjusting (3 mm) screw to adjust the pressure.
- Tightening torque : 0.25 kgf·m (1.81 lbf·ft)
- If pressure is lower than specification, turn relief valve adjusting screw clockwise.
- If the pressure is higher than the specification, turn the adjusting screw counterclockwise.

⚠ **The MCV relief valve adjustment screw is very sensitive. Operate in 1/4 turn increments to avoid system overpressure.**

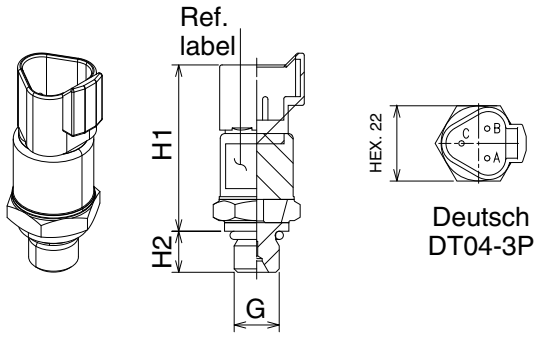
⑨ Repeat step ⑦, ⑧. If pressure is to specifications, remove test equipment.



6. PRESSURE SENSORS

1) LOAD PRESSURE SENSOR

(1) Structure



· Tightening torque : 2.5 ~ 3.0 kgf·m
(18 ~ 21.7 lbf·ft)

Pin map	Function
A	+ Supply
B	- Supply
C	Output

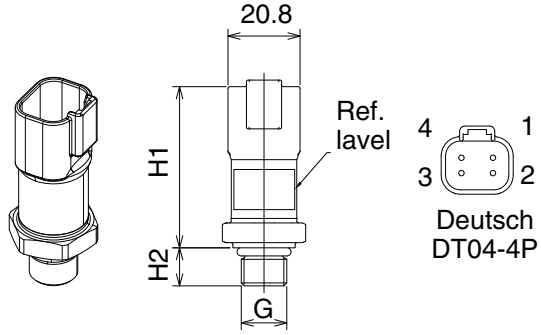
70D9V4BS10

Item	Medium	Thread (G)	H1 (mm)	H2 (mm)	Measuring range (bar)	Voltage (V)	Electircal connections
Fork load pressure sensor	Oil	9/16-18 UNF	49	12	0 ~ 350	5 ± 0.5	CD-70 (CN-17)

※ O-ring (S611-012001) : 11.89×1.98 (AS568-906, NBR Hs90)

2) PUMP PRESSURE SENSOR

(1) Structure



· Tightening torque : 2.5 ~ 3.0 kgf·m
(18 ~ 21.7 lbf·ft)

Pin map	Function
1	+ Supply
2	- Supply
3	-
4	Output

70D9V6HS15

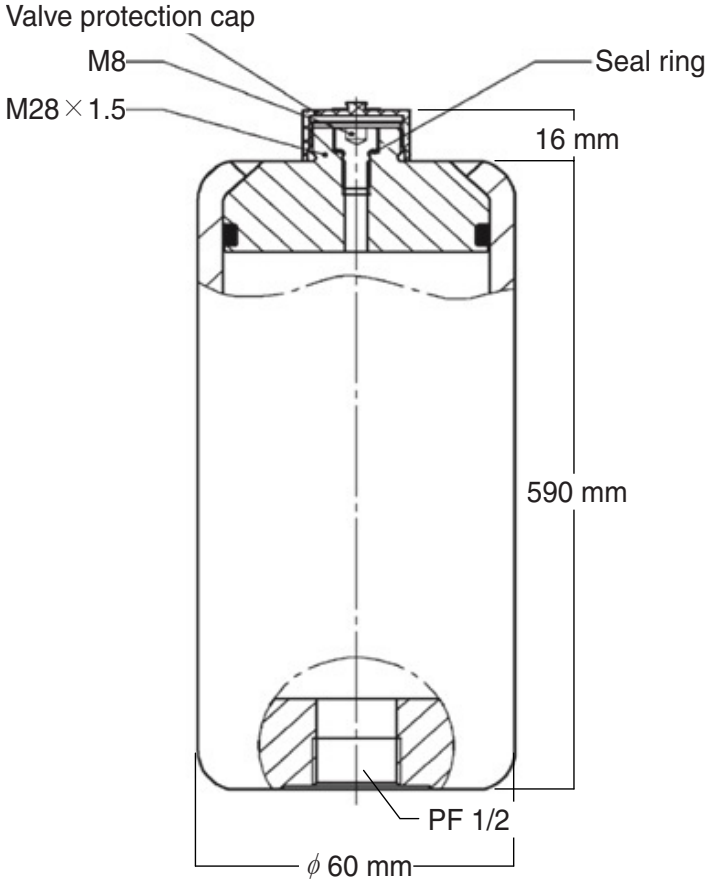
Item	Medium	Thread (G)	H1 (mm)	H2 (mm)	Measuring range (bar)	Pressure output signal (V)	Voltage (V)	Electircal connections
Pump pressure sensor (LS)	Oil	9/16-18 UNF	49	12	0 ~ 250	1 ~ 5	Max. 30	CD-5

※ O-ring (S611-012001) : 11.89×1.98 (AS568-906, NBR Hs90)

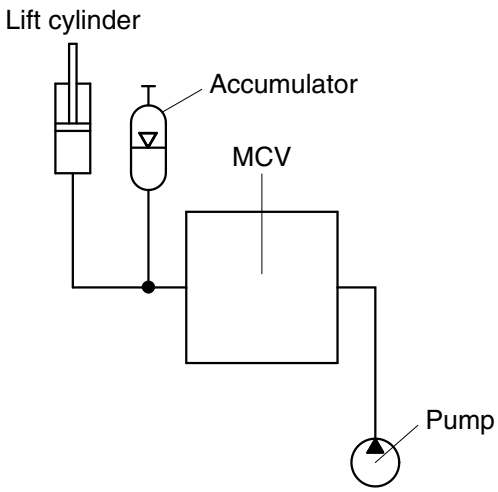
7. MAST ACCUMULATOR

1) STRUCTURE

· Tightening torque : 2 kgf·m (14.7 lbf·ft)



35D9VB6HS52



35D9VB6HS59

Parts No.	Normal volume	Pre-charging pressure at 20 ℃ (68 °F)	Gas	Weight
35FV-05000	0.5 ℓ (0.13 U.S. gal)	25 bar (363 psi)	Nitrogen gas N_2	4. 8 kg (10.6 lb)

※ Max. working pressure : 280 bar (4000 psi), shell, rod material : carbon steel

※ Permitted operating temperature : -20 ~ +80 ℃ (-4 ~ +176 °F), seal material : NBR/PUR

The mast accumulator is installed in the hydraulic line of the lift cylinder to absorb fork vibration and reduce hydraulic pulsation, which acts as a shock absorber to reduce vibration that may occur when climbing slopes or driving on rough road surfaces. This helps to prevent damage to fragile items such as glass or ceramics (porcelain) by ensuring the stability of the truck. In addition, when applied to hydraulic attachments (e.g. paper roll clamps, carton clamps, etc.), it can be configured and utilized to help reduce damage to the load through "prevent slipping of loads".

※ The accumulator works effectively under light and heavy loads. The higher the load, the smaller the absorption effect.

※ Compared with the case without the accumulator, this device can repeat overrun and underrun for a certain period of time when the fork stops. The phenomenon is slightly different depending on the load conditions, so please understand its characteristics before operation.

2) PRE-CHARGE PRESSURE

The accumulator is supplied pre-charged with nitrogen gas. The pre-fill pressure provided is indicated on the label of the accumulator shell or engraved on the surface of the top shell of the accumulator. A gas valve connection terminal is provided on the top of the accumulator to adjust the filling pressure (depending on the load or workplace conditions) as needed.

· First, it can be adjusted in the range of 6 ~ 50 bar (87 ~ 725 psi), and more can be adjusted.

· Based on temperature of 20 ℃ (68 ℉), charging is prohibited under high temperature conditions.

3) MAINTENANCE

⚠ **Under no circumstances should the piston accumulator be welded, soldered or mechanically repaired.**

(1) Normal checks

The basic maintenance instructions for the piston type mast accumulator are as follows. To maintain trouble-free operation, it is recommended to perform the following maintenance procedures regularly.

· Check that the connection is tihgt and there are no oil or gas leaks.

· Check the fastening parts.

· Accumulator pre-charge pressure test

(2) Checking for oil leakage into the gas side

Hydraulic oil in the accumulator may leak to the gas side through the piston seal. Check this in the following way. In this case, there is oil leakage on the gas side, so replace the accumulator.

· If a higher filling pressure than the previous test is found.

· When oil or oil mist comes out when loosening the M8 screw with a 6 mm hex. wrench.

※ **If there is oil leakage inside the accumulator, it is recommended not to repair it and replace the parts.**

· The supplied HYDAC SK280 piston accumulator is a non-repairable sealed product.

· It is an economical product with excellent durability and non-repairable structure, optimizing size and weight to reduce costs.

(3) Pre-charge pressure testing and frequency

※ **Check the charging pressure of the accumulator after completely draining the hydraulic oil from the lift cylinder line. If the cylinder line is not fully evacuated, the gas filling pressure may look different. Also, when disconnecting the accumulator connection piping, the pressure oil in the cylinder line must be discharged first.**

It t is recommended to check the filling pressure as follows.

· Initial 250 hour or 6 weeks

· Once 2000 hours or every year.

If there is no significant gas loss during the initial inspection, check 2000 hours.

※ **if the truck continues to run in harsh workplace (or high operating temperature) conditions, it should be tested more often.**

4) GAS RELEASE AND CHARGING

(1) Release

① Loosen the plastic cap and loosen the M8 screw tightly locked to the gas valve connection on the top of the accumulator with a 6 mm hex. wrench and lock it again.

② Connect FPU to the accumulator gas vlave.

※ **Release valve (D) be sure to connect while locked.**

③ Open the accumulator valve (counterclockwise) with the spindle of the FPU and check the gas.

④ Open the release valve of FPU slowly (counter-clockwise) and blow out nitrogen gas until the set pressure is confirmed. Pressure is measured at room temperature around 20 ℃ (68 ℉).

⑤ When the set pressure is reached, close the release valve (clockwise) and close the accumulator valve with the spindle.

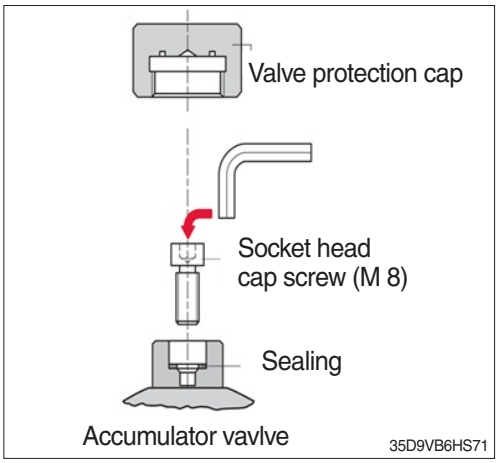
⑥ Wait 5-10 minutes for the filled nitrogen gas pressure to stabilize, then recheck the set pressure and adjust if necessary.

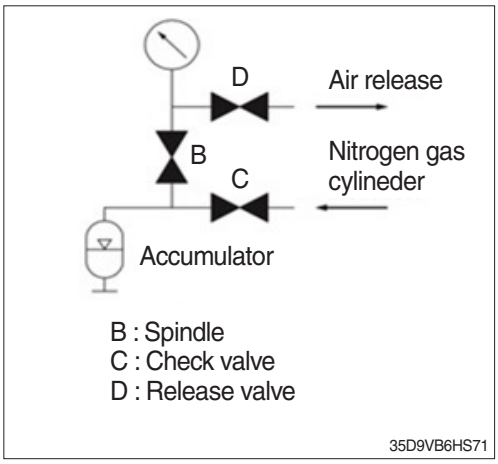
⑦ Open the release valve and blow out gas in the FPU.

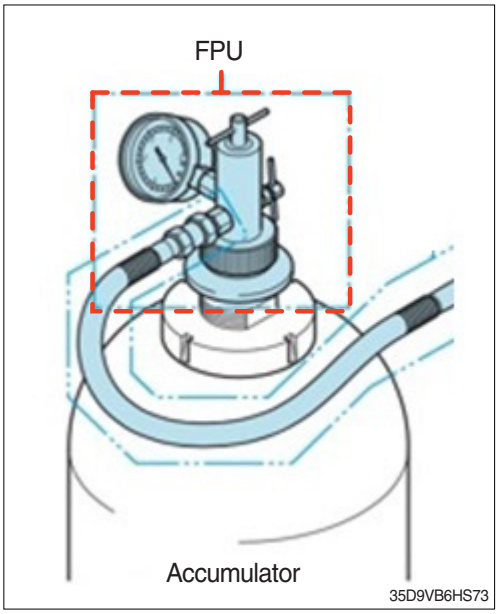
※ **If there is gas in the charging hose and FPU, it cannot be separated, and it is very dangerous if it is forcibly separated. Be sure to separate the charging hose and after blowing out the gas inside the FPU.**

⑧ Separate the FPU from the accumulator.

⑨ Tighten the M8 screw on the top of the accumulator to 2.0 kgf·m (15 lbf·ft) and tighten the plastic cap by hand.







(2) Charging

※ **The filling kit operation method was prepared based on HYDAC product standards.**

※ **Accumulator gas pressure adjustment and charging kit must be purchased separately.**

※ **To recharge nitrogen gas, it is convenient to use the HYDAC FPU-1 unit.**

⚠ **Must be filled with clean nitrogen gas only. Never use oxygen or air. Explosion hazard. Basically, nitrogen must use a minimum class 4.0. (99,99 %, filtering < 3 µm)**

① Connect the charging hose to the nitrogen gas cylinder and FPU. Be sure to connect the release valve while it is closed. The release valve has a structure that lengthens when locked and decreases when released.

② Loosen the plastic cap and loosen the M8 screw tightly locked to the gas valve connection on the top of the accumulator with a 6 mm hex. wrench and lightly lock it again.

③ Connect FPU to the accumulator.

④ Using the spindle of FPU, open the M8 screw on the top of the accumulator. (counterclockwise)

⑤ Slowly open the valve of the nitrogen gas cylinder and check the pressure of the gas injected into the accumulator.

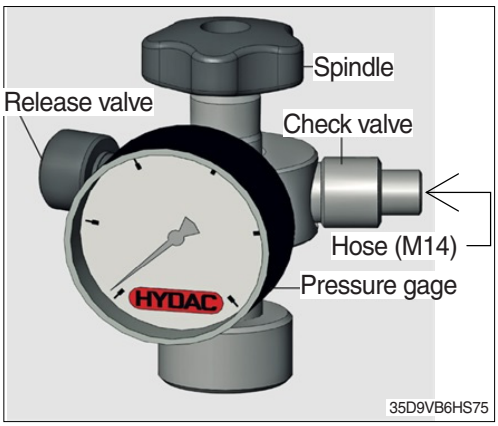
⑥ When filling is complete, close the gas valve of the accumulator using the valve of the nitrogen gas cylinder and the spindle of the FPU.

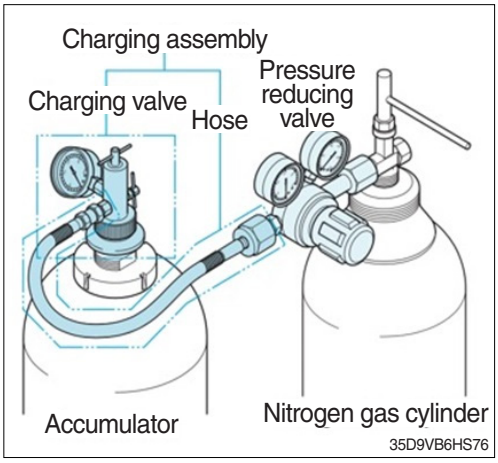
※ **When adding nitrogen to the accumulator filled with nitrogen gas, wait 5-10 minutes for the temperature and pressure of the gas mixture to stabilize, then check the pressure again and adjust if necessary.**

⑦ Open the release valve of FPU to remove nitrogen from the charging hose and FPU.

⑧ Using the spindle of FPU, open the accumulator valve, check the gauge, and adjust the release valve to blow out the accumulator nitrogen to the desired pressure.

⑨ When the desired pressure is reached, close the release valve of the FPU and close the gas valve of the accumulator using the spindle.



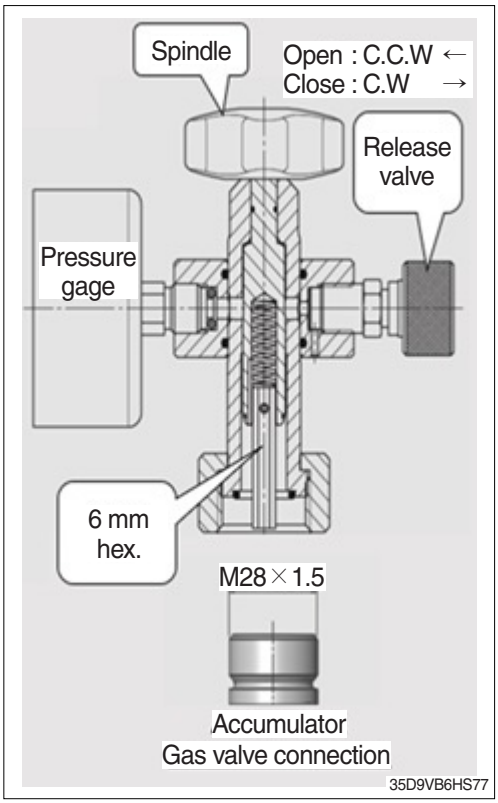


⑩ Open the release valve and blow out nitrogen gas in the FPU.

※ **If there is gas in the charging hose and FPU, it cannot be separated, and it is very dangerous if it is forcibly separated. Be sure to separate the charging hose and after blowing out the gas inside the FPU.**

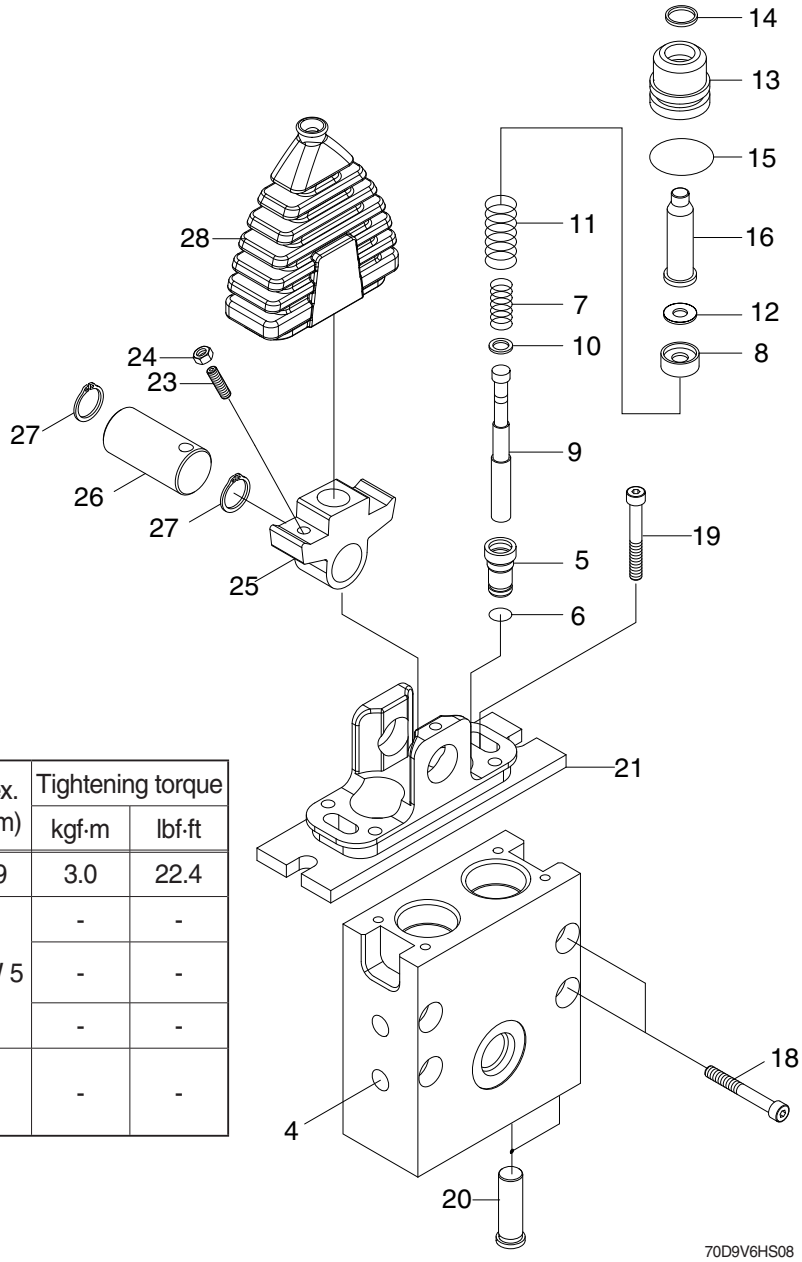
⑪ Remove the FPU from the accumulator.

⑫ Tighten the M8 screw on the top of the accumulator to 2.0 kgf·m (15 lbf·ft) and tighten the plastic cap by hand.



8. REMOTE CONTROL VALVE

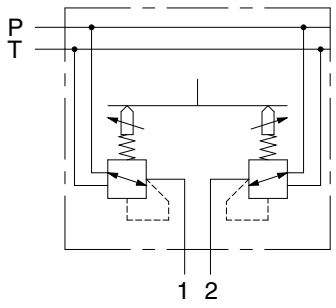
1) STRUCTURE



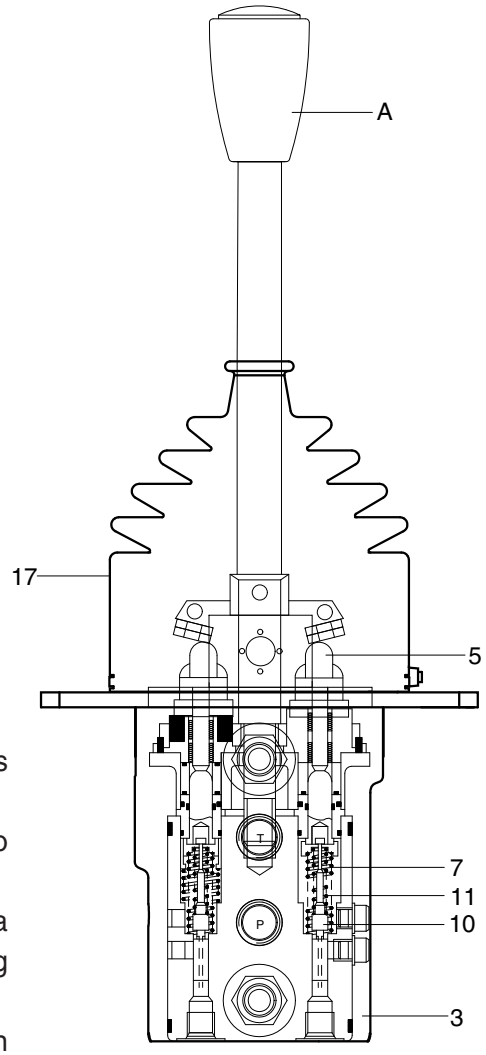
Port name	Port thread	Hex. (mm)	Tightening torque	
			kgf·m	lbf·ft
All port	9/16-18UNF	19	3.0	22.4
Bolt - tie 3SP	M6 × 40L (8 EA)	SW 5	-	-
Bolt - tie 4SP	M6 × 40L (4 EA) M6 × 75L (4 EA)		-	-
Bolt - tie 5SP	M6 × 75L (8 EA)		-	-
Bolt cover	M4 × 20L (12 EA) M4 × 20L (16 EA) M4 × 20L (20 EA)	-	-	-

1	Body	12	Stopper	21	Cover
4	Plug	13	Plug	23	Bolt
5	Plug	14	Oil seal	24	Nut
6	O-ring	15	O-ring	25	Guide
7	Spring	16	Push rod	26	Pin
8	Spring seat	17	O-ring	27	Spring pin
9	Spool	18	Bolt	28	Boot
10	Spool	19	Bolt		
11	Shim	20	Cap		

2) OPERATION



HYDRAULIC CIRCUIT



100D7RCV01

(1) Hydraulic functional principle

Pilot devices with end position locks operate as direct operated pressure reducing valves.

They basically comprise of control lever (A), two pressure reducing valves, body (3) and locks.

Each pressure reducing valve comprises of a plunger kit (5), a metering spring (7) and a spring (11).

At rest, control lever(A) is held in its neutral position by return springs (11). Ports (1, 2) are connected to tank port T.

When control lever (A) is deflected, plunger kit (5) is pressed against return spring (11) and metering spring (7).

Metering spring (7) initially moves docking rod (10) downwards and closes the connection between the relevant port and tank port T. At the same time the relevant port is connected to port P. The control phase starts as soon as docking rod (10) finds its balance between the force from metering spring (7) and the force, which results from the hydraulic pressure in the relevant port (ports 1, 2).

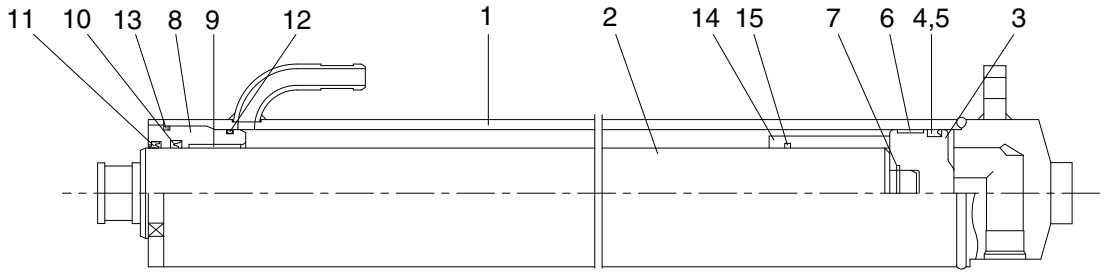
Due to the interaction between docking rod (10) and metering spring (7) the pressure in the relevant port is proportional to the stroke of plunger (5) and hence to the position of control lever (A).

This pressure control which is dependent on the position of the control lever and the characteristics of the control spring permits the proportional hydraulic control of the main directional valves and high response valves for hydraulic pumps.

A rubber bellows (17) protects the mechanical components in the housing from contamination.

9. LIFT CYLINDER

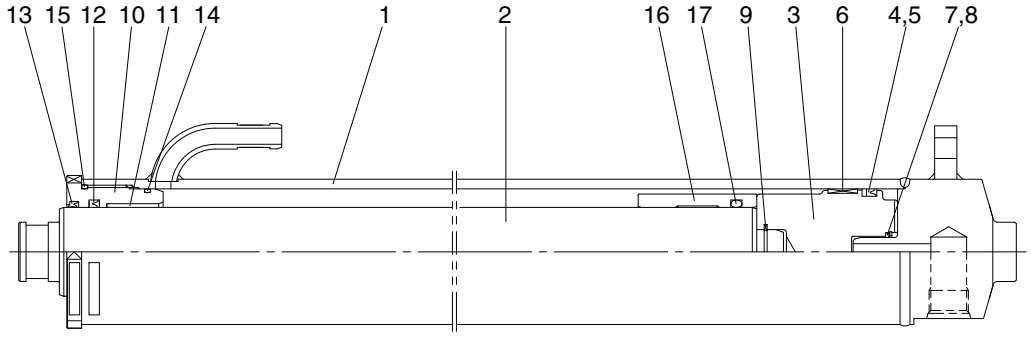
1) V-MAST



50D9HS12A

1	Tube assy	6	Wear ring	11	Dust wiper
2	Rod	7	Cushion seal	12	O-ring
3	Piston	8	Gland	13	O-ring
4	Piston seal	9	Du bushing	14	Spacer
5	Back up ring	10	Rod seal	15	O-ring

2) TF/TS MAST

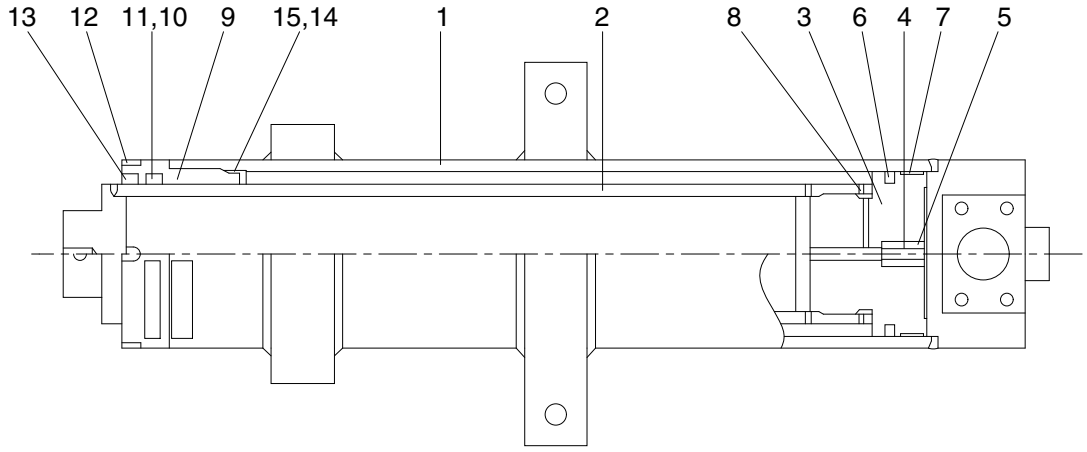


D507HS12

1	Tube assy	7	Cushion seal	13	Dust wiper
2	Rod	8	Retaining ring	14	O-ring
3	Piston	9	Retaining ring	15	O-ring
4	Piston seal	10	Gland	16	Spacer
5	Back up ring	11	Du bushing	17	O-ring
6	Wear ring	12	Rod seal		

10. FREE LIFT CYLINDER

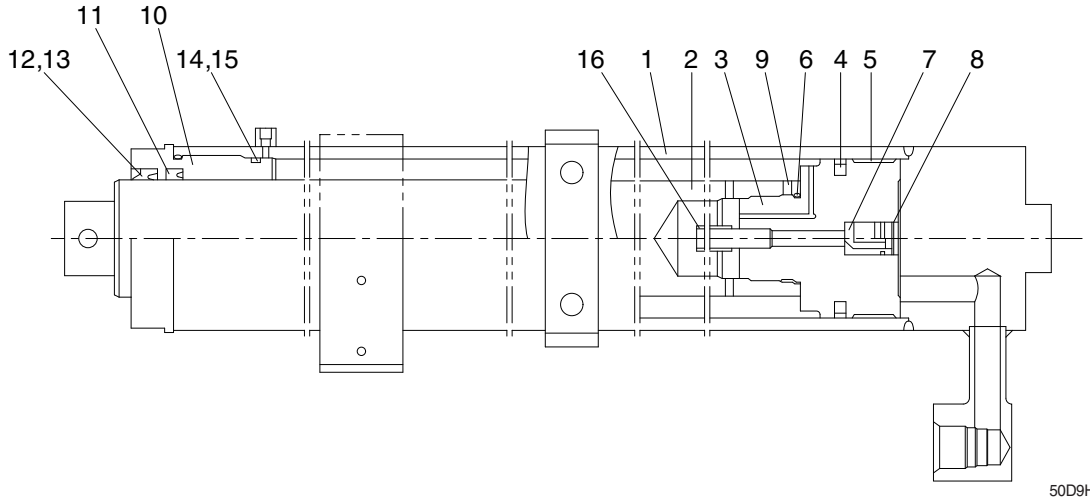
1) TF-MAST



50D9HS12B

1	Tube assy	6	GLYD ring	11	Back up ring
2	Rod assy	7	Wear ring	12	Dust wiper
3	Piston	8	Set screw	13	Snap ring
4	Check valve	9	Gland	14	O-ring
5	Retaining ring	10	Rod seal	15	Back up ring

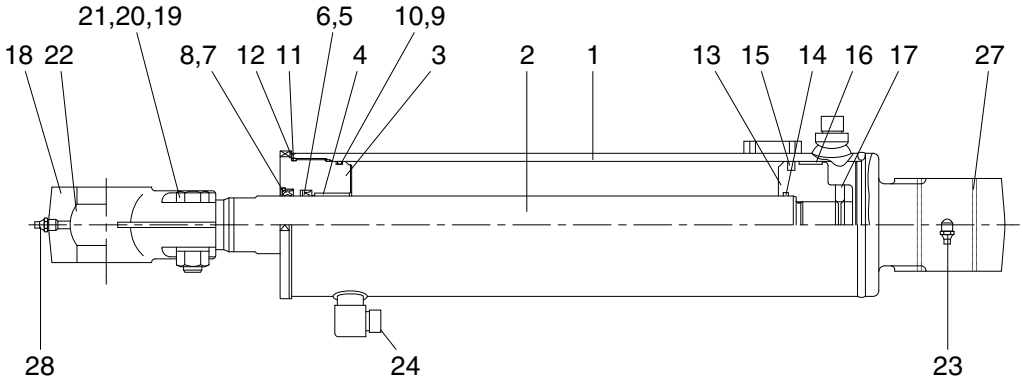
2) TS MAST



50D9HHS12C

1	Tube assy	7	Check valve	13	Retaining ring
2	Rod	8	Retaining ring	14	O-ring
3	Piston	9	Set screw	15	Backup ring
4	Piston seal	10	Rod cover	16	Pipe
5	Wear ring	11	U-packing		
6	O-ring	12	Dust wiper		

11. TILT CYLINDER



50D9HS12C

1	Tube assy	10	Back up ring	19	Hex bolt
2	Rod	11	O-ring	20	Hex nut
3	Rod cover	12	Washer	21	Spring washer
4	Rod bushing	13	Piston	22	Spherical bearing
5	U-packing	14	O-ring	23	Grease nipple
6	Back up ring	15	Piston seal	24	O-ring
7	Dust wiper	16	Wear ring	27	Rod bushing
8	Stop ring	17	Set screw	28	Grease nipple
9	O-ring	18	Eye		

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) CHECK ITEM

(1) Check visually for deformation, cracks or damage of rod.

(2) Set mast vertical and raise 1 m (39 inch) from ground. Wait for 10 minutes and measure hydraulic drift (amount forks move down and amount mast tilts forward).

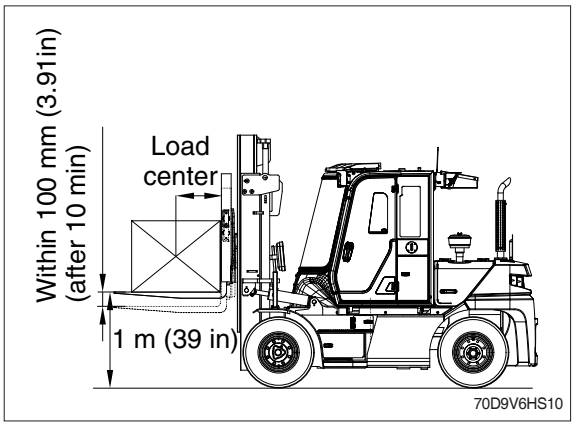
· **Check condition**

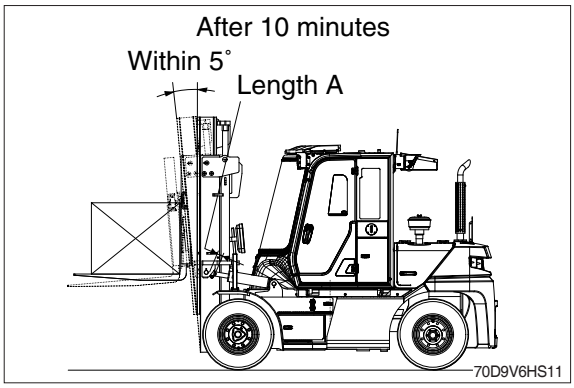
- Hydraulic oil : 45±5 ℃ (113±41 ℉)
- Rated capacity load
- Mast substantially vertical
- Key OFF, operator non-existence

· **Hydraulic drift**

- Down (Downward movement of forks)
  : Within 100 mm (3.9 in)
- Forward (Extension of tilt cylinder)
  : Within 5° or length (A) 67.5 mm (2. 7in)

(3) If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.



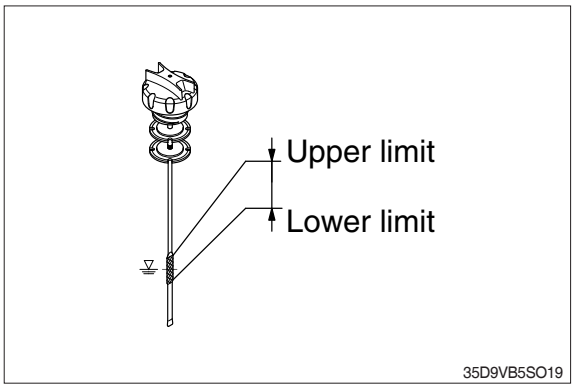


2) HYDRAULIC OIL

(1) Using dipstick, measure oil level, and oil if necessary.

(2) When changing hydraulic oil, clean suction strainer (screwed into outlet port pipe) and return filter (screwed into inlet pipe).

· Dipstick length = 260 mm (7.9 in)



3) CONTROL VALVE

(1) Raise forks to maximum height and measure oil pressure. Check the oil pressure.

Model	Unit	Pressure
70D-9VB	bar (psi)	210 ± 3 (3050 ± 43)
		★185 ± 3 (2680 ± 43)

★ : EU, AN coporate sales equipment

2. TROUBLESHOOTING

1) SYSTEM

Problem	Cause	Remedy
Large fork lowering speed	· Seal inside control valve defective. · Oil leaks from joint or hose. · Seal inside cylinder defective.	· Replace spool or valve body. · Replace. · Replace packing.
Large spontaneous tilt of mast	· Tilting backward : Check valve defective. · Tilting forward : tilt lock valve defective. · Oil leaks from joint or hose. · Seal inside cylinder defective.	· Clean or replace. · Clean or replace. · Replace. · Replace seal.
Slow fork lifting or slow mast tilting	· Lack of hydraulic oil. · Hydraulic oil mixed with air. · Oil leaks from joint or hose. · Excessive restriction of oil flow on pump suction side. · Relief valve fails to keep specified pressure. · Poor sealing inside cylinder. · High hydraulic oil viscosity. · Mast fails to move smoothly. · Oil leaks from lift control valve spool. · Oil leaks from tilt control valve spool.	· Add oil. · Bleed air. · Replace. · Clean filter. · Adjust relief valve. · Replace packing. · Change to SAE10W, class CD engine oil. · Adjust roll to rail clearance. · Replace spool or valve body. · Replace spool or valve body.
Hydraulic system makes abnormal sounds	· Excessive restriction of oil flow pump suction side. · Gear or bearing in hydraulic pump defective.	· Clean filter. · Replace gear or bearing.
Control valve lever is locked	· Foreign matter jammed between spool and valve body. · Valve body defective.	· Clean. · Tighten body mounting bolts uniformly.
High oil temperature	· Lack of hydraulic oil. · High oil viscosity. · Oil filter clogged.	· Add oil. · Change to SAE10W, class CD engine oil. · Clean filter.
Actuator (cylinder or motor) works slowly or does not operate.	· Shortage of oil in oil tank. · Decrease of relief valve pressure. · Spool got stuck. · Shortage of oil flow to the valve.	· Check the oil level in the oil tank. · Install pressure gauge on the circuit, and check the pressure with it by handling the lever. · Check that manual lever moves smoothly. Check that lever stroke is enough. · Check that oil flow of the pump is within specified rate.

Problem	Cause	Remedy
High oil temperature	· Lack of hydraulic oil. · High oil viscosity. · Oil filter clogged.	· Add oil. · Change to SAE10W, class CD engine oil. · Clean filter.
Cylinder lowers considerably under normal circumstance.	· Internal leakage of cylinder happens frequently. · Excessive leakage from spool of the valve. · Spool got stuck. · Leakage in a part of the circuit.	· Fit the stop valve on the pipe between valve and cylinder, observe the internal leakage of cylinder. · Check the oil viscosity is not too low. · Check that manual lever moves smoothly. · Check the circuit. Observe leakage from pipes.
Pressure does not increase sufficiently.	· Defect of relief valve. · Leakage in a part of the circuit.	· Check the relief valve. · Check the circuit. Observe leakage from pipes.
Temperature rising of the hydraulic oil.	· Working with higher pressure than rated pressure. · Low viscosity of oil. · Leakage from a part of the circuit. · Oil leakage in the pump. · Insufficient suction of the pump.	· Check the flow pressure. · Check the sort of oil and viscosity. · Check if the circuit is relieved at all times. · Check if the temperature of pump surface higher 30˚C than oil temperature. · Check the oil tank volume. Check if the suction strainer is blocked.
Steering force is heavy.	· Defect of steering relief valve.	· Check the steering relief valve.

2) MAIN PUMP

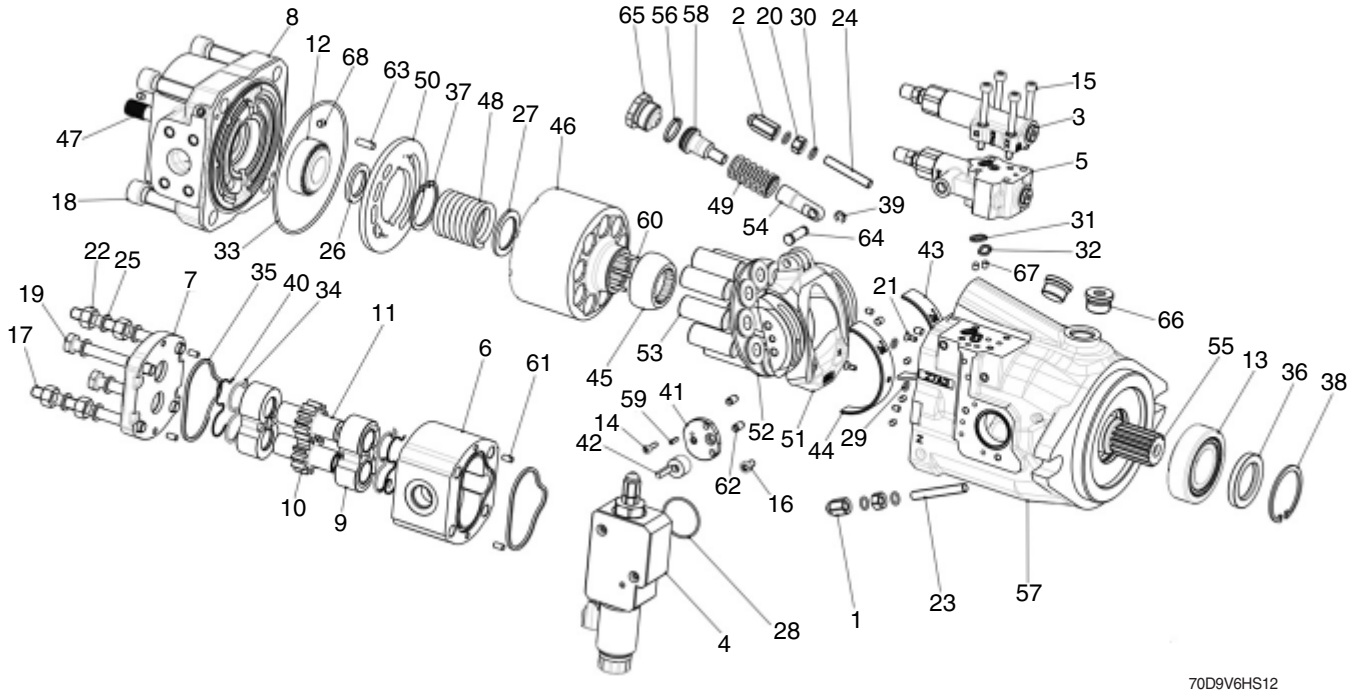
Problem	Cause	Remedy
Unusual noises No or insufficient flow	· Insufficient air bleeding of the hydraulic system.	· Fill the axial piston pump, suction line for the hydraulic pump and the oil tank. · Completely air bleed the pump and hydraulic system. · Inspect and correct or replace. - Installation position
	· Insufficient suction conditions - Viscosity of the hydraulic fluid too high - Suction pressure too low - Impermissible filter in the suction line - Foreign particles in the suction line	· Optimize inlet conditions. - Use suitable hydraulic fluid. - Fill the suction line with hydraulic fluid. - Remove foreign particles from the suction line.
	· Improper mounting of the axial piston pump	· Inspect and correct the mounting of the pump. - Observe tightening torques.
	· Improper mounting of assembled parts (hydraulic lines)	· Mount assembled parts according to the information provided.
	· Pump control valve vibration	· Optimize the adjustment of the axial piston pump and the pressure limitation in the hydraulic system.
	· Mechanical damage to the main pump (e.g. bearing damage)	· Inspect and correct or replace.
No or insufficient flow	· Faulty mechanical drive (e.g. defective coupling & spline) · Hydraulic fluid not in optimal viscosity range	· Inspect and correct or replace. · Check temperature range and use suitable hydraulic fluid.
No or insufficient pressure	· Insufficient pilot pressure or control pressure · Output actuator defective (e.g. hydraulic cylinder)	· Check pilot pressure or control pressure. Inspect and correct. · Inspect and correct.
Pressure Flow fluctuations Instabilities	· Malfunction of the control device of the axial piston pump · Wear or mechanical damage to the axial piston pump · Unstable control signal	· Inspect and correct. · Inspect and correct or replace. · Inspect and correct.
Increased, unusual vibration	· Bearings worn	· Inspect and correct or replace.
Excessively high temperature of hydraulic fluid and housing	· Wrong setting or malfunction in the pressure relief and pressure control valves e.g.) - high pressure relief valve - pressure cut-off - pressure controller · Axial piston pump worn	· Optimize the adjustment of the pressure limitation and pressure control valves of the axial piston pump and the pressure safeguarding in the hydraulic system. · Inspect and correct. · Inspect and correct or replace.

3) CYLINDER

Problem	Cause	Remedy
Oil leaks out from rod cover through rod	· Foreign matters on packing. · Unallowable score on rod. · Unusual distortion of dust seal. · Chrome plating is striped.	· Replace packing. · Smooth rod surface with an oil stone. · Replace dust seal. · Replace rod.
Oil leaks out from cylinder rod cover thread	· O-ring damaged.	· Replace O-ring.
Rod spontaneously retract	· Scores on inner surface of tube. · Unallowable score on the inner suface of tube. · Foreign matters in piston seal.	· Smooth rod surface with an oil stone. · Replace cylinder tube. · Replace piston seal.
Wear (clearance between cylinder tube and wear ring)	· Excessive clearance between cylinder tube and wear ring.	· Replace wear ring.
Abnormal noise is produced during tilting operation	· Insufficient lubrication of anchor pin or worn bushing and pin. · Bent tilt cylinder rod.	· Lubricate or replace. · Replace.

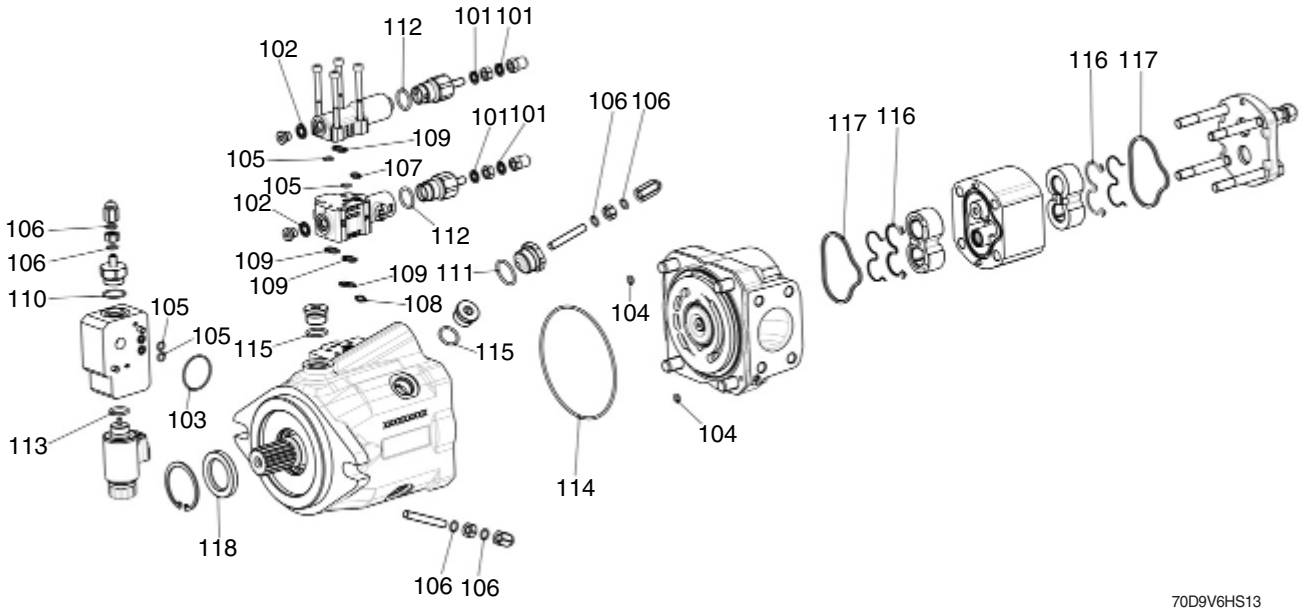
1. MAIN PUMP

1) STRUCTURE



1	Lock nut	24	Screw (M8×50)	47	Hub
2	Lock nut	25	Washer	48	Piston spring
3	Flow compensator	26	Washer	49	Spring
4	Displacement regulator	27	Washer	50	Valve plate
5	Flow compensator	28	O-Ring	51	Swash plate
6	Housing	29	O-Ring	52	Piston guide plate
7	Rear Cover	30	Seal	53	Piston
8	Cover	31	Seal	54	Connection shaft
9	Thrust plate	32	Seal	55	Version shaft
10	Drive gear	33	O-Ring	56	Segment
11	Drive gear	34	Seal	57	Pump body
12	Roller bearing	35	Seal	58	Piston
13	Roller bearing	36	Shaft seal	59	Dowel pin
14	Screw (M4×14)	37	Ring	60	Dowel pin
15	Screw (M6×60)	38	Snap ring	61	Dowel pin
16	Screw (M6×10)	39	Ring	62	Dowel pin
17	Stud bolt (M10×120)	40	Seal plate	63	Dowel pin
18	Screw (M14×45)	41	Drive Support	64	Dowel pin
19	Screw	42	Drive regulator	65	Plug
20	Nut (M8)	43	Swash plate	66	Plug
21	Screw (M4×10)	44	Swash plate	67	Plug
22	Nut	45	Ring spline	68	Plug
23	Screw (M8×60)	46	Cylinder block		

· Seal kit (101~118)



101	Washer	107	O-Ring	113	O-Ring
102	Washer	108	Seal	114	O-Ring
103	O-Ring	109	Seal	115	O-Ring
104	O-Ring	110	O-Ring	116	Seal
105	O-Ring	111	O-Ring	117	Seal
106	Seal	112	O-Ring	118	Shaft seal

2) GENERAL INSTRUCTION

(1) Purpose

The following document shows all replacement steps for all seals, belonging to the pump. When you see a leakage, you must follow the replacement instruction only for the components involved in the leak. This explain the most common replacements, that concern shaft seal, compensators seals and internal pump seals (piston and gear).

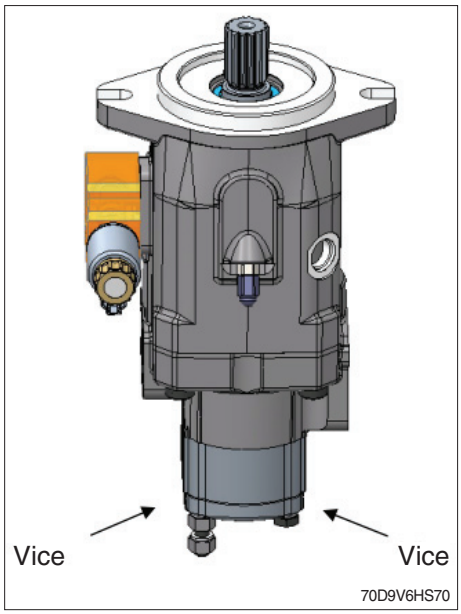
(2) Suggestion

① Check the parts have not been damaged during the shipment.
② Work in a clean area.
③ Clean with solvent (except the seals) and dry air all components before assembling.
④ Pay attention not to damage the machined surfaces.
⑤ The components need to be fitted in place without forcing them. If too much force is required, it is due to a bad clearances issues.
⑥ When hand pressure is not enough, use only mallet and never hammer.
⑦ Respect the tightening torque for bolts.
⑧ Pay attention when you see a warning sign.

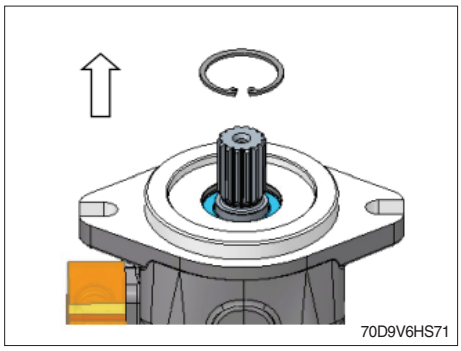
3) SHAFT SEAL REPLACEMENT

(1) Put the pump in vertical, with the shaft facing up.

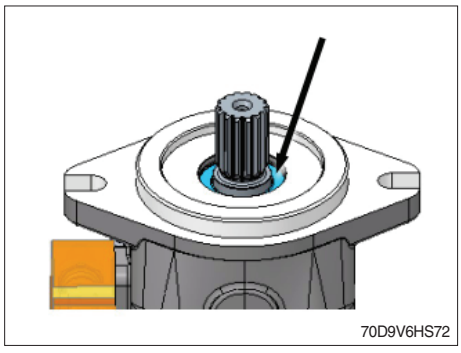
⚠ **You need to find something suitable for the cover geometry, in order to put the pump in vertical position.**



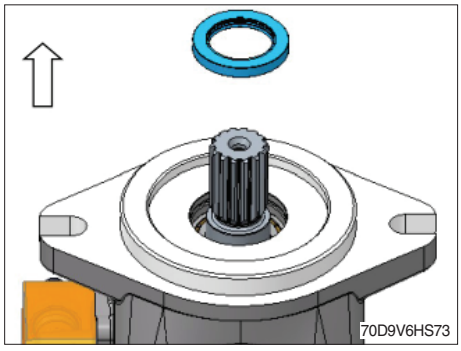
(2) Remove the snap ring.



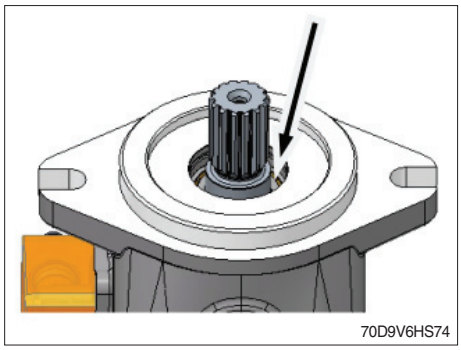
(3) Realize a small hole (or more small holes) in the shaft seal.



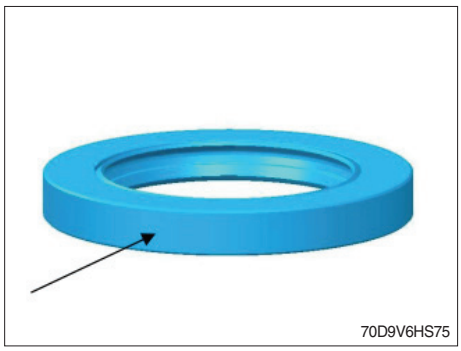
(4) Use an artisanal tool or a screwdriver, in order to deform the shaft seal and remove it. Holes made before can help to enter between shaft seal lip and the shaft, with the tool or the screwdriver.



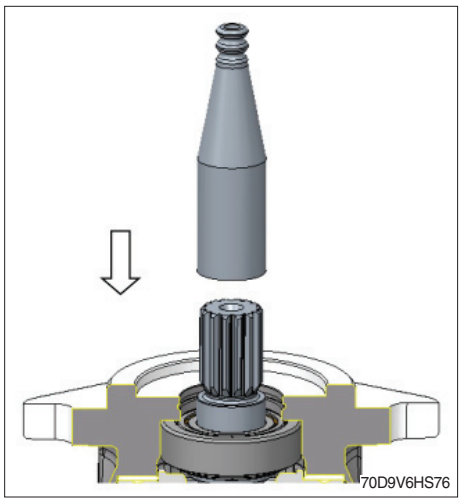
(5) Clean the surface with compressed air.



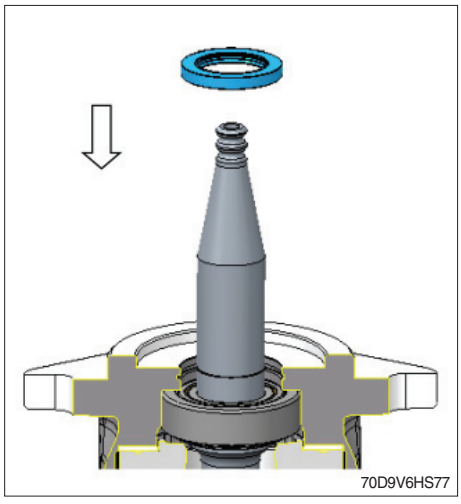
(6) Put a thin layer of clean grease on the contact surface.



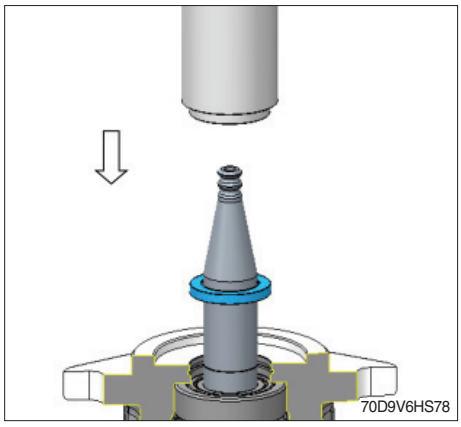
(7) Protect the shaft seal using a proper protection for the shaft end.



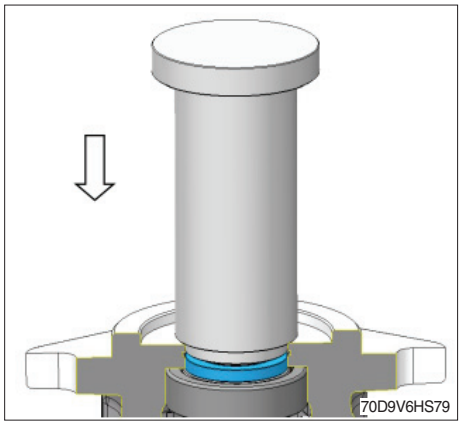
(8) Do not damage the shaft seal lip while assembling the seal on the shaft. Pay attention both to the shaft end and to the little gap in the diameter between the shaft end and the seat of the shaft seal.



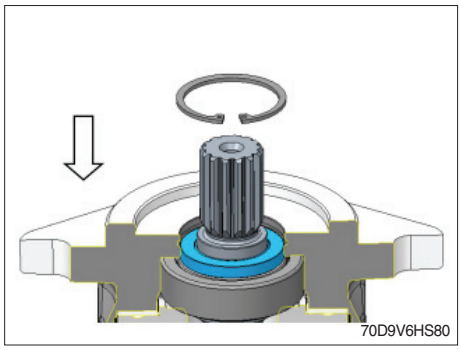
(7) Use a proper tool to push the shaft seal close to its seat. The shaft seal must be kept always perpendicular to the shat to not damage the seal lip.



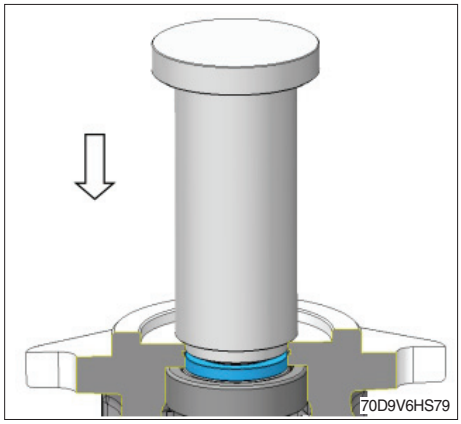
(8) Be careful not to push the shaft seal inside the case. It is sufficient to push it in order to have enough space for the snap ring to be placed near its seat.



(9) Insert the snap ring.

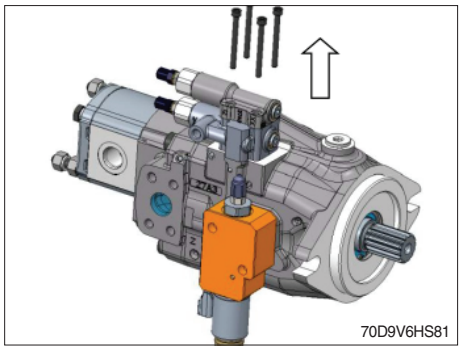


(10) Use a proper tool to push the snap ring in its seat. The shaft seal is going to be pushed by the snap ring in the correct position.

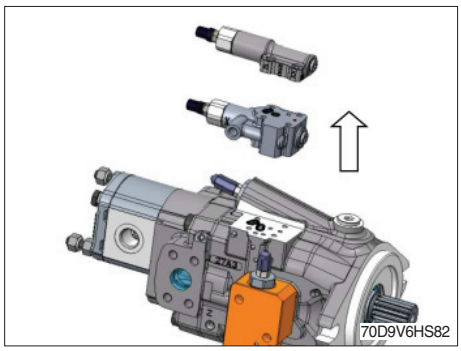


4) COMPENSATOR SEALS REPLACEMENT

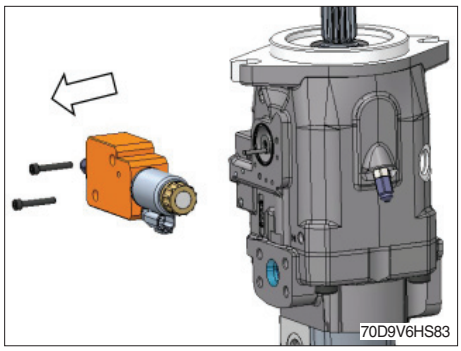
(1) Remove the screws of the compensators.



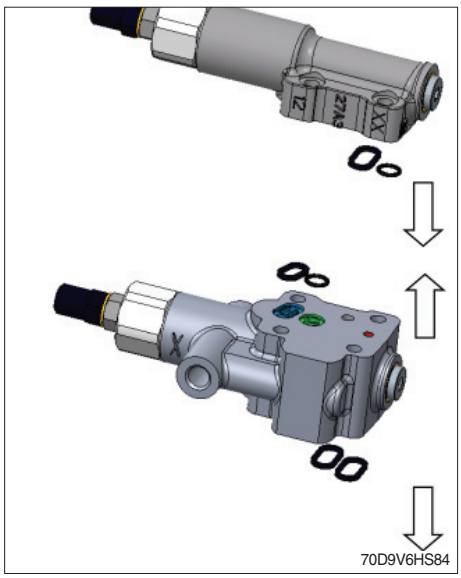
(2) Remove the pressure and the flow compensators.



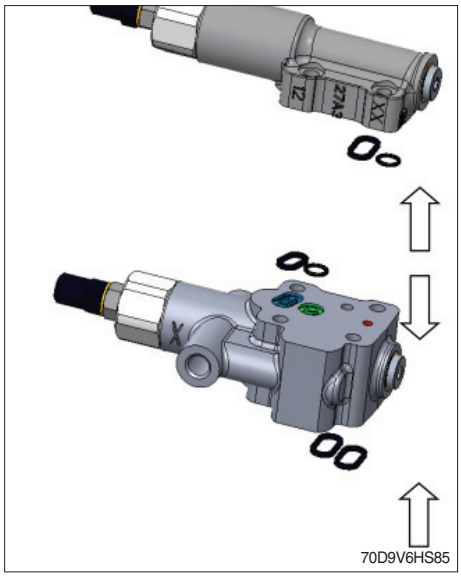
(3) Remove the DEC (Displacement Electronic Control).



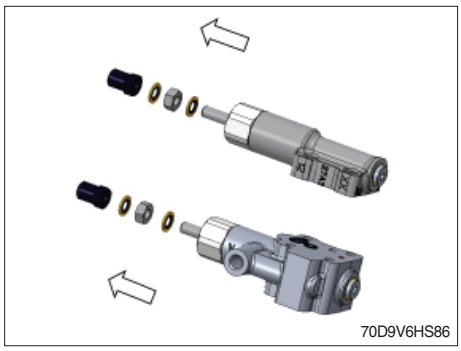
(4) Remove the O-ring seals.



(5) Insert the new O-ring seals.



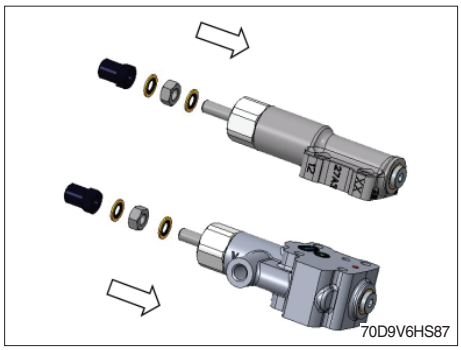
(6) Remove nut and washer.



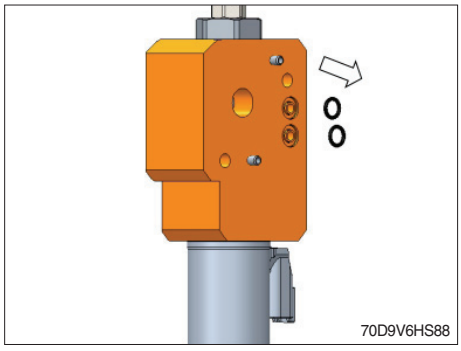
(7) Insert new washers. Tightening torque of nut and plug.

· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)

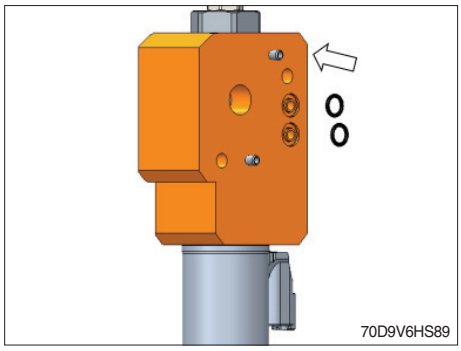
⚠ **Keep attention to do not touch the limiter screws or you will change the calibration of pressure and flow compensators.**



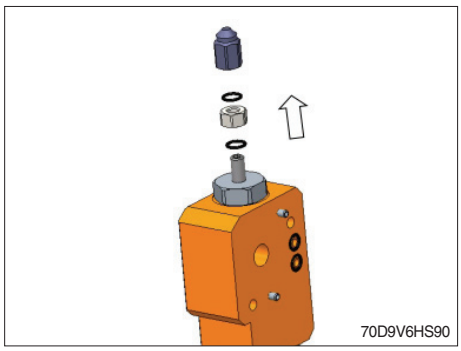
(8) Remove the O-ring seals.



(9) Insert the new O-ring seals.



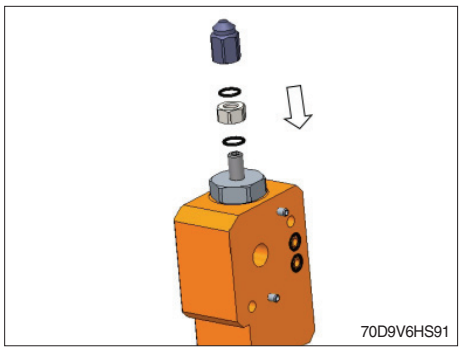
(10) Remove plug, nut and the O-ring seals.



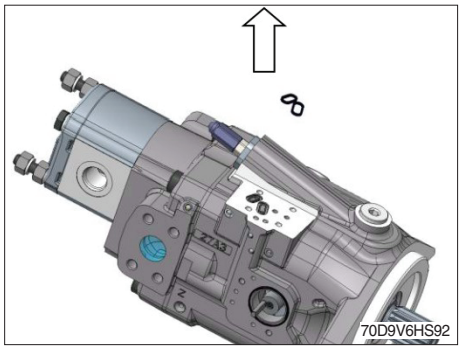
(11) Insert the new O-ring seals. Tightening torque of nut and plug.

· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)

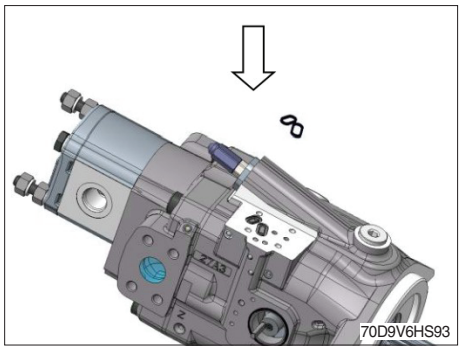
⚠ **Keep attention to do not touch the limiter screws or you will change the calibration.**



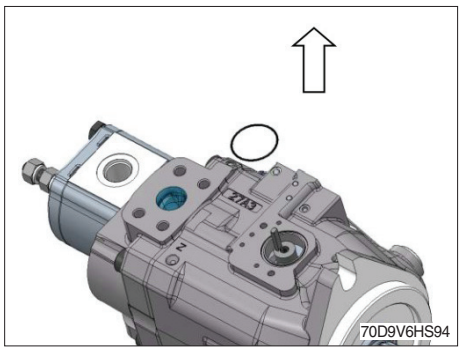
(12) Remove the O-ring seals on the compensator plane.



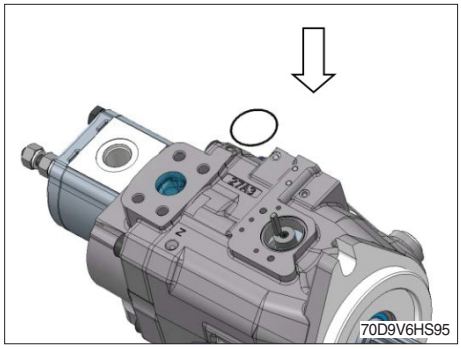
(13) Insert the new O-ring seals on the compensator plane.



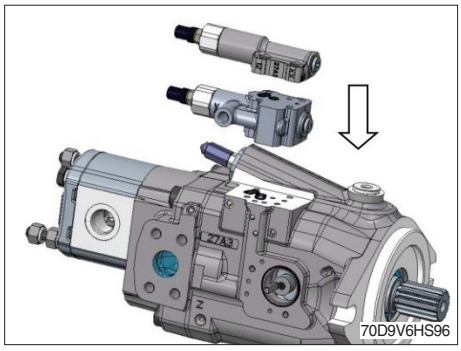
(14) Remove the O.ring seals on DEC (Displacement Electronic Control) plane.



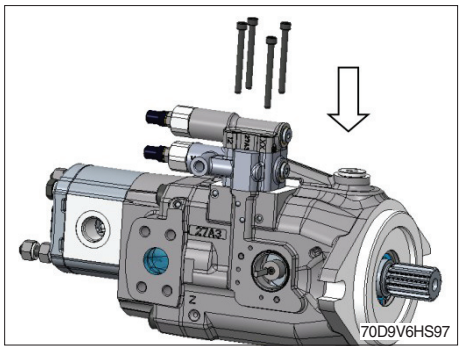
(15) Insert the new O-ring seals on DEC (Displacement Electronic Control) plane.



(16) Reassemble the flow and the pressure regulators.

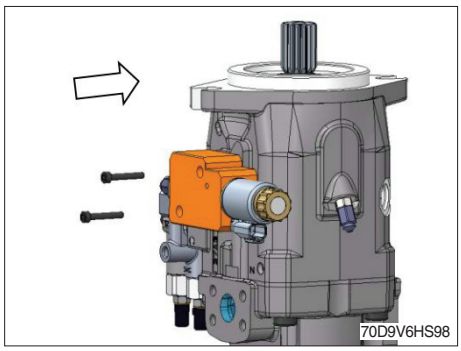


(17) Tighten the bolts with a torque wrench.
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)



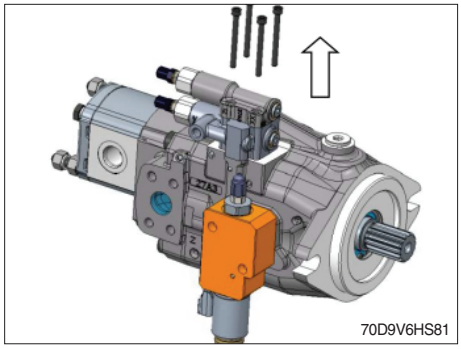
(18) Reassemble the DEC (Displacement Electronic Control). Tighten the bolts with a torque wrench.
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)

⚠ **Keep attention, in order to reassemble the torque limit in the right way, you need to spin the limiter, using the eccentric as reference, pushing it against the body pump.**

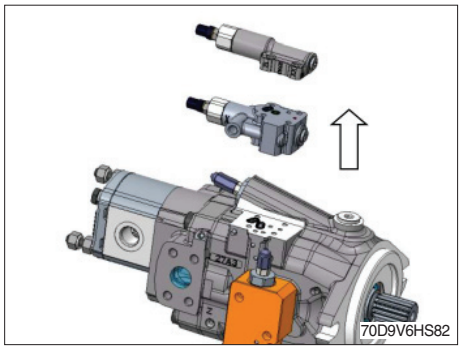


5) PISTON PUMP SEALS REPLACEMENT

(1) Remove the screws of the compensators.

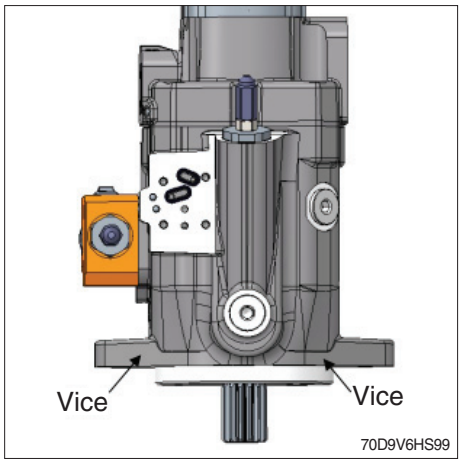


(2) Remove the pressure and the flow compensators.

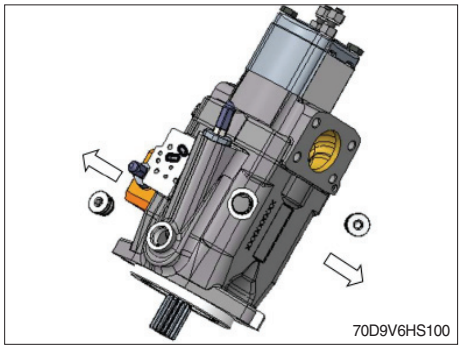


⚠ **Use some aluminum protection on the vice to not damage the machined surfaces. Put the pump in vertical position. Grab the pump by the pilot.**

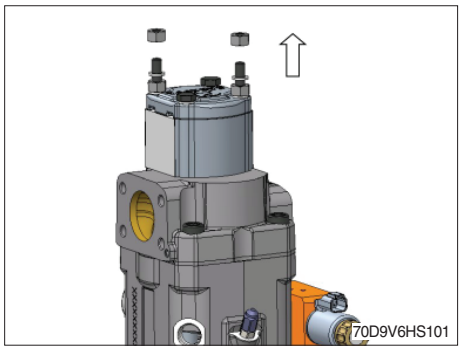
(3) Loosen the screws.



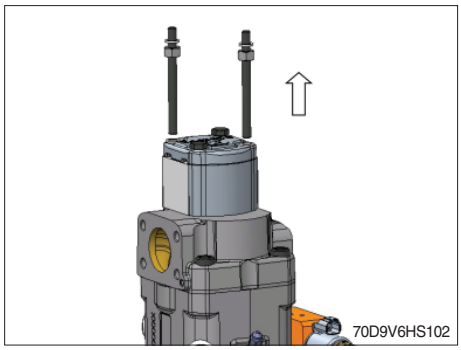
(4) Remove the drain plugs.



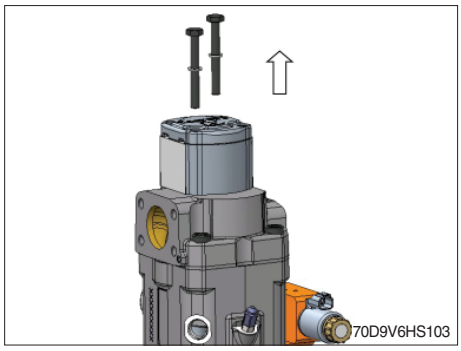
(5) Remove the nut from stud bolt from gear pump section.



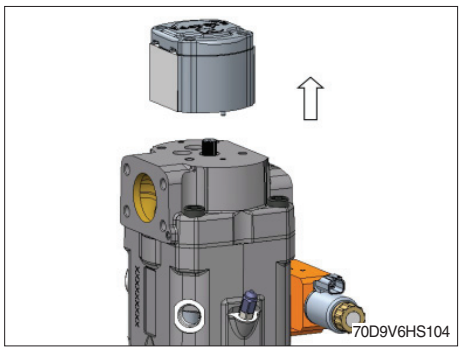
(6) Remove the nut, washers and stud bolt from gear pump section.



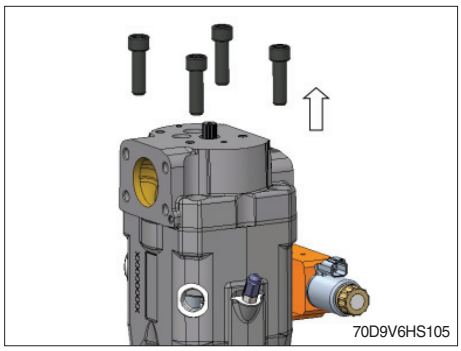
(7) Remove the screws and washers from gear pump section.



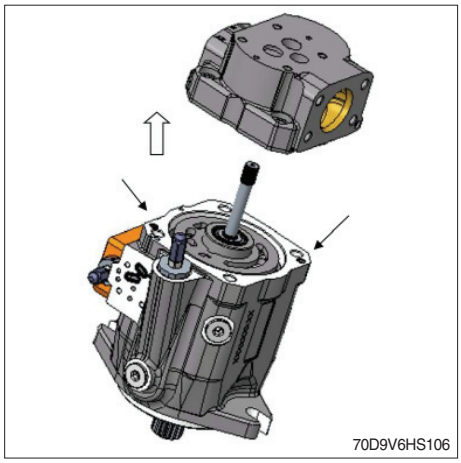
(8) Remove the gear pump section.



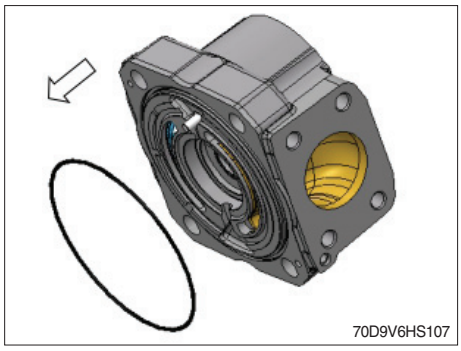
(9) Remove the screws from the cover.



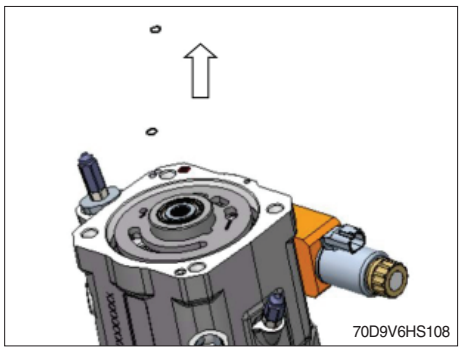
(10) Remove gently the cover slipping the fingers between it and the case in order to keep the valve plate that could be attached to the cover.
In this view and following ones, the bearing is represented as a single piece, but actually the outer ring will remain fixed to the cover because of the interference between parts. The mobile part of the bearing is the only one that will remain on shaft.
Attention to the little O-ring near the screws holes indicated with the black arrows.
Remove also the hub.



(11) Remove the seals from the cover.

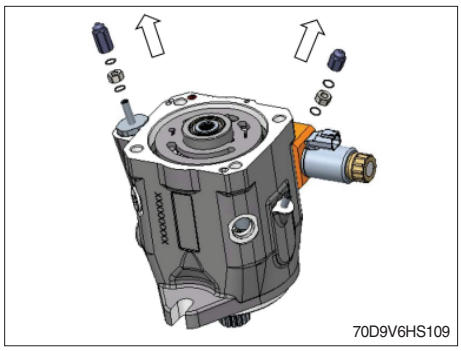


(12) Remove the O-rings from the body.

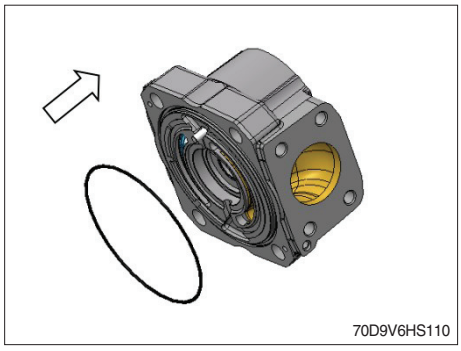


(13) Remove plugs from the max and min displacement limiter and their seals.

⚠ **Keep attention to don't touch the limiter screws or you will change the max or min displacement of your pump.**

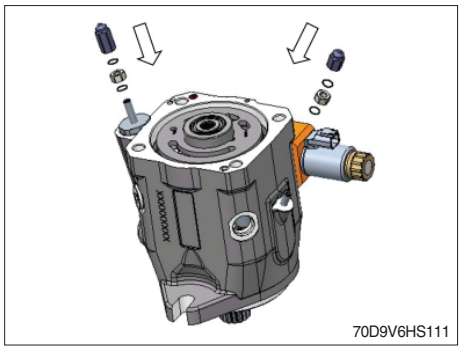


(14) Insert the new static seals.

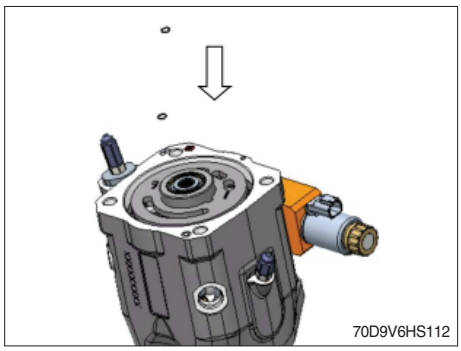


(15) Insert the new O-rings and reassemble the max and min displacement limiters. Tighten the plug M8 and the nut M8.

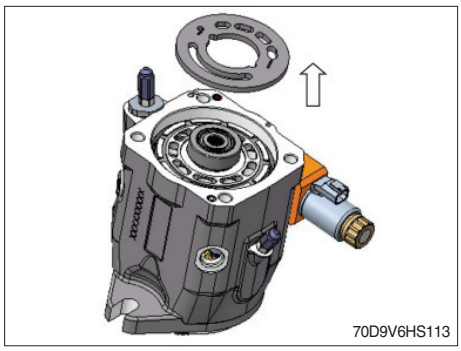
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)



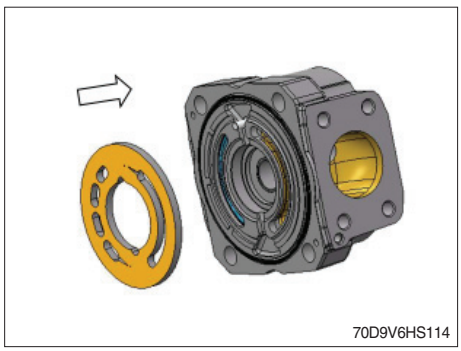
(16) Insert the new O-rings.



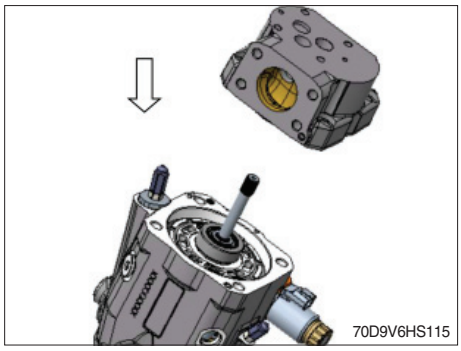
(17) Remove the valve plate.



(18) Use grease in order to attach valve plate to the cover, following the pin.



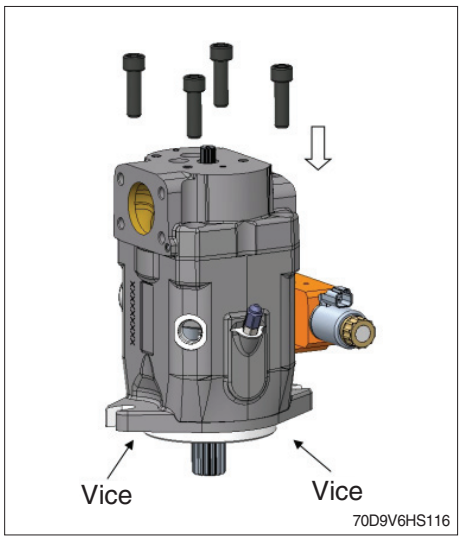
(19) Reassemble the hub and the cover.



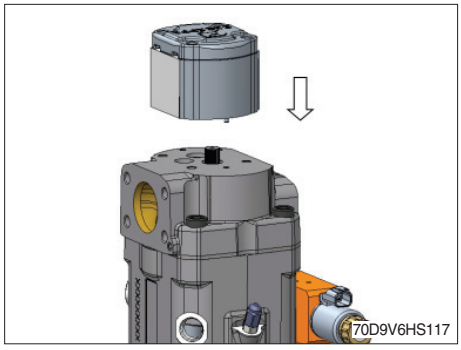
⚠ **Put the pump in the vice. Use some aluminum protection on the vice to not damage the machined surfaces. Put the pump in vertical position. Grab the pump by the pilot.**

(20) Tighten the bolts with a torque wrench.

· Tightening torque : 13.2 kgf·m (95.5 lbf·ft)

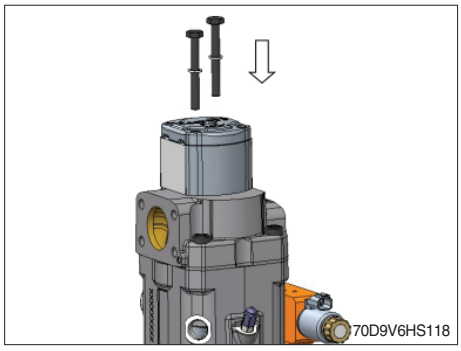


(21) Reassemble the gear pump section.

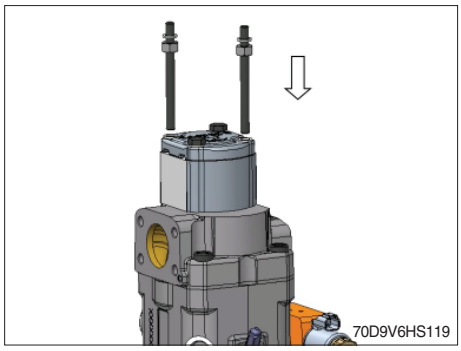


(22) Tighten the screws with a torque wrench.

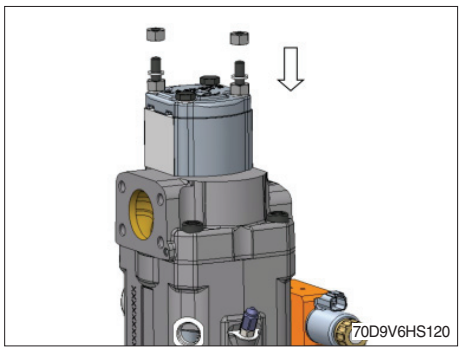
· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)



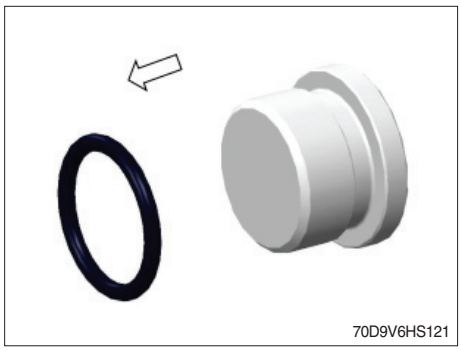
(23) Reassemble the nut, washers and stud bolt.
· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)



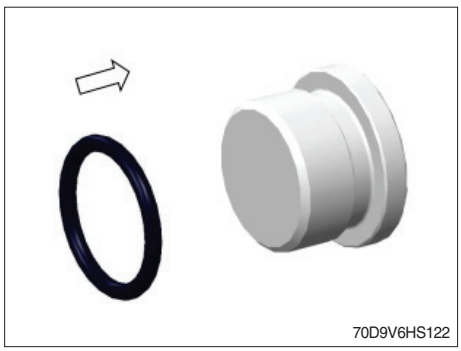
(24) Reassemble the nut from stud bolt.



(25) Remove the O-ring from the drain plugs.

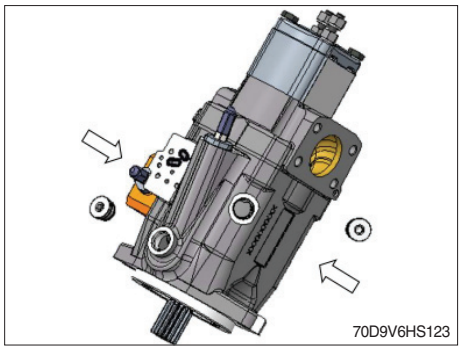


(26) Insert the new O-ring.

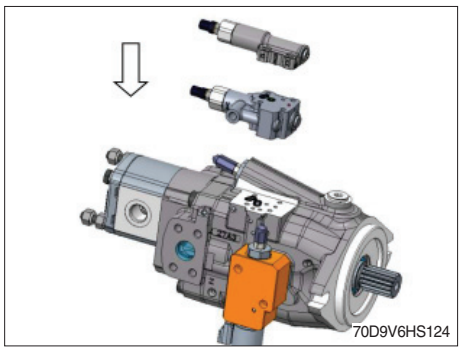


(27) Insert the plug in the body.

· Tightening torque : 3.1 kgf·m (22.4 lbf·ft)

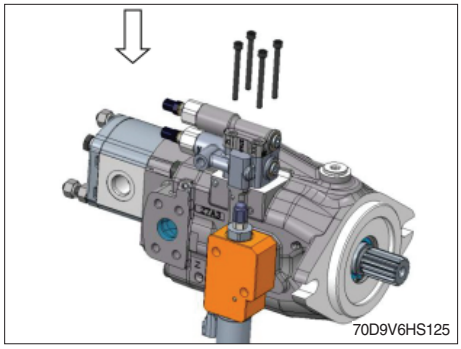


(28) Reassemble the flow and the pressure regulators.



(29) Tighten the bolts with a torque wrench.

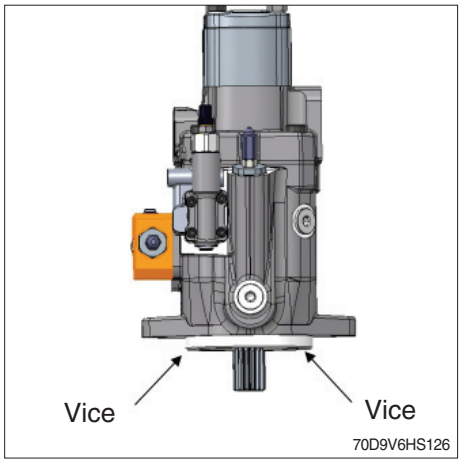
· Tightening torque : 1.5 kgf·m (10.9 lbf·ft)



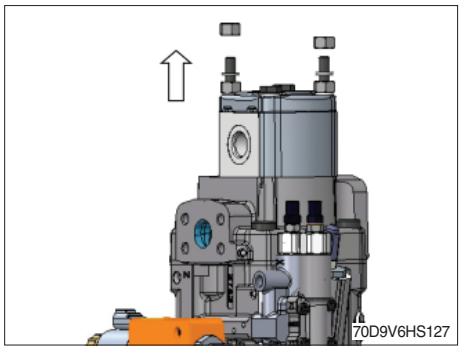
6) GEAR PUMP SEALS REPLACEMENT

⚠ Use some aluminum protection on the vice to not damage the machined surfaces. Put the pump in vertical position. Grab the pump by the pilot.

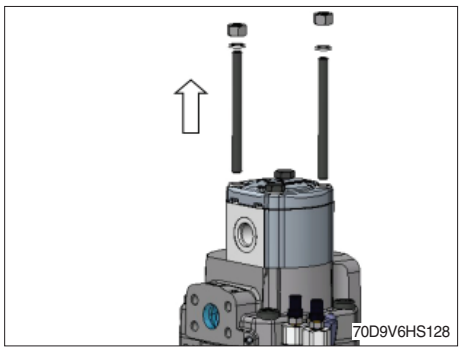
1) Loosen the screws.



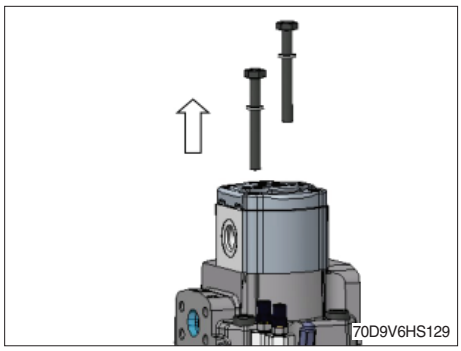
(6) Remove the nut from stud bolt from gear pump section.



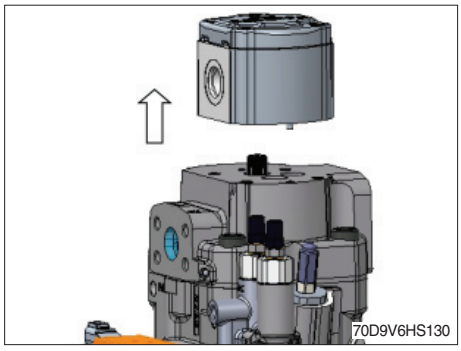
(7) Remove the nut, washers and stud bolt from gear pump section.



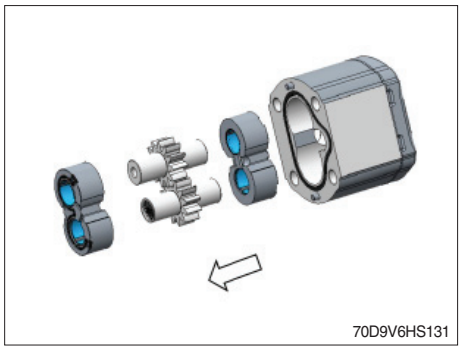
(8) Remove the screws and washers from gear pump section.



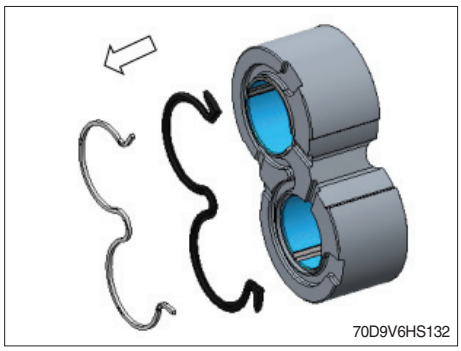
(8) Remove the gear pump section.



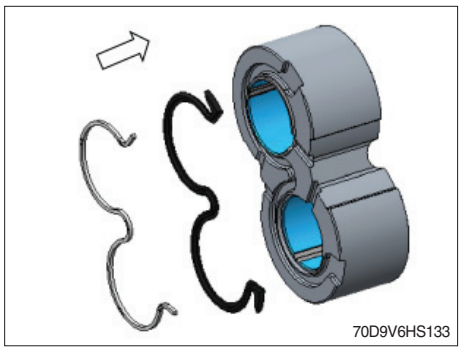
(9) Remove thrust plates and gears from the housing.



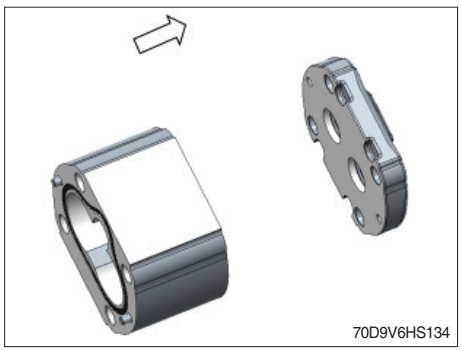
(10) Remove seal and anti-extrusion seal.



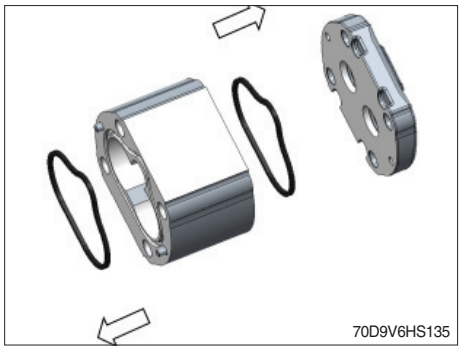
(11) Insert new seal and anti-extrusion seal.



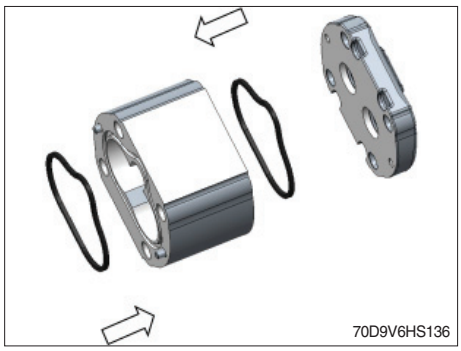
(12) Remove rear cover.



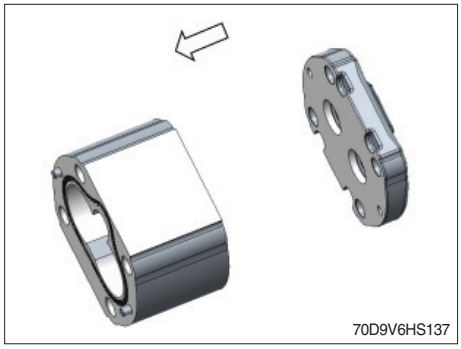
(13) Remove seal of the housing.



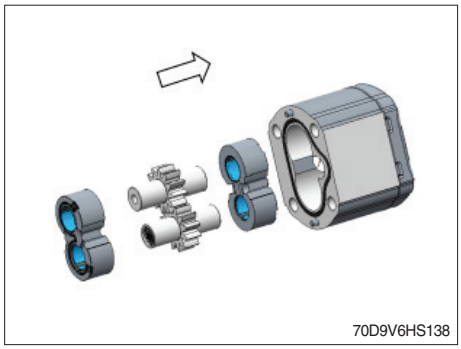
(14) Insert new seal of the housing.



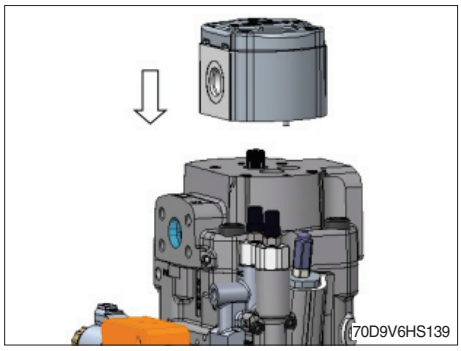
(15) Reassemble rear cover.



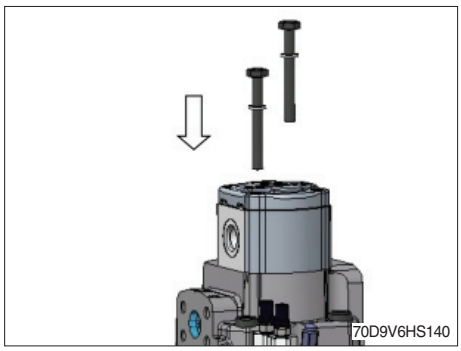
(16) Reassemble thrust plates and gears.



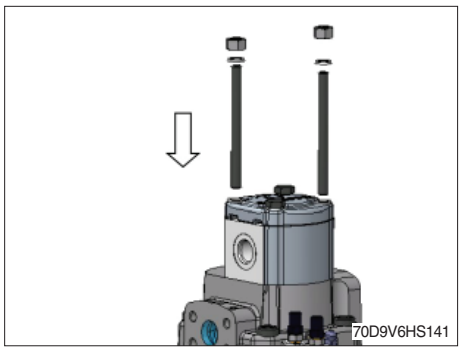
(17) Reassemble the gear pump section.



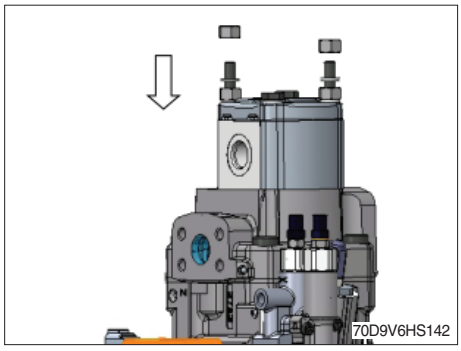
(18) Reassemble the screws and washers from gear pump section. Tighten the screws with a torque wrench.
· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)



(19) Reassemble the nut, washers and stud bolt from gear pump section.
· Tightening torque : 4.6 kgf·m (33.3 lbf·ft)



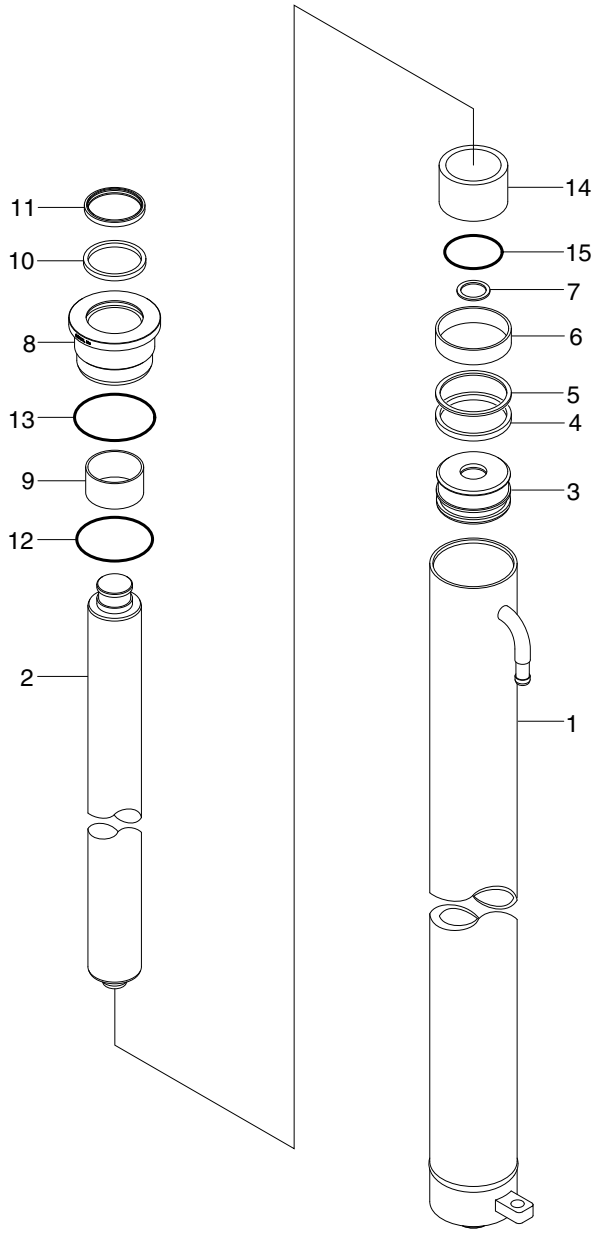
(20) Reassemble the nut from stud bolt from gear pump section.



3. LIFT CYLINDER

1) STRUCTURE

(1) V-mast

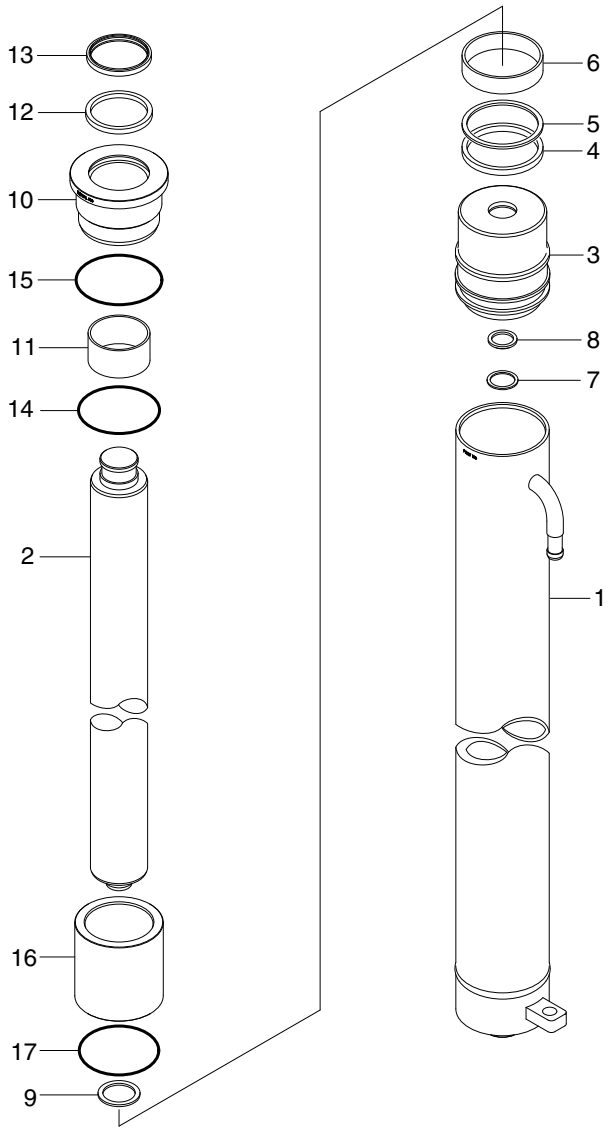


· I.D × O.D × stroke (standard)
85 × 98 × 1335 mm
(3.3 × 3.9 × 52.6 in)
· Rod O.D : 60 mm (2.4 in)

50D9HS19

1	Tube assy	6	Wear ring	11	Dust wiper
2	Rod	7	Cushion seal	12	O-ring
3	Piston	8	Gland	13	O-ring
4	Piston seal	9	Du bushing	14	Spacer
5	Back up ring	10	Rod seal	15	O-ring

(2) TF/TS-mast

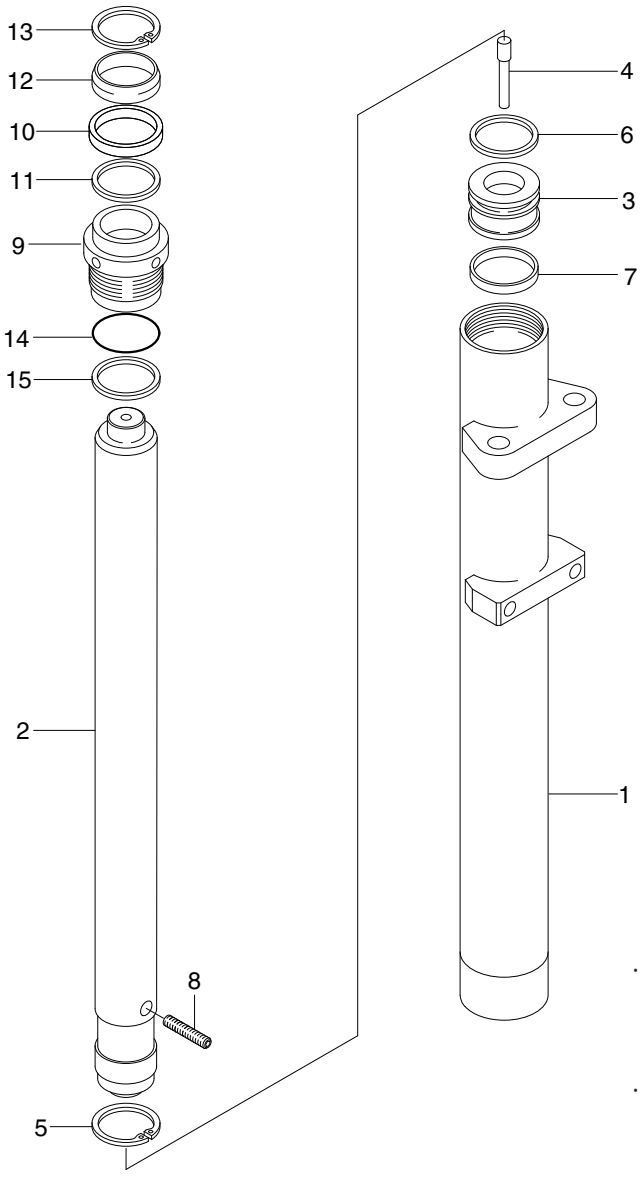


· I.D × O.D × stroke (standard)
85 × 98 × 1335 mm
(3.3 × 3.9 × 52.6 in)
· Rod O.D : 60 mm (2.4 in)

50D9HS20

1	Tube assy	7	Cushion seal	13	Dust wiper
2	Rod	8	Retaining ring	14	O-ring
3	Piston	9	Retaining ring	15	O-ring
4	Piston seal	9	Gland	16	Spacer
5	Back up ring	10	Du bushing	17	O-ring
6	Wear ring	11	Rod seal		

(3) Free lift (TF-mast)

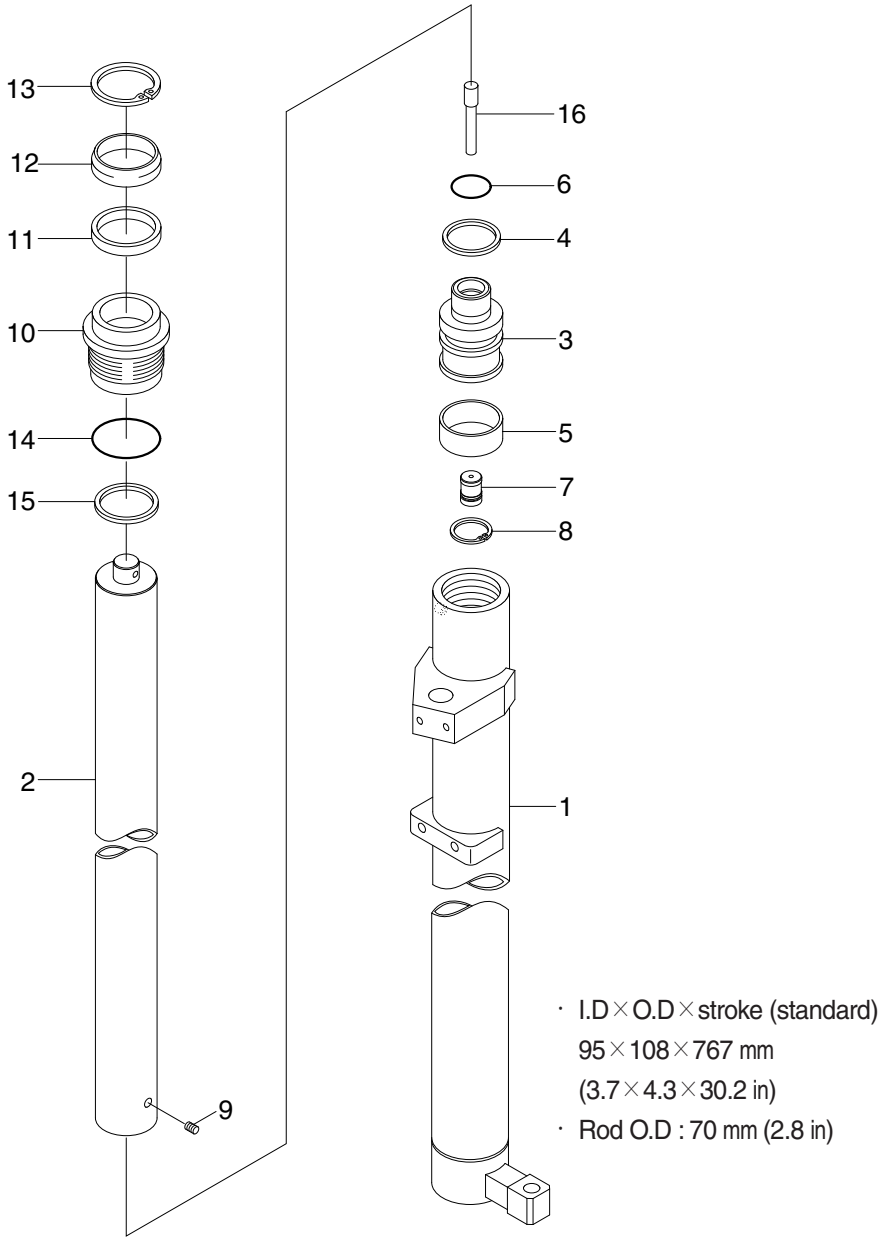


· I.D × O.D × stroke (standard)
85 × 98 × 1335 mm
(3.3 × 3.9 × 52.6 in)
· Rod O.D : 60 mm (2.4 in)

50D9HS21

1	Tube assy	6	GLYD ring	11	Back up ring
2	Rod assy	7	Wear ring	12	Dust wiper
3	Piston	8	Set screw	13	Snap ring
4	Check valve	9	Gland	14	O-ring
5	Retaining ring	10	Rod seal	15	Back up ring

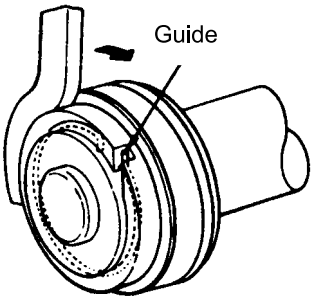
(4) Free lift (TS-mast)



1	Tube assy	7	Check valve	13	Retaining ring
2	Rod	8	Retaining ring	14	O-ring
3	Piston	9	Set screw	15	Backup ring
4	Piston seal	10	Rod cover	16	Pipe
5	Wear ring	11	U-packing		
6	O-ring	12	Dust wiper		

2) DISASSEMBLY

(1) Hold the cylinder tube in a vice, loosen the cylinder head and remove it.
Remove the spacer from the cylinder tube and knock out the bushing. Hook a wrench in the hole in the retainer at the piston end and turn. Lever up the edge of the guide, then turn the guide in again and the guide can be removed.



D503HS20

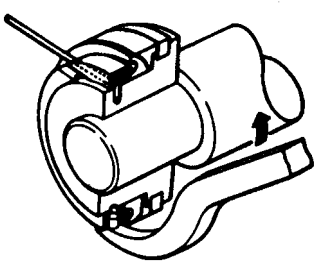
3) CHECK AND INSPECTION

mm (in)

Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.05~0.25 (0.002~0.01)	0.4 (0.0015)	Replace bushing
Clearance between piston ring & tube	0.05~0.35 (0.002~0.013)	0.5 (0.02)	Replace piston ring

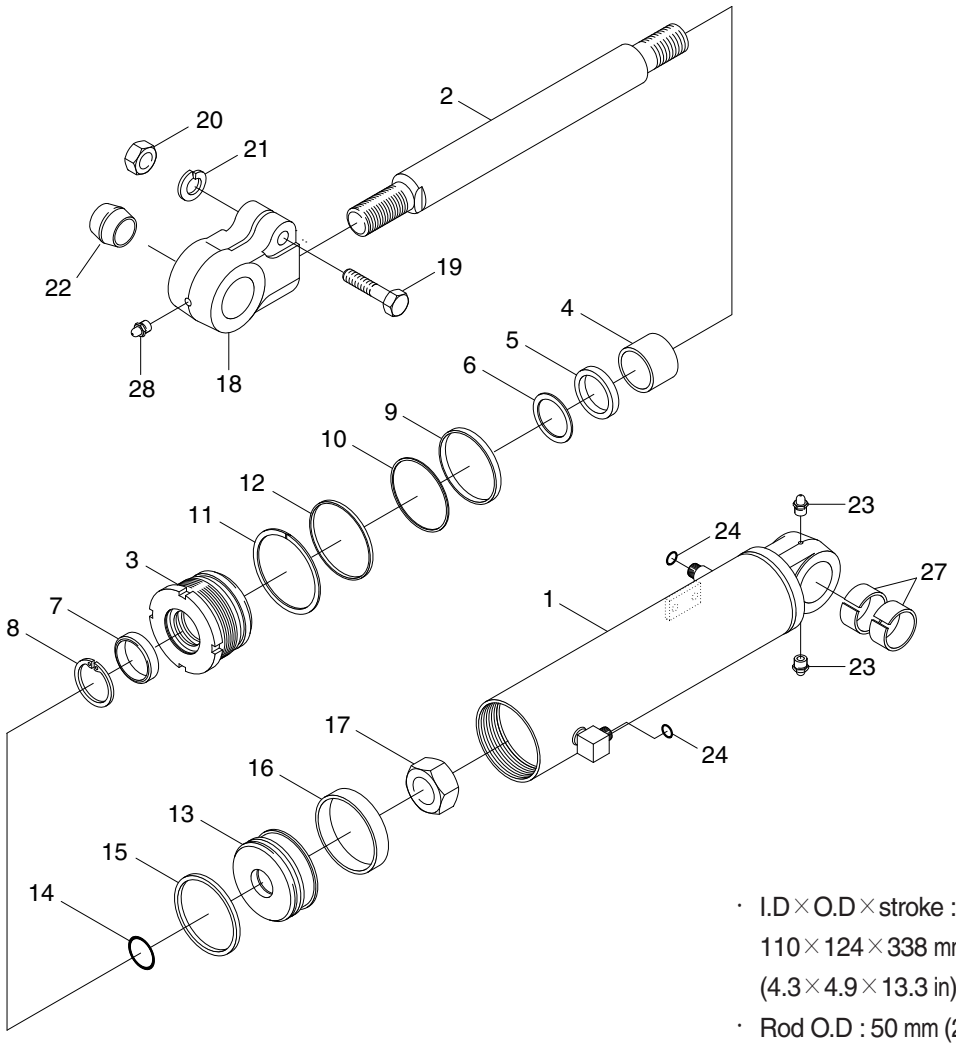
4) ASSEMBLY

(1) Soak the piston ring in hydraulic oil at a temperature of 40 to 50℃, expand the inside diameter and assemble on the piston. Install a piston seal.
Bend the edge of the guide and rotate it to install the guide completely.


D503HS21

4. TILT CYLINDER

1) STRUCTURE



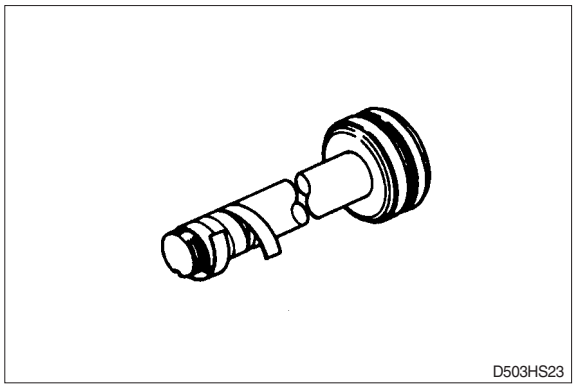
· I.D × O.D × stroke :
110 × 124 × 338 mm
(4.3 × 4.9 × 13.3 in)
· Rod O.D : 50 mm (2.0 in)

70D9V6HS17

1	Tube assy	10	Back up ring	19	Hex bolt
2	Rod	11	O-ring	20	Hex nut
3	Rod cover	12	Washer	21	Spring washer
4	Rod bushing	13	Piston	22	Spherical bearing
5	U-packing	14	O-ring	23	Grease nipple
6	Back up ring	15	Piston seal	24	O-ring
7	Dust wiper	16	Wear ring	27	Rod bushing
8	Stop ring	17	Set screw	28	Grease nipple
9	O-ring	18	Eye		

2) DISASSEMBLY

(1) Hold the parallel parts of the cylinder tube bottom in a vice and mark the rod head end to show how much it is screwed in, then remove the rod head. Next, hook a wrench into the notch at the cylinder head and remove the cylinder head from cylinder tube.
When doing this, wind tape round the threaded part of the rod and be careful not to damage the dust seal and rod seal inside cylinder head.


D503HS23

3) CHECK AND INSPECTION

mm (in)

Check item	Standard size	Repair limit	Remedy
Clearance between cylinder rod & bushing	0.072~0.288 (0.003~0.011)	0.5 (0.020)	Replace bushing
Clearance between rod head bushing & pin	0.10~0.35 (0.004~0.014)	0.6 (0.024)	Replace bushing