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 or ECV), 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 OR ECV

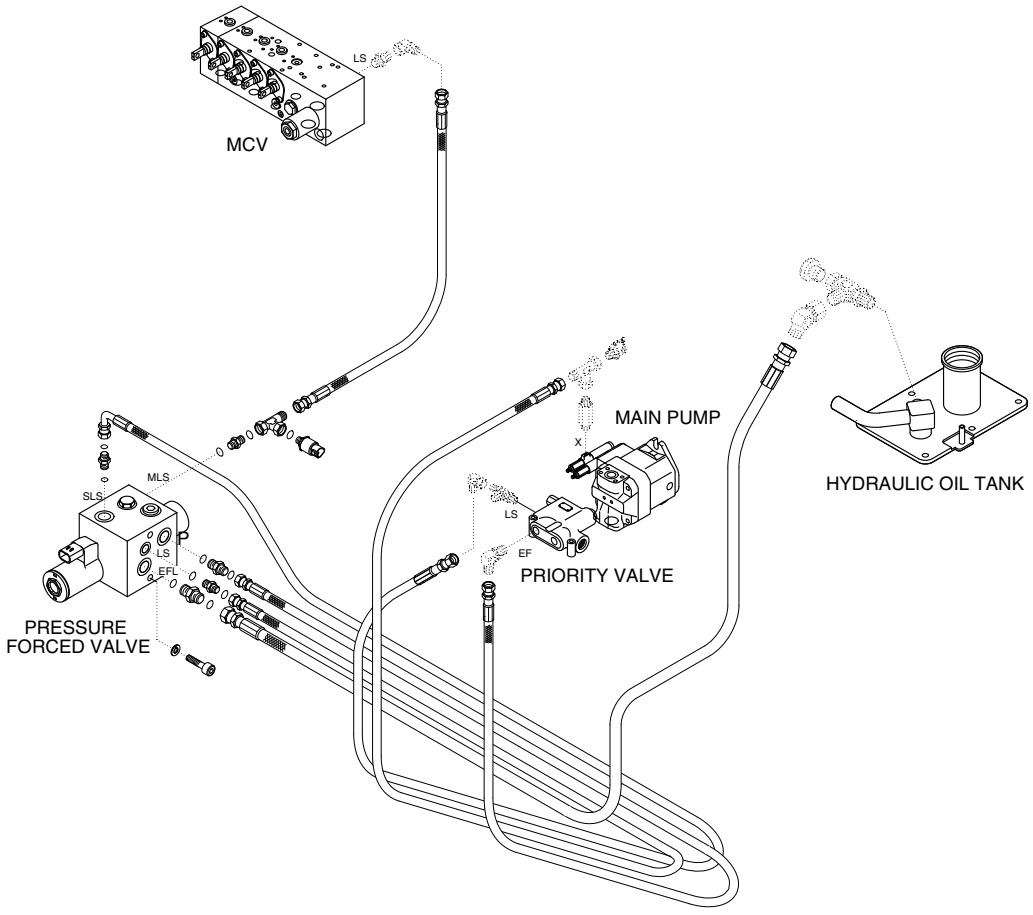
· Lift function, Tilt function, Auxiliary function (Sideshift etc.), Fingertip controller (ECV)

3) HYDRAULIC OIL TANK

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

4) PRESSURE FORCED VALVE

· Built-in Shuttle valve



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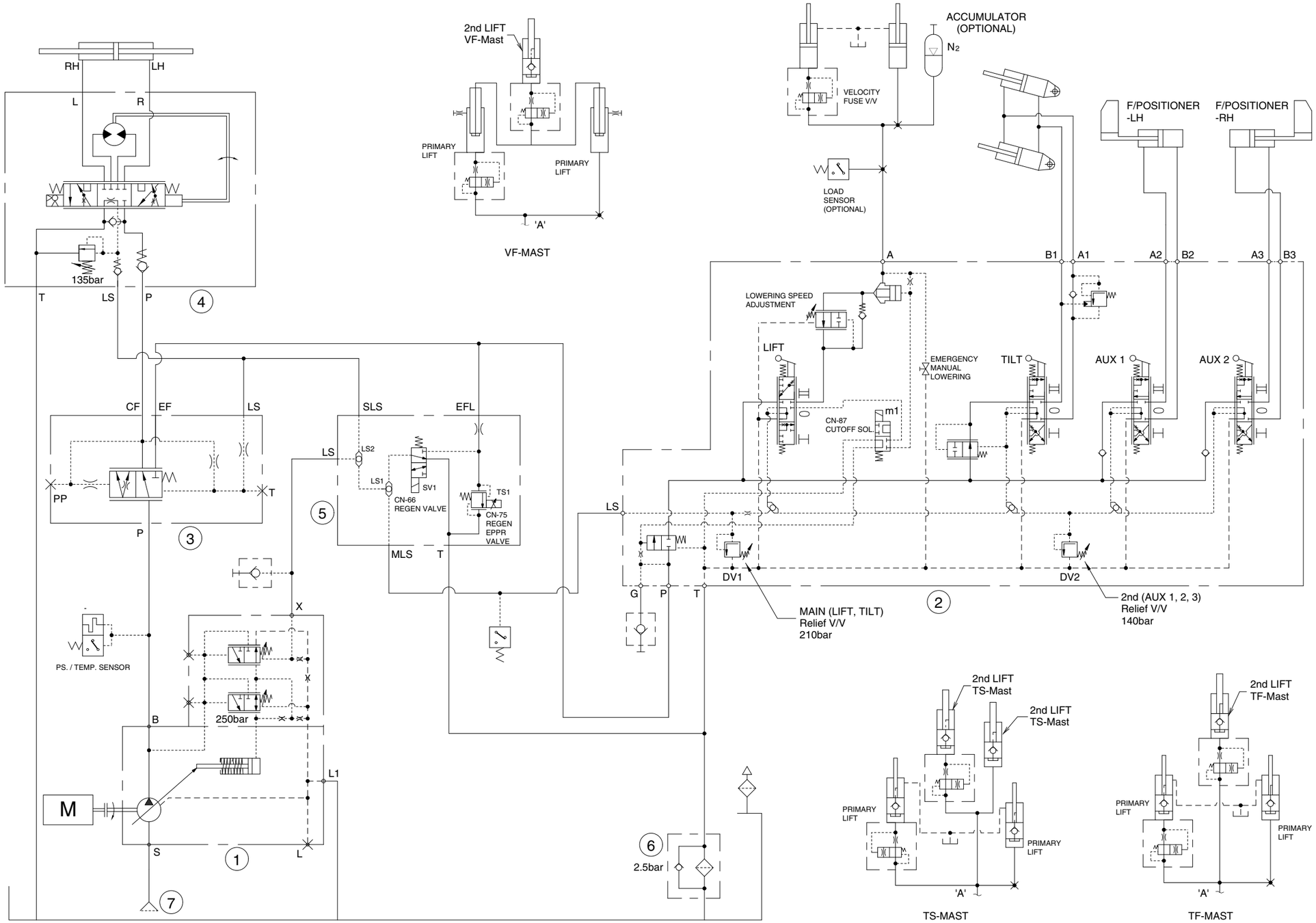
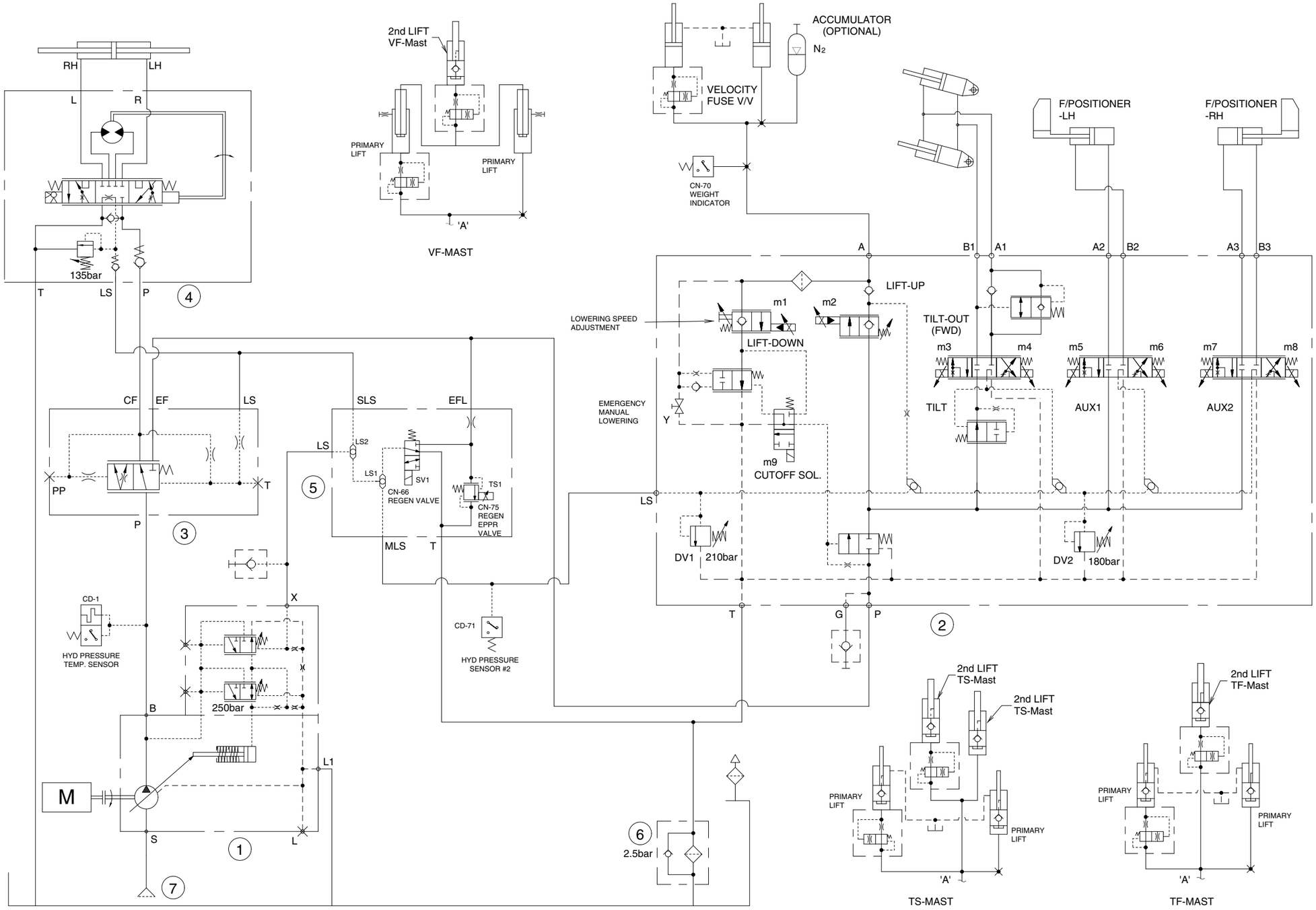
2. HYDRAULIC CIRCUIT

1) MANUAL



2) FINGERTIP (OPTIONAL)



1 Piston pump
2 MCV
3 Priority valve
4 Steering unit
5 PF valve
6 Return filter
7 Strainer

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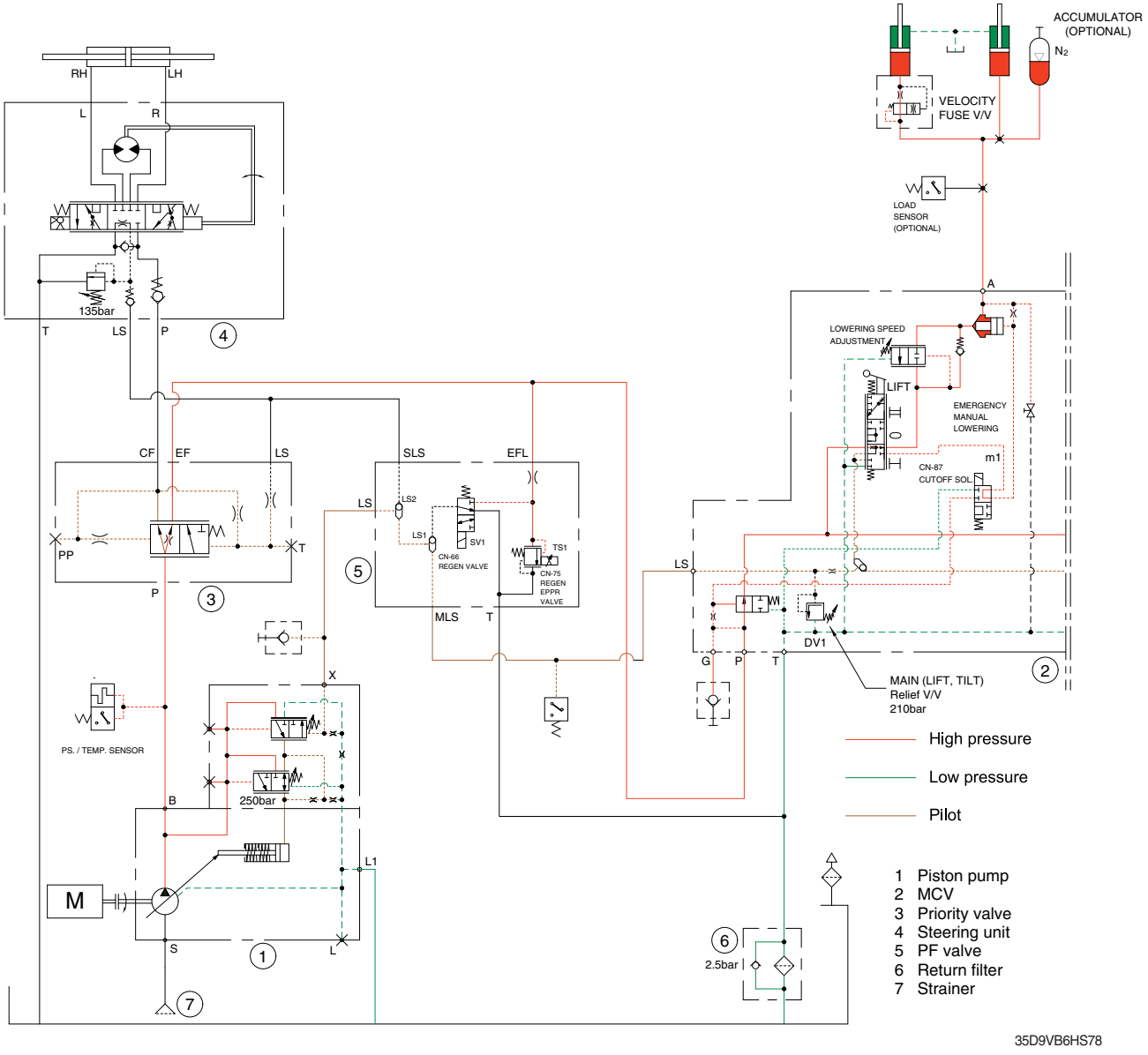
3. WORK EQUIPMENT HYDRAULIC CIRCUIT

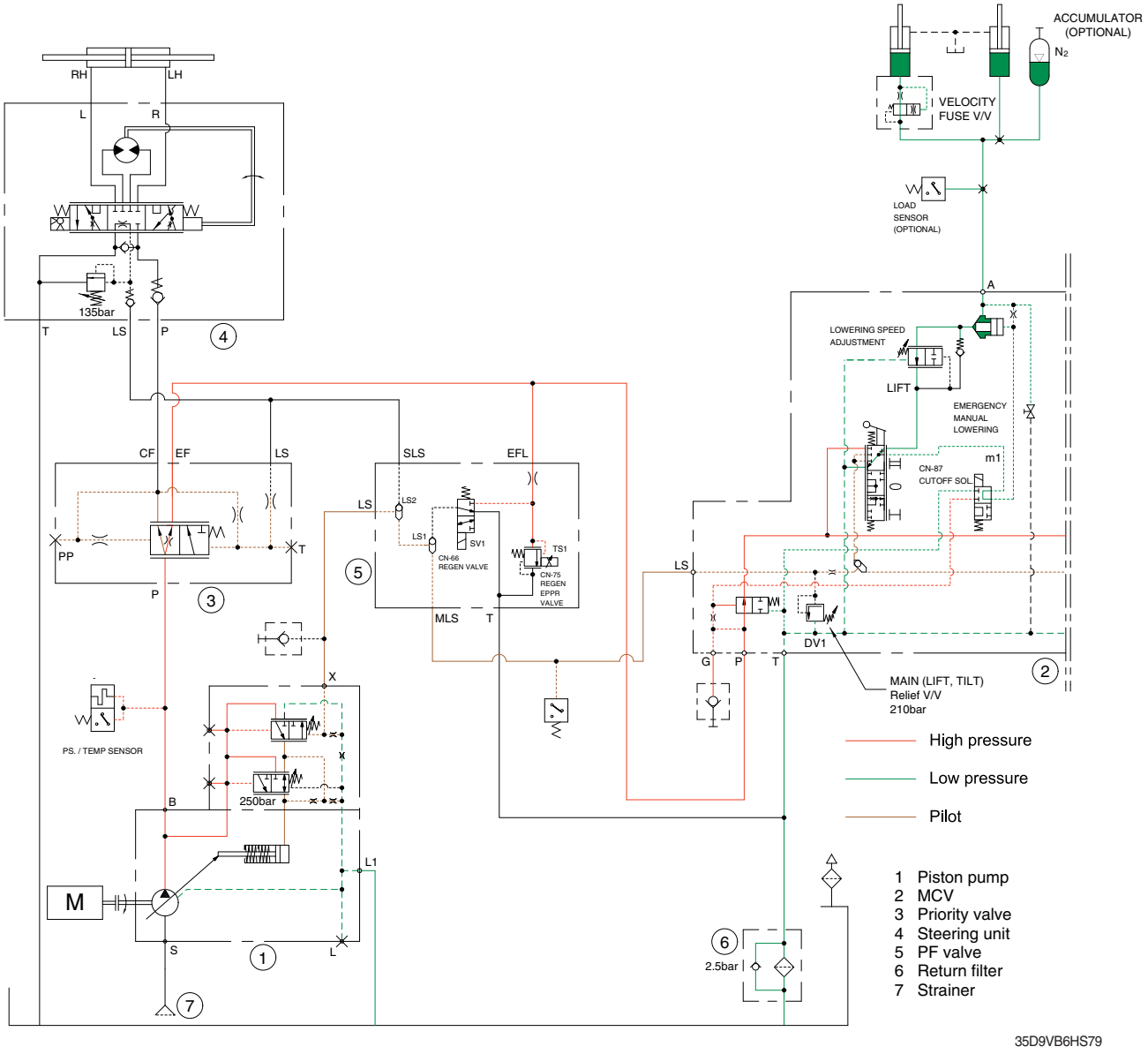
1) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION



When the lift control lever is pulled back, the spool in the first block is moves to lift position.
The oil from the piston pump (1) flows into main control valve (2) through the priority valve (3). 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.

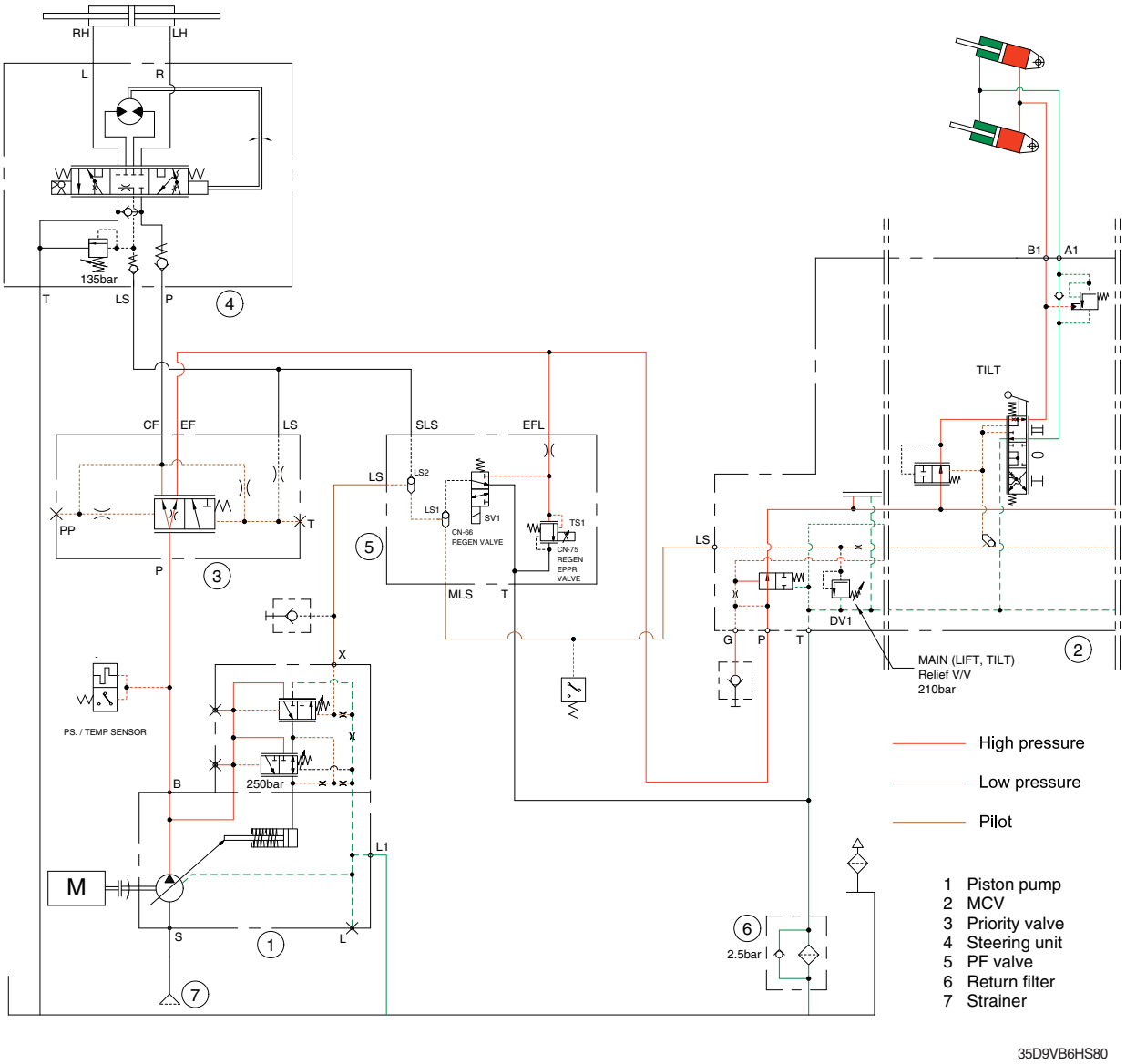
2) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION



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 FORWARD POSITION



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

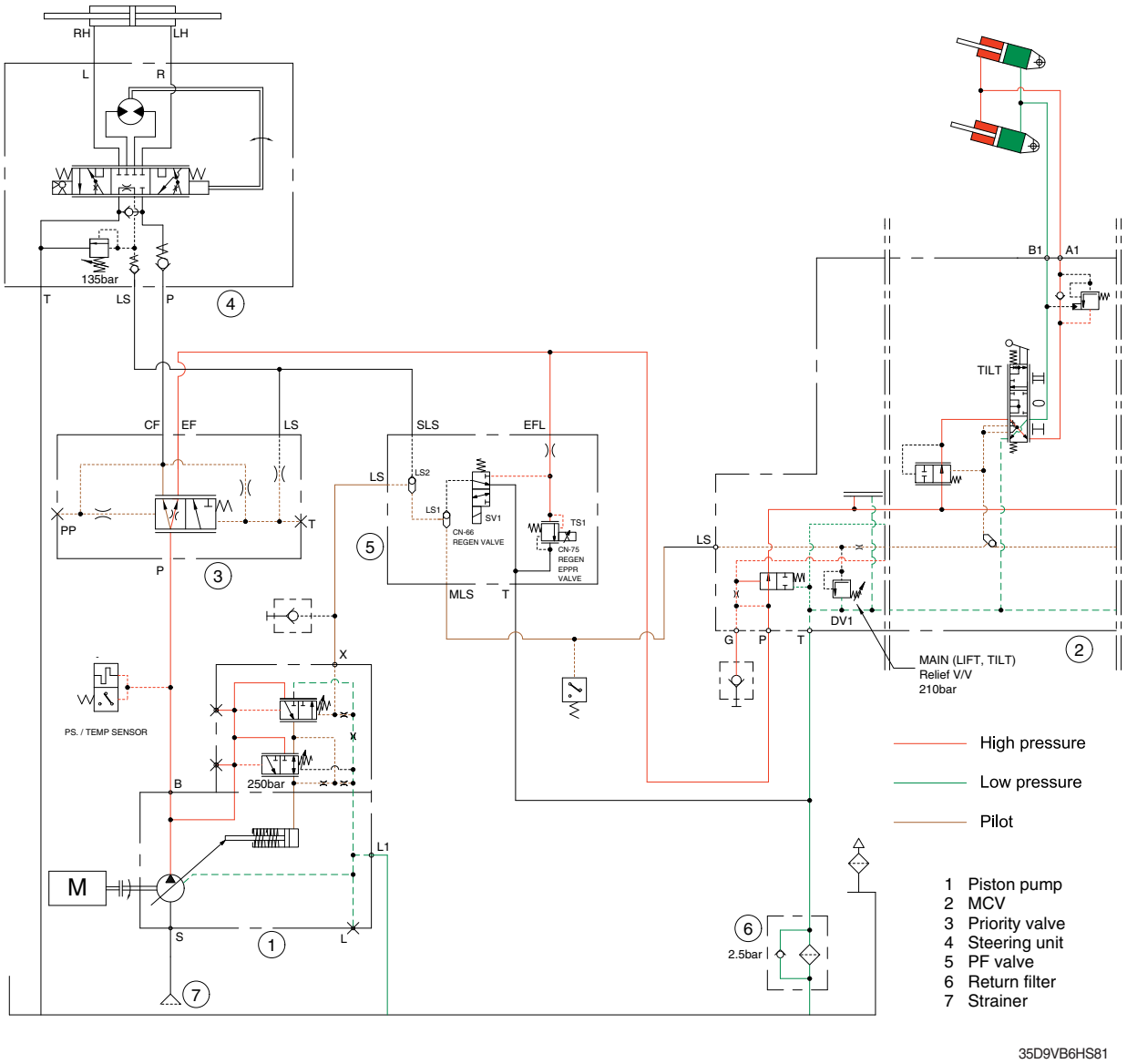
The oil from the piston pump (1) flows into main control valve (2) through the priority valve (3). Then goes to the large chamber of tilt cylinder by pushing the load check valve of the spool and lift lock valve.

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) 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.

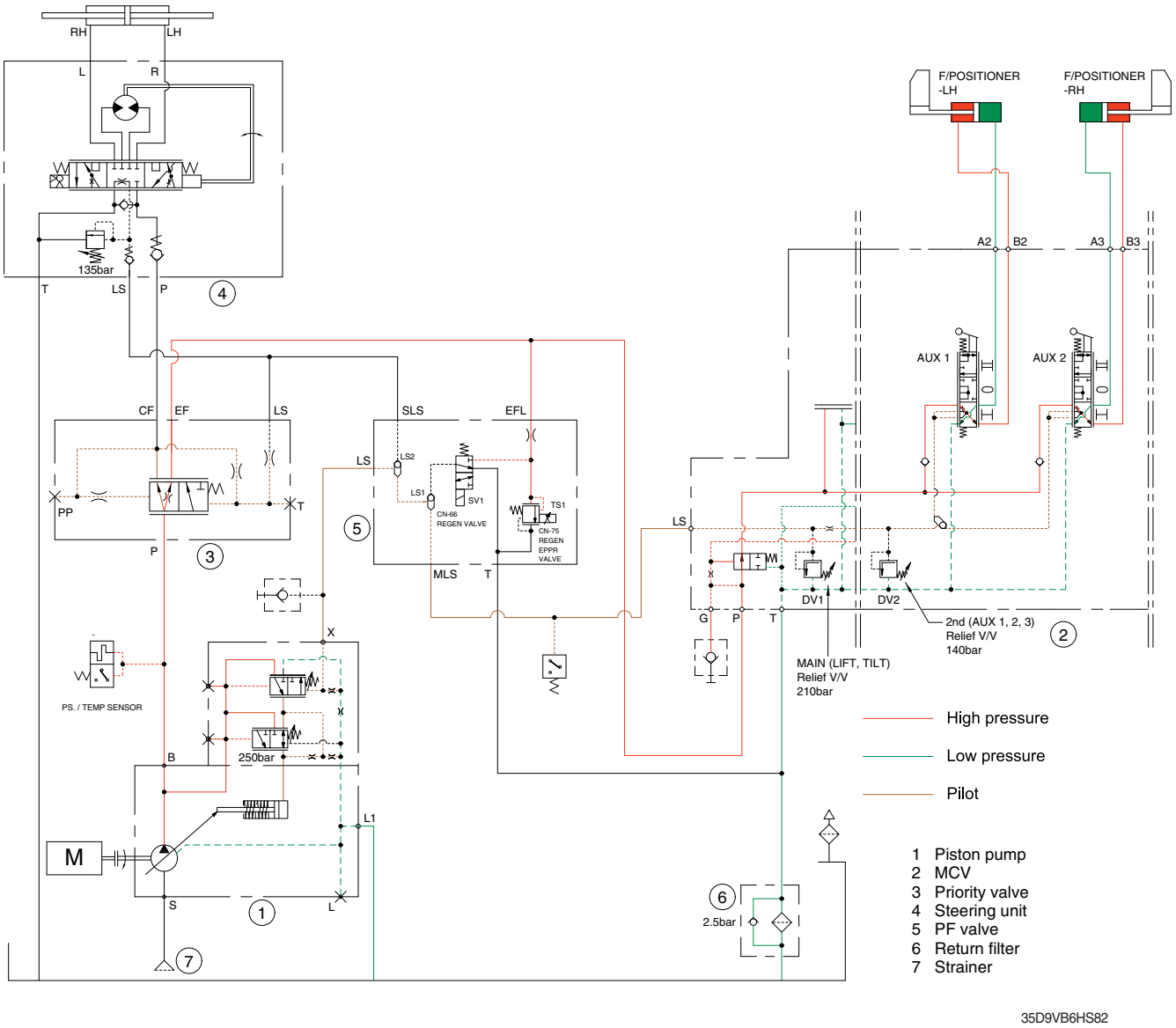
The oil from the piston pump (1) flows into main control valve (2) through the priority valve (3). Then goes to the small chamber of tilt cylinder by pushing the load check valve of the spool and lift lock valve.

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.

5) WHEN THE FORK POSITIONER LEVER IS IN THE SPREAD-OUT POSITION (OPTION)



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When the fork positioner lever is pulled backward, the spool in the third, fourth block is moved to fork positioner spread out position.

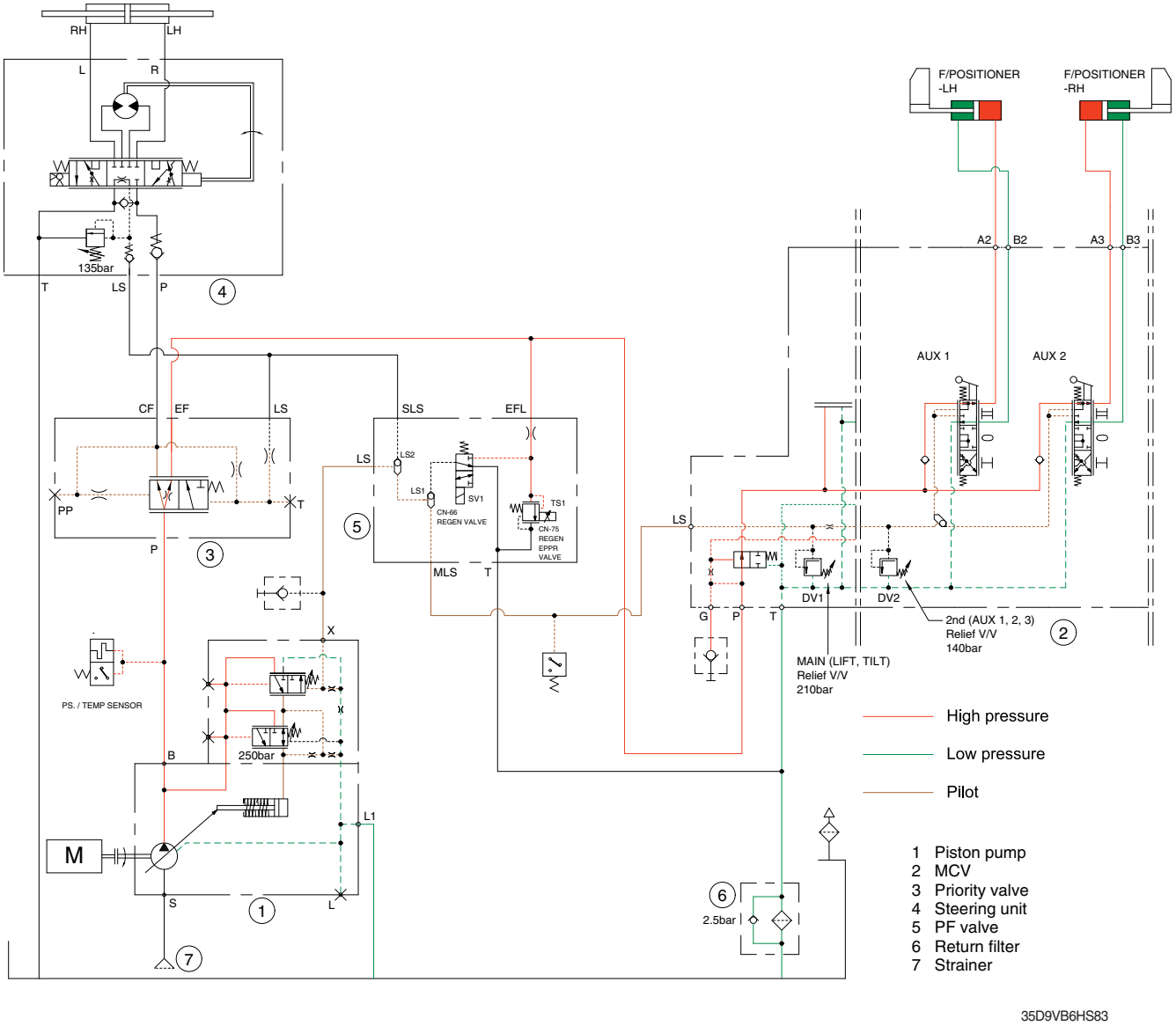
The oil from the piston pump (1) flows into main control valve (2) through the priority valve (3). Then goes to the large chamber of fork positioner cylinder by pushing the load check valve of the spool and lift lock valve.

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

When this happens, the forks are spread out.

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

6) WHEN THE FORK POSITIONER LEVER IS IN THE CLOSE POSITION (OPTION)



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When the fork positioner lever is pushed forward, the spool in the third, fourth block is moved to fork positioner spread out position.

The oil from the piston pump (1) flows into main control valve (2) through the priority valve (3). Then goes to the small chamber of fork positioner cylinder by pushing the load check valve of the spool and lift lock valve.

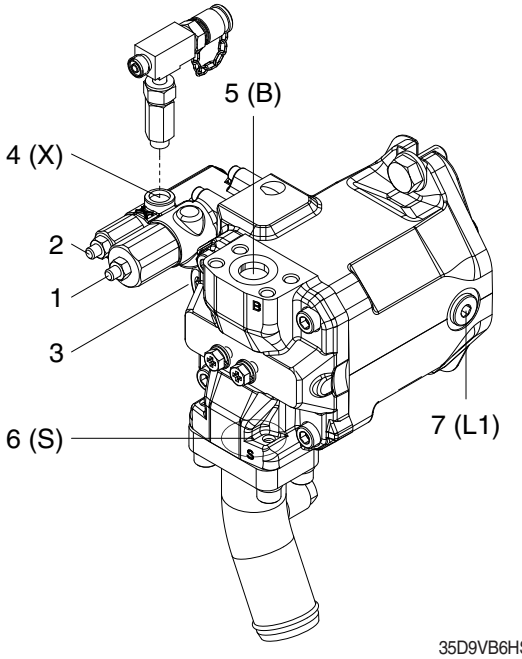
The oil at the large chamber of fork positioner cylinder returns to hydraulic oil tank through the hydraulic oil cooler and return filter at the same time.

When this happens, the forks are close.

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

4. MAIN PUMP

1) STRUCTURE



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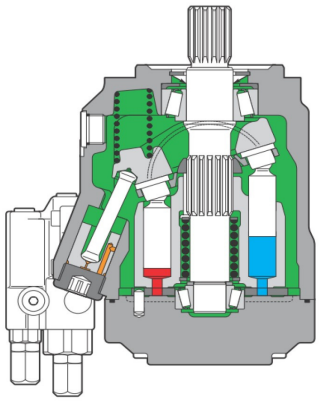


Pump cross section

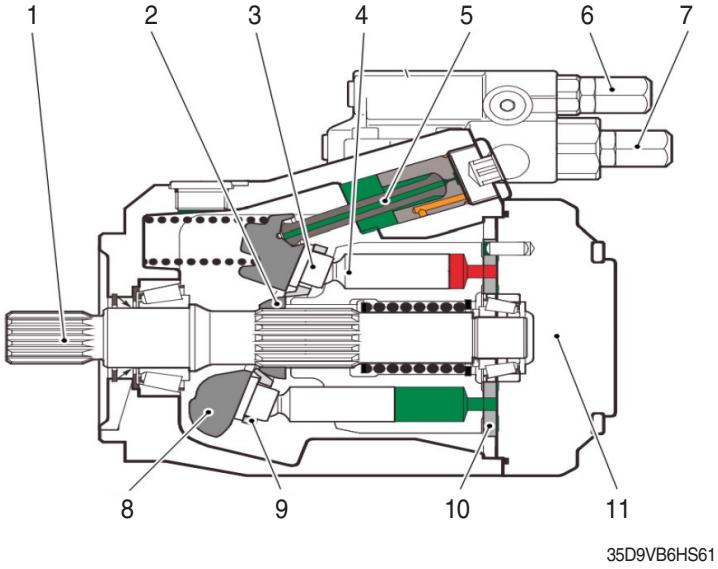
35D9VB6HS58

Port	Port size	Tightening torque	
		kgf·m	lbf·ft
B	3/4"	3.5	25.3
L1	7/8-14 UNF	7.3	53.1
S	1-1/4"	5	36.2
X	7/16-20 UNF	1.5	11.1

1 Flow compensator
2 Pressure compensator
3 Pump regualtor valve
4 Load Sense (LS) port X
5 Pressure port B
6 Suction port S
7 Drain port L1

2) OPERATION

(1) General



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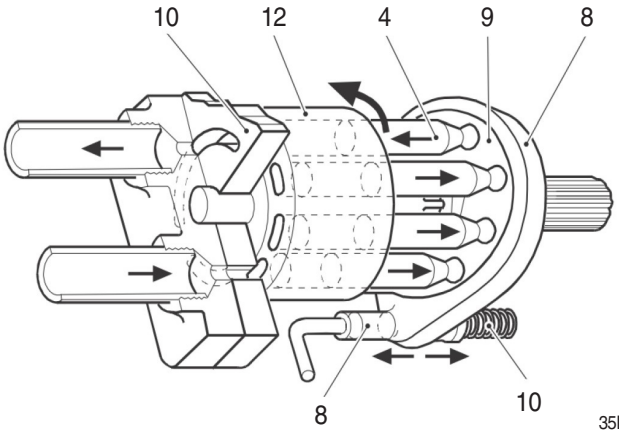

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1 Drive shaft
2 Sleeve (retaining ball)
3 Slider
4 Piston
5 Regualting piston
6 Pressure compensator
(adusting screw, max. Pressure)
7 Flow compensator
(adjusting screw, stand-by pressure)
8 Swash plate
9 Regualting plate
10 Valve palte (distributor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

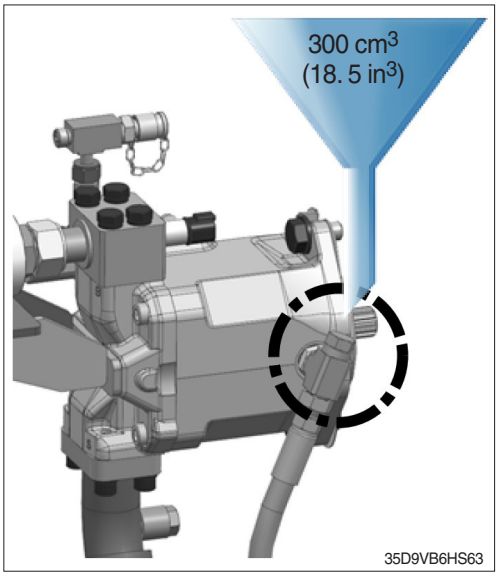
When the shaft turns, the cylinder rotor (12) will rotate. The angle of the regulating plate (9) results in the pistons being pulled in and out of the cylinder rotor by the sliders. The pistons' (4) stroke is changed by changing the angle of the yoke.

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).

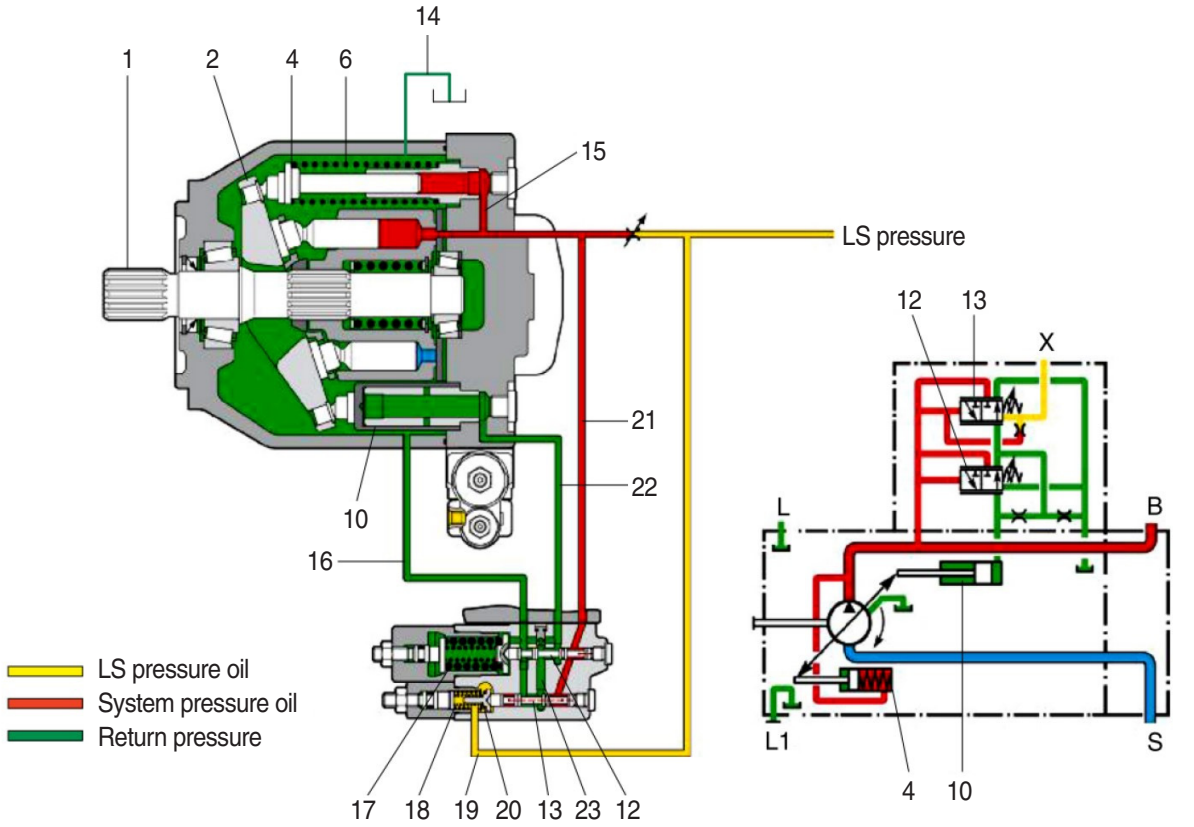
When the pistons are pressed in, the oil is forced out at the bottom, through the valve plate (10). A small amount of oil is forced through the piston head and lubricates the slider and yoke. The yoke does not rotate, which means that the pistons always suck and respectively force oil in a certain part 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.**



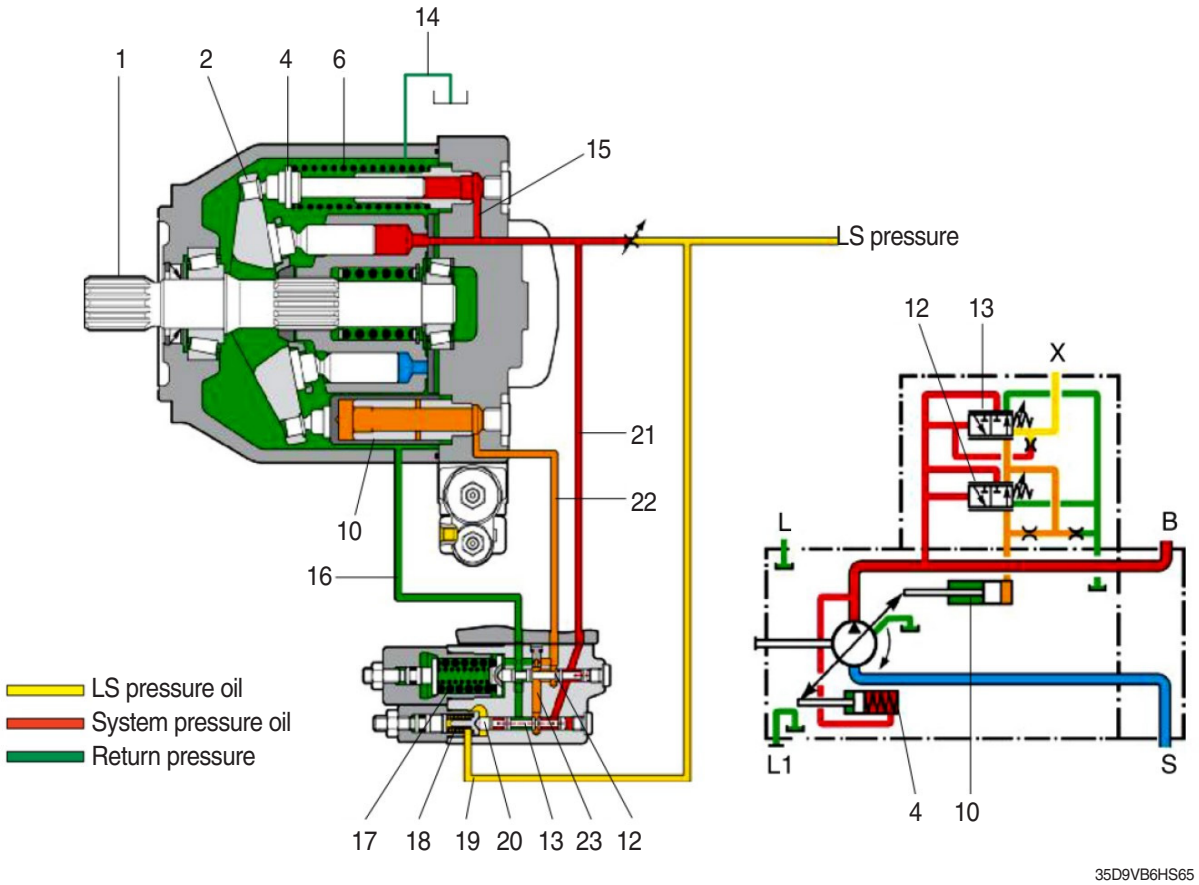
(2) Upstroking



1	Drive shaft	13	Flow compensator spool	19	LS line from pump
2	Swash plate	14	Case drain	20	Cavity
3	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

Upstroking of the pump occurs as flow demand from attachment (MCV) and steering system. The increased flow demand causes a LS pressure in LS line (19). The LS pressure in LS line (19) combines with the force of spring (18) in cavity (20). The force of spring (18) causes pump pressure to be higher than the LS pressure (19). If the combination of LS pressure and of spring force is greater than the pump discharge pressure, this difference pressure causes spool (13) to move right. As spool (13) moves right, the spool (13) blocks the flow of supply oil to control piston (10). Pump swash plate (2) is controlled by pressure and flow as much as hydraulic system requests. When the oil flow to control piston (10) is blocked, the pilot oil in passage (22) drains to passage (23). The oil then flows past pressure compensator spool (12) and through passage (16) into the housing and via the drain line (14) to tank. Supply oil flows through passage (15) to counter piston (4). The oil acts against counter piston (4). The oil combines with the force of counter spring (6). This causes swash plate (2) to upstroke. This also causes the pump flow to increase. As flow requirements are satisfied, the pump output pressure increase. The pressure increases until the pressure in passage (15) moves flow compensator spool (13) up to be satisfied with system requirement for pressure and flow.

(3) Destroking

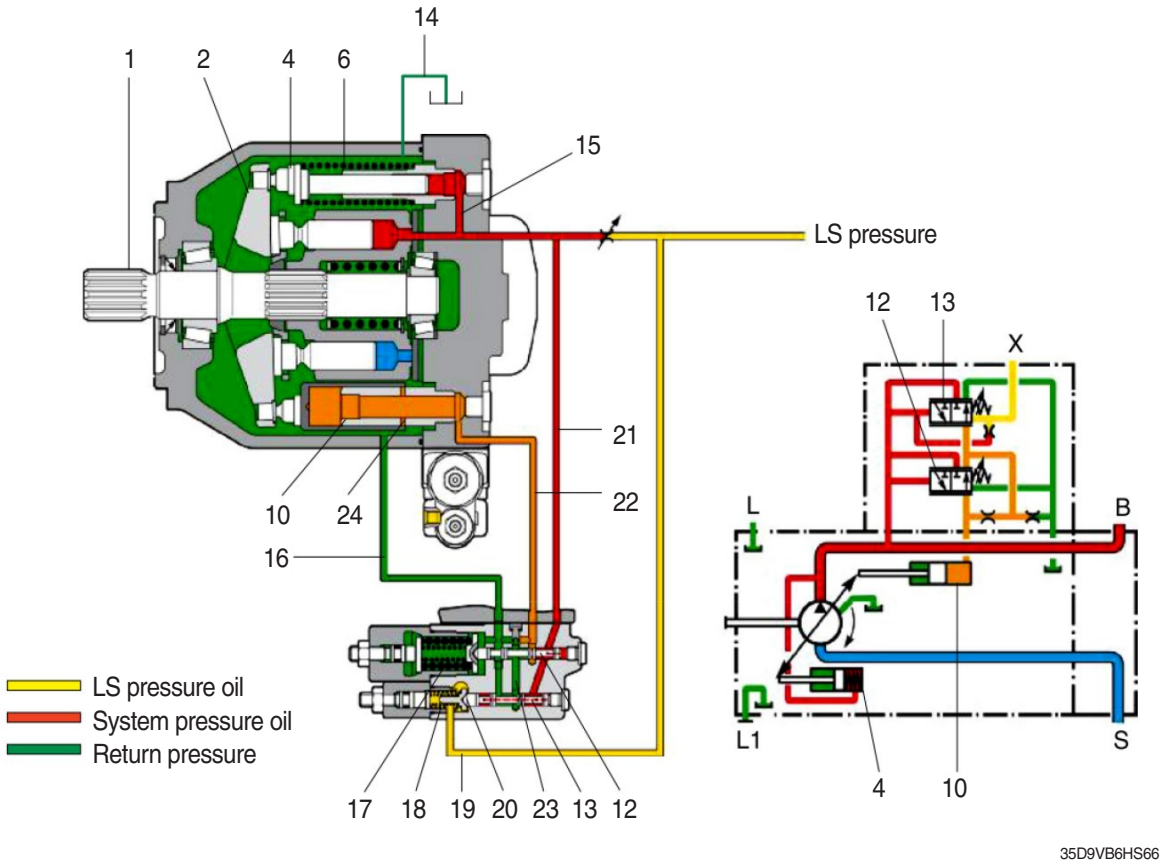


1	Drive shaft	13	Flow compensator spool	19	LS line from pump
2	Swash plate	14	Case drain	20	Cavity
3	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

The decreased flow demand causes a LS pressure in line (19). The LS pressure in line (19) combines with the force of spring (18) in cavity (20). This combination of LS pressure and of spring force is less than the pump pressure in passage (21). This causes flow compensator spool (13) to move left. Pump oil now flows through passage (15). The oil then flows past flow compensator spool (13), through passage (22), and then to control piston (10). The pump pressure behind control piston (10) is now greater than the combined force of counter piston(4) and of counter spring (6). The angle of swash plate (2) decreases. This decreases the pump output and the system pressure. When the lower flow requirements are met, flow compensator spool (13) moves right up to the balanced position. Swash plate (2) maintains an angle that is sufficient to provide the lower required pressure. If the operator does not turn the steering wheel and does not move MCV, then the pump will return to low pressure standby.

· Control piston → Changes pump displacement; influenced by controller.
· Counter piston → Helps to change pump displacement but no possible to control this piston.

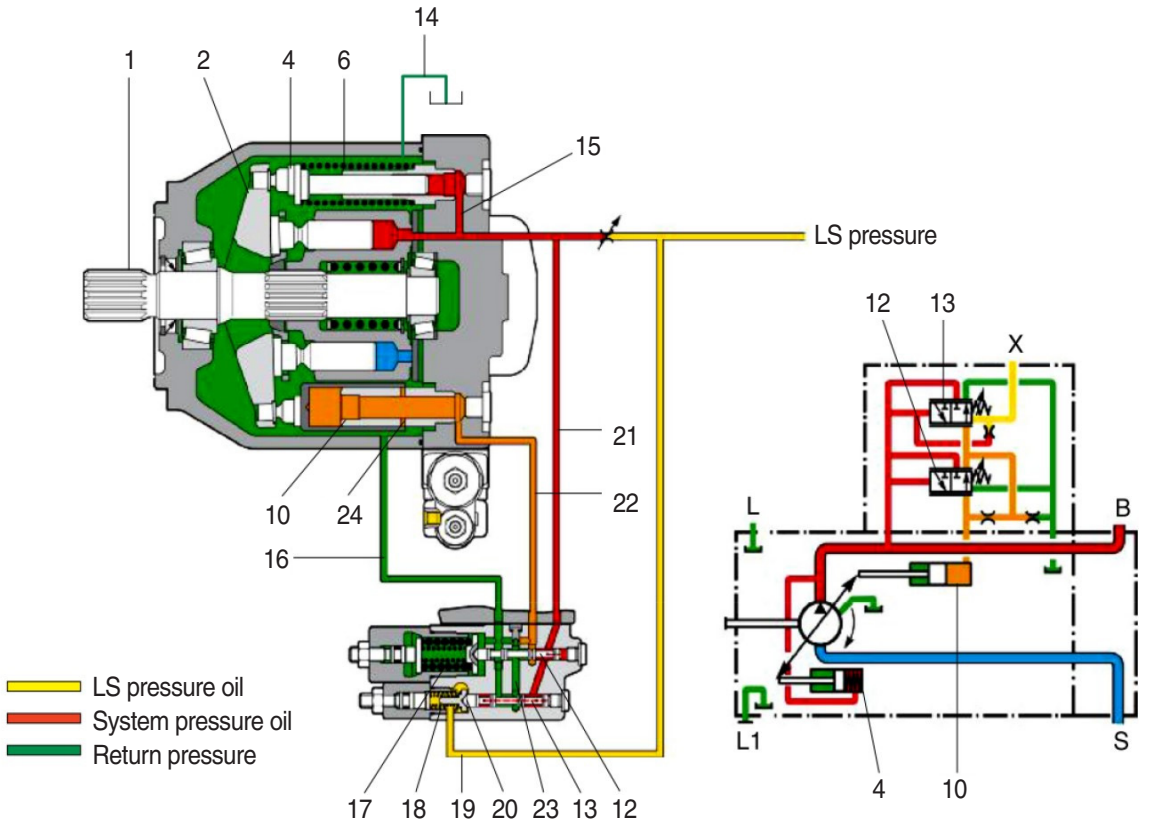
(4) Low pressure standby



1	Drive shaft	13	Flow compensator spool	19	LS line from pump
2	Swash plate	14	Case drain	20	Cavity
3	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

Low pressure standby constitutes the following condition a running engine and inactive steering and attachment. There are no flow demands on the pump or pressure demands on the pump. Therefore, there is no LS pressure in line (19). Before you start the engine, counter spring (6) holds swash plate (2) at the maximum angle. As the pump begins to turn, oil begins to flow and pressure increases in the system. because of close centered steering unit and close centered hydraulic system. As this pressure increase, the pressure pushes flow compensator spool(13) against spring(18). This causes flow compensator spool (13) to move left. This opens passage (23) in order to allow pressure oil to flow to control piston (10). The oil acts against control piston (10) in order to overcome the force of counter spring (6). The oil causes control piston (10) to move to the left. When control piston (10) moves to the left, the piston moves swash plate (2) toward the minimum angle. Control piston (10) continues to move to the left until cross-drilled hole (24) allows the oil to drain to the case. Cross-drilled hole (24) limits the maximum travel of control piston (10) to the left. The pump supplies a sufficient amount of flow that compensates for system leakage. The pump also supplies a sufficient of flow that compensates for leakage to the pump case. The leakage to the pump case is a result of the cross-drilled hole. The pump maintains low pressure stand-by.Low pressure stand-by pressure should not exceed 30 bar (435 psi). Low pressure standby will vary in the same pump as the system leakage or the pump leakage increases. The pump will upstroke slightly in order to compensate for the increasing leakage. Control piston (10) will cover more of the cross-drilled hole.

(5) High pressure standby



1	Drive shaft	13	Flow compensator spool	19	LS line from pump
2	Swash plate	14	Case drain	20	Cavity
3	Counter piston	15	Passage	21	Passage
6	Counter spring	16	Passage	22	Passage
10	Control piston	17	Spring	23	Cavity
12	Pressure compensator spool	18	Spring		

When the hydraulic system stalls under load or when the cylinders reach the end of the stroke, the main system pressure increases. But LS pressure (19) is regulated by LS relief valve on steering system and MCV system. The pressure difference between discharged pump and LS pressure equal to spring (18). It means no flow is necessary. Therefore, discharged pressure push flow compensator spool (13) left. Supply oil now flows past flow compensator spool (13) and through passage (23). The oil flows past flow compensator spool (13) and into passage (22). The oil then flows to control piston (10). Pump swash plate (2) will be minimum displacement if the operator does not turn the steering wheel and MCV, then the pump will return to low pressure standby.

3) CHECKS AND ADJUSTMENTS

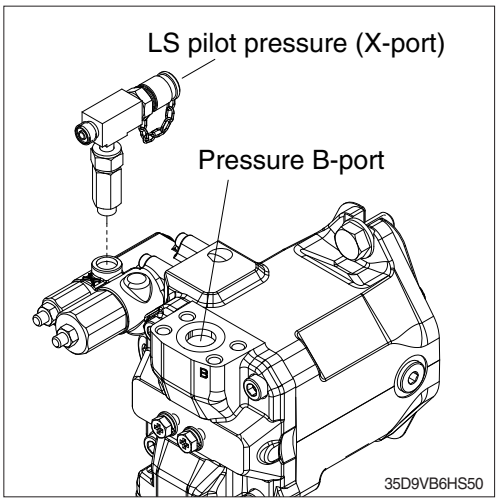
(1) Margin pressure check

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".

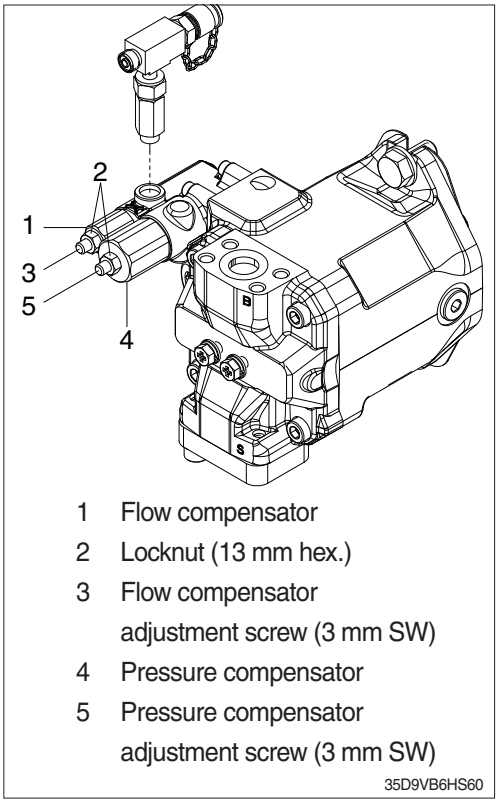
Gague B- X	bar	psi
	22 ± 1	320 ± 14.5



(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 2.2 kgf·m (15.9 lbf·ft).



(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 ± 3	3625 ± 43

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.

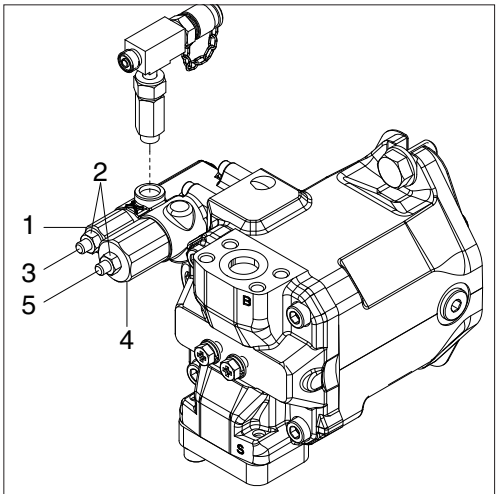
c. Put the pressure compensator adjustment screw back to its original position by turning the adjustment screw counter clockwise by the number of turns noted earlier.

d. Tighten locknut on pressure compensator adjustment screw to 2.2 kgf·m (15.9 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 2.2 kgf·m (15.9 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)

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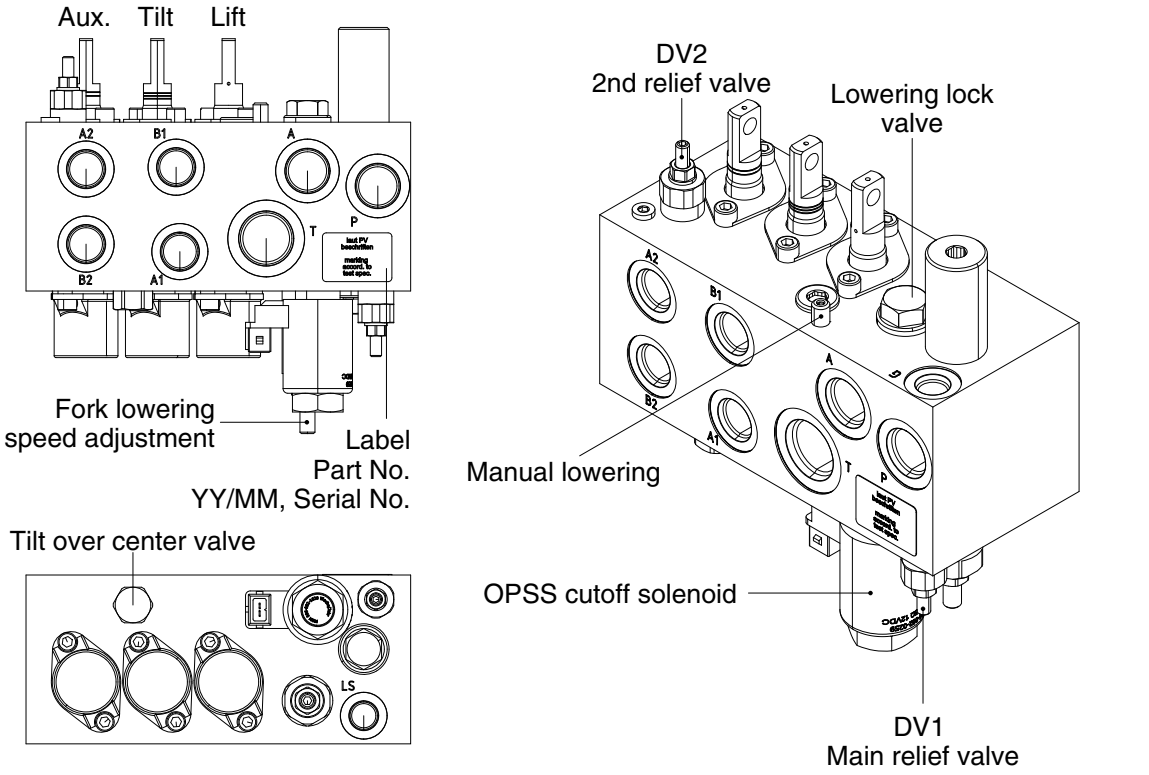
5. MAIN CONTROL VALVE

1) STRUCTURE

(1) 3 spool



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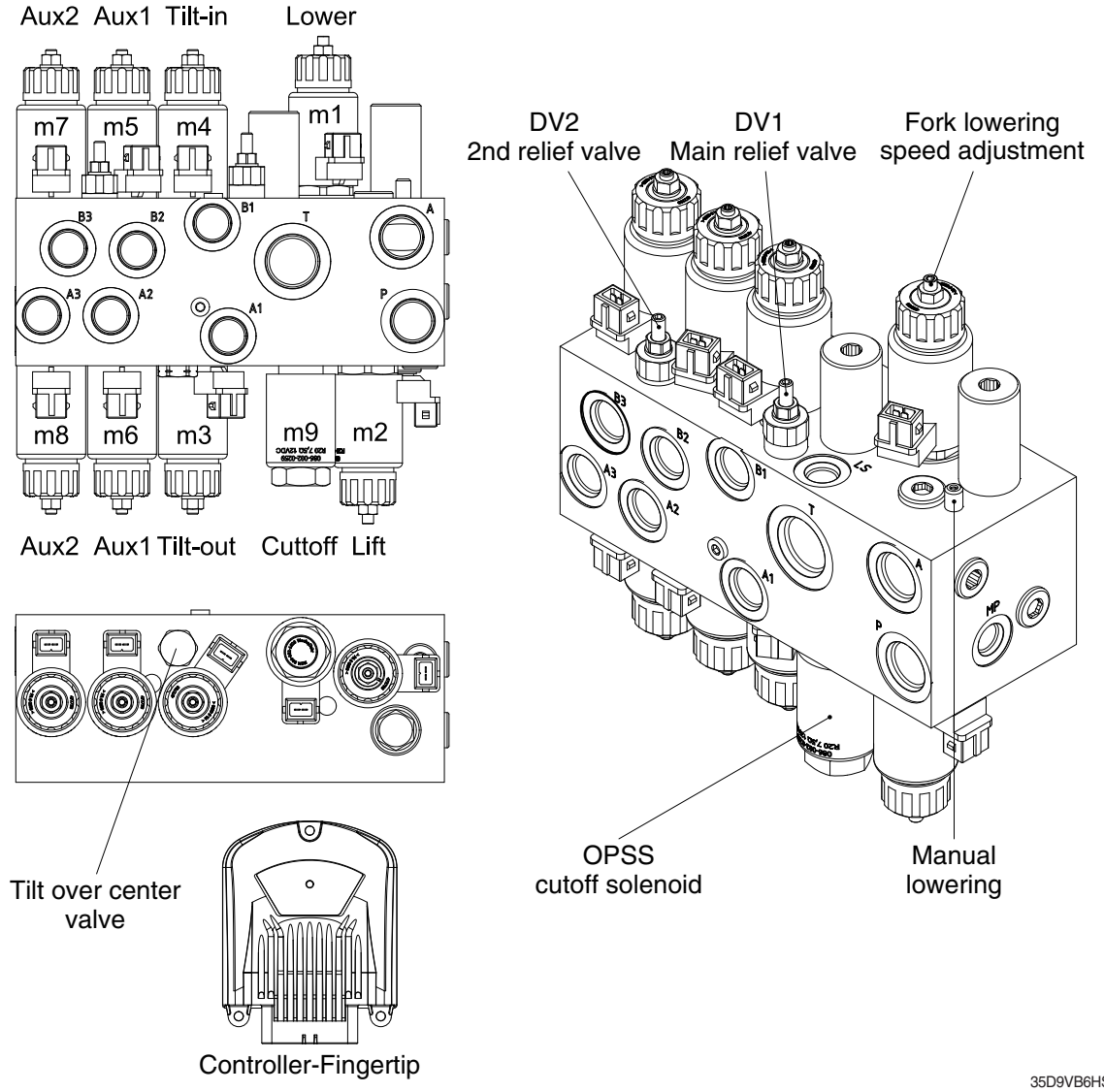
Port	Port name	Port size	Tightening torque	
			kgf·m	lbf·ft
A	Lift / Lower	1-1/16-12 UN	12	86.8
A1, B1	Tilt rod / head	3/4-16 UNF	5	36.2
A-, B-	Aux 1, Aux 2, Aux 3	3/4-16 UNF	5	36.2
P	Inlet	7/8-14 UNF	7	50.6
T	Outlet	1 1/16-12 UN	12	86.8
G, LS	Gauge, Pilot	9/16-18UNF	4	28.9

(2) Fingertip MCV (option)



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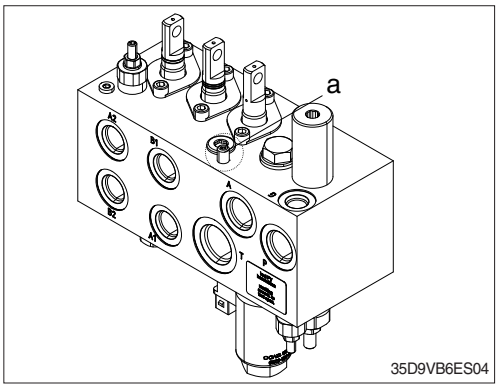
Port	Port name	Port size	Tightening torque	
			kgf·m	lbf·ft
A	Lift / Lower	1-1/16-12 UN	12	86.8
A1, B1	Tilt rod / head	3/4-16 UNF	5	36.2
A-, B-	Aux 1, Aux 2	3/4-16 UNF	5	36.2
P	Inlet	7/8-14 UNF	7	50.6
T	Outlet	1 1/16-12 UN	12	86.8
G, LS	Gauge, Pilot	9/16-18UNF	4	28.9

2) FUNCTION

(1) Emergency fork lowering

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



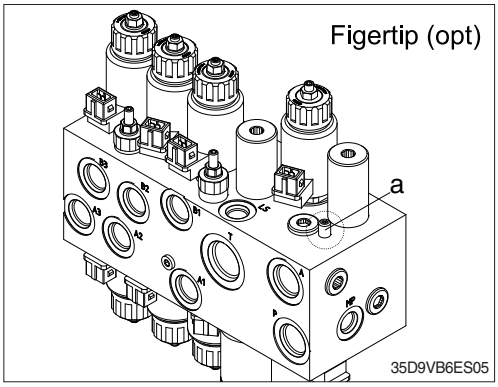
⚠ Manual override features are intended for emergency use, not for continuous-duty operation.

① Open the bonnet.

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

※ **Do not exceed a tightening torque of maximum 0.25 kgf·m (1.81 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 MCV 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 MCV.

(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)
  - 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.)

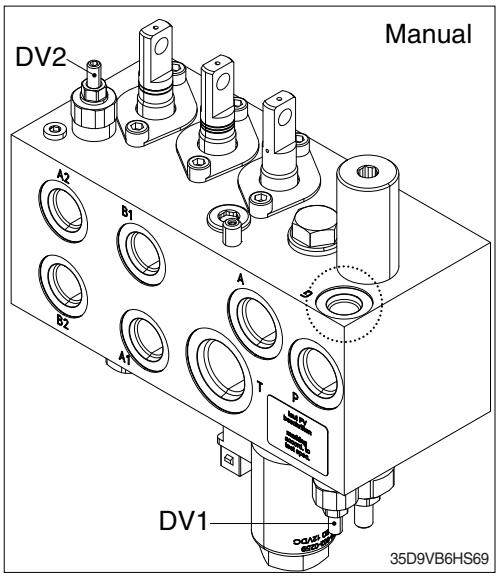
⚠ **Hot hydraulic oil can cause serious burns to skin. Do not touch hydraulic components or oil during test. Make sure hydraulic oil has cooled to safe temperature before installing or removing test equipment.**

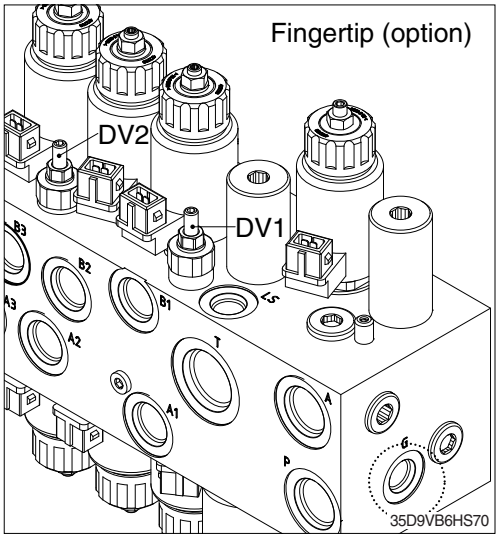
⚠ **Hydraulic oil under pressure can be injected into skin. Lower forks to ground and relieve all circuit pressure before removing test plugs from valve.**

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 Open the bonnet.
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.

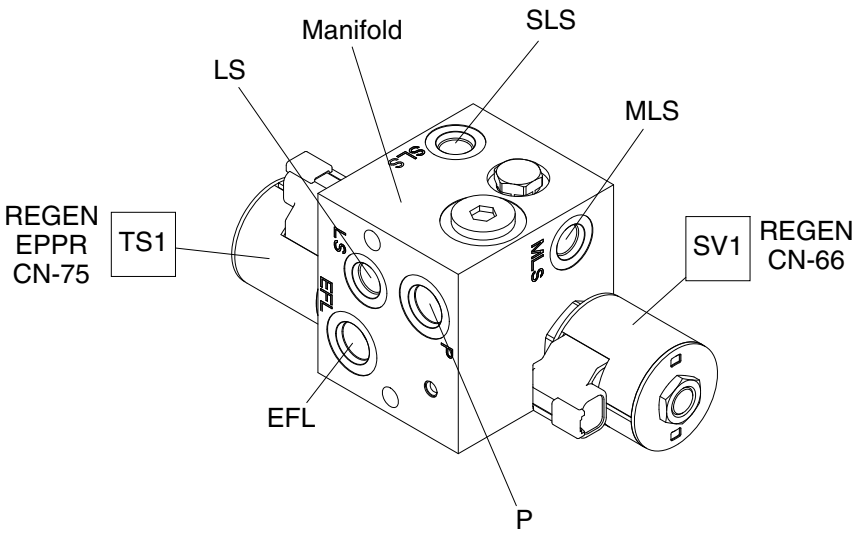
⚠ **The MCV relief valve adjustment screw is very sensitive. Operate in 1/4 turn increments to avoid system overpressure.**

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





6. PRESSURE FORCED VALVE



35D9VB6HS86

Port	Port size	Component	Related issues	Remarks
LS	G 1/4	Pump 'X'	Pump, Load sensing	-
EFL	G 3/8	Hyd oil tank 'TT'	Back pressure	-
P	G 3/8	Priority valve 'EF'	Load sensing	-
SLS	G 1/4	MCV LS or ECV LS	Load sensing	-
MLS	G 1/4	*HO P sensor #2	Working device operation	MCV or ECV
	-	*HO T/P sensor #1	Working device operation	PUMP, CD-71
SV1	-	Regen valve; ON/OFF	Working device operation	CN-66
TS1	-	Regen valve; EPPR	Noise/Vibration, DPF state	CN-75

* HO T/P SENSOR : Hydraulic oil, Temperature & Pressure sensor

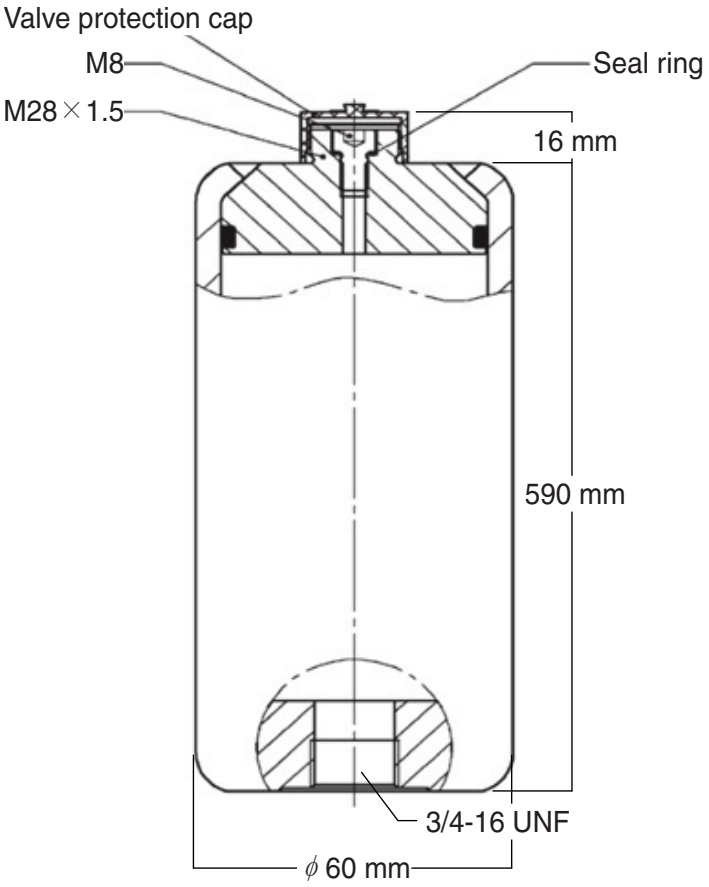
It is a DPF Aiding hydraulic system that helps the engine aftertreatment system. It is possible to work with the working device during automatic regeneration. However, there is a difference between the working device and the running operation when the automatic reproduction rice production is simultaneous, and the forced reproduction (stopping reproduction) is required when the automatic reproduction is not completed.

This valve follows the RMCU control method according to the DPF Aiding Level condition. Noise is generated because pressure is created to remove DPF during the control process.

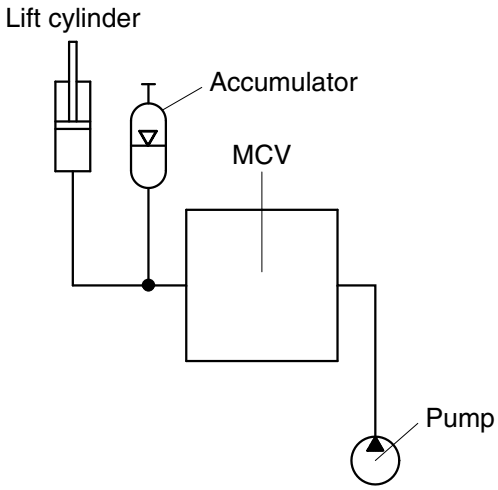
The control method includes operating temperature conditions for preventing an abnormal rise in oil temperature.

7. MAST ACCUMULATOR

1) STRUCTURE



35D9VB6HS52



35D9VB6HS59

Parts No.	Normal volume	Pre-charging pressure at 20 ℃ (68 ℉)	Gas	Weight
31HK-70060	1 ℓ (0.26 U.S. gal)	10 bar (145 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 ℉), 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.

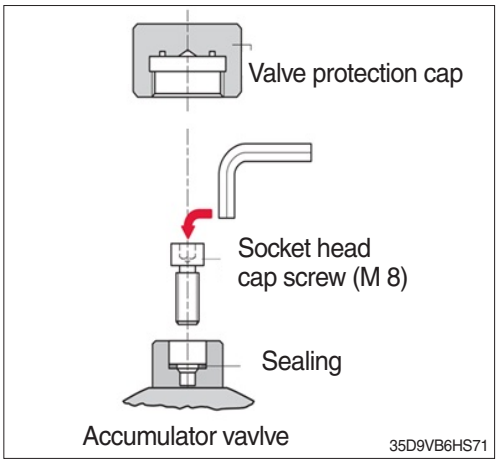
⑥ Wait 5-10 minutes for the filled nitrogen gas pressure to stabilize, then recheck the set pressure and adjust if necessary.

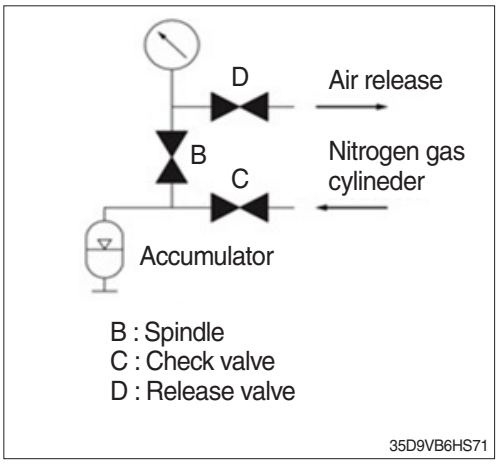
⑦ Open the release valve and blow out gas in the FPU.

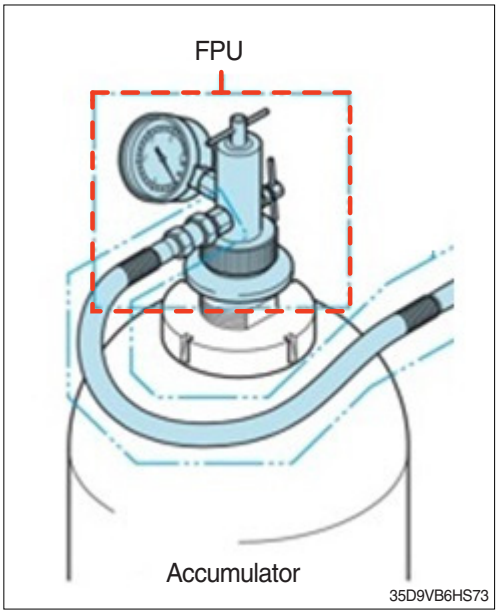
※ **If there is gas in the charging hose and FPU, it cannot be separated, and it is very dangerous if it is forcibly separated. Be sure to separate the charging hose and after blowing out the gas inside the FPU.**

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.

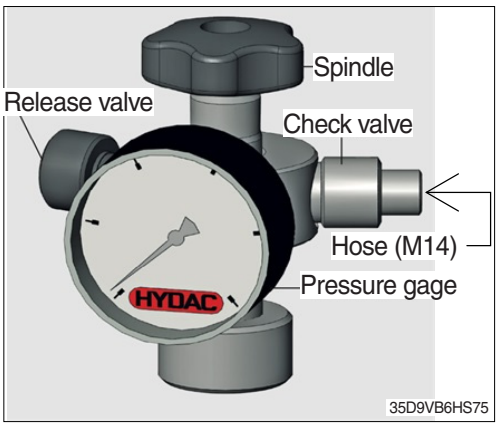
⑥ When filling is complete, close the gas valve of the accumulator using the valve of the nitrogen gas cylinder and the spindle of the FPU.

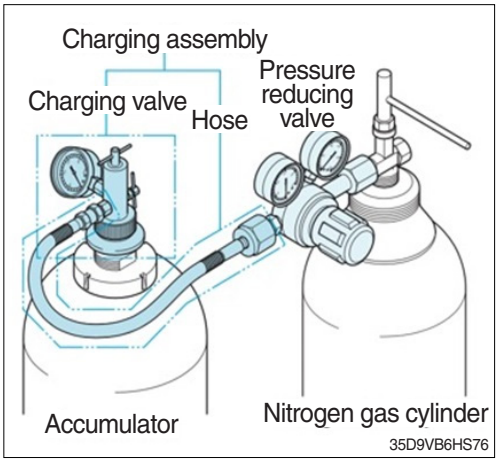
※ **When adding nitrogen to the accumulator filled with nitrogen gas, wait 5-10 minutes for the temperature and pressure of the gas mixture to stabilize, then check the pressure again and adjust if necessary.**

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.



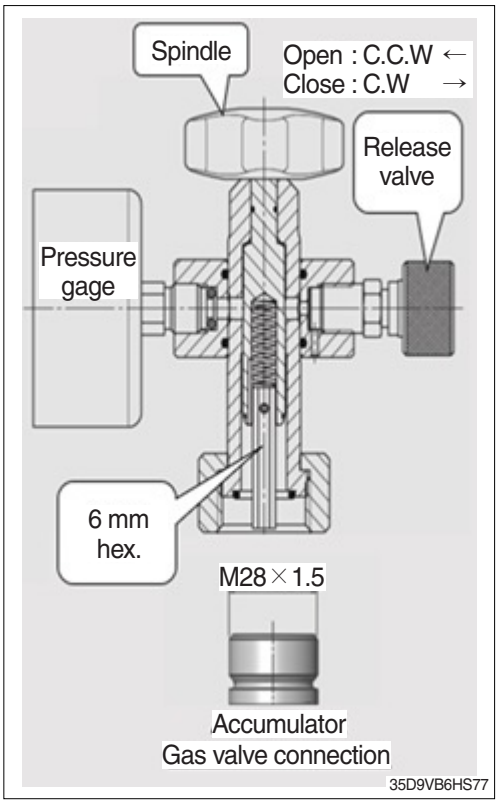


⑩ Open the release valve and blow out nitrogen gas in the FPU.

※ **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.**

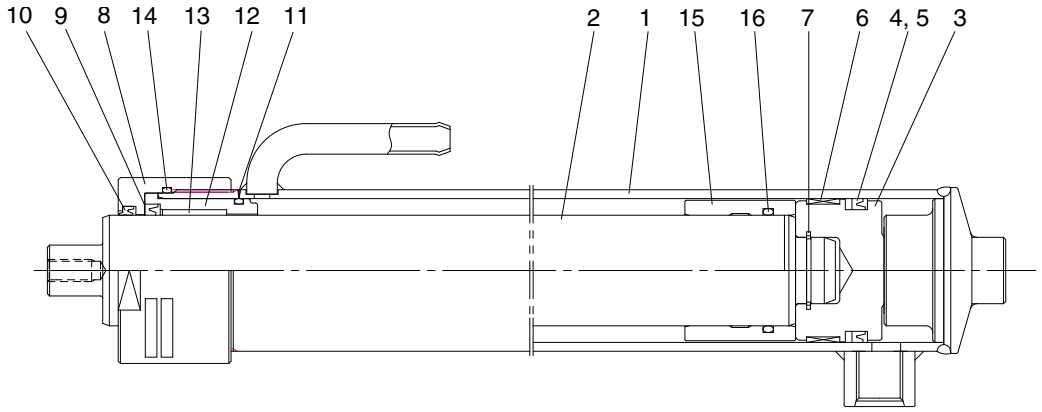
⑪ Remove the FPU from the accumulator.

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. LIFT CYLINDER

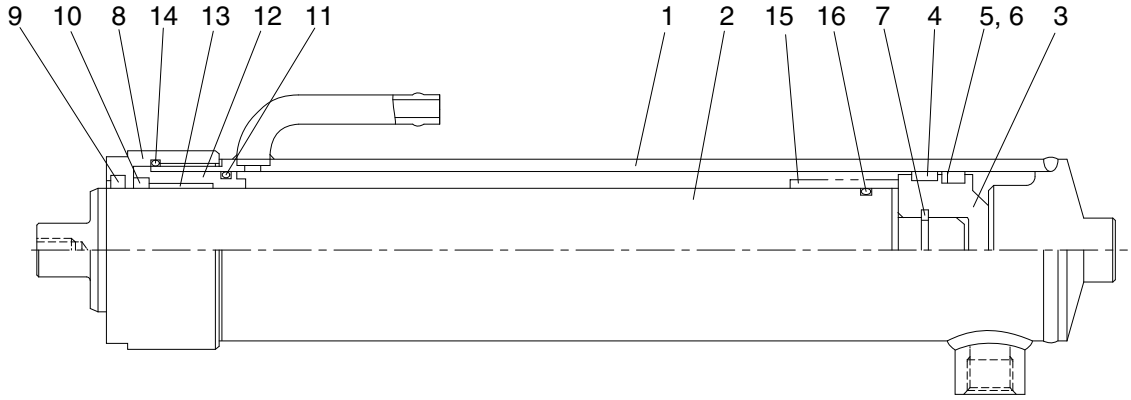
1) V MAST (35/40/45D-9VB, 40/45D-9VC, 50DN-9VC)



35D9FHS125

1	Tube assy	7	Retaining ring	13	Rod busing
2	Rod	8	Rod cover	14	O-ring
3	Piston	9	U-packing	15	Spacer
4	U-packing	10	Dust wiper	16	O-ring
5	Back up ring	11	O-ring		
6	Wear ring	12	Guide		

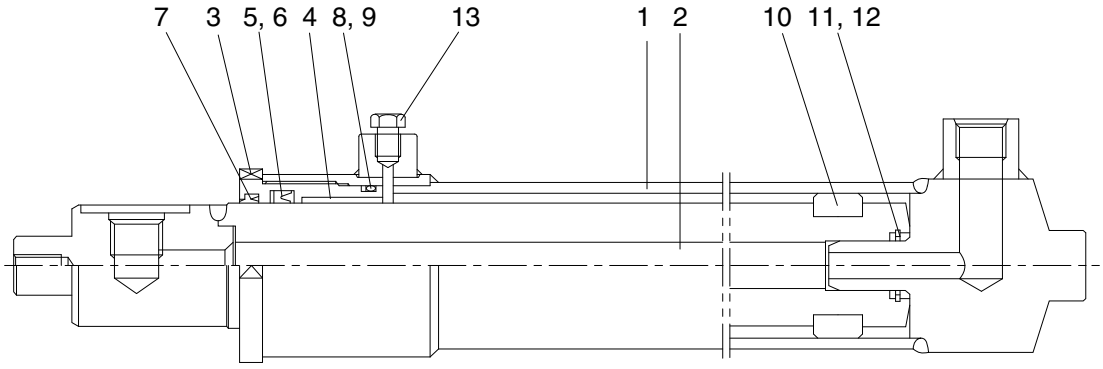
2) V MAST (50DN-9VB)



35D9FHS126

1	Tube assy	7	Stop ring	13	DU busing
2	Rod	8	Rod cover	14	O-ring
3	Piston	9	Dust wiper	15	Spacer
4	Wear ring	10	U-packing	16	O-ring
5	U-packing	11	O-ring		
6	Back up ring	12	Stopper		

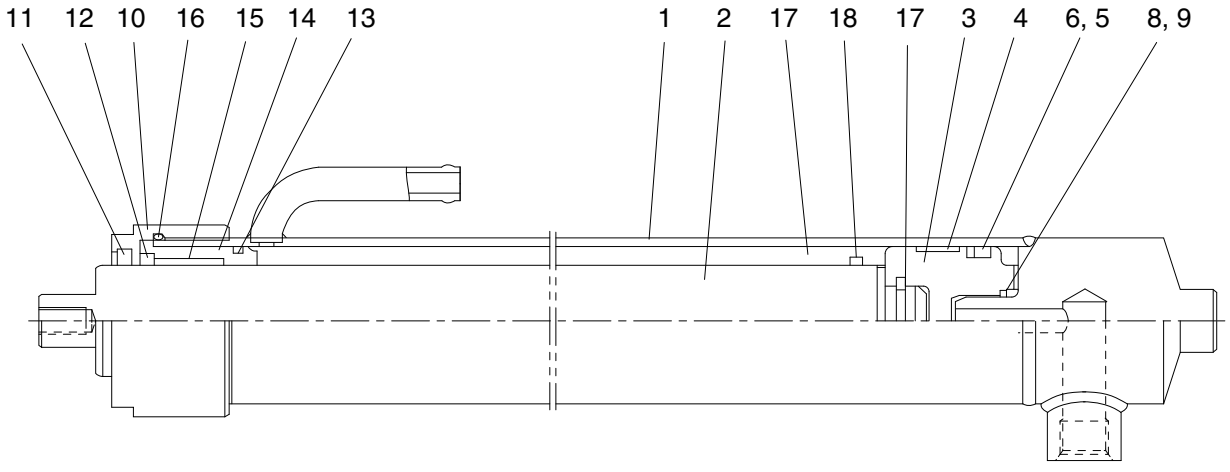
3) VF MAST



35D9FHS127

1	Tube assembly	6	Back up ring	11	Cushion seal
2	Rod assy	7	Dust wiper	12	Retaining ring
3	Rod cover	8	O-ring	13	Bleeder
4	Rod bushing	9	Back up ring		
5	U-packing	10	Piston ring		

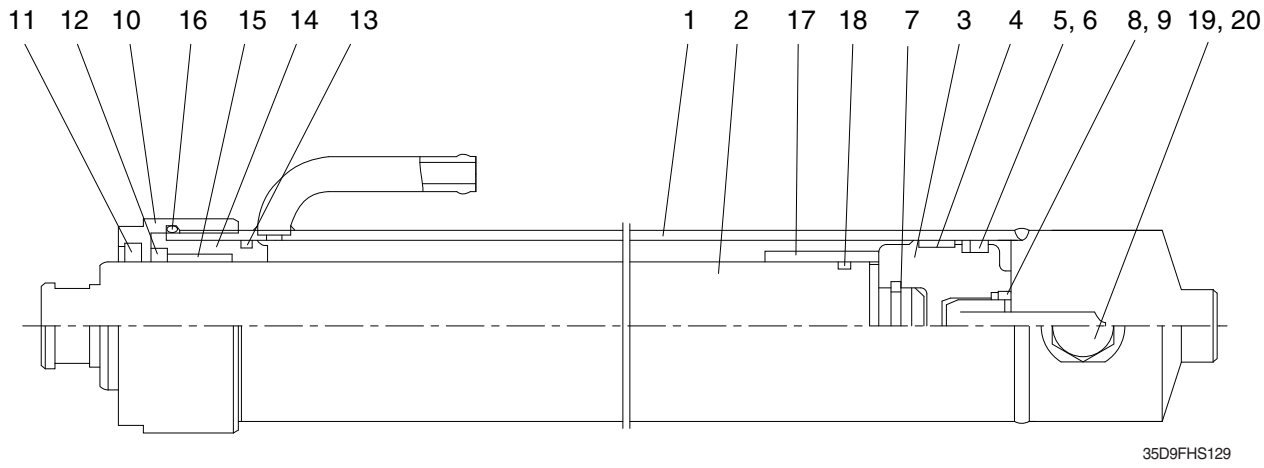
4) TF MAST (35/40/45D-9VB, 40/45D-9VC, 50DN-9VC)



35D9FHS128

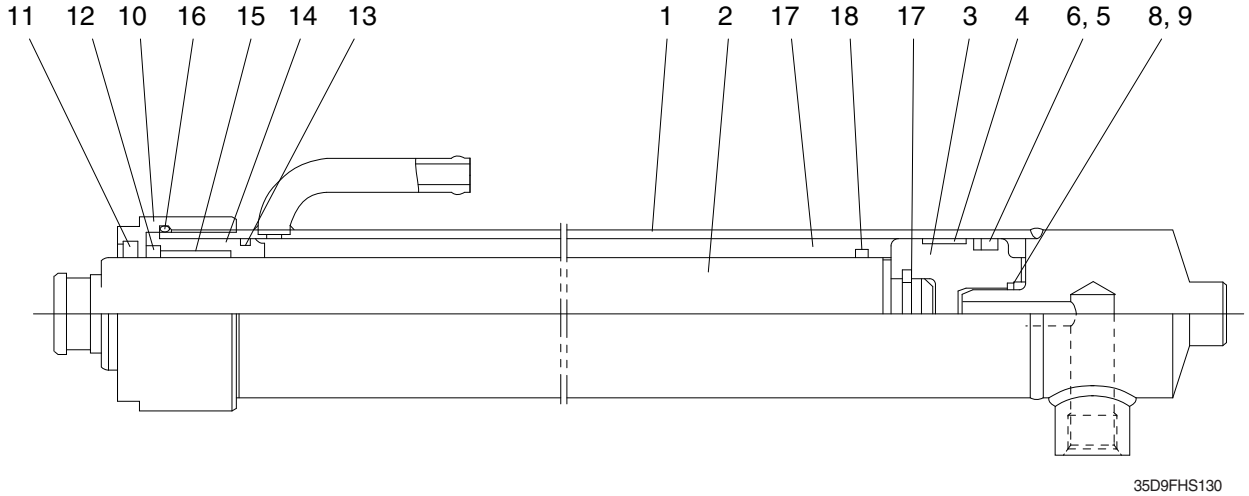
1	Tube assembly	7	Stop ring	13	O-ring
2	Rod	8	Cushion seal	14	Stopper
3	Piston	9	Retaining ring	15	Rod bushing
4	Wear ring	10	Rod cover	16	O-ring
5	U-packing	11	Dust wiper	17	Spacer
6	Back up ring	12	U-packing	18	O-ring

5) TF AND TS-MAST (50DN-9VB)



1	Tube assembly	8	Cushion seal	15	Rod bushing
2	Rod	9	Retaining ring	16	O-ring
3	Piston	10	Rod cover	17	Spacer
4	Wear ring	11	Dust wiper	18	O-ring
5	U-packing	12	U-packing	19	Plug
6	Back up ring	13	O-ring	20	O-ring
7	Stop ring	14	Stopper		

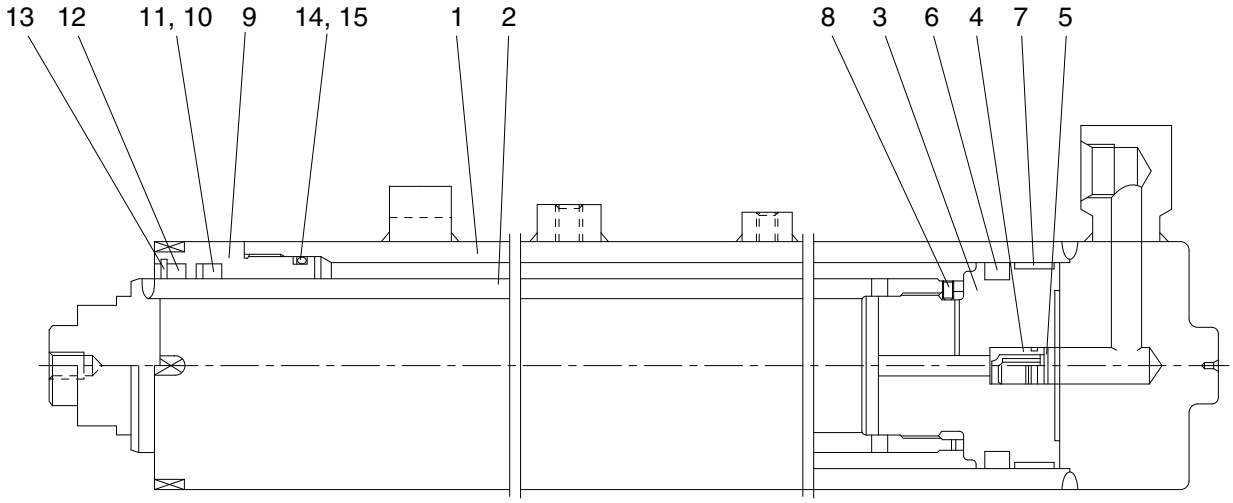
6) TS MAST (35/40/45D-9VB, 40/45D-9VC, 50DN-9VC)



1	Tube assembly	7	Stop ring	13	O-ring
2	Rod	8	Cushion seal	14	Stopper
3	Piston	9	Retaining ring	15	Rod bushing
4	Wear ring	10	Rod cover	16	O-ring
5	U-packing	11	Dust wiper	17	Spacer
6	Back up ring	12	U-packing	18	O-ring

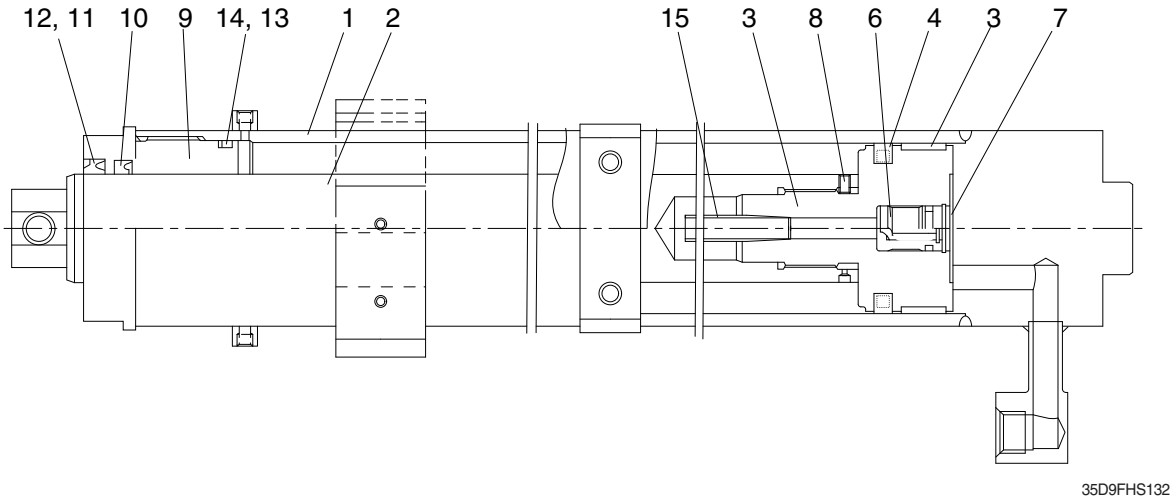
9. FREE LIFT CYLINDER

1) VF AND TF MAST (35/40/45D-9VB, 40/45D-9VC, 50DN-9VC)



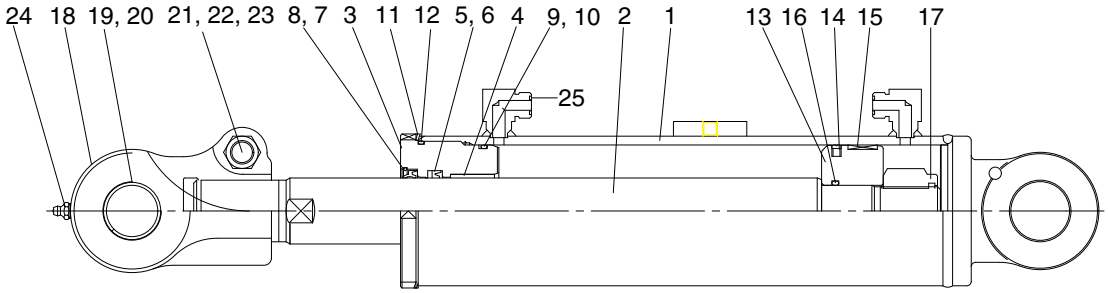
1	Tube assembly	6	Piston seal	11	Back up ring
2	Rod assembly	7	Wear ring	12	Dust wiper
3	Piston	8	Set screw	13	Retaining ring
4	Check valve	9	Rod cover	14	O-ring
5	Retaining ring	10	U-packing	15	Back up ring

2) TS MAST



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

10. TILT CYLINDER



35D9FHS133

1	Tube assy	10	Back up ring	19	Spherical bearing
2	Rod	11	Lock washer	20	Retaining ring
3	Rod cover	12	O-ring	21	Hexagon bolt
4	Rod bushing	13	Piston	22	Hexagon nut
5	U-packing	14	Piston seal	23	Spring washer
6	Back up ring	15	Wear ring	24	Grease nipple
7	Dust wiper	16	O-ring	25	O-ring
8	Stop ring	17	Nylon nut		
9	O-ring	18	Rod eye		

1. OPERATIONAL CHECKS

1) CHECK ITEM

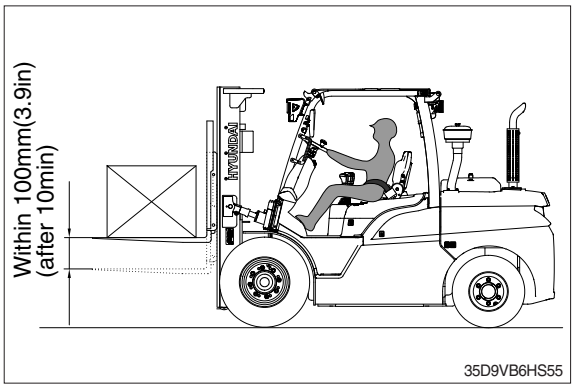
(1) Check visually for deformation, cracks or damage of rod.

(2) Load maximum load, set mast vertical and raise 1m from ground. Wait for 10 minutes and measure hydraulic drift (amount forks move down and amount mast tilts forward).

· **Hydraulic drift**

- Down (Downward movement of forks)
  : Within 100 mm (3.9 in)
- Forward (Extension of tilt cylinder)
  : Within 5 °

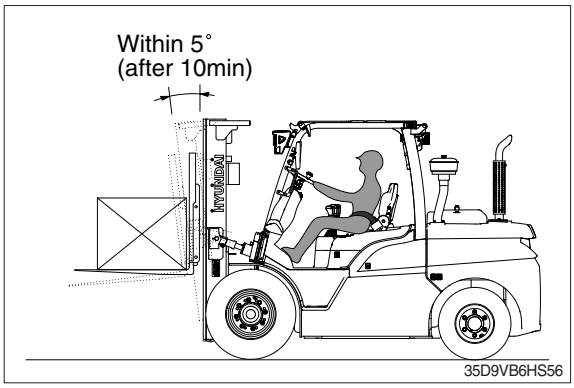
If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.



(3) Check that clearance between tilt cylinder bushing and mounting pin is within standard range.

mm (in)

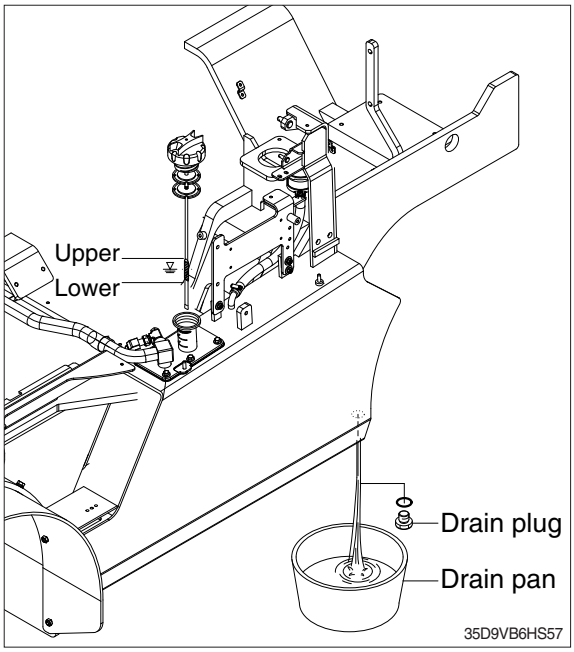
Standard	Under 0.6 (0.02)



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).



3) CONTROL VALVE

(1) Raise forks to maximum height and measure oil pressure.
Check that oil pressure is 210 bar.
(3050 psi)

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 CF 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 CF engine oil. · Clean filter.

Problem	Cause	Remedy
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.
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) LIFT CYLINDER

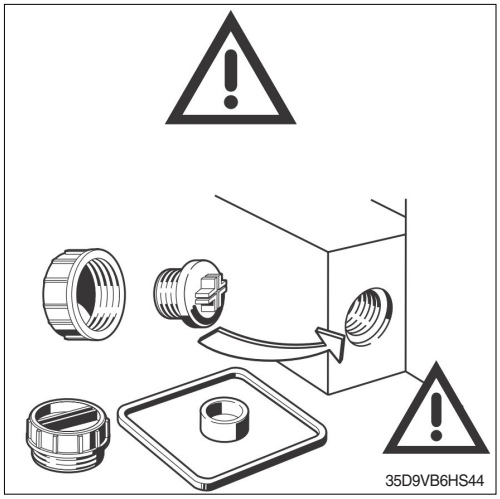
Problem	Cause	Remedy
Oil leaks out from rod cover through rod	· Foreign matters on packing. · Unallowable score on rod. · Unusual distortion of dust seal. · Chrome plating is striped.	· Replace packing. · Smooth rod surface with an oil stone. · Replace dust seal. · Replace rod.
Oil leaks out from cylinder 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

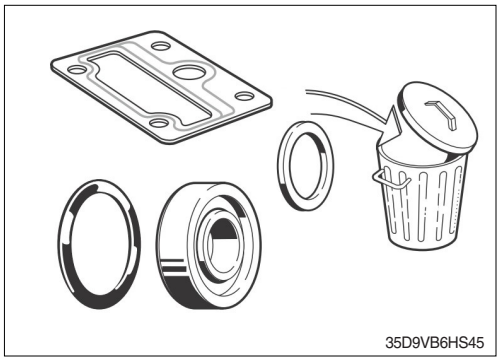
1) DISASSEMBLY AND ASSEMBLY

(1) General precautions

· Observe the following notes when repairing hydraulic components. Close all ports of the hydraulic component.

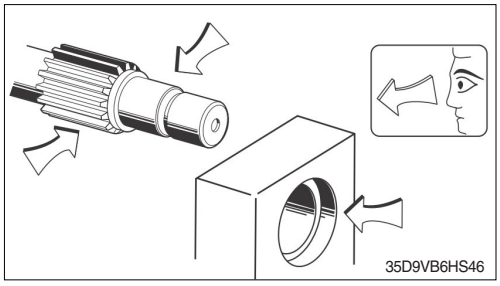


· Replace all seals. Use only original spare parts.

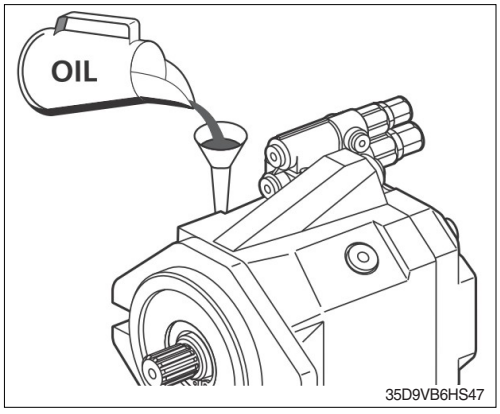


· Check all seal and sliding surfaces for wear.

△ **Rework of sealing area (ex. abrasive paper) can damage the surface.**

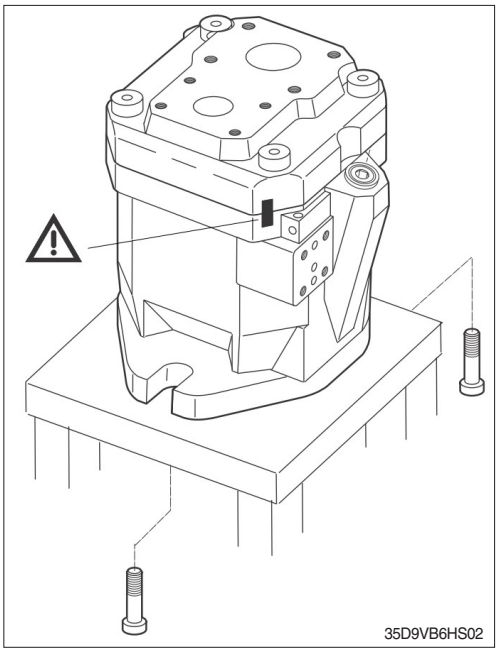


· Fill the hydraulic units with the recommended hydraulic fluid before commissioning.

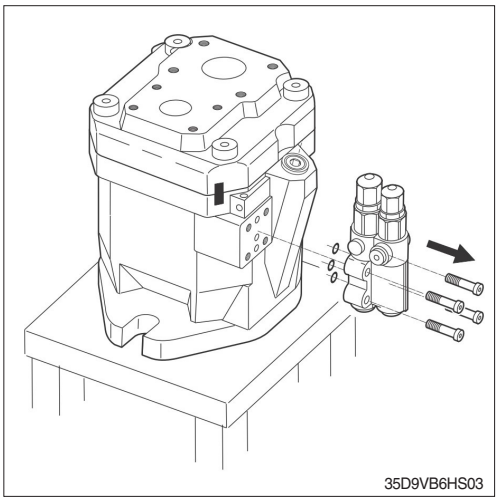


(2) Disassembly

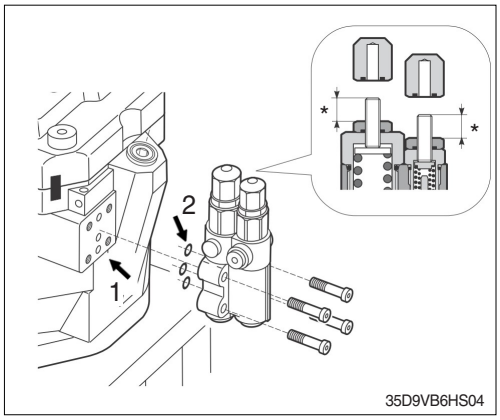
① Mark the location of the connection plate on the housing of pump.

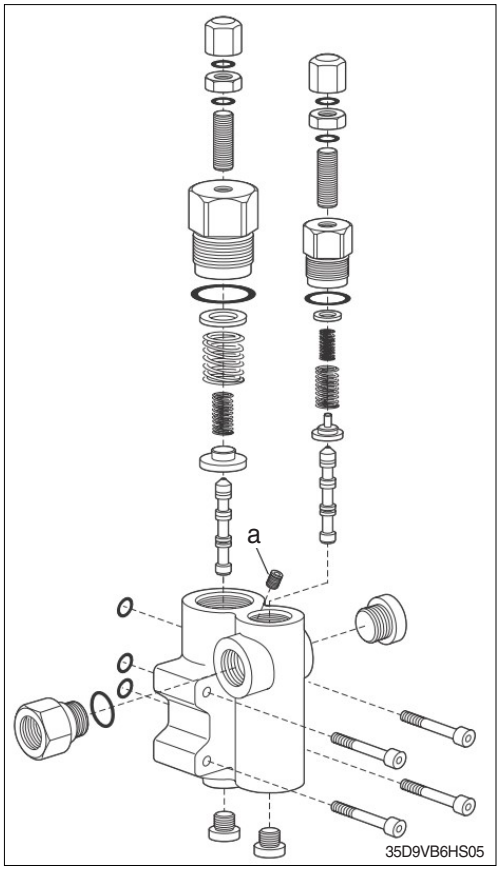


② Remove the control valve.

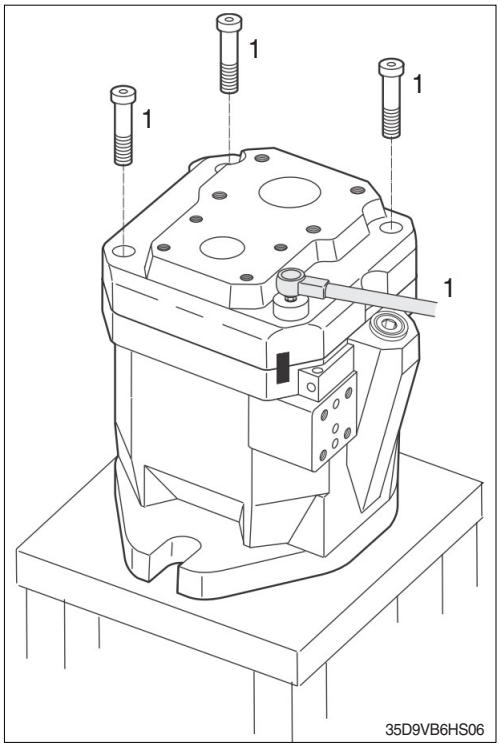


③ Remove the control valve, measure dimension (*) and note down. Check sealing surface (1). Check O-rings (2).
a : Orifice



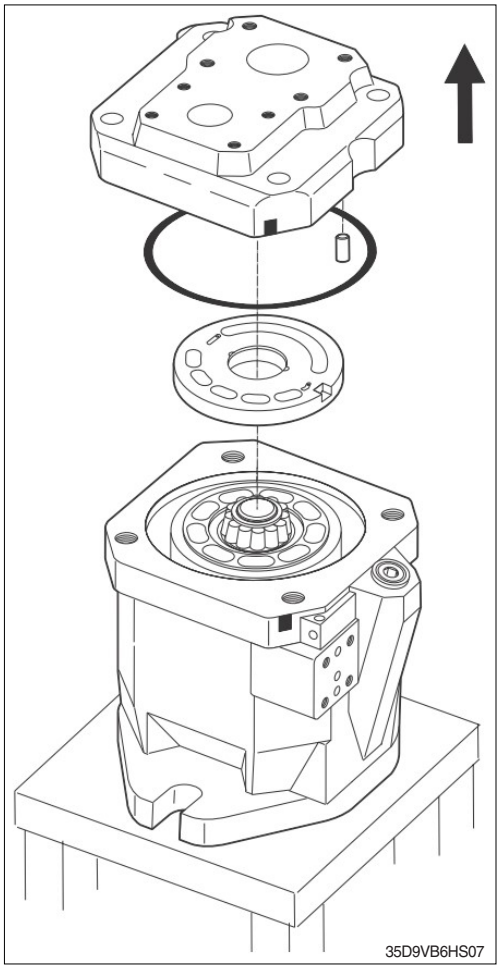


④ Remove the socket screws (1).



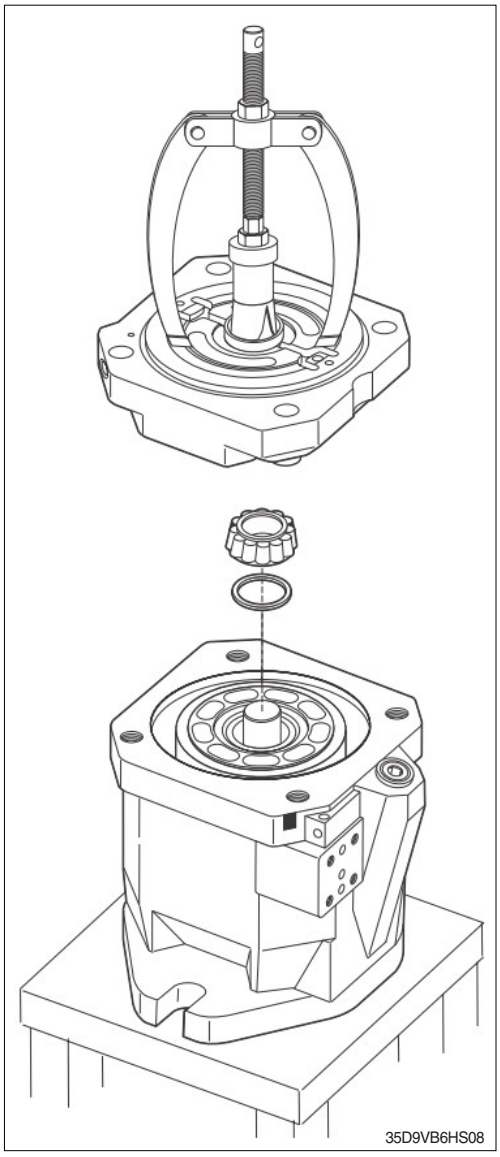
⑤ Remove connection plate.

⚠ **Control plate can drop down - keep tight while removing connection plate.**

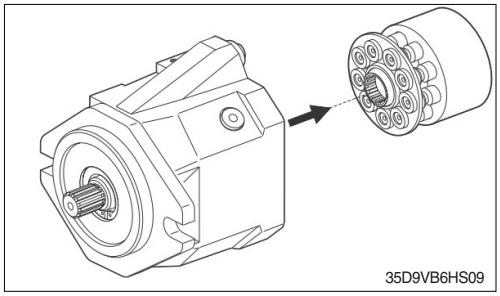


⑥ Pull bearing of the connection plate out using a bearing puller and remove bearing and shim.

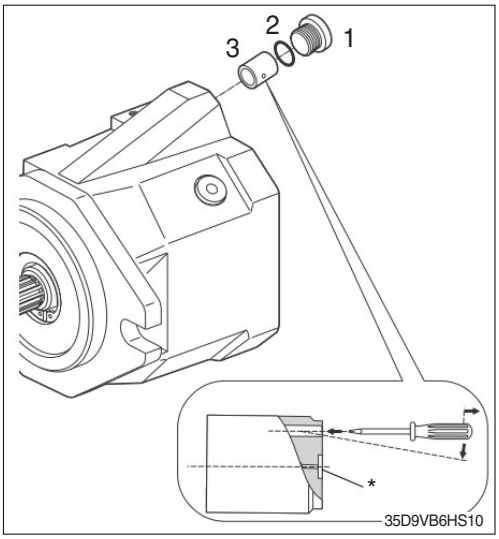
△ **Do not damage the sealing surface.**



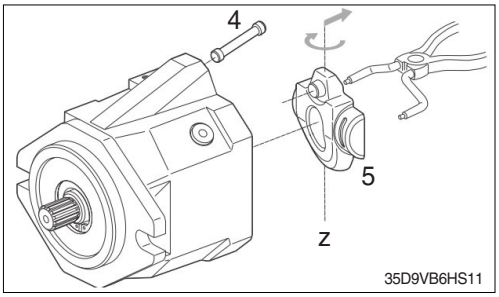
⑦ Remove the rotary group in a horizontal position.



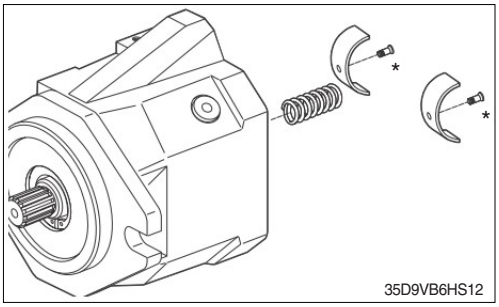
⑧ Remove plug (1) with seal (2). Pull out control piston (3) (flat surface*) with tool.



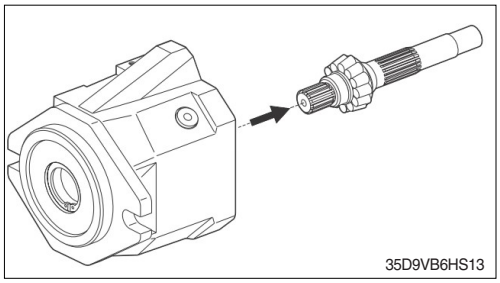
⑨ Remove piston rod and swash plate. Turn swash plate (5) inside of the housing slightly along Z-axis with tool. Remove piston rod (4) and swash plate (5).



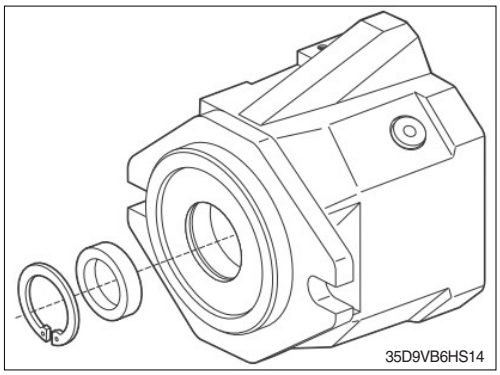
⑩ Remove bearing shells and bearing.



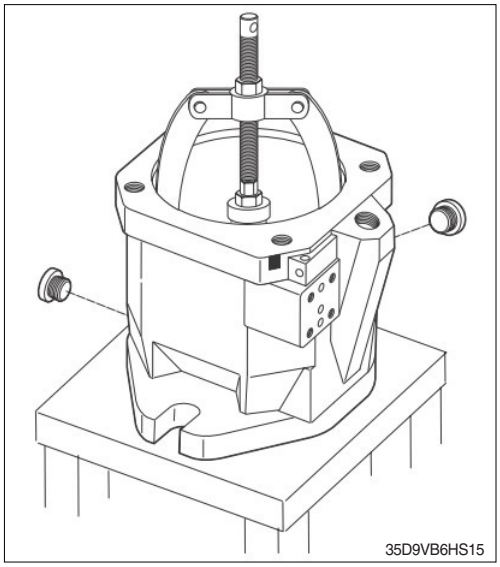
⑪ Remove drive shaft with bearing.



⑫ Remove circlip and shaft seal.

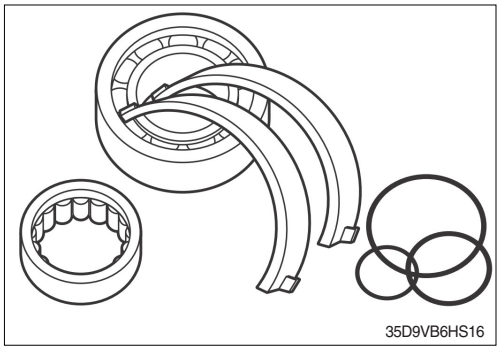


⑬ Pull out outer race of tapered bearing out of housing press seat. Use bearing puller. Remove all plugs and stop ring.

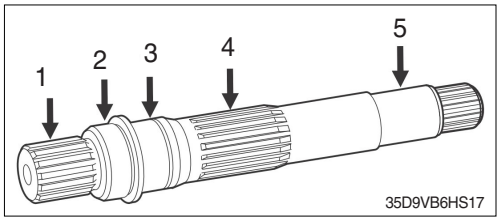


(3) Inspection notes

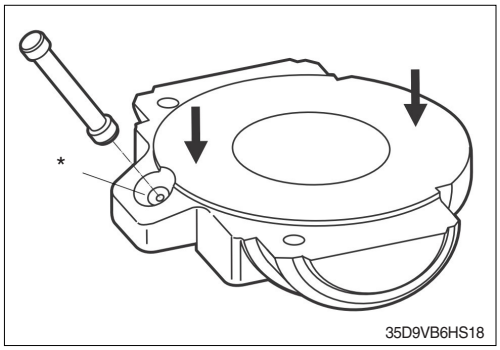
· Renew all bearings and seals.



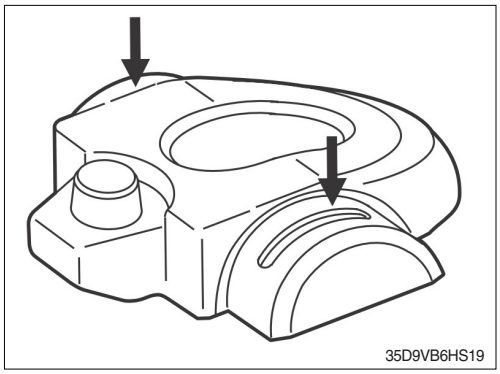
· Check :
(1) Wear on slines, fretting
(2) Drive shaft seal wear grooves
(3) Bearing seat
(4) Splines for cylinder drive
(5) Bearing seat



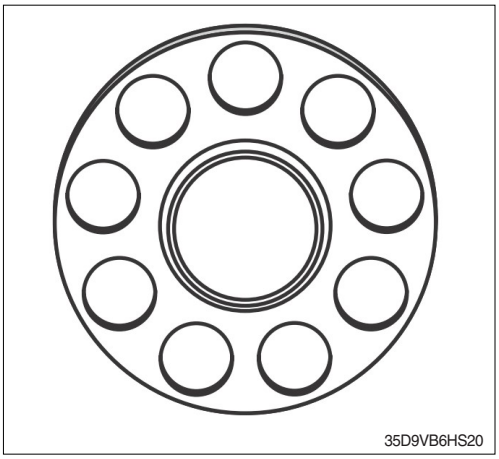
· Check sliding surface free of grooves. Check for freedom of piston rod movement



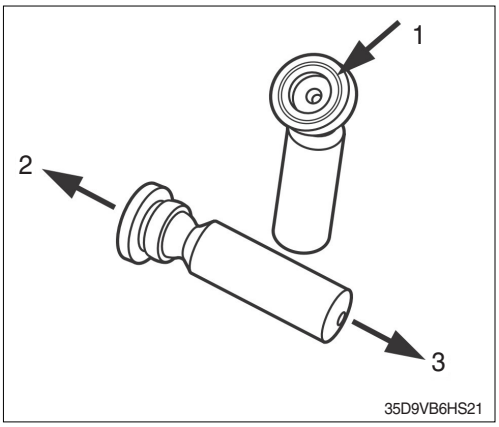
· Bearing surfaces



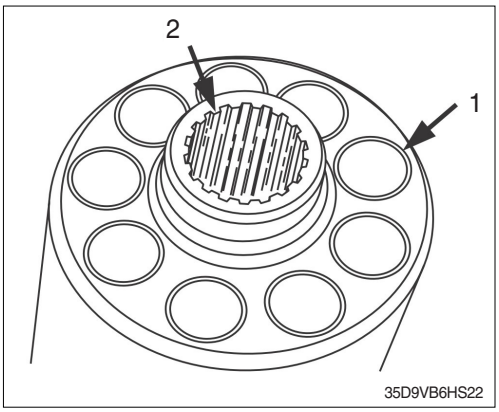
· Check that the retaining plate is free of grooves and that there is no wear in the slipper pad area.



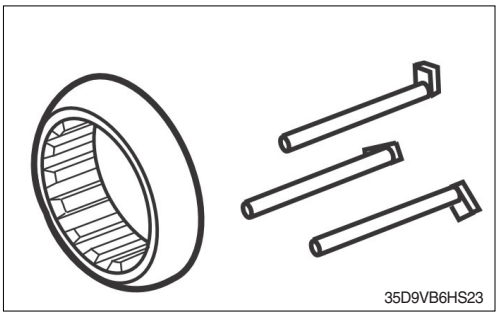
· Check to see that there are no scratches or metal deposits on the sliding surface (1), and that there is no axial play (2). (pistons must only be replaced as a set)



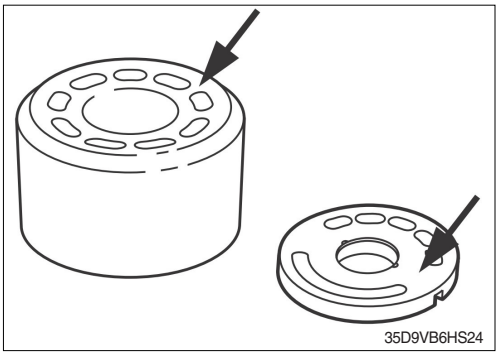
· Check cylinder bores (1), splines (2).



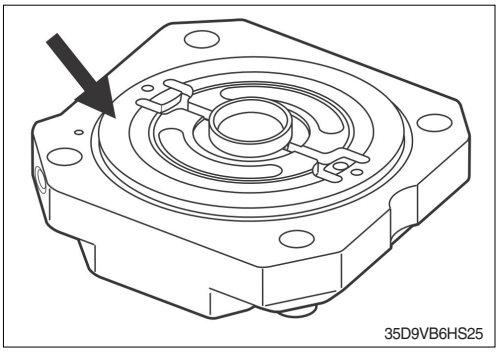
· Free of grooves, no signs of wear.



· Check cylinder sliding surface free of grooves, no wear, no embedded foreign particles. That there are no scratches on the control plate. (Only replace them as a set)

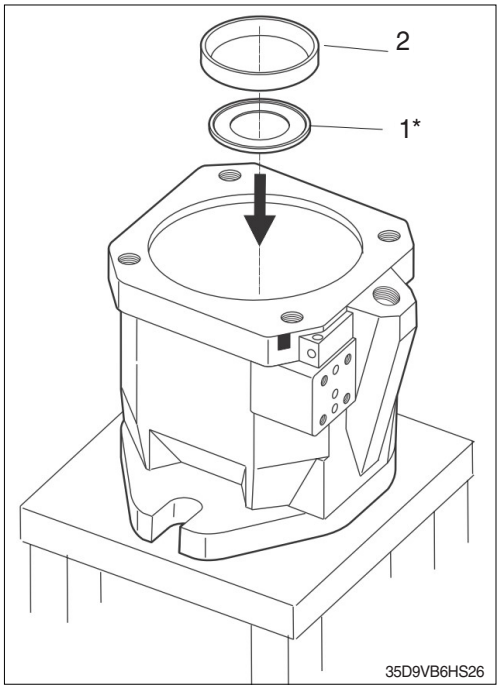


· Check mounting surface - control plate undamaged



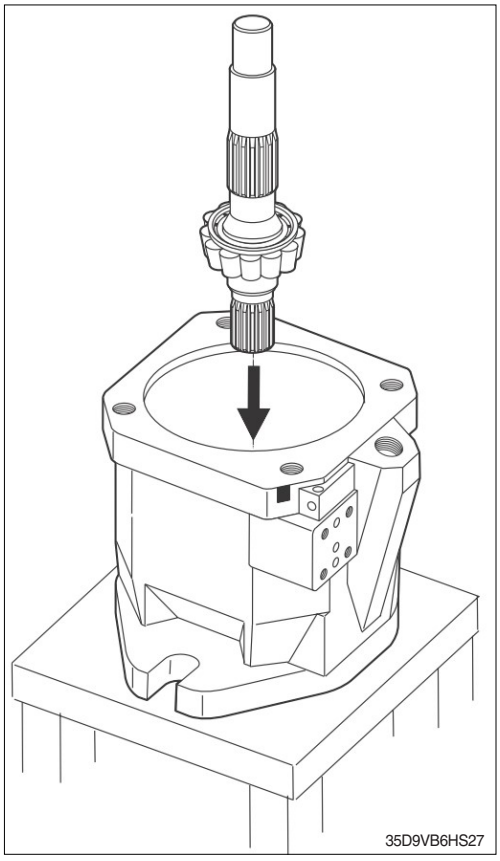
(4) ASSEMBLY

① Assemble stop ring. Press-in distance ring with tool.

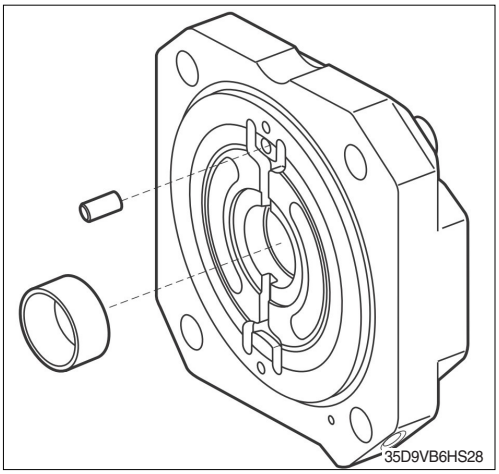


② Assemble shaft in correct position.

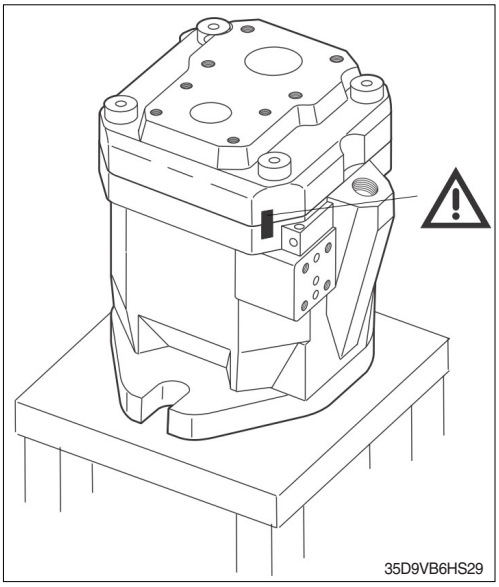
⚠ **Do not cut shaft seal.**



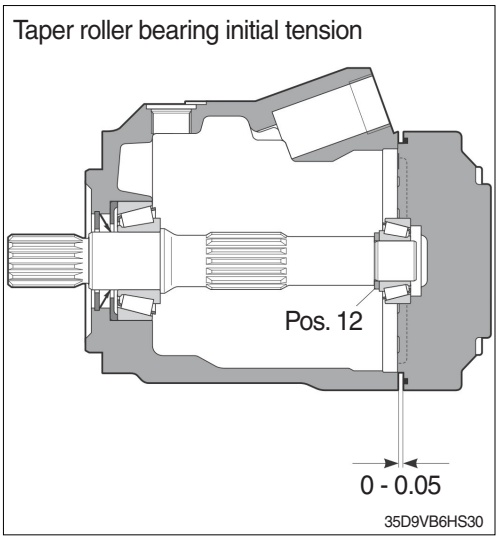
③ Press-in outer racer of rear bearing into connection plate.



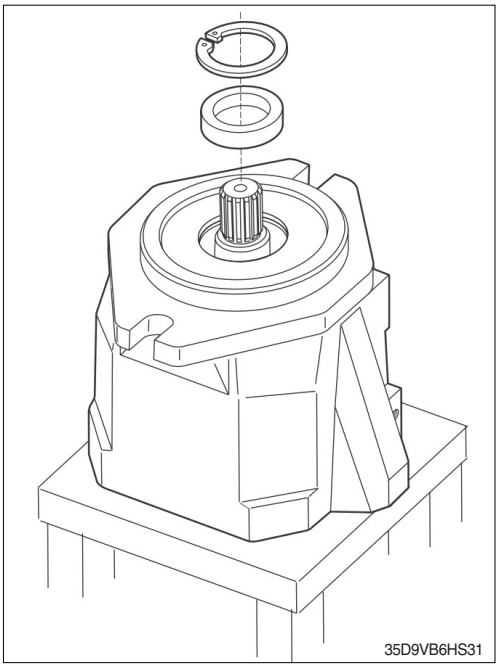
④ Assemble connection plate to pump acc. sign. Pull 4 socket screws tight.
Adjustment of taper roller bearing set see below. Disassemble connection plate.



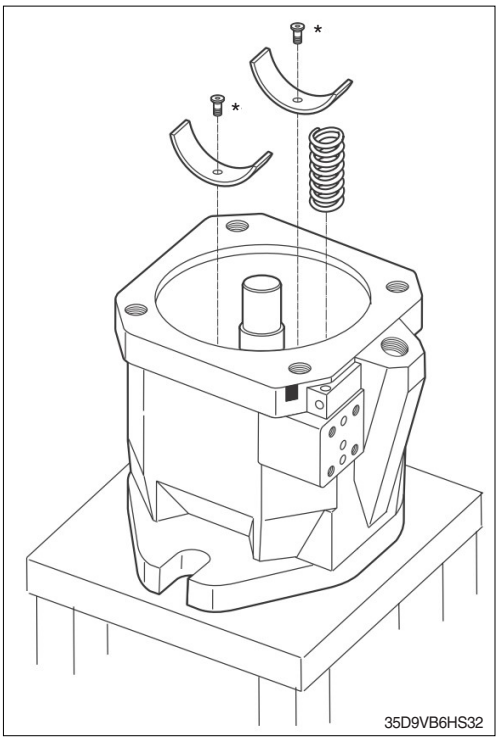
· Adjustment of taper roller bearing
Cast iron housing must have initial tension of the bearings: 0 ~ 0.05 mm, grind Pos. 12 if necessary.



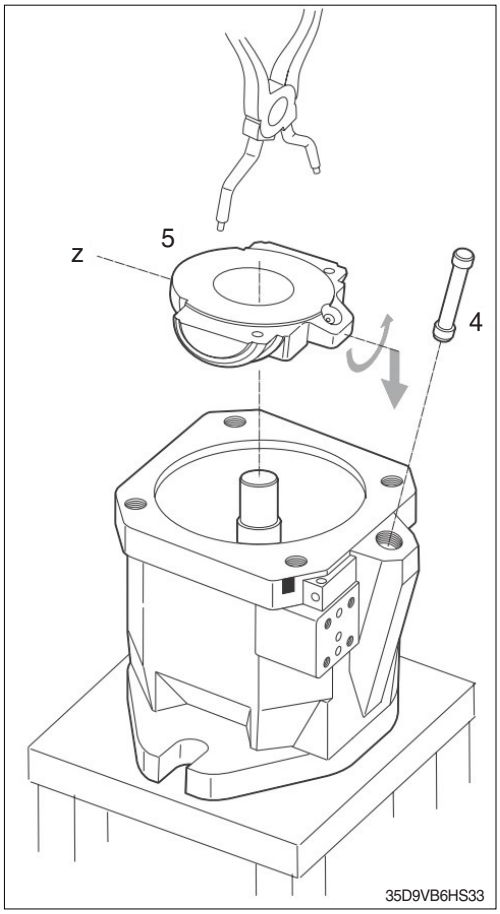
⑤ Assembly instruction shaft seal.



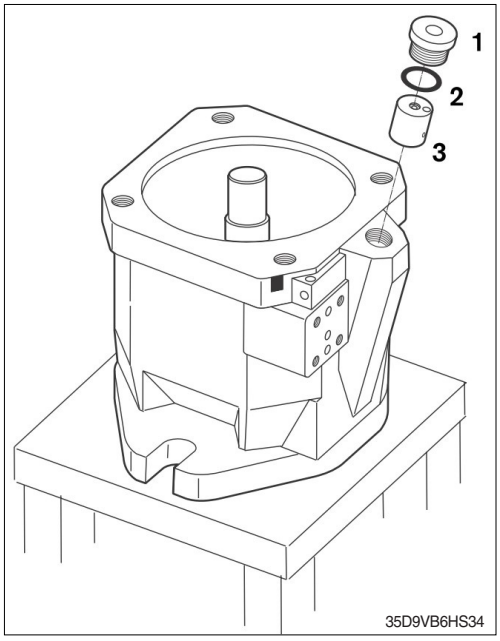
⑥ Fit in bearing shells and spring. Fix with grease.



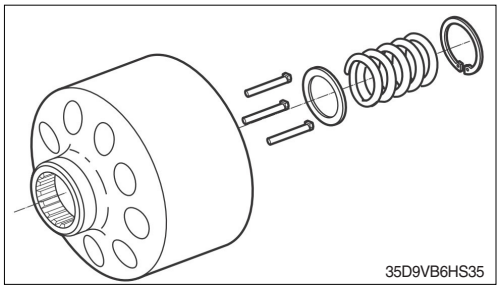
⑦ Assemble swash plate (5) and piston rod (4) into pump. Spring guide pin in correct position. Check correct position of the spring.



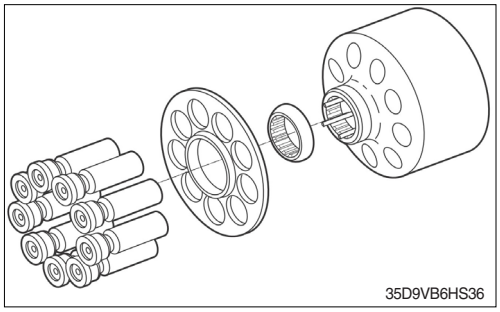
⑧ Assemble piston rod (4), control piston (3), seal (2), and plug (1).
Pull plug tight.
Size 28, 45, 60
M_A = 19.4 + 2.04 kfg·m (140 + 14.8 lbf·ft)
Size 85
M_A = 32.7 + 2.04 kgf·m (237 + 14.8 lbf·ft)
Secure with Loctite 242.



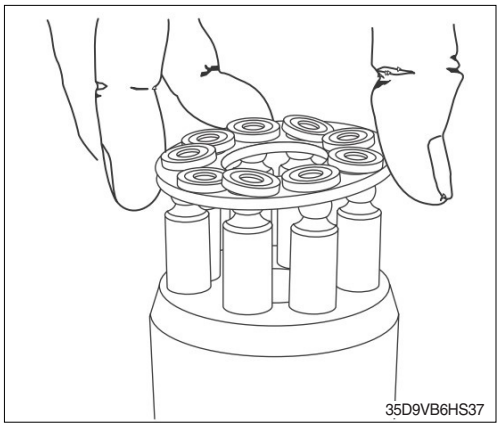
⑨ Fit pressure pins using an assembly aid.



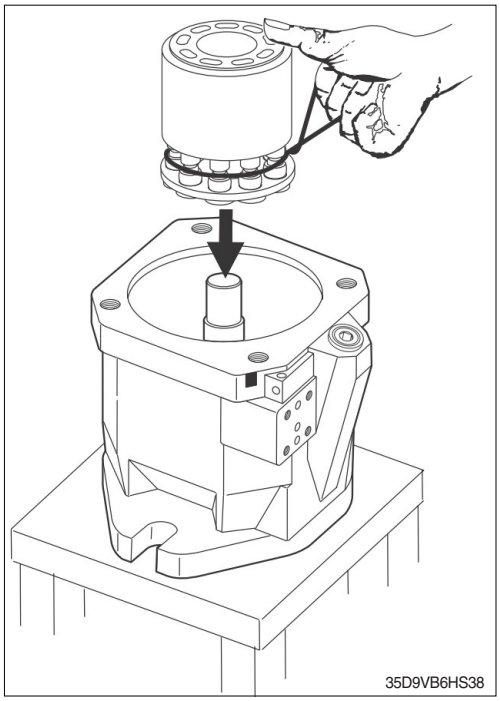
⑩ Pre-tension the spring using a suitable device.



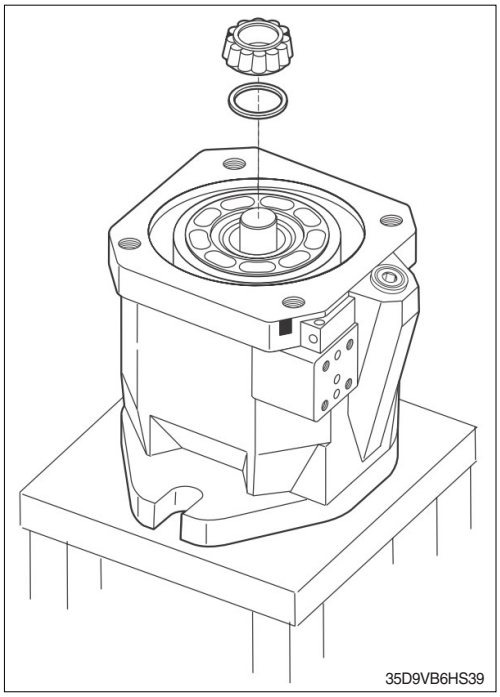
⑪ Assemble piston with retaining plate. (Oil piston and slipper pad)



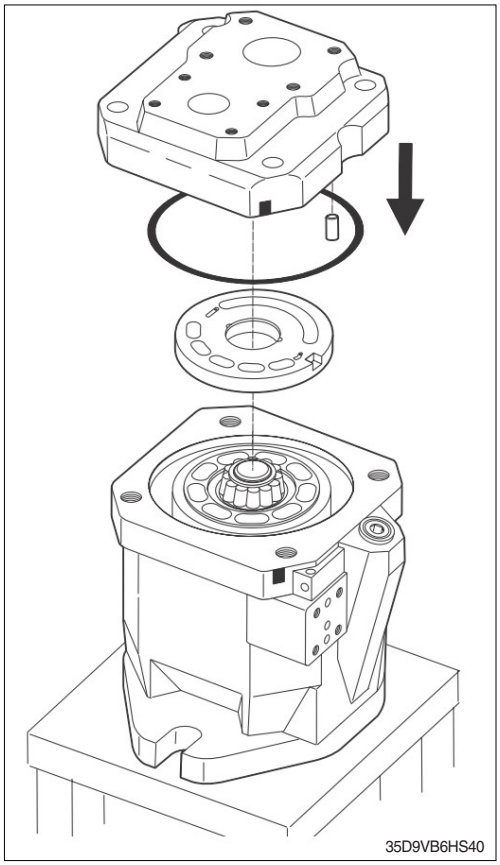
⑫ Fit rotary group. Hold the pistons by usning an O-ring.



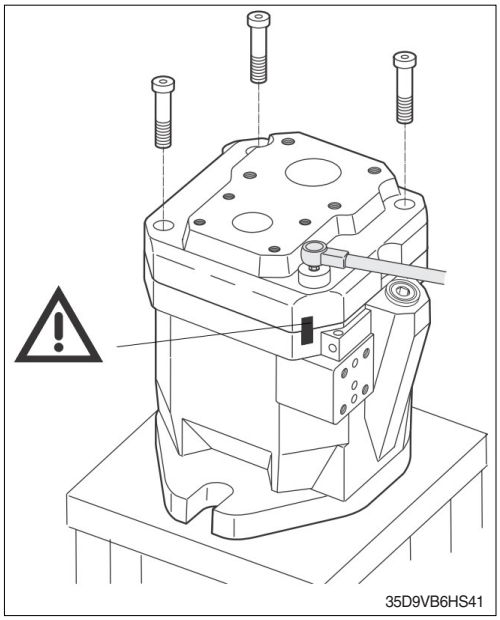
⑬ Assemble bearing and adjustment shim to shaft.



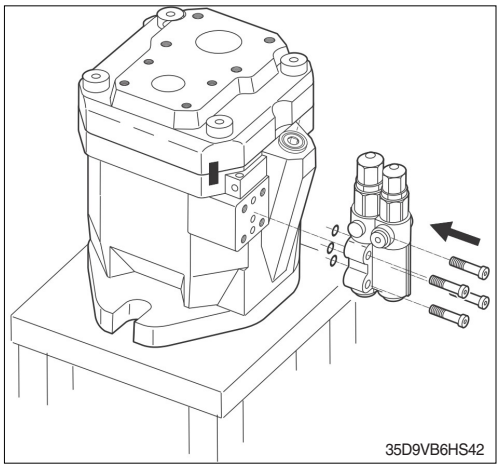
⑭ Fit O-ring and control plate. Fix with grease. Check correct position to pin.



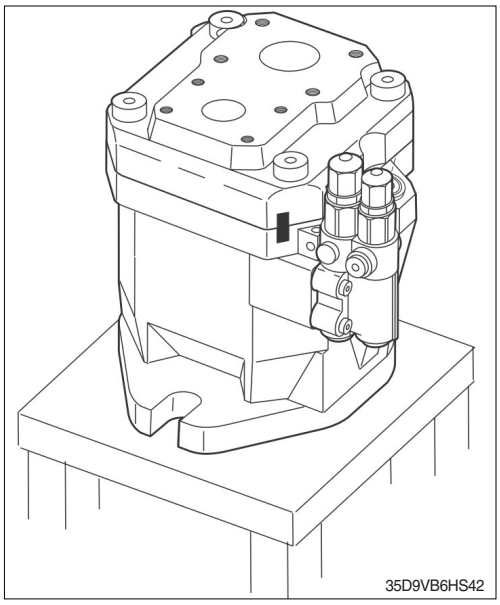
⑮ Assemble connection plate. Check the correct position to housing. Sign! Pull screws tight acc.



⑯ Assemble control valve. Valve adjustment

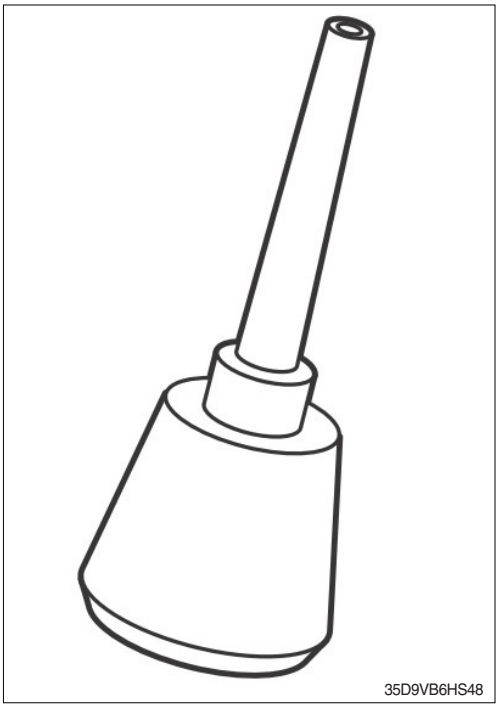


⑰ Final pump assembly. Double check of the housing signs.

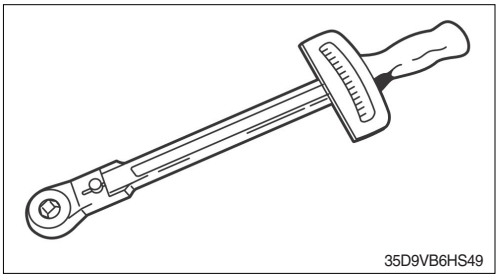


(5) TOOLS TIGHTENING TORQUES

· Loctite types used:
For all break-off plugs : No. 601
For all other parts : No. 242



· Bolt tensile strength grade : 8.8, 10.9, 12.9



		M4	M5	M6	M8	M10	M12	M14	M16	M18	M20	M24	M30
M_A kgf·m (lbf·ft)	0.9 (6.5)	0.2 (1.7)	0.5 (3.7)	0.9 (6.3)	2.1 (15.5)	4.2 (30.3)	7.3 (53.1)	11.7 (84.9)	18.0 (130)	24.5 (177)	35.7 (258)	61.2 (443)	125 (900)
	1.1 (8.0)	0.3 (2.4)	0.7 (5.3)	1.2 (8.9)	3.0 (21.4)	5.9 (42.8)	10.2 (73.8)	16.8 (122)	25.5 (185)	35.7 (258)	50.0 (362)	85.7 (620)	170 (1233)
	1.3 (9.5)	0.4 (3.0)	0.9 (6.3)	1.5 (10.7)	3.6 (25.8)	7.1 (51.7)	12.3 (89.3)	19.9 (144)	30.6 (221)	41.8 (303)	60.2 (436)	101.0 (731)	204 (1476)

※ M_A [kgf·m (lbf·ft)] = max. tightening torque (lubricated screws μ = 0.125)

(6) ASSEMBLY TIGHTENING TORQUES

· Plugs with internal hexagon, O-ring and UNF-, UN- threads to SAE J 514

Thread	Tightening torque M_A	
	kgf·m	lbf·ft
7/16-20 UNF	1.5	11.1
9/16-18 UNF	2.6	18.5
3/4-16 UNF	7.3	53.1

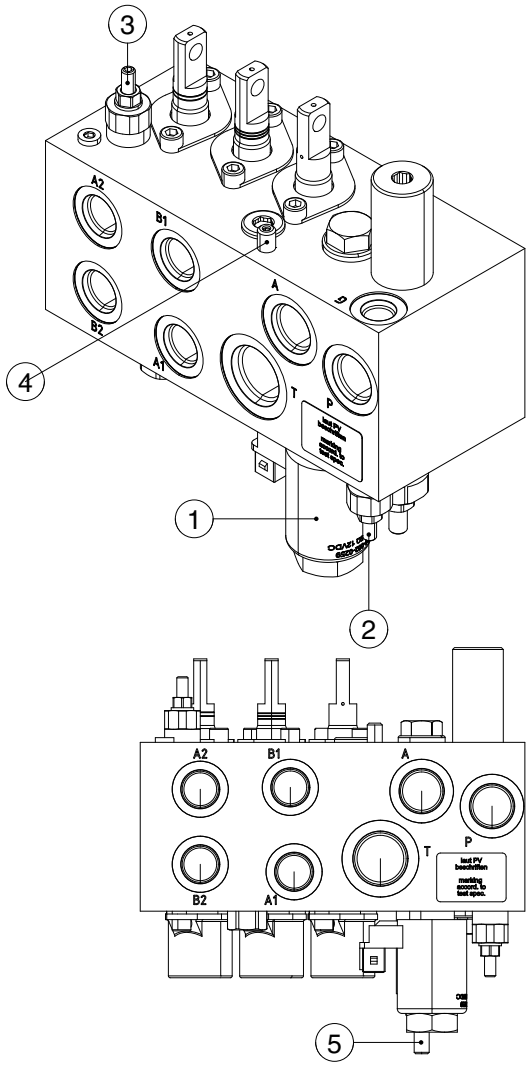
· Bolts

Thread	8.8T		10.9T		12.9T	
	Tightening torque M_A					
	kgf·m	lbf·ft	kgf·m	lbf·ft	kgf·m	lbf·ft
M4	0.3	2.3	0.5	3.3	0.5	3.9
M5	0.6	4.5	0.9	6.6	1.1	7.7
M6	1.1	7.7	1.6	11.4	1.8	13.3
M8	2.6	18.5	3.8	27.3	4.4	31.7
M10	5.2	37.6	7.7	55.4	8.9	64.2

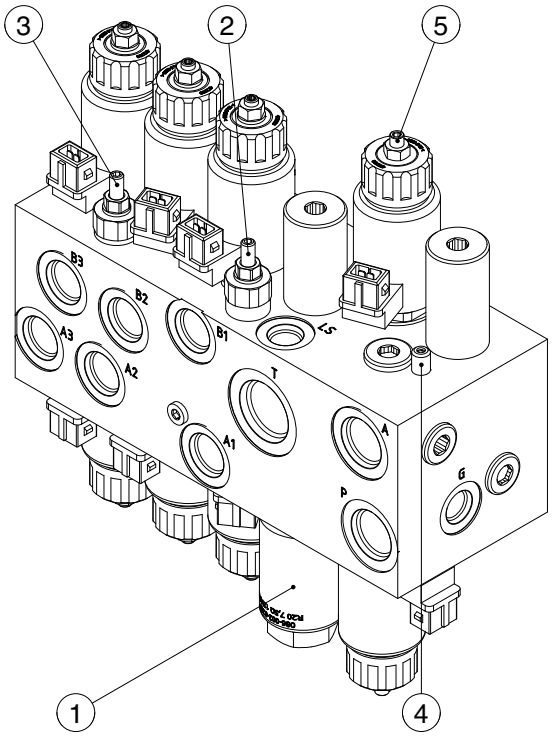
2. MAIN CONTROL VALVE

1) STRUCTURE

Manual



Fingertip (option)



35D9VB6HS51

1 OPSS cutoff solenoid
2 Main relief valve (DV1)
3 2nd reilief valve (DV2)
4 Manual lowering
5 Fork lowering speed adjustment

2) DISASSEMBLY AND ASSEMBLY

(1) Cutoff solenoid

① Park the forklift safely and full lower the forkcarriage.

② Operate the lever in the engine off (key ON) state to discharge the pressure oil in the MCV.

③ Open the bonnet. Loosen nut of the cutoff solenoid and remove coil from the check valve.

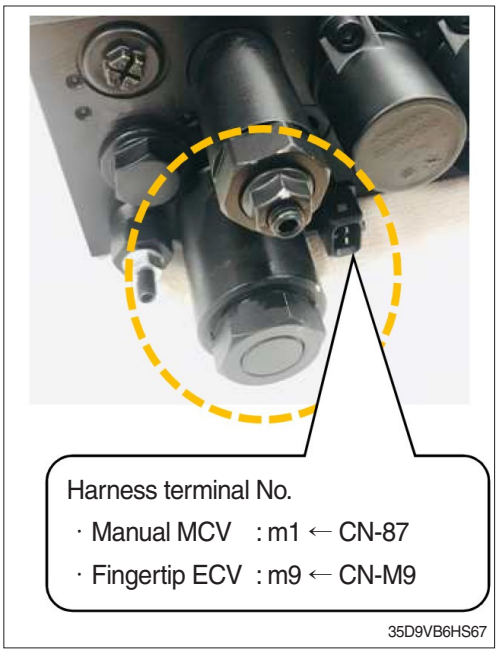
④ Clean the check valve and valve block so that opened valve block cannot become contaminated.

⑤ Loosen the check valve with spanner 17 mm (0.7 in). Apply a light coat of hydraulic oil to the o-rings of the new check valve and insert a new check valve and screw in tightly.

· Tightening torque : 4 kgf·m (28.9 lbf·ft)

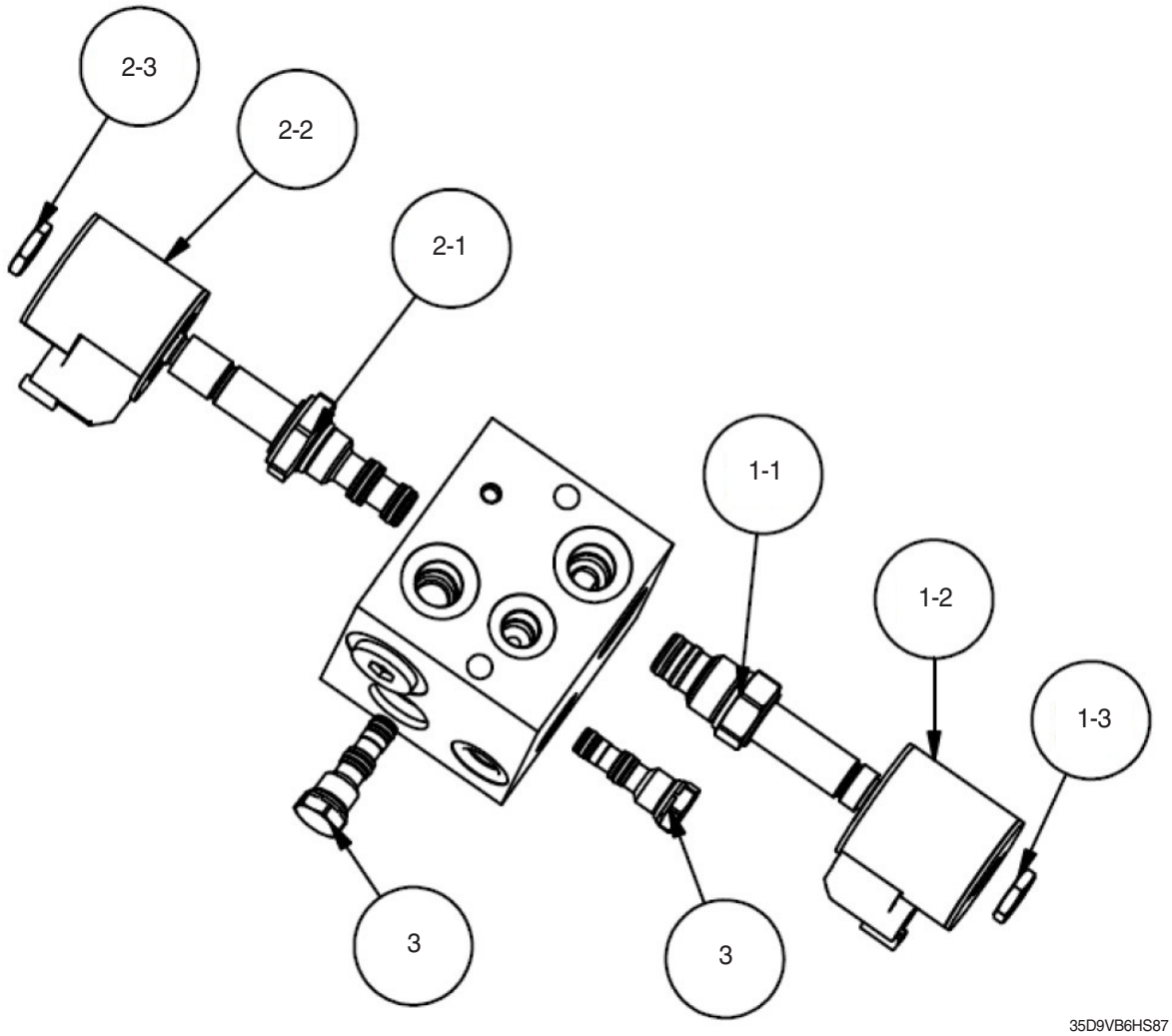
⑥ Refit the solenoid coil according to the direction and tighten with the o-ring side of the nut facing the coil.

· Tightening torque : 0.7 kgf·m (5.1 lbf·ft)



3. PRESSURE FORCED VALVE

1) STRUCTURE



No.	Item	Tightening torque		Remarks
		kgf·m	lbf·ft	
1-1	TS1	3.5	25	Proportional valve
1-2	CL1	-	-	Coil
1-3	Nut	0.8	6	25.4 mm (1 inch) hex head
2-1	SV1	2.8	20	ON/OFF Solenoid valve
2-2	CL1	-	-	Coil
2-3	Nut	0.8	6	19mm (3/4 inch) hex head
3	LS1, 2	2.8	20	3way shuttle valve

2) DISASSEMBLY

(1) TS1

Clean the valve installation surface. Disassemble Nut with 25.4 mm (1 inch) size spanner. Take out electronic coil. Disassemble valve with 25.4 mm (1 inch) spanner

(2) SV1

Clean the valve installation surface. Disassemble Nut with 19.1 mm (3/4 inch) size spanner. Take out electronic coil. Disassemble valve with 17.5 mm (11/16 inch) spanner

(3) LS

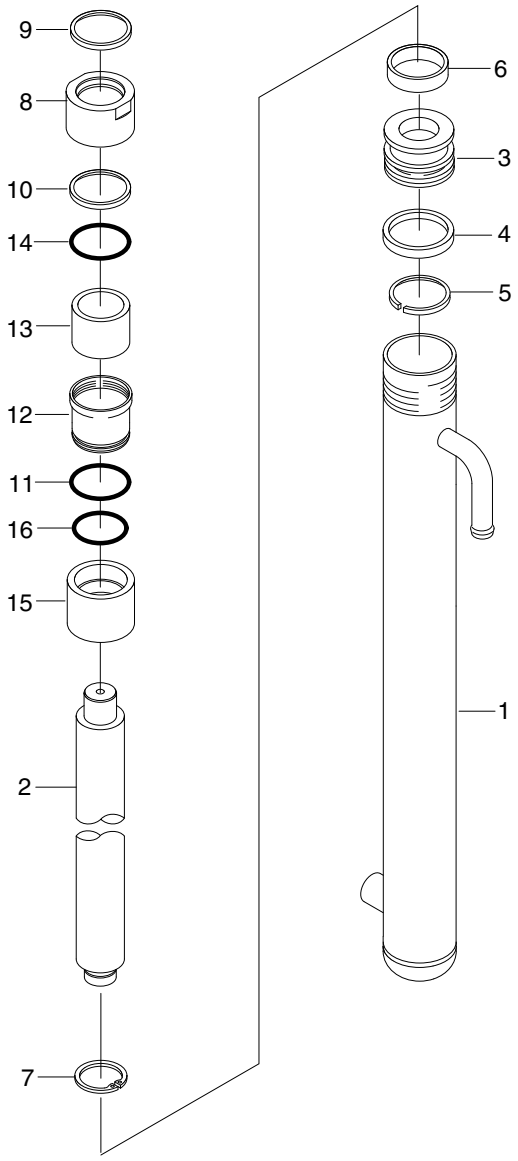
Clean the valve installation surface. Disassemble with 25.4 mm (1 inch) size spanner.

3) ASSEMBLY

Assemble is a reverse order of disassemble and should be performed by trained technician with calibrated torque wrench otherwise the manifold performance will be out of specification.

4. LIFT CYLINDER

1) STRUCTURE



D357HS19

1	Tube assy	7	Retaining ring	13	Rod busing
2	Rod	8	Rod cover	14	O-ring
3	Piston	9	U-packing	15	Spacer
4	U-packing	10	Dust wiper	16	O-ring
5	Back up ring	11	O-ring		
6	Wear ring	12	Guide		

※ Parts list is based on the 35/40/45D-9VB, 40/45D-9VC, 50DN-9VC.

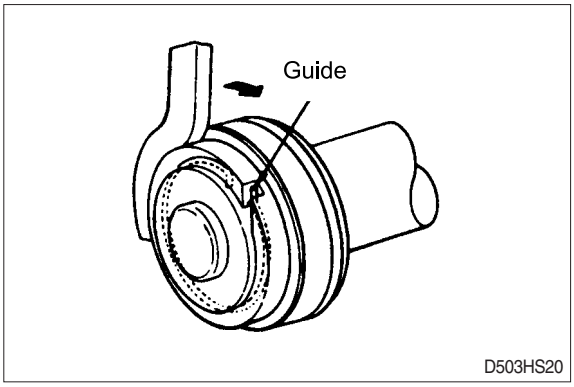
· **Specification (standard)**

Unit : mm (inch)

Model	I.D	O.D	Stroke	Rod O.D
35/40/45D-9VB, 40/45D-9VC 50DN-9VC (V300)	65 (2.6)	73 (2.9)	1485 (58.5)	50 (2.0)
50DN-9VB (V290)	70 (2.8)	82 (3.2)	1435 (56.5)	55 (2.2)

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.



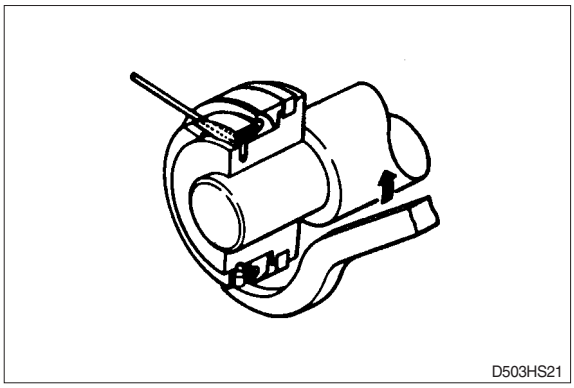
3) CHECK AND INSPECTION

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

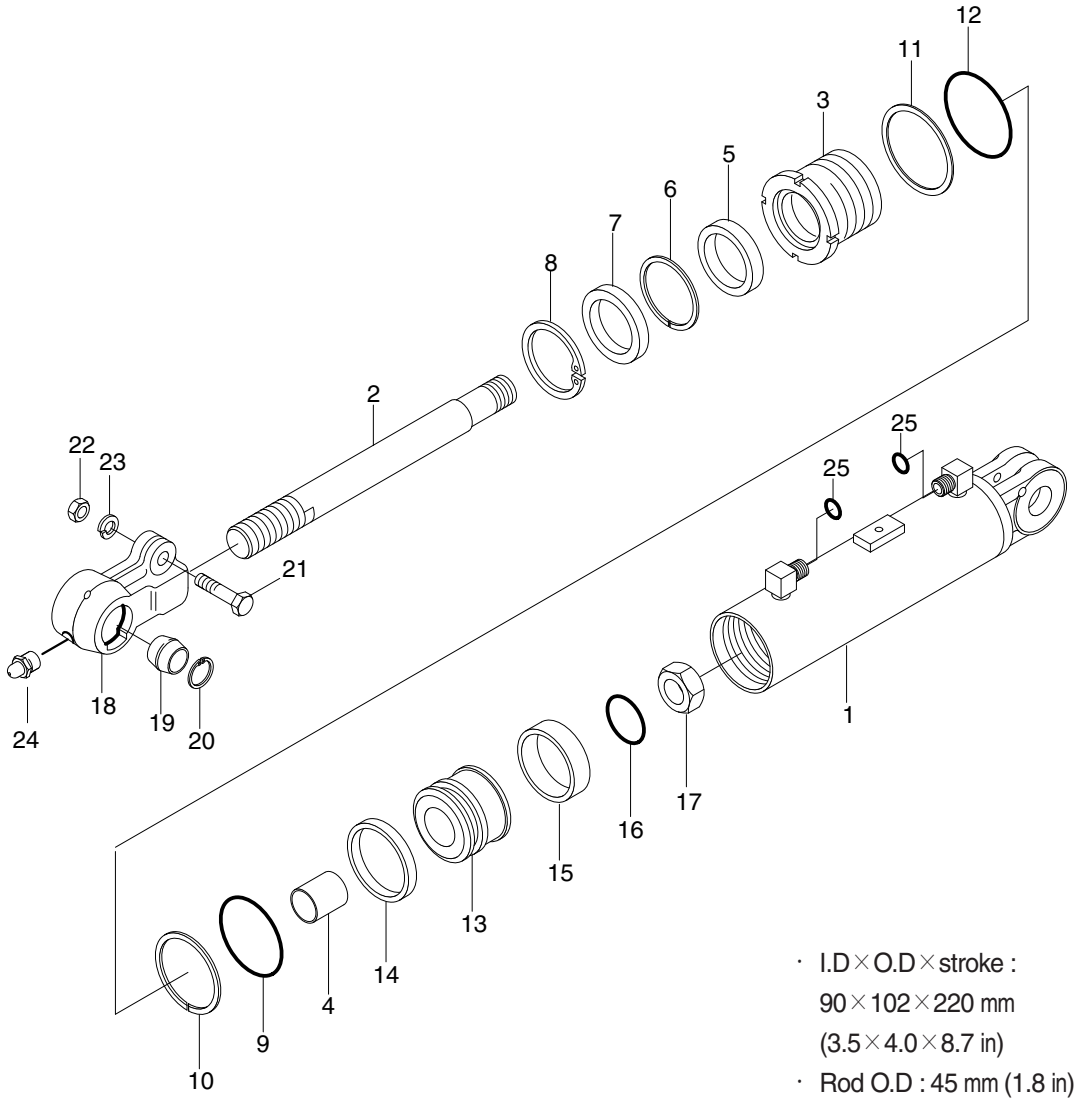
4) ASSEMBLY

(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.



5. TILT CYLINDER

1) STRUCTURE



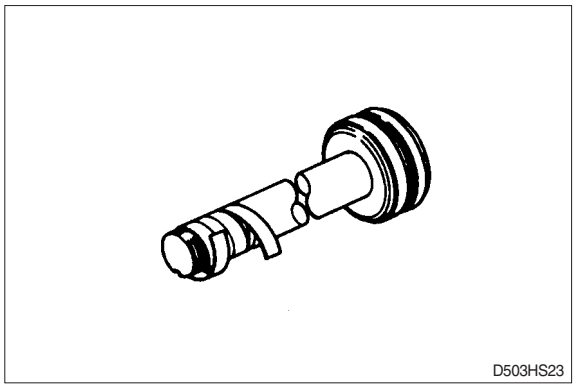
· I.D × O.D × stroke :
90 × 102 × 220 mm
(3.5 × 4.0 × 8.7 in)
· Rod O.D : 45 mm (1.8 in)

35D9FHS16

1	Tube assy	10	Back up ring	19	Spherical bearing
2	Rod	11	Lock washer	20	Retaining ring
3	Rod cover	12	O-ring	21	Hexagon bolt
4	Rod bushing	13	Piston	22	Hexagon nut
5	U-packing	14	Piston seal	23	Spring washer
6	Back up ring	15	Wear ring	24	Grease nipple
7	Dust wiper	16	O-ring	25	O-ring
8	Stop ring	17	Nylon nut		
9	O-ring	18	Rod 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.



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