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

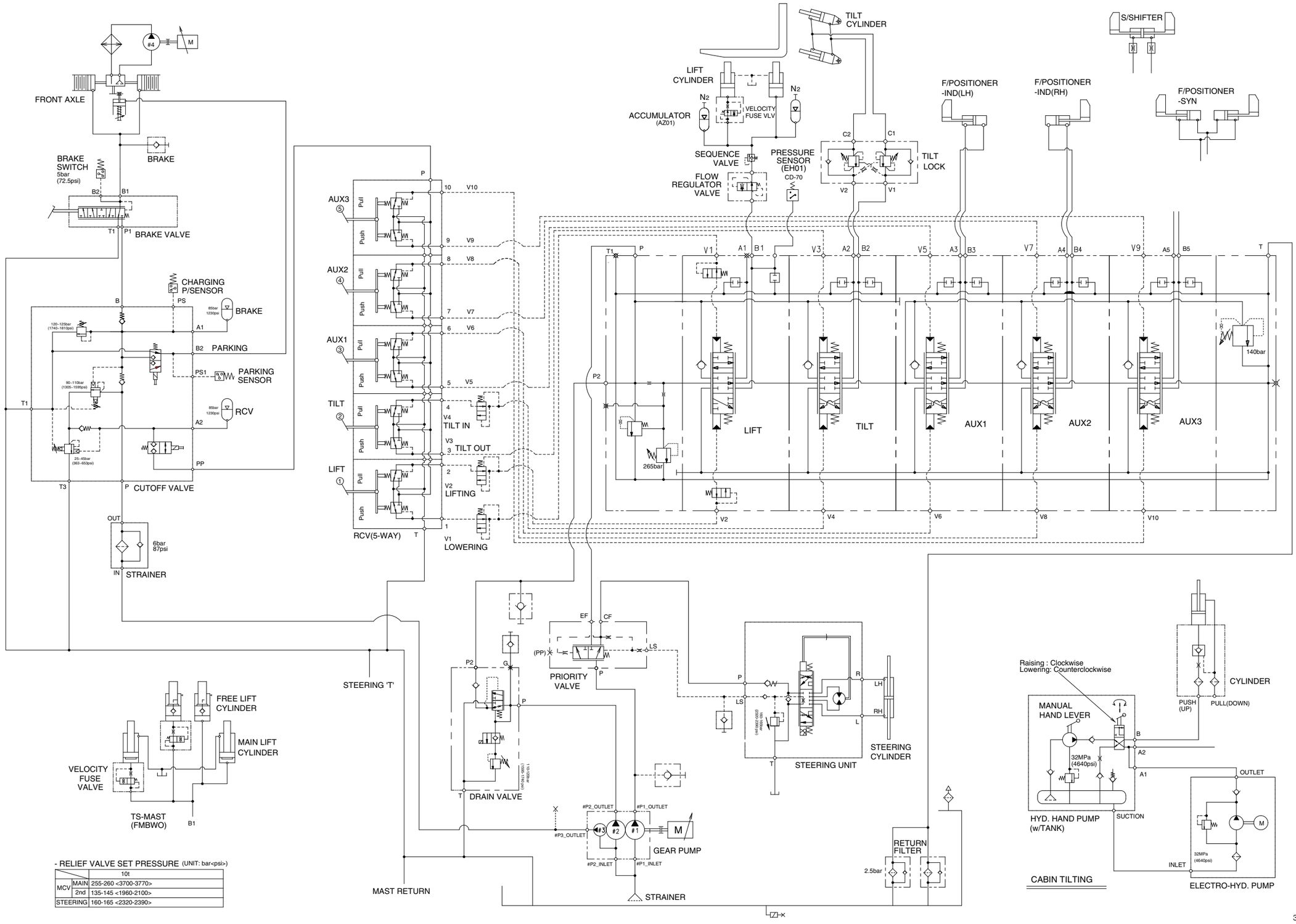
· Lift function, Tilt function, Auxiliary function (Sideshift etc.).

3) RCV

4) HYDRAULIC OIL TANK

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

2. HYDRAULIC CIRCUIT

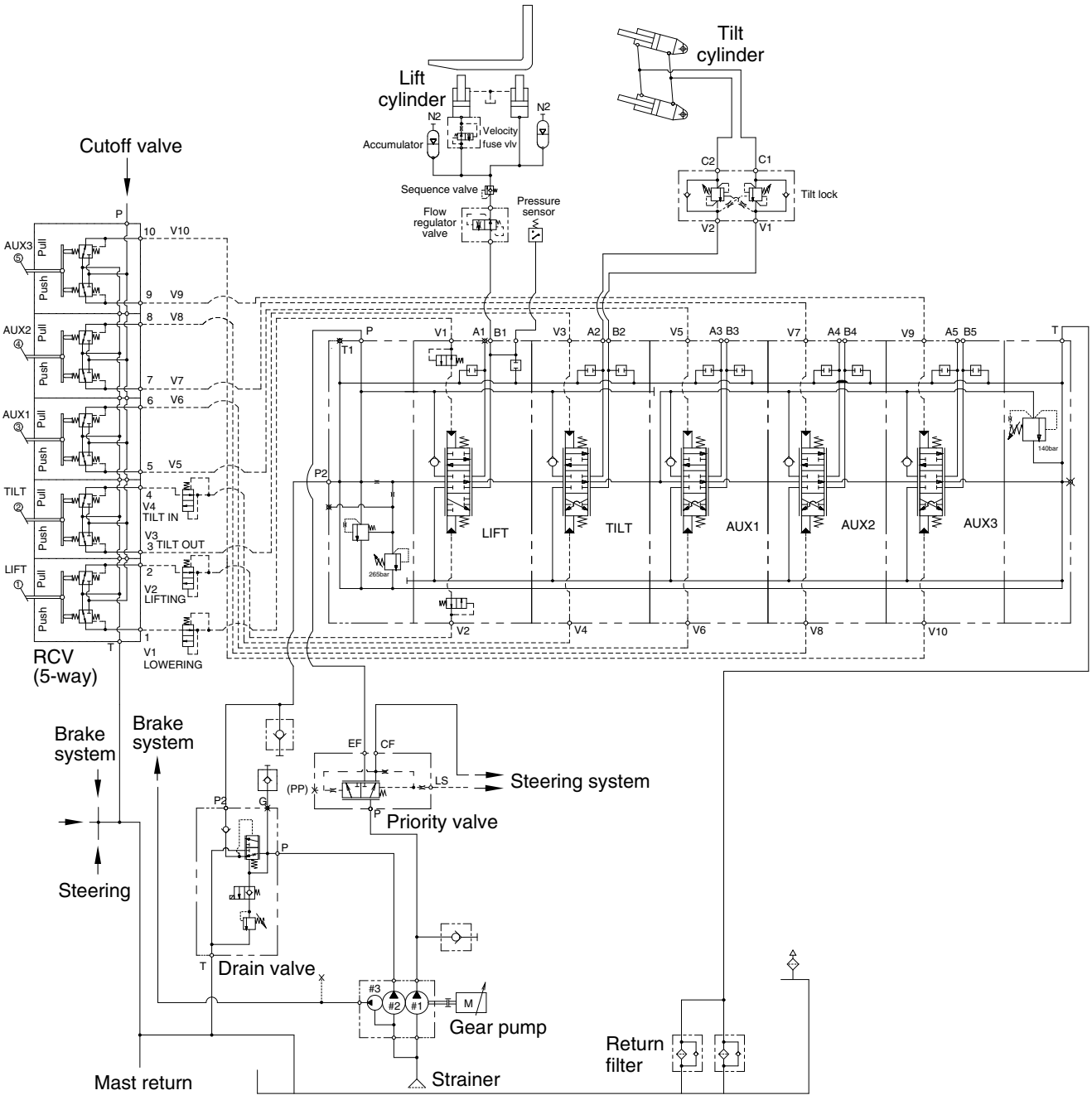


- RELIEF VALVE SET PRESSURE (UNIT: bar<psi>)

		10t
MCV	MAIN	255-260 <3700-3770>
	2nd	135-145 <1960-2100>
STEERING		160-165 <2320-2390>

3YFJ-00300-03

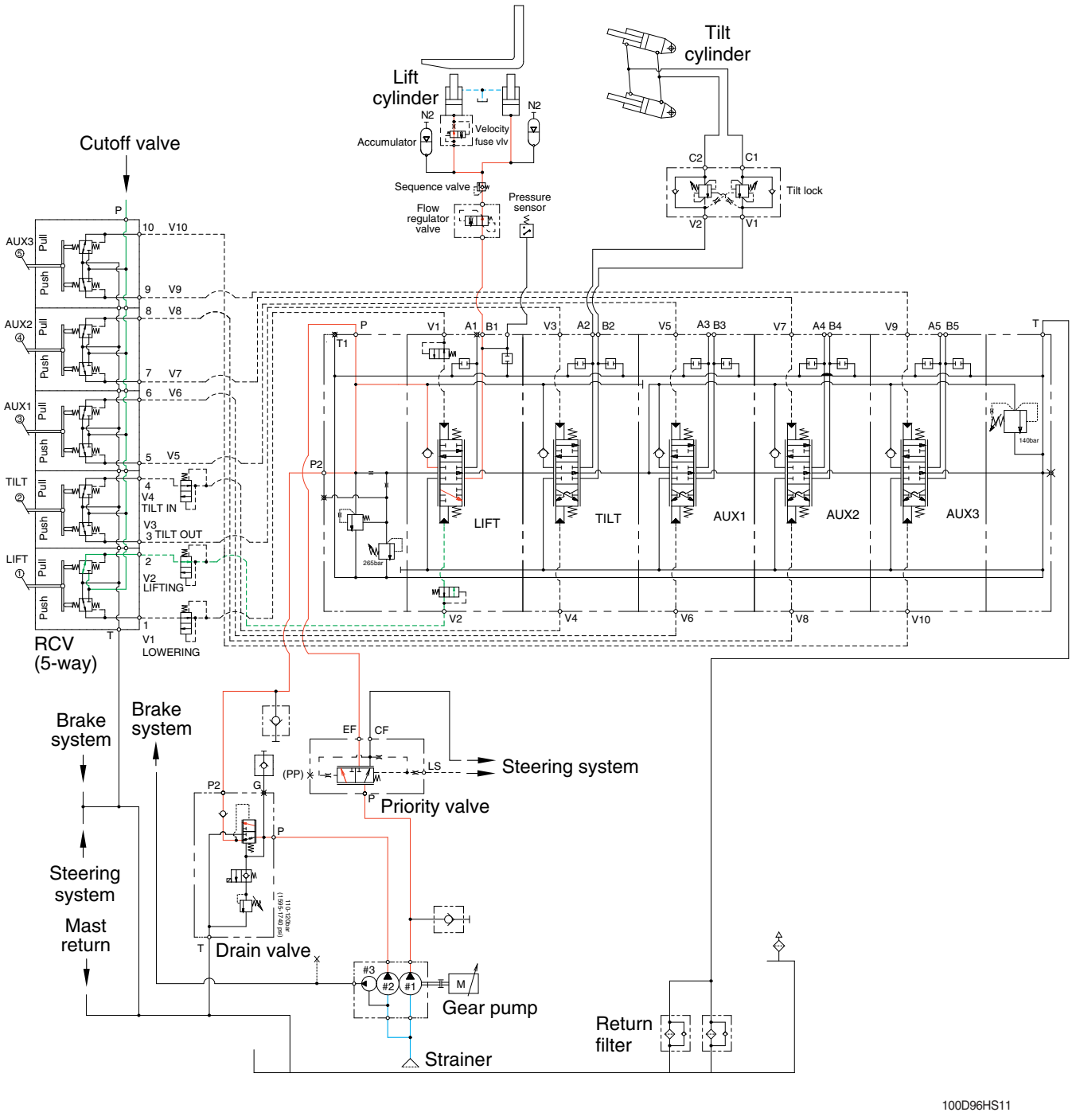
1) WORK EQUIPMENT



100D96HS10

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

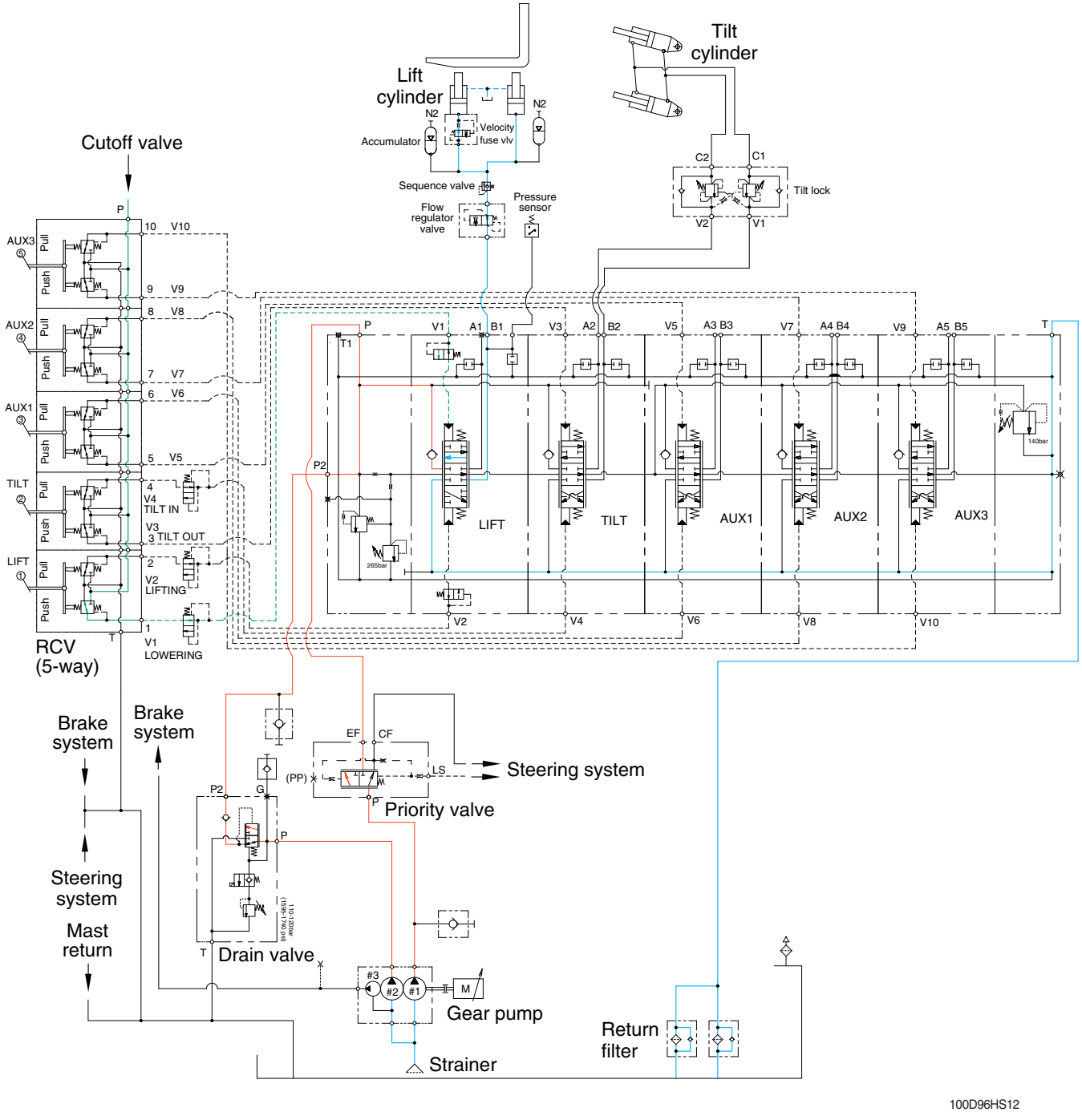
2) WHEN THE LIFT CONTROL LEVER IS IN THE LIFT POSITION



When the lift control lever is pulled back, the spool on the first block is moves to lift position.
The oil from hydraulic gear pump flows into main control valve and then goes to the large chamber of lift cylinder by pushing the load check valve of the spool.
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.

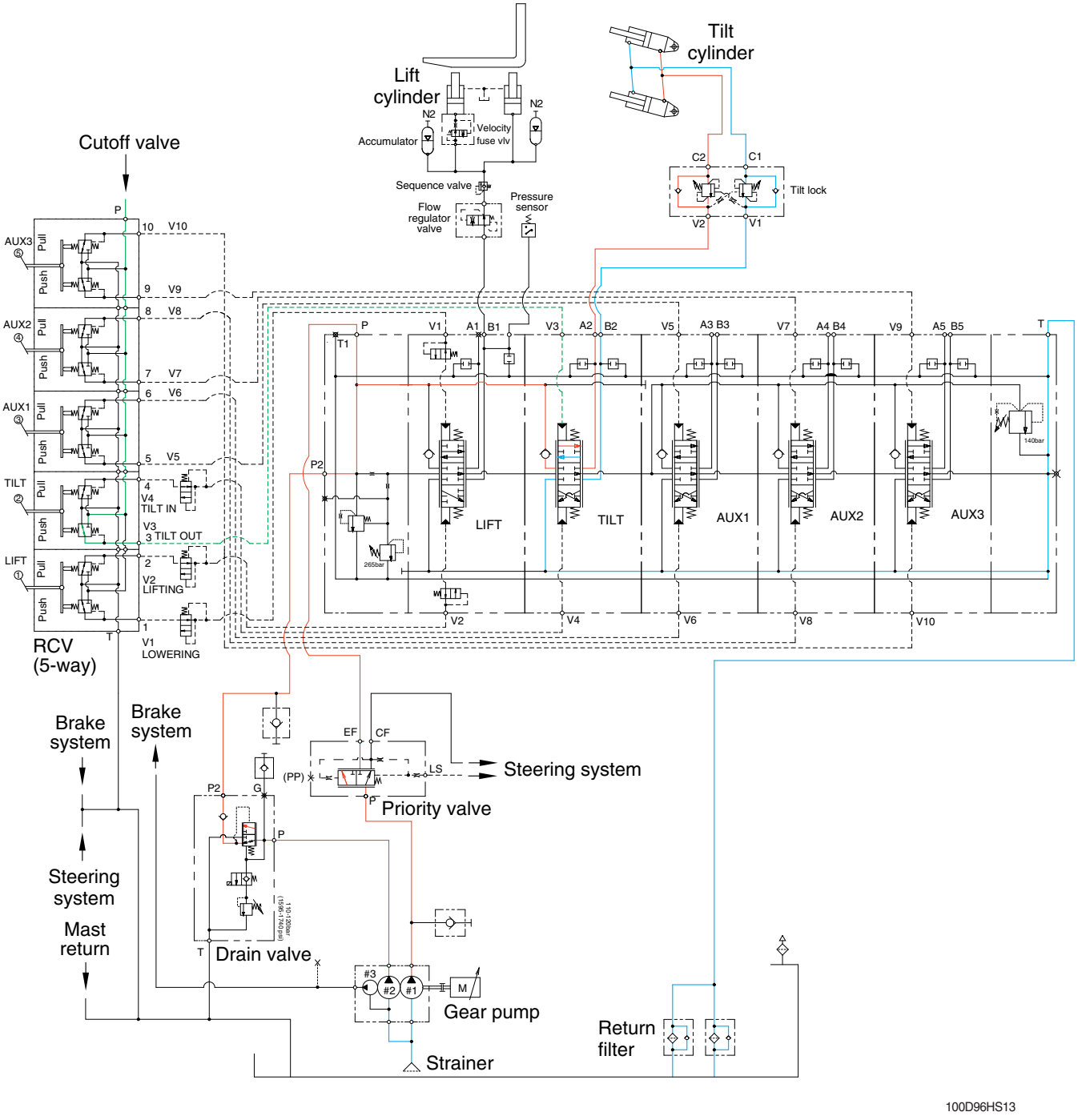
3) WHEN THE LIFT CONTROL LEVER IS IN THE LOWER POSITION



When the lift control is pushed forward, the spool on the first block is moved to lower position.
The work port (B1) and the small chamber and the large chamber are connected to the return passage, so the lift will be lowered due to its own weight.

※ 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 on the second block is moved to tilt forward position.

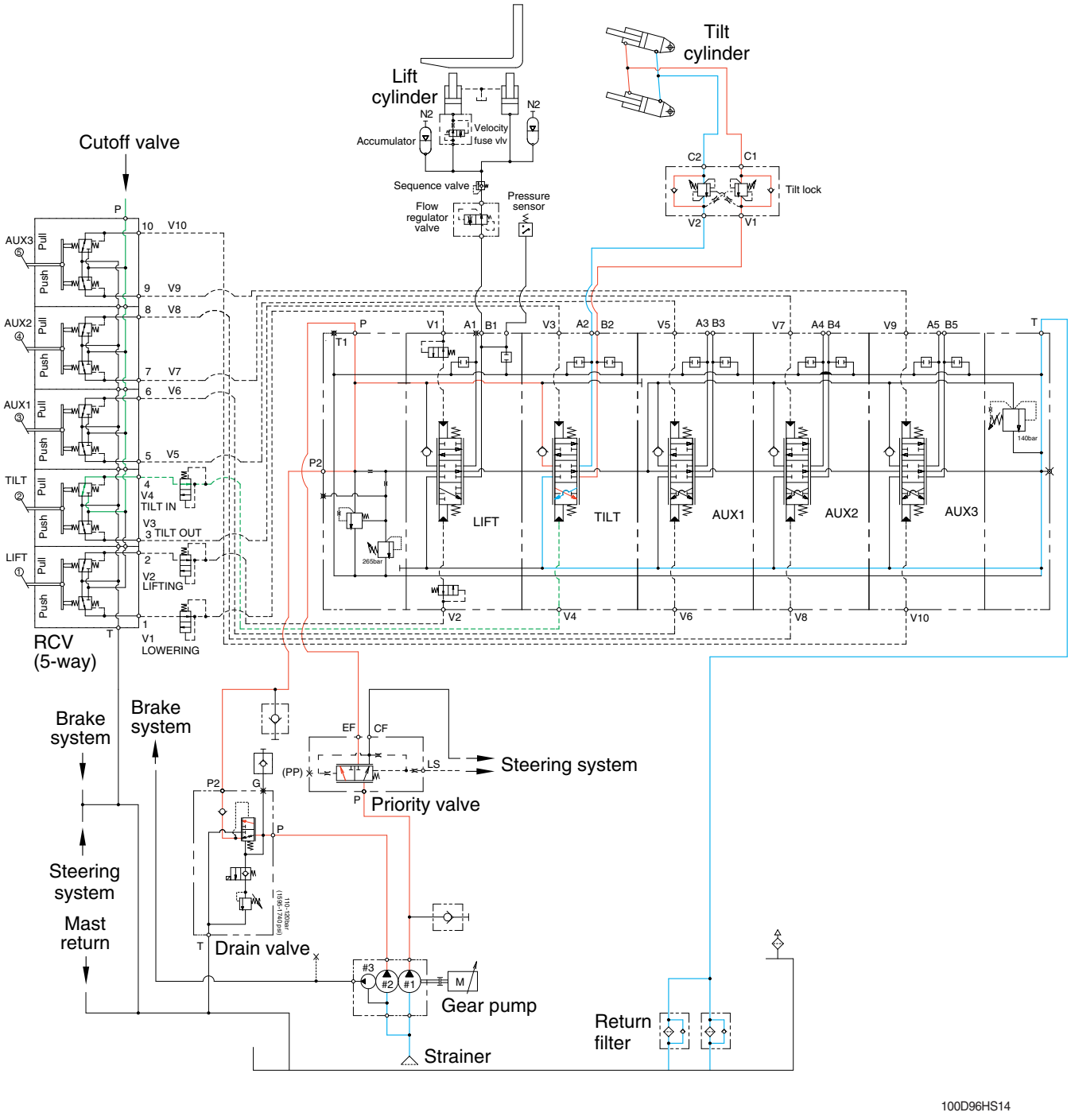
The oil from hydraulic gear pump flows into main control valve and then goes to the large chamber of tilt cylinder by pushing the load check valve of the spool.

The oil at the small chamber of tilt cylinder returns to hydraulic tank 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.

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



100D96HS14

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

The oil from hydraulic gear pump flows into main control valve and then goes to the small chamber of tilt cylinder by pushing the load check valve of spool.

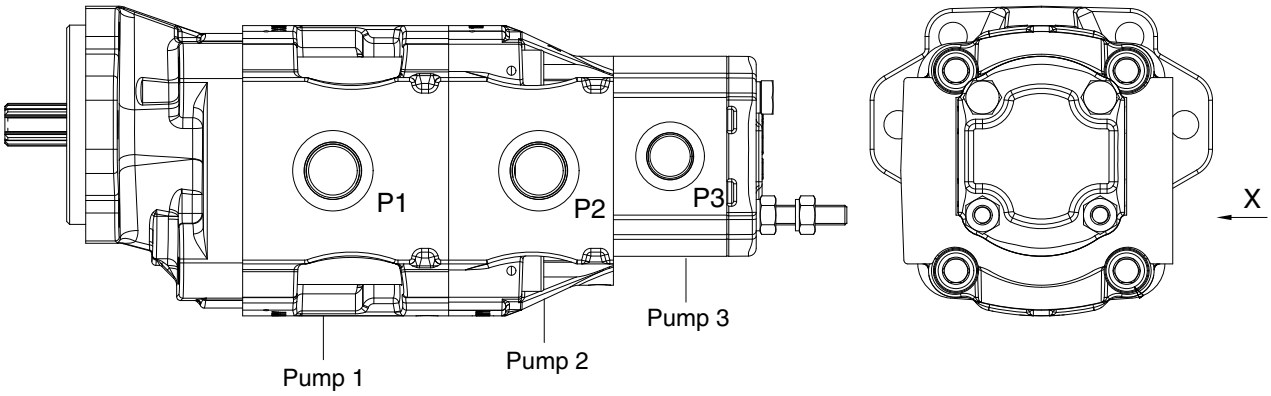
The oil at the large chamber of tilt cylinder returns to hydraulic tank at the same time.

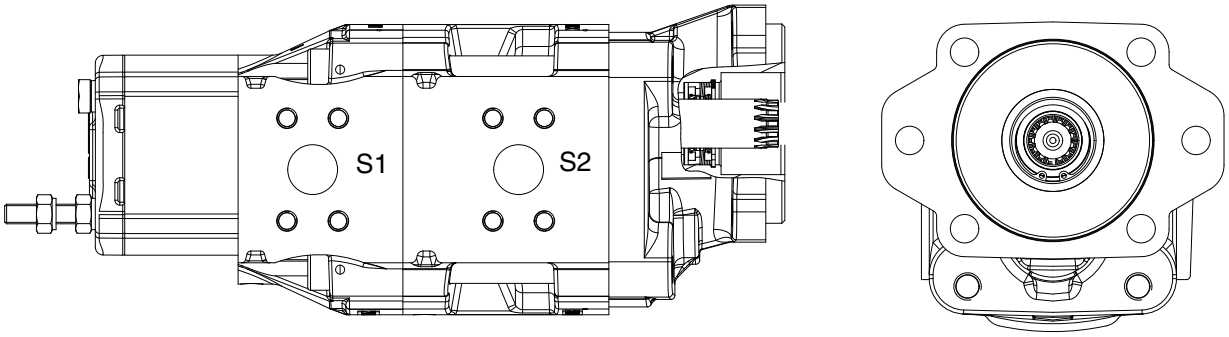
When this happens, the mast tilt backward.

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

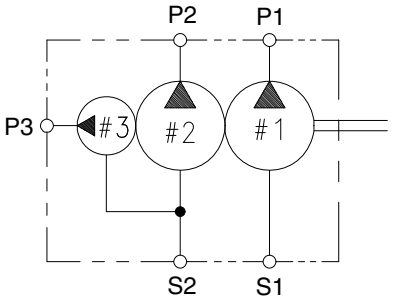
3. HYDRAULIC GEAR PUMP

1) STRUCTURE





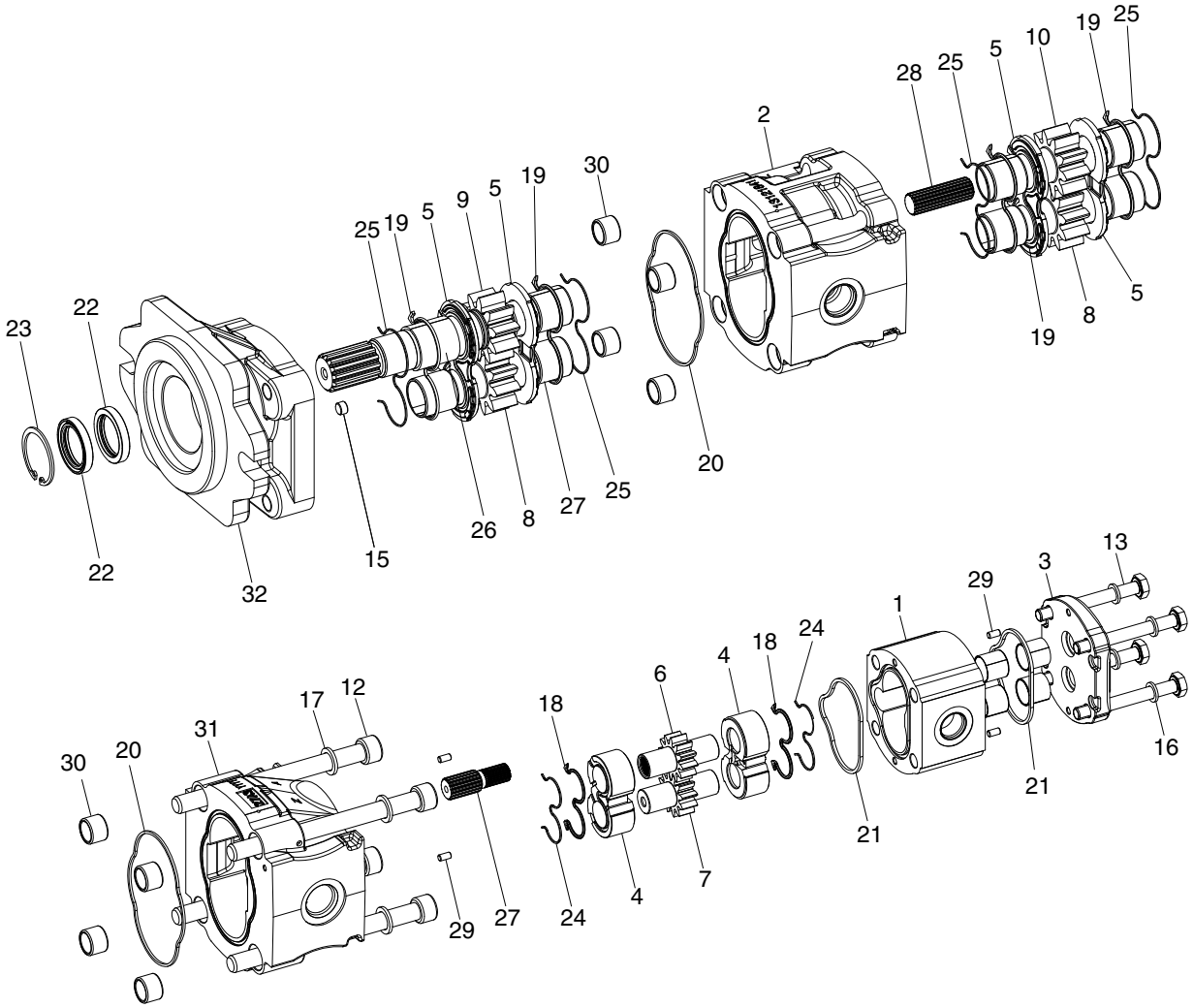
View X



Port	Port name	Size
S1	Pump 1 suction port	25.4
S2	Pump 2 suction port	25.4
P1	Pump 1 delivery port	1 1/16-12
P2	Pump 2 delivery port	1 1/16-12
P3	Pump 3 delivery port	7/8-14

100D9MP01

2) EXPLODED VIEW

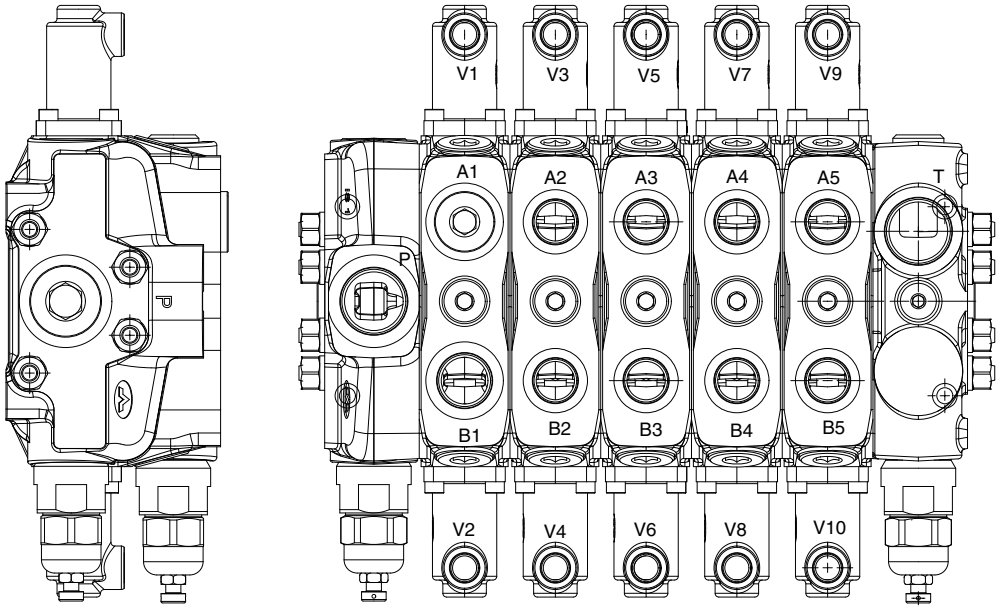


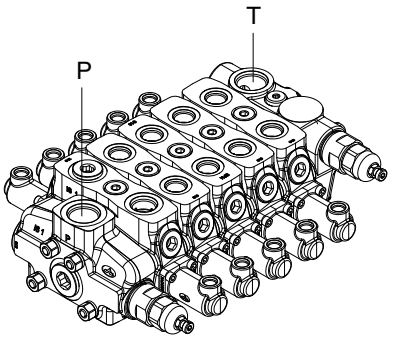
100D9MP02

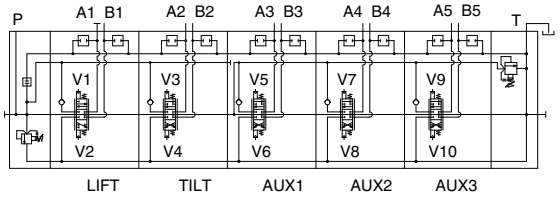
1	Housing	12	Screw	23	Ring
2	Body	13	Screw	24	Antiextrusion plate
3	Rear cover	14	Nut	25	Antiextrusion ring
4	Thrust plate	15	Screw	26	Sleeve bearing
5	Thrust plate	16	Washer	27	Hub
6	Drive gear	17	Washer	28	Hub
7	Driven gear	18	Seal	29	Dowel pin
8	Driven gear	19	Seal	30	Steel bushing
9	Drive gear	20	Upper seal	31	Body
10	Drive shaft	21	Square seal	32	Front cover
11	Bolt	22	Shaft seal		

4. MAIN CONTROL VALVE

1) STRUCTURE (5 Spool)







HYDRAULIC CIRCUIT

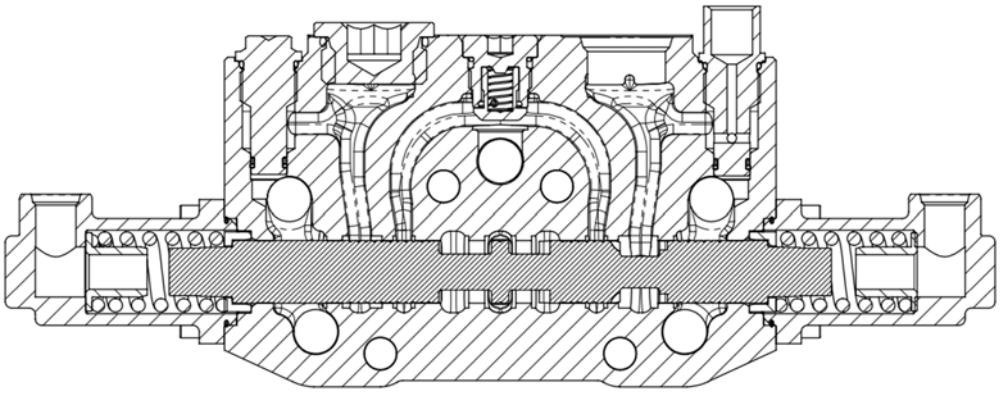
100D9MCV01

Port	Port name	Size
P	Inlet port	1 5/16"-12
T	Tank port	1 5/16"-12
A1~A5	Work port	7/8"-14
B1~B5	Work port	7/8"-14
V1~V10	Pilot port	9/16"-18

2) OPERATION

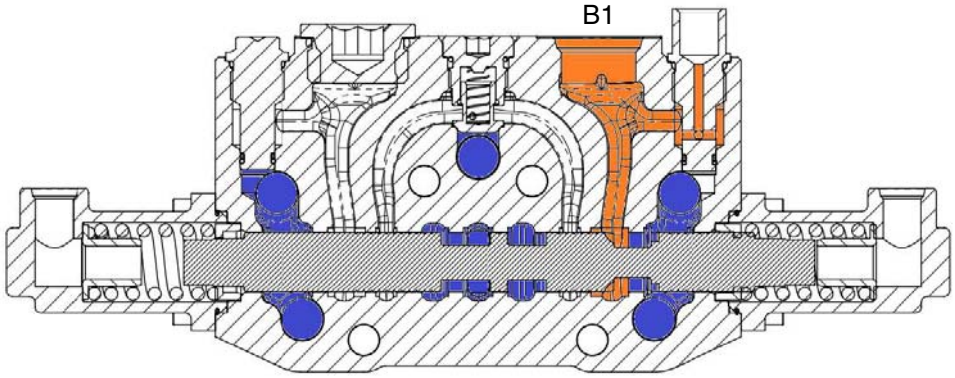
(1) Lift section

① Neutral position



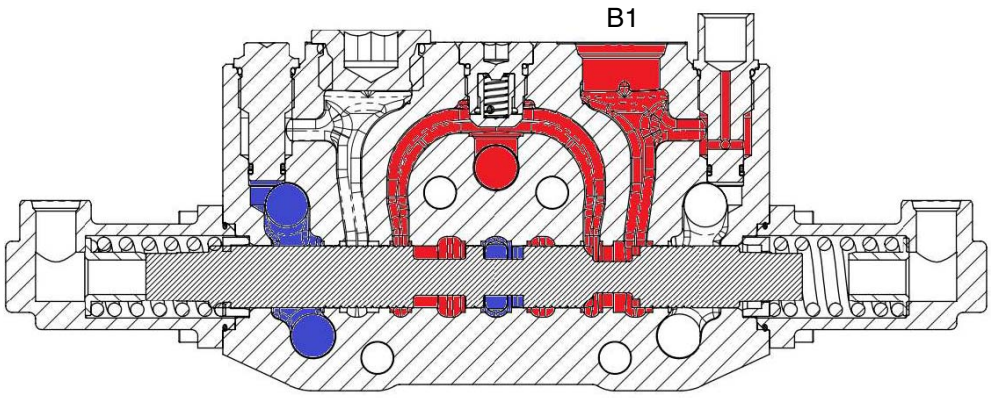
100D9MCV02

② Lower position



100D9MCV03

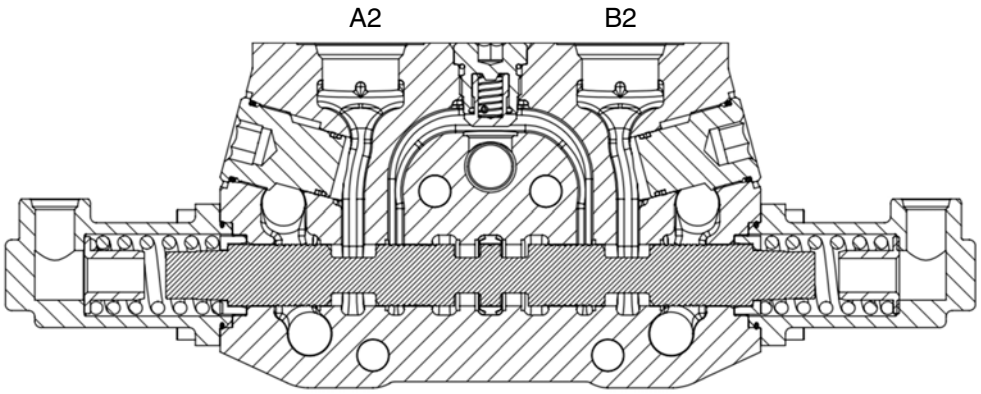
③ Lift position



100D9MCV04

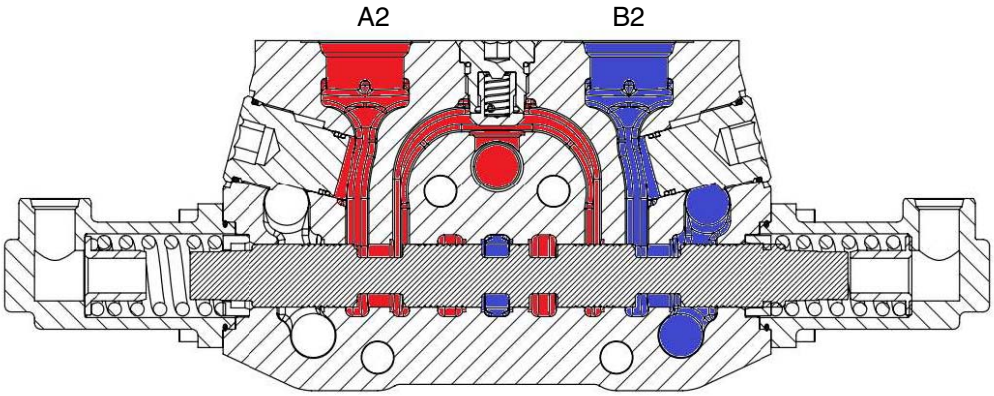
(2) Tilt section

① Neutral position



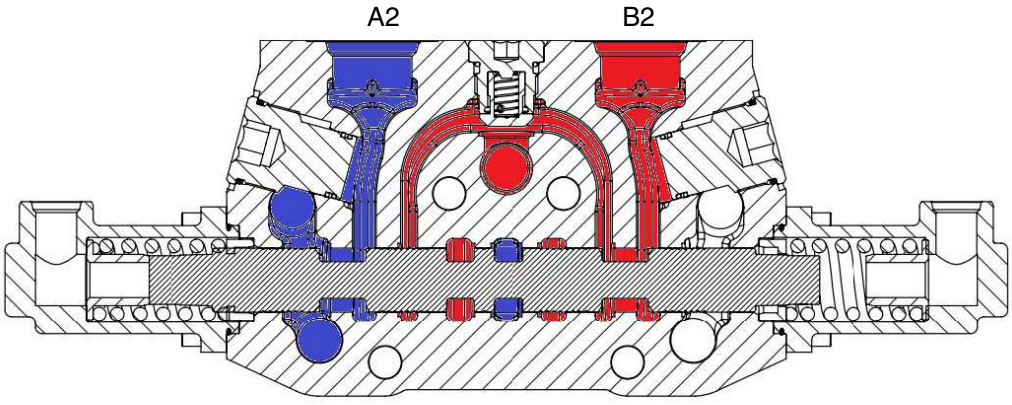
100D9MCV05

② Forward position



100D9MCV06

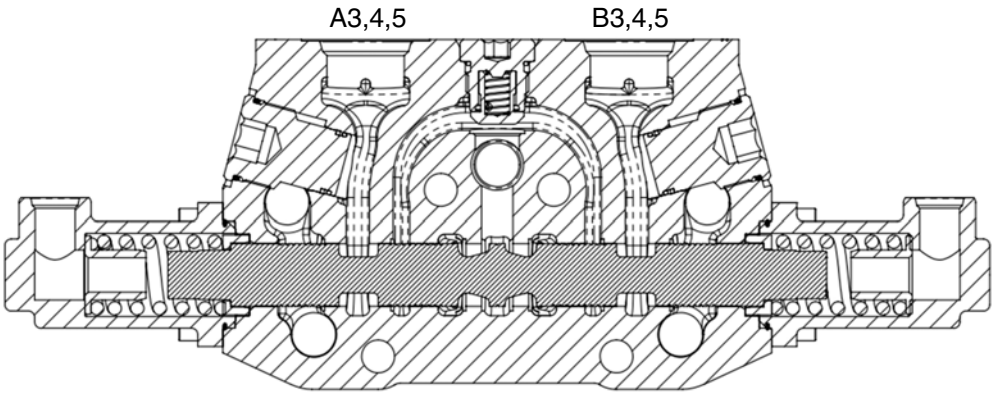
③ Backward position



100D9MCV07

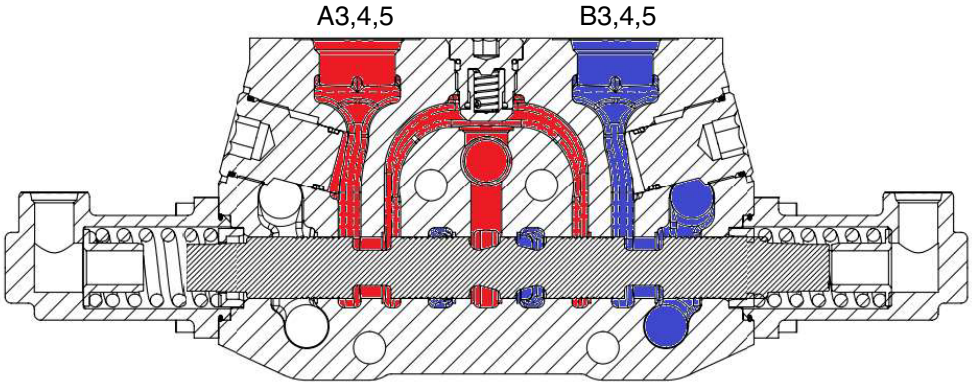
(3) Aux 1, 2, 3 section

① Neutral position



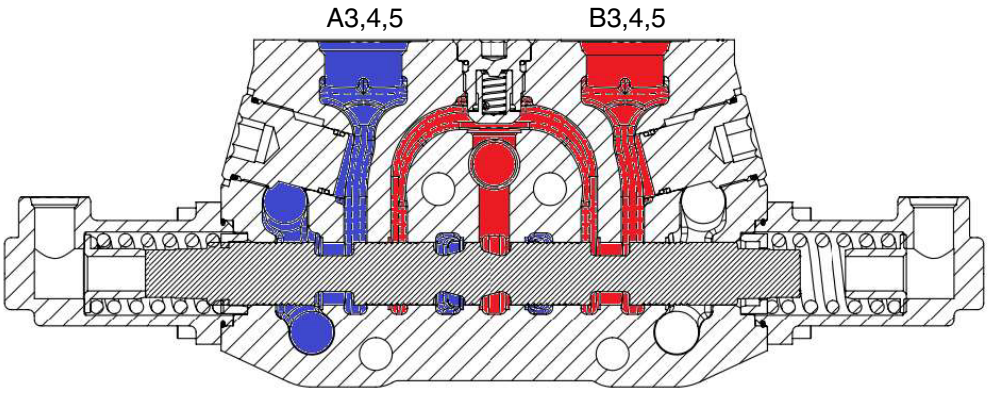
100D9MCV08

② P -> A position



100D9MCV09

③ P -> B position



100D9MCV10

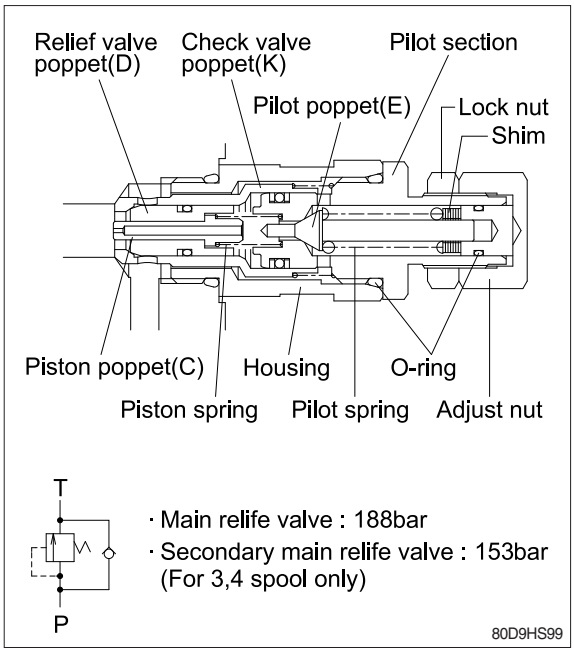
3) MAIN RELIEF VALVE

(1) Pressure setting

A good pressure gauge must be installed in the line which is in communication with the work port relief. A load must be applied in a manner to reach the set pressure of the relief unit.

Procedure

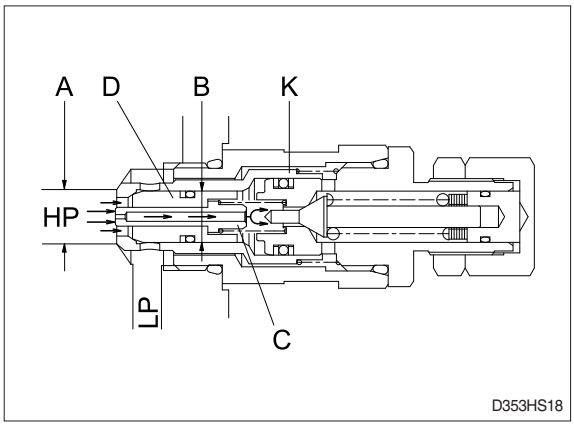
① Loosen lock nut.
② Set adjusting nut to desired pressure setting.
③ If desired pressure setting cannot be achieved, add or remove shims as required.
④ Tighten lock nut.
⑤ Retest in similar manner as above.



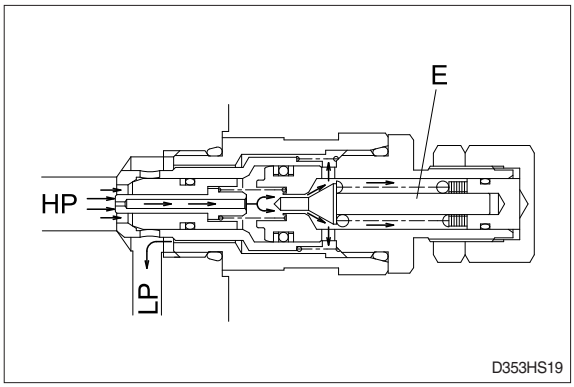
(2) Function

① As work port relief

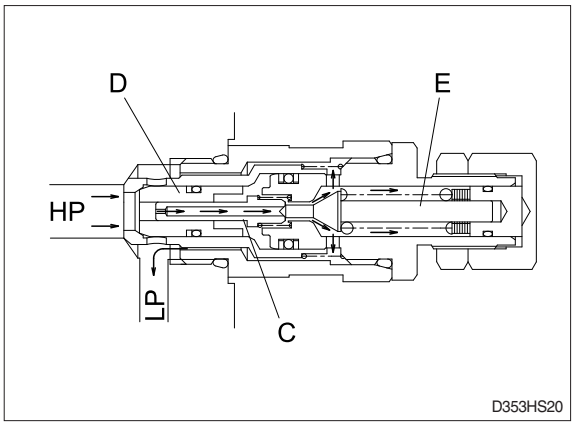
The relief valve is in communication between the high pressure port HP and low pressure LP. Oil is admitted through the hole in poppet C and because of the differential area between diameters A and B relief valve poppet D and check valve poppet K are tightly seated as shown.



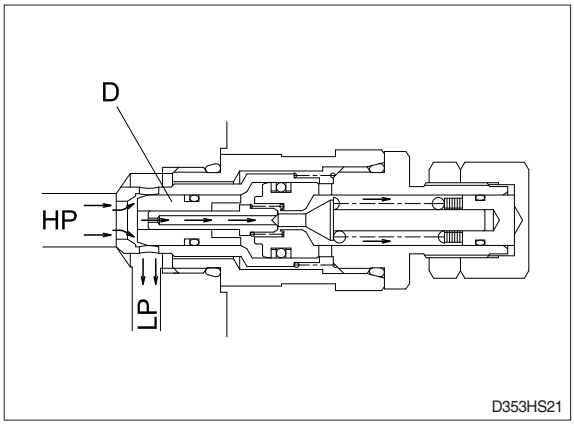
The oil pressure in the high pressure port HP has reached the setting of the pilot poppet spring force and unseats the pilot poppet E and oil flows around the poppet through the cross drilled holes and to the low pressure area LP.



The loss of oil behind poppet C, effected by the opening of pilot poppet E, causes poppet C to move back and seat against pilot puppet E. This shuts off the oil flow to the area behind relief valve poppet D, and causes a low pressure area internally.

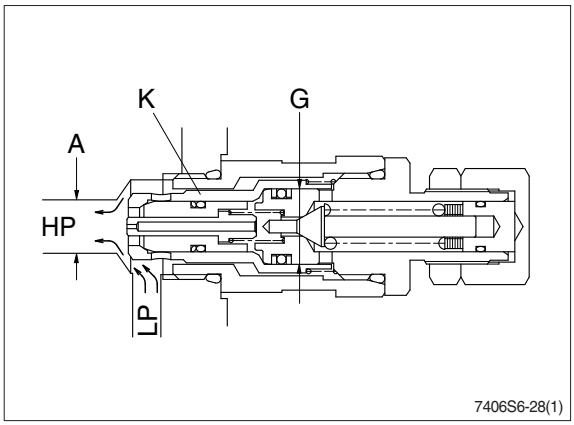


The imbalance of pressure on the inside as compared to that of the high pressure port HP, forces the relief valve poppet D to open and relieve the oil directly to the low pressure chamber LP in the valve.



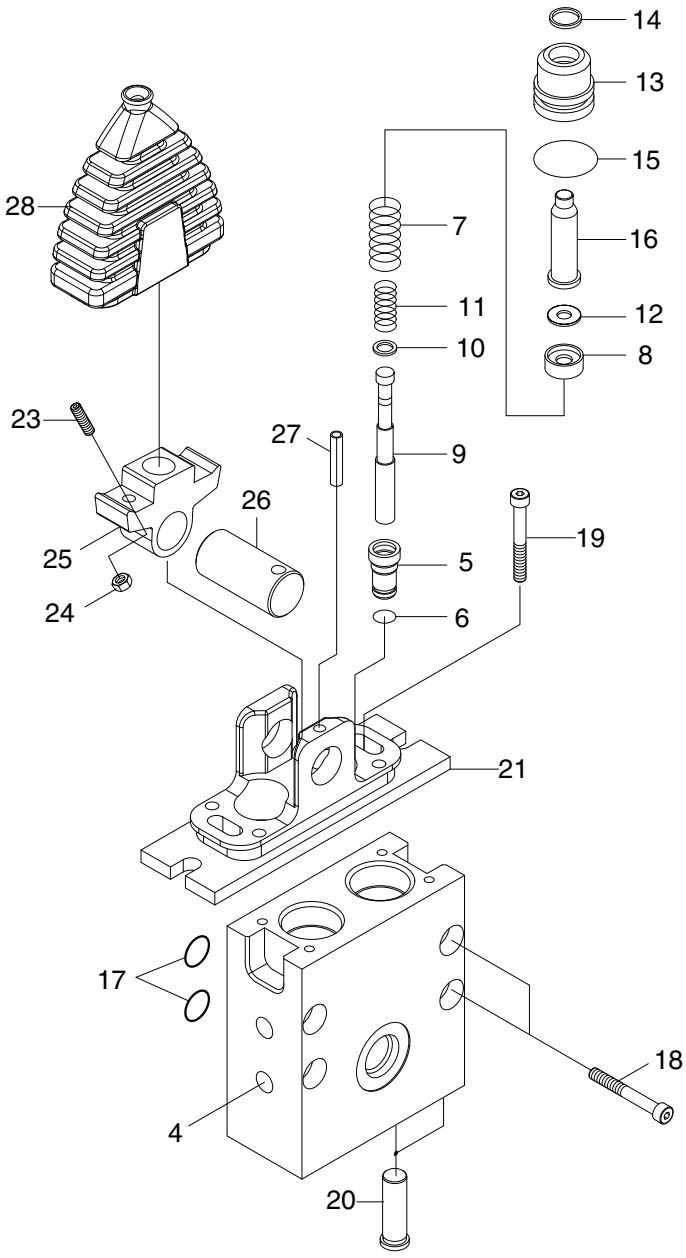
② As anti void

The anti-void unit supplies oil to the high pressure port HP when cavitation has occurred. A lower pressure exists in the port HP compared to the low pressure chamber LP. The difference between the effective area of diameter A and G causes imbalance of the check valve poppet K which unseats, thus allowing oil from the low pressure chamber LP to enter the port HP and fill the void.



5. REMOTE CONTROL VALVE

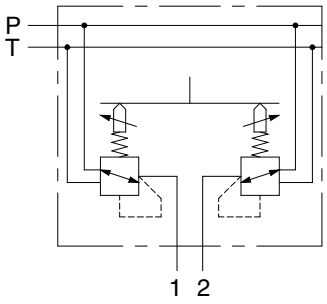
1) STRUCTURE



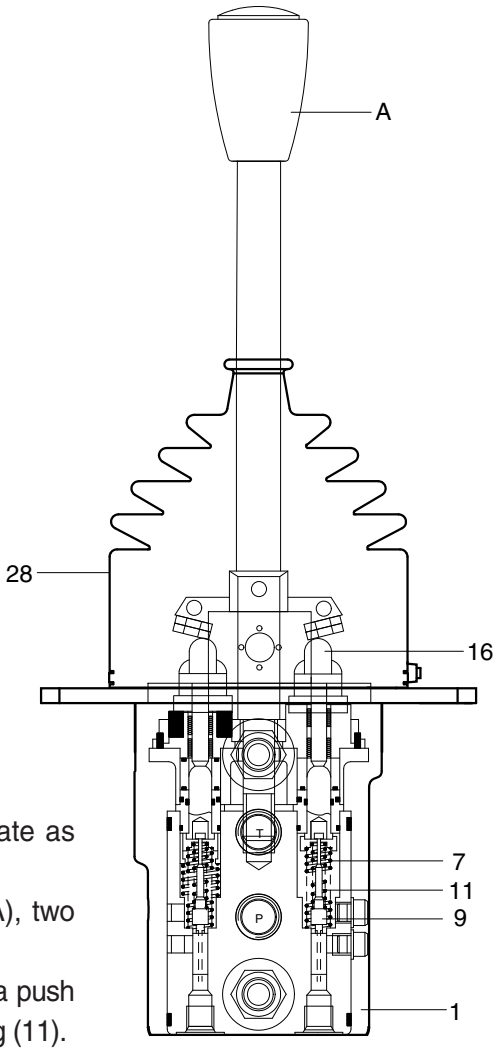
100D96RCV01

1	Body	12	Stopper	21	Cover
4	Plug	13	Plug	23	Socket 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	Socket bolt	28	Boot
10	Shim	19	Wrench bolt		
11	Spring	20	Cap		

2) OPERATION



HYDRAULIC CIRCUIT



100D96RCV02

(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 (1) and locks.

Each pressure reducing valve comprises of a push rod kit (16), 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, push rod kit (16) is pressed against return spring (11) and metering spring (7).

Metering spring (7) initially moves docking spool (9) 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 spool (9) 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 spool (9) and metering spring (7) the pressure in the relevant port is proportional to the stroke of push rod (16) and hence to the position of control lever (A).

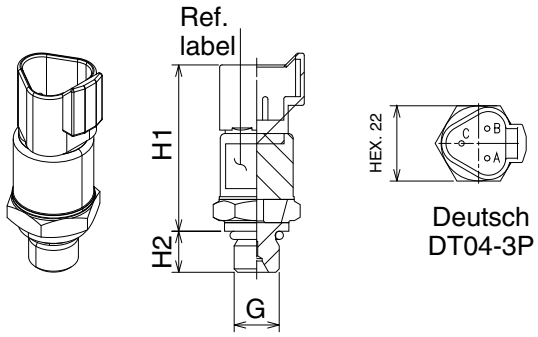
This pressure control which is dependent on the position of the control lever and the characteristics of the control spring permits the proportional hydraulic control of the main directional valves and high response valves for hydraulic pumps.

A rubber bellows (28) protects the mechanical components in the housing from contamination.

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

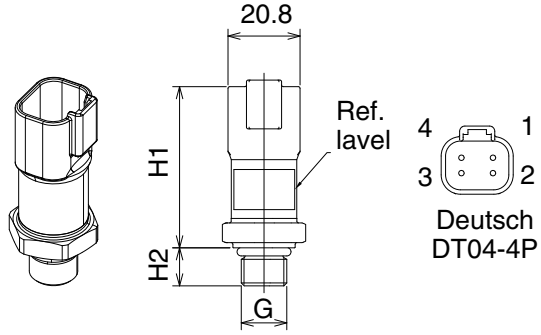
70D9V4BS10

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

※ 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

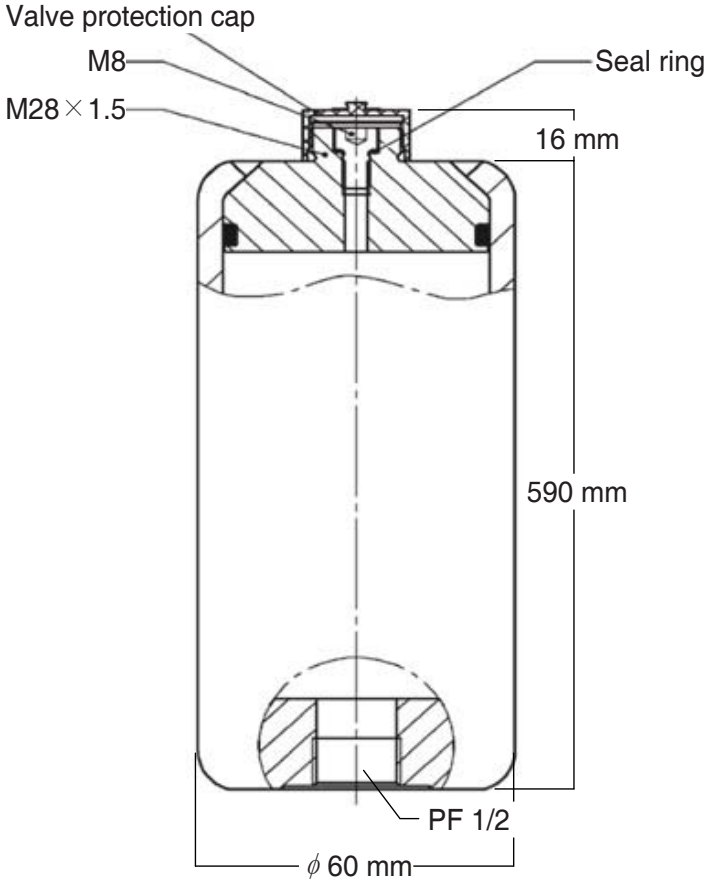
Item	Medium	Thread (G)	H1 (mm)	H2 (mm)	Measuring range (bar)	Pressure output signal (V)	Voltage (V)	Electircal connections
Pump pressure sensor (LS)	Oil	9/16-18 UNF	49	12	0 ~ 250	1 ~ 5	Max. 30	CD-5

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

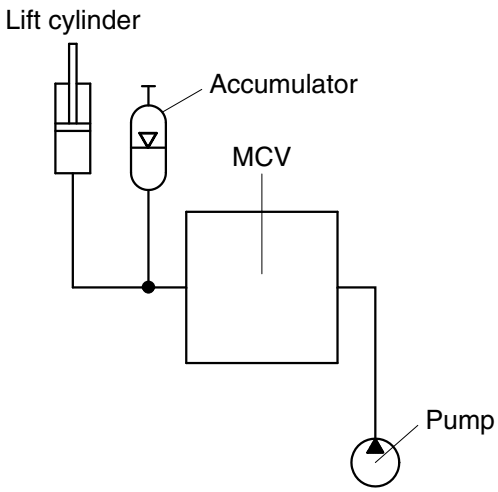
7. MAST ACCUMULATOR

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.

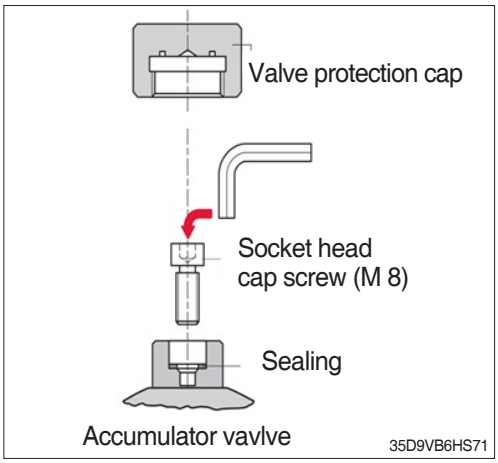
⑥ Wait 5-10 minutes for the filled nitrogen gas pressure to stabilize, then recheck the set pressure and adjust if necessary.

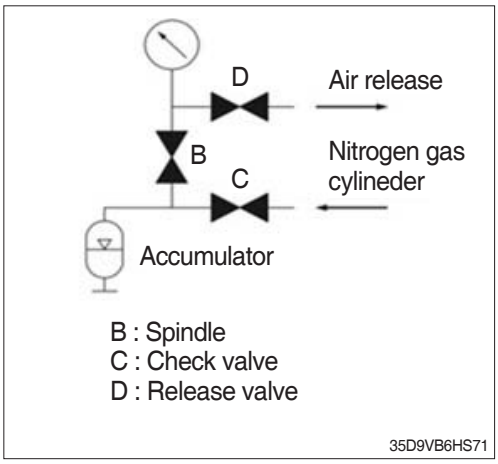
⑦ Open the release valve and blow out gas in the FPU.

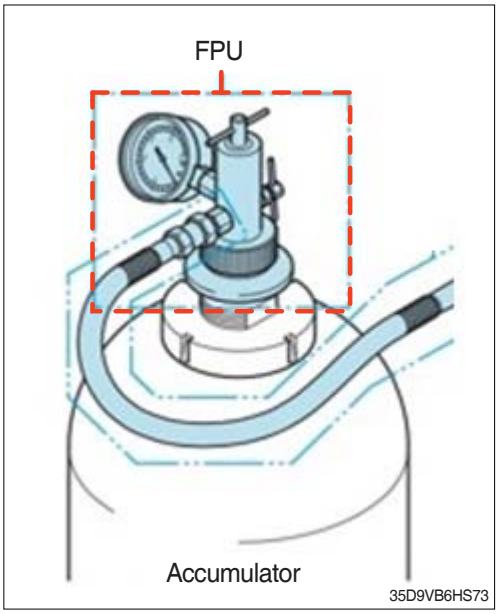
※ **If there is gas in the charging hose and FPU, it cannot be separated, and it is very dangerous if it is forcibly separated. Be sure to separate the charging hose and after blowing out the gas inside the FPU.**

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.







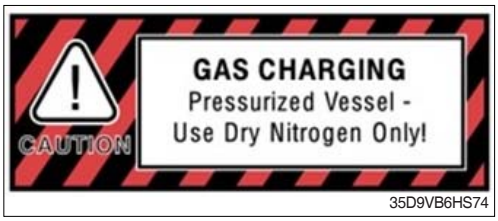
(2) Charging

※ **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.

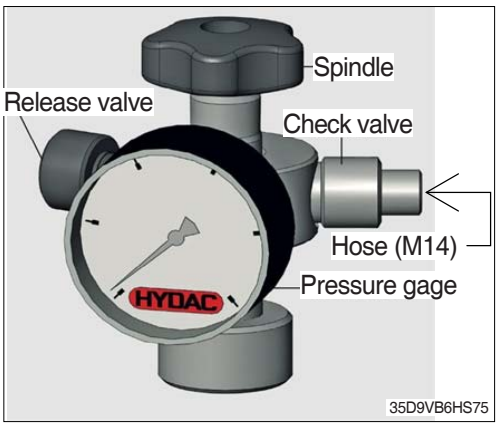
⑥ When filling is complete, close the gas valve of the accumulator using the valve of the nitrogen gas cylinder and the spindle of the FPU.

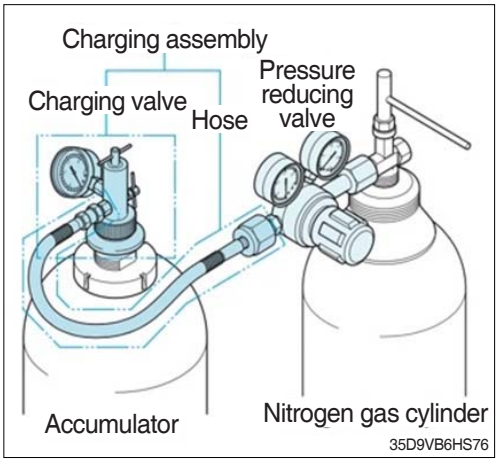
※ **When adding nitrogen to the accumulator filled with nitrogen gas, wait 5-10 minutes for the temperature and pressure of the gas mixture to stabilize, then check the pressure again and adjust if necessary.**

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.



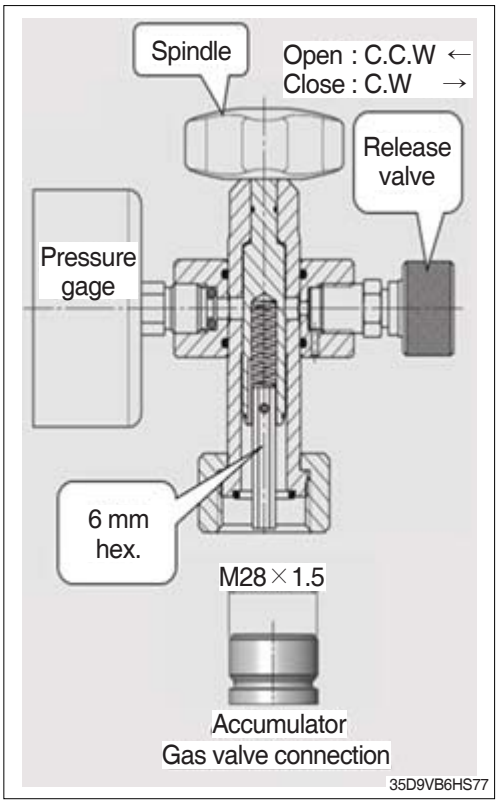


⑩ Open the release valve and blow out nitrogen gas in the FPU.

※ **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.**

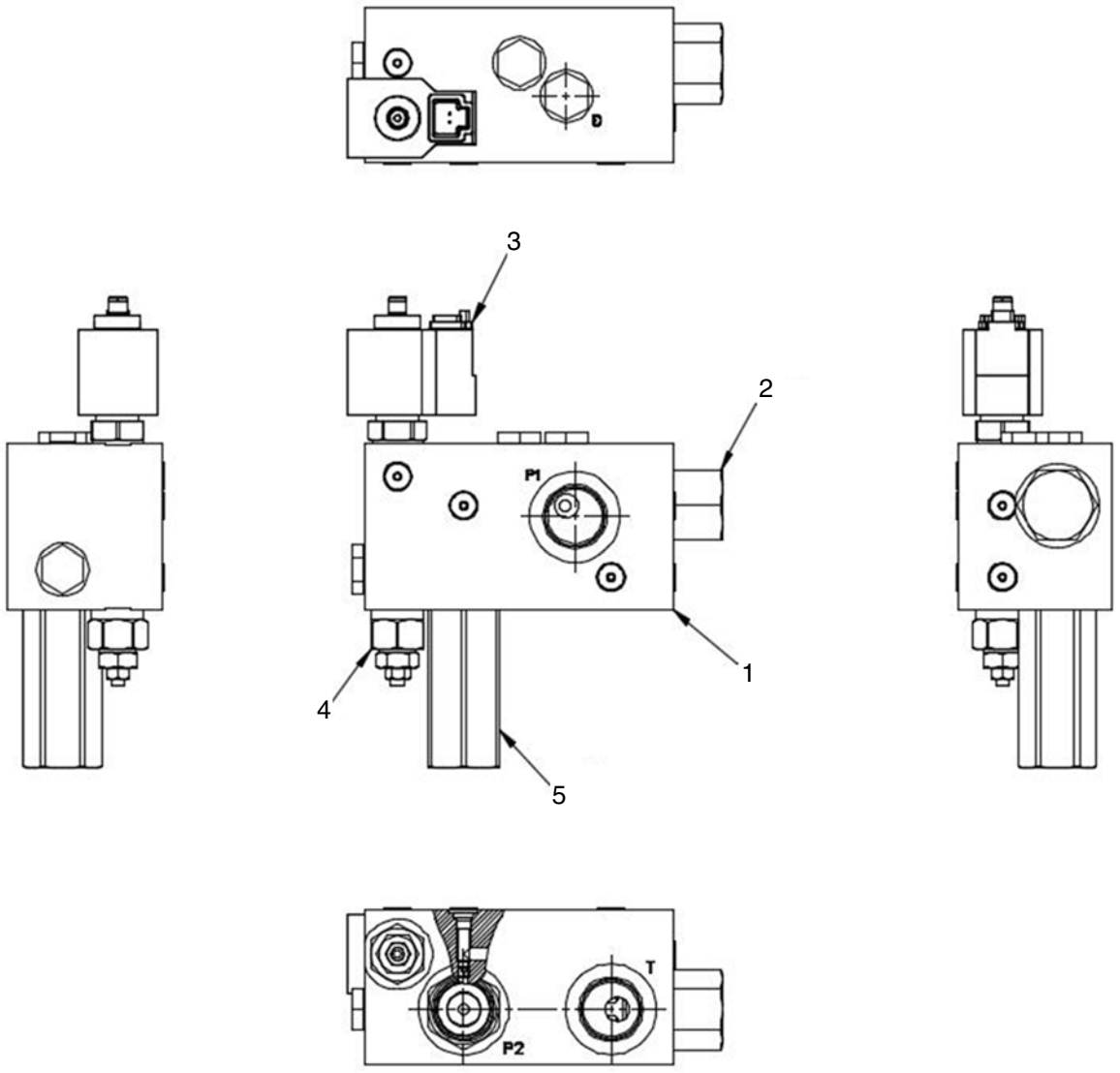
⑪ Remove the FPU from the accumulator.

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. DRAIN VALVE

1) STRUCTURE



100D96DV01

1	Manifold	3	Solenoid valve	5	Check valve
2	Logic valve	4	Relief valve		

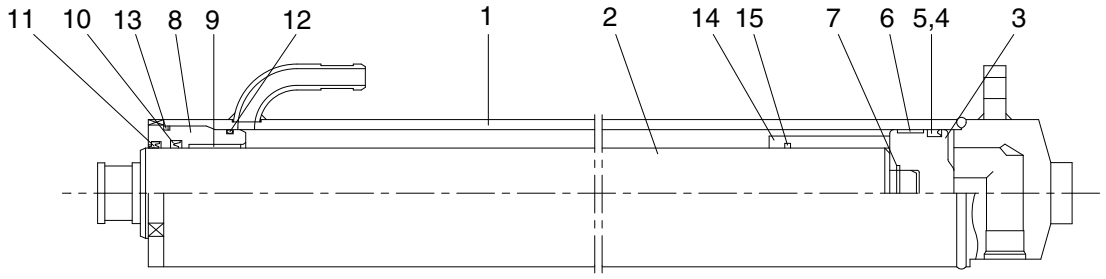
2) OPERATION

The system pressure is reached setting value (110~120 bar), the solenoid valve is energized by the MCU and the oil drains to tank

- Prevent the engine stall in low rpm with load condition.
- High rated flow at rated pressure

9. LIFT CYLINDER

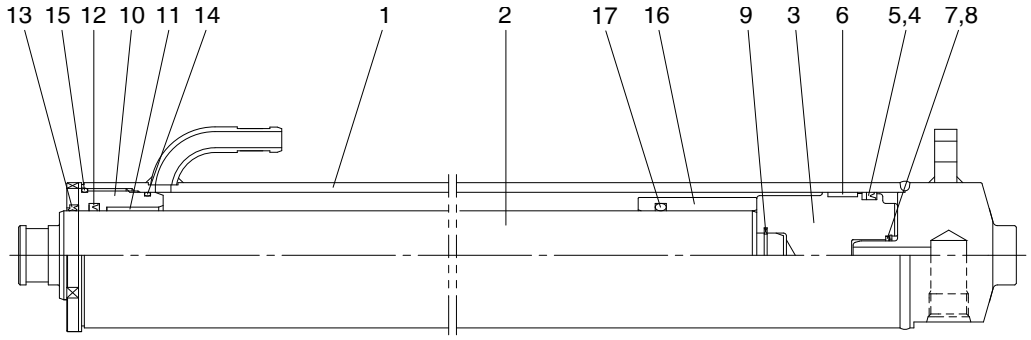
1) V MAST



3YFJ-07020

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) TS MAST

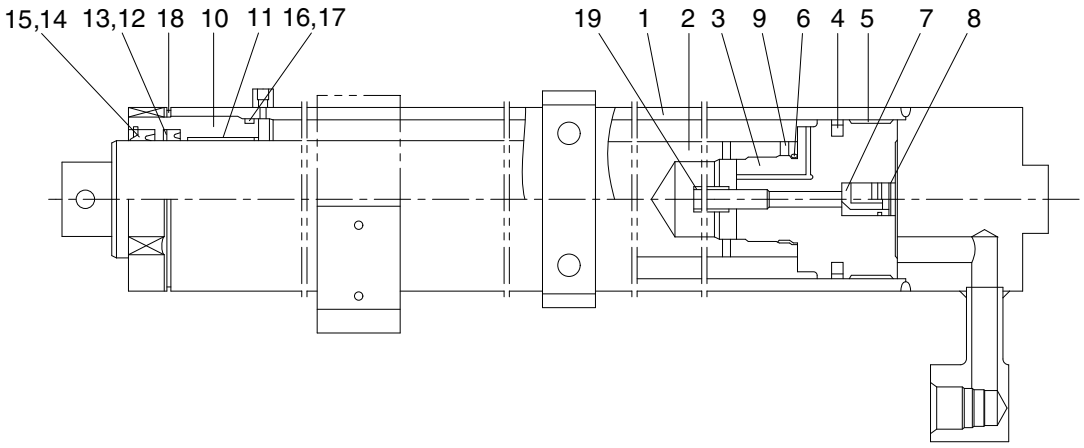


3YFJ-07210

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

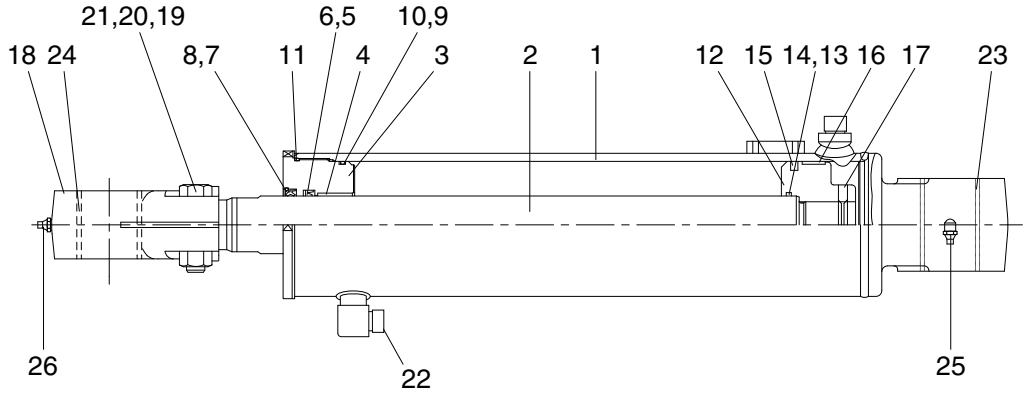
1) TS MAST



3YFJ-17110

1	Tube assy	8	Retaining ring	15	Retaining ring
2	Rod	9	Set screw	16	O-ring
3	Piston	10	Rod cover	17	Backup ring
4	Piston seal	11	Rod bushing	18	O-ring
5	Wear ring	12	U-packing	19	Pipe
6	O-ring	13	Backup ring		
7	Check valve	14	Dust wiper		

11. TILT CYLINDER



3YFJ-08500

1	Tube assy	10	Back up ring	19	Hex bolt
2	Rod	11	O-ring	20	Hex nut
3	Rod cover	12	Piston	21	Spring washer
4	Pin bushing	13	O-ring	22	O-ring
5	U-packing	14	Back up ring	23	Rod bushing
6	Back up ring	15	Piston seal	24	Rod bushing
7	Wiper ring	16	Wear ring	25	Grease nipple
8	Stop ring	17	Set screw	26	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).

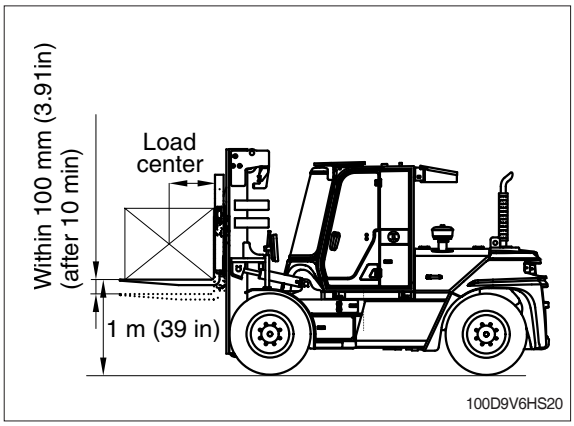
· **Check condition**

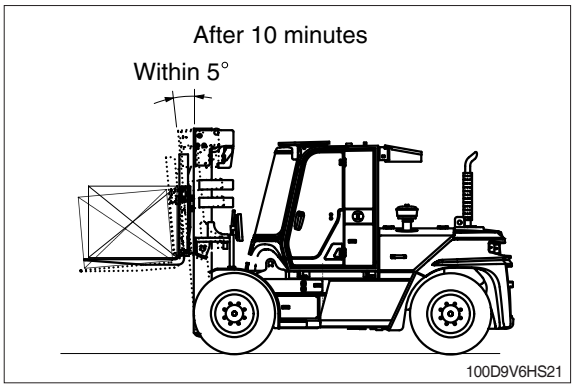
- Hydraulic oil : 45±5 ℃ (113±41 ℉)
- Rated capacity load
- Mast substantially vertical
- Key OFF, operator non-existence

· **Hydraulic drift**

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

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

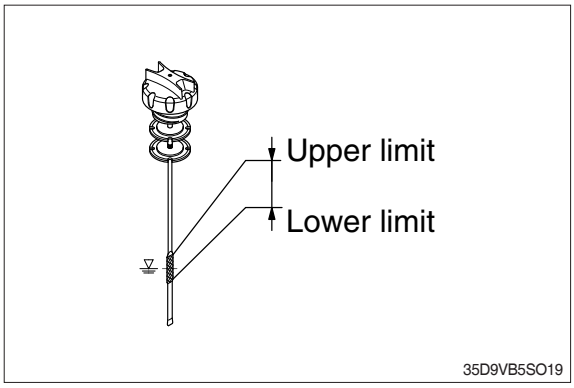




2) HYDRAULIC OIL

(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).



3) CONTROL VALVE

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

Model	Unit	Pressure
100D-9	bar (psi)	265 (3769)

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

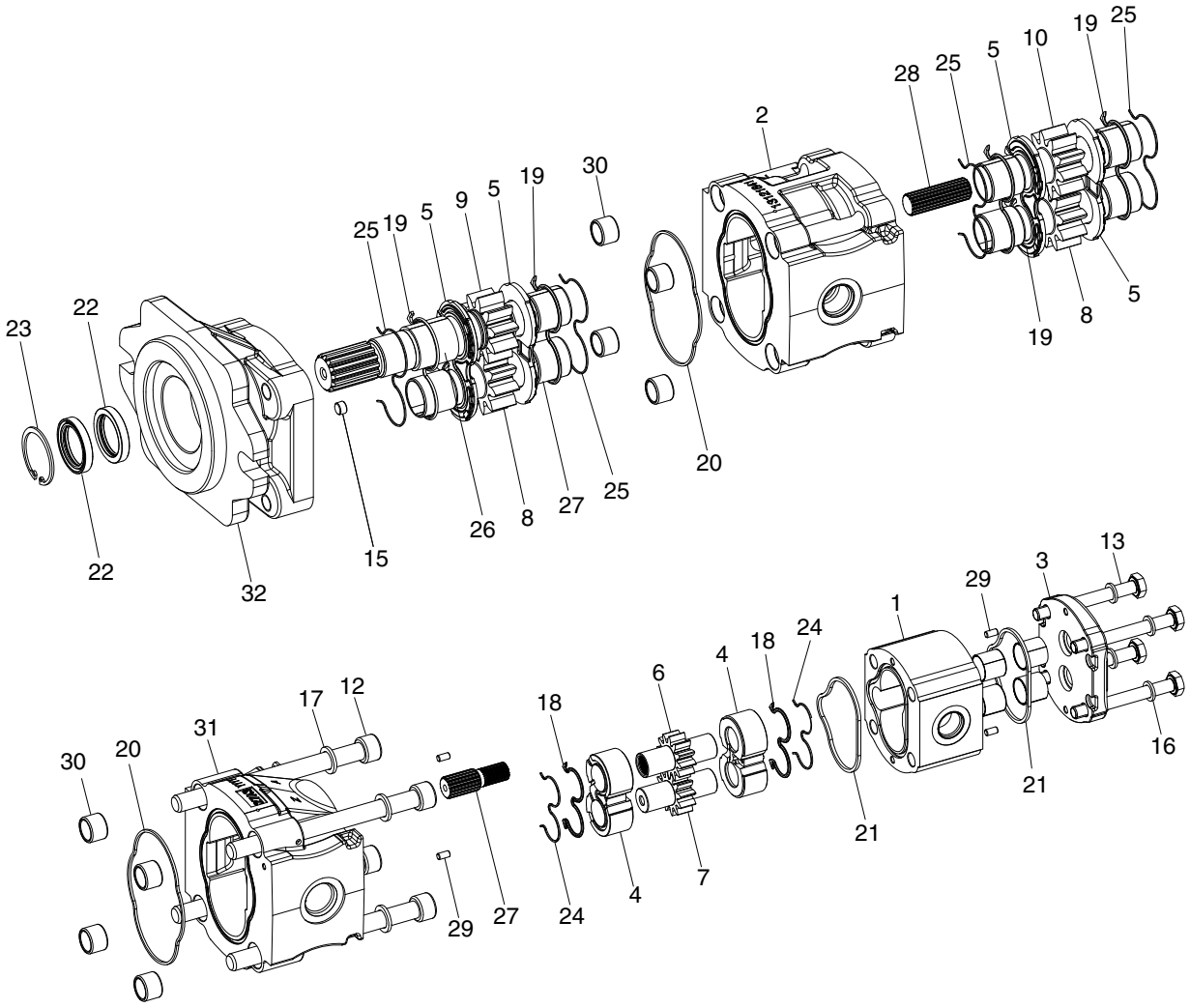
Problem	Cause	Remedy
Unusual noises No or insufficient flow	· Insufficient air bleeding of the hydraulic system.	· Fill the axial piston pump, suction line for the hydraulic pump and the oil tank. · Completely air bleed the pump and hydraulic system. · Inspect and correct or replace. - Installation position
	· 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



100D9MP02

1	Housing	12	Screw	23	Ring
2	Body	13	Screw	24	Antiextrusion plate
3	Rear Cover	14	Nut	25	Antiextrusion ring
4	Thrust plate	15	Screw	26	Sleeve bearing
5	Thrust plate	16	Washer	27	Hub
6	Drive gear	17	Washer	28	Hub
7	Driven gear	18	Seal	29	Dowel pin
8	Driven gear	19	Seal	30	Steel bushing
9	Drive gear	20	Upper seal	31	Body
10	Drive shaft	21	Square seal	32	Front cover
11	Bolt	22	Shaft seal		

2) GENERAL INSTRUCTION

(1) Cleanliness

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

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

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

※ Gear journals and gear faces are super finished. Take care not to touch these surfaces after oil and solvent.

(2) Lubrication of moving parts

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

(3) Tools required for assembly

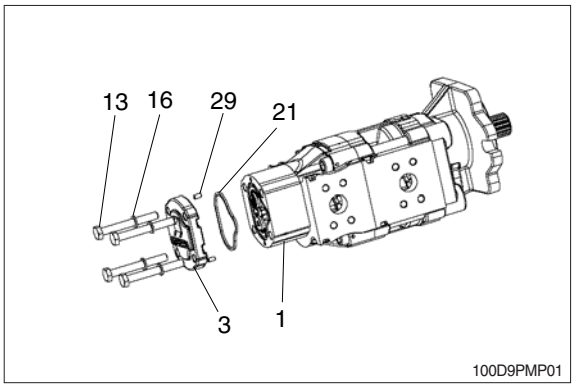
① Socket set (1/2" drive)
② Internal snap ring pliers
③ Shaft seal sleeve or clear tape
④ Torque wrench (30 kgf · m capacity)
⑤ Plastic hammer
⑥ Torque wrench box end adapters

3) DISASSEMBLY

(1) Rear section

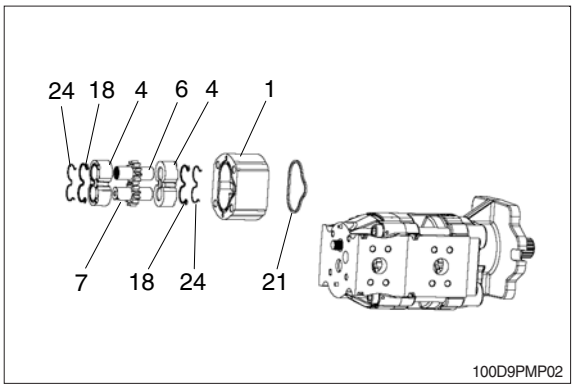
① Loosen and remove the clamp screw (13) from rear working section (1).

※ Related parts
Washer (16), rear cover (3), dowel pin (29) and square-ring (21).



② Remove driving gear (6), driven gear (7) with thrust plate parts (4, 18, 24), keeping gear as straight as possible, and working section (1) also.

※ Related parts
Antiextrusion plate (24), seal (18), thrust plate (4), working body (1) and square ring (21).

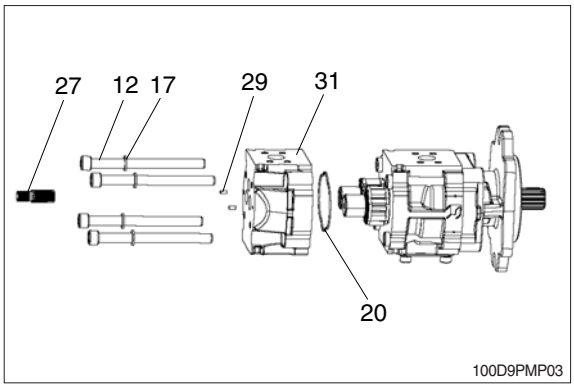


(2) Center section

① Remove through hub (27) from driving shaft (10).

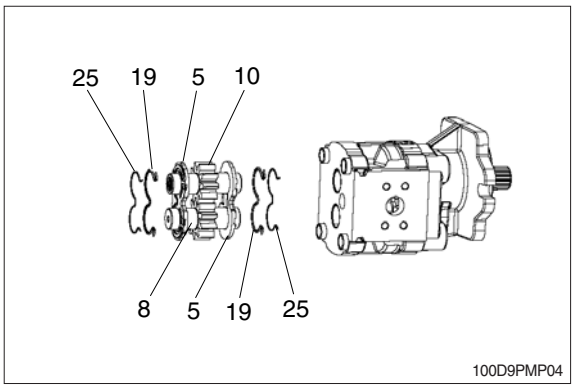
② Loosen and remove the clamp screw (12) with washer (17), and then remove the working section (31) with dowel pin (29).

※ Related parts
Upper seal (20).



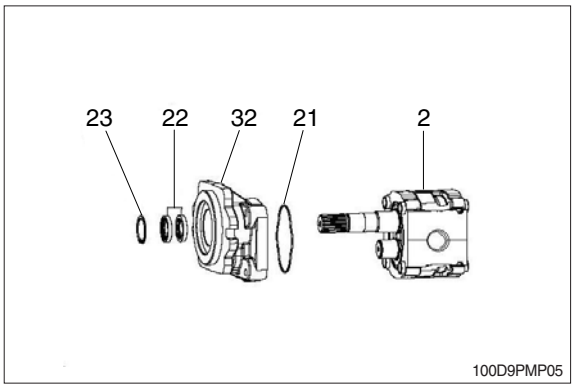
③ Remove driving gear (10), driven gear (8) with thrust plate parts (5, 19, 25), keeping gear as straight as possible, from first working body.

※ Related parts
Antiextrusion ring (25), seal (19) and thrust plate (5).



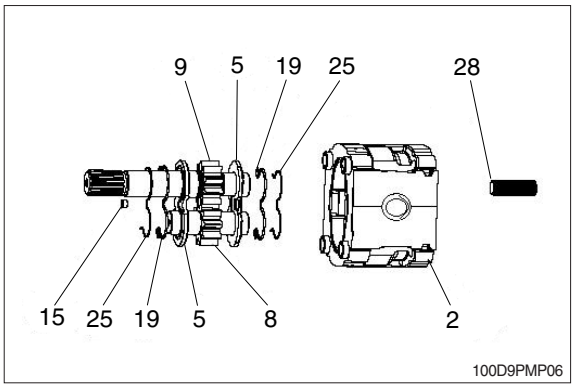
(3) Front section

① Remove the snap-ring (23) and shaft seal (22), and then remove mounting flange (32) and square ring (21) from working section (2).



② Remove driving gear (9), driven gear (8) with through hub (28) and thrust plate parts (5, 19, 25) from the working body (2), keeping gear as straight as possible.

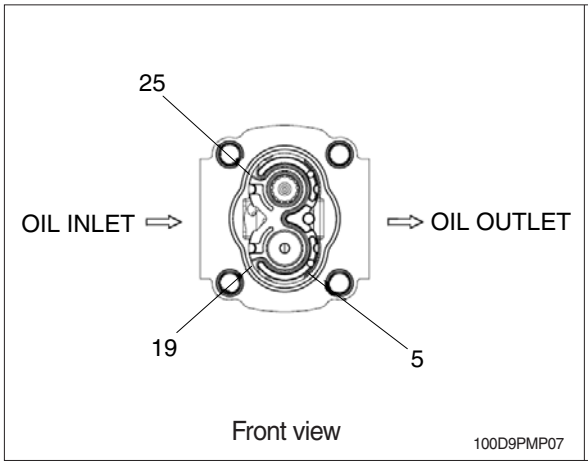
※ Related parts
Screw (15), antiextrusion ring (25), seal (19) and thrust plate (5).

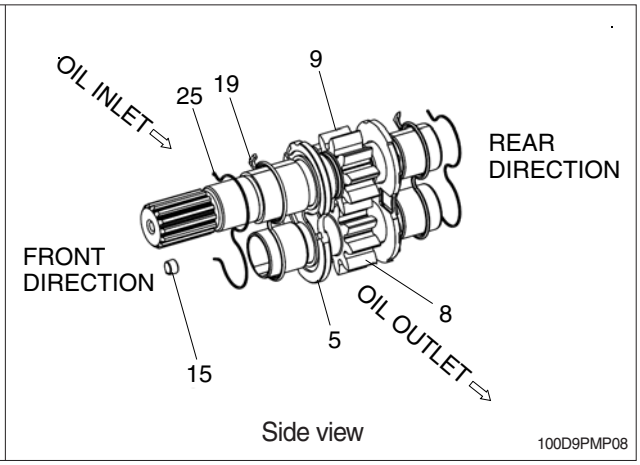


4) REASSEMBLY

※ Information for assembly way of thrust plates

It is important that all of thrust plate parts in this hydraulic pump should be assembled such as below picture during reassembly. Below figures show assembling sequence and direction.



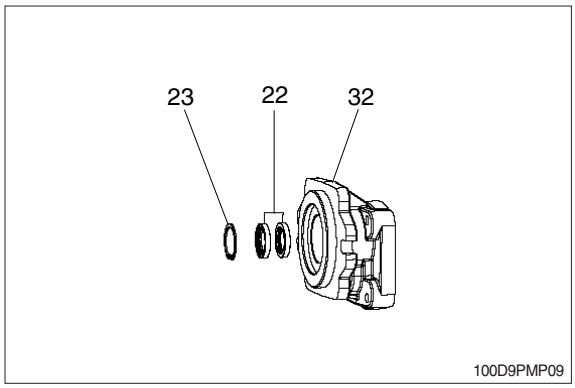


5	Thrust plate	9	Drive gear	24	Antiextrusion plate
8	Driven gear	15	Screw	25	Antiextrusion ring

(1) Front cover area

① Insert the shaft seal (22) carefully and fit it inside of mounting flange (32) with proper tool.

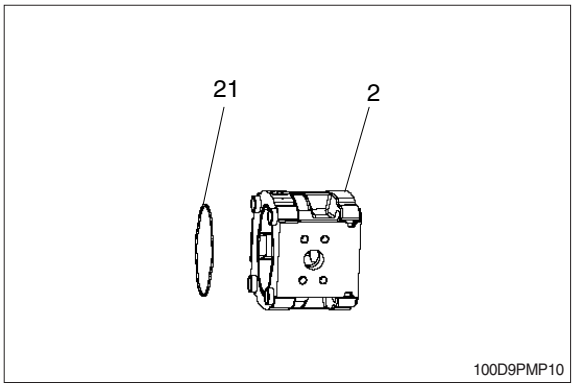
② Fit the snap-ring (23) in pre-arranged position with proper tool.



(2) Center section

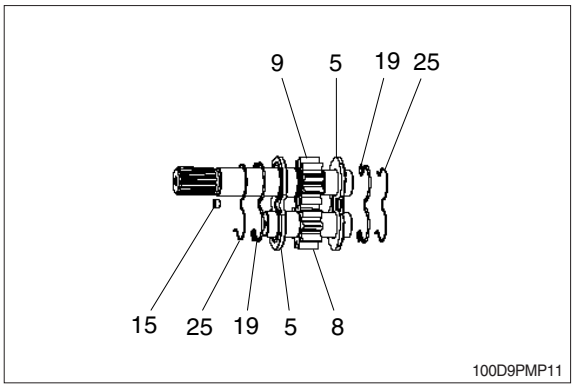
① Fit the square ring (21) on the prearranged groove of the working section (2).

※ Smear clean grease on the square ring (21) to avoid drifting away of square ring from the working section (2).



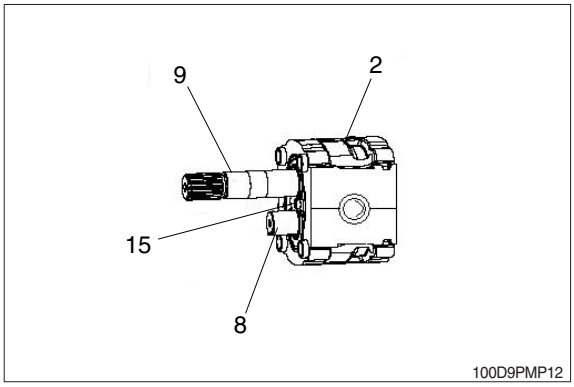
② Locate the seal (19) on the groove prearranged on the thrust plate (5).
③ Then, locate antiextrusion ring (25) on the groove pre-arranged on the seals (5, 19) with screw (15).

※ Smear clean grease on the seal (19, 25). (The front and rear thrust plates and seals and antiextrusion ring are same.)

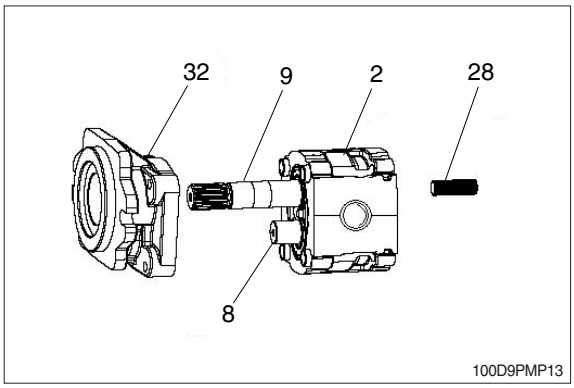


④ Insert the drive gear (9) and driven gear (8) into working section (2) while keeping the gears straight.

※ Locate thrust plate (5+19+25) with care for the direction.

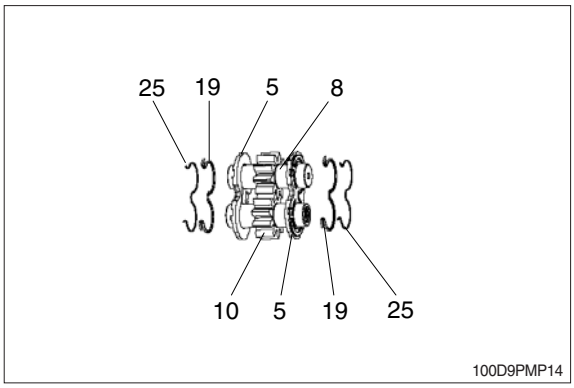


⑤ Locate the completed mounting flange (32+22+23) to working section (2) while tacking care not to give any damage on the shaft seal by edge of shaft (9).
⑥ Insert the through shaft (28) to rear side of the drive shaft (9).

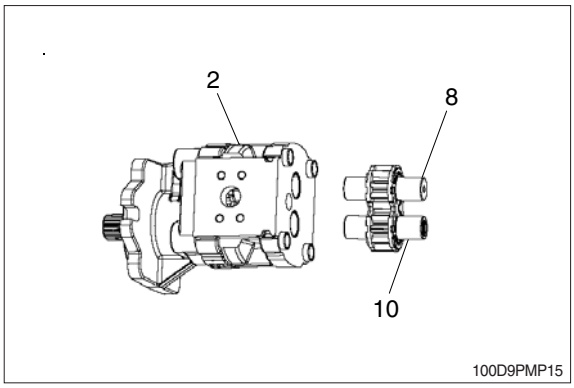


⑦ Locate the seal (19) on the groove prearranged on the thrust plate (5).
⑧ Then, locate antiextrusion ring (25) on the groove pre-arranged on the seals (5, 19).

※ Smear clean grease on the seal (5, 19) (The front and rear thrust plates and seals and antiextrusion ring are same.)

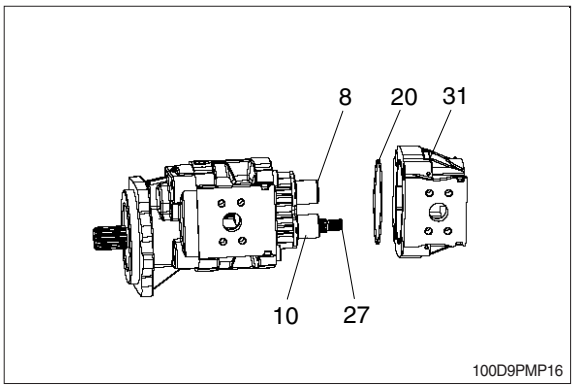


⑨ Insert the drive shaft (10) and driven gear (8) including the completed thrust plate (5+19+25) into working section (2) while keeping the plate straight.

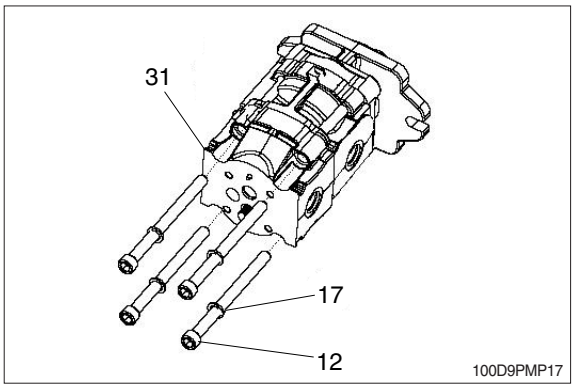


⑩ Insert the through shaft (27) into drive shaft (10), and then locate the working body (31) after inserting the squaring ring (20) to body (31).

※ Smear clean grease on the upper seal (20) to avoid drifting away of upper seal from the working body (31).



⑪ Tighten the bolt (12) with washer (17) in a cross pattern to torque valve of 140 Nm.

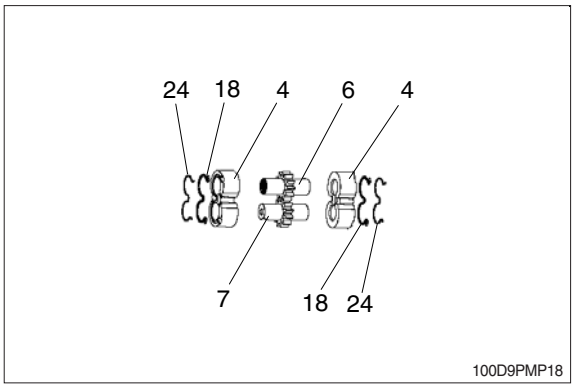


(3) Rear section

① Locate the seal (18) on the groove prearranged on the thrust plate (4).

② Then, locate antiextrusion plate (24) on the groove pre-arranged on the seals (4, 18).

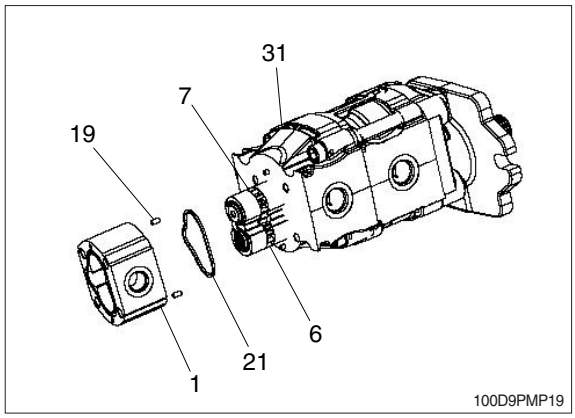
※ Smear clean grease on the seal (4, 18) (The front and rear thrust plates and seals and back-up ring are same.)



③ Locate the drive gear (6) and driven gear (7) with thrust plate parts (4+18+24) into working section (31).

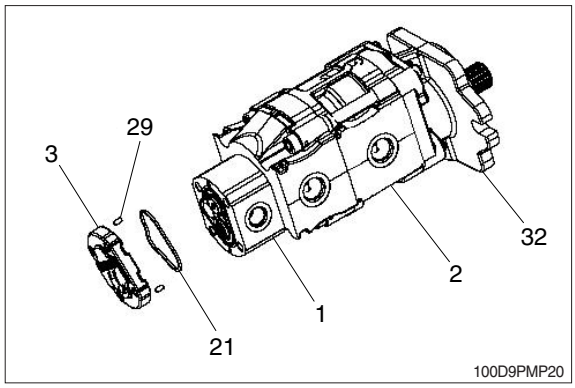
④ Insert the dowel pin into the working section (31) and then, locate the rear working section (1) to working section (31) while keeping the gear straight.

※ Smear clean grease on the square ring (21) to avoid drifting away of square ring from the rear working section (1).



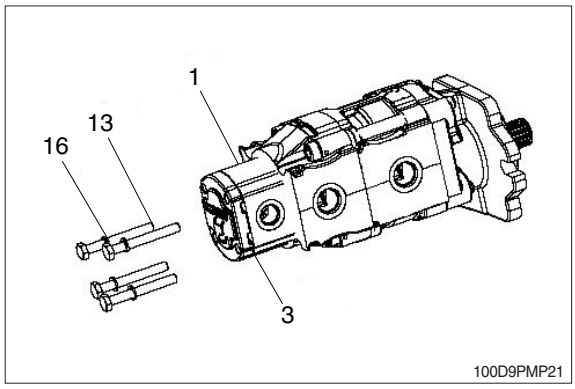
⑤ Locate the rear cover (3) after inserting the square ring (21) and the dowel pin (29) into the rear working section (1).

※ Smear clean grease on the square ring (21) to avoid drifting away of square ring (21) from the rear cover (3).

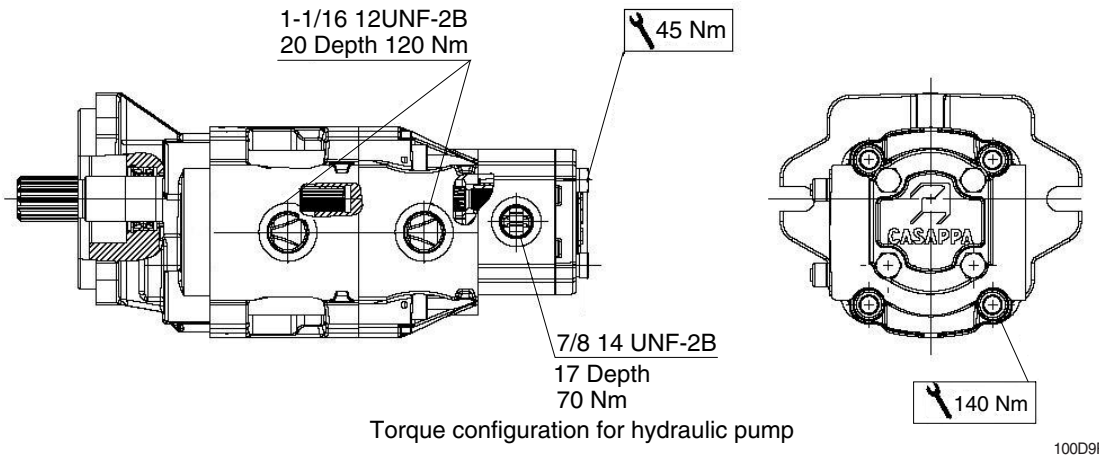


⑥ Tighten the screw (13) with washer (16) in a cross pattern to torque valve of 45 Nm.

※ Check that the pump rotate freely when the driving shaft is turned by hand. If not a thrust plate seal may be pinched.



(4) Reference



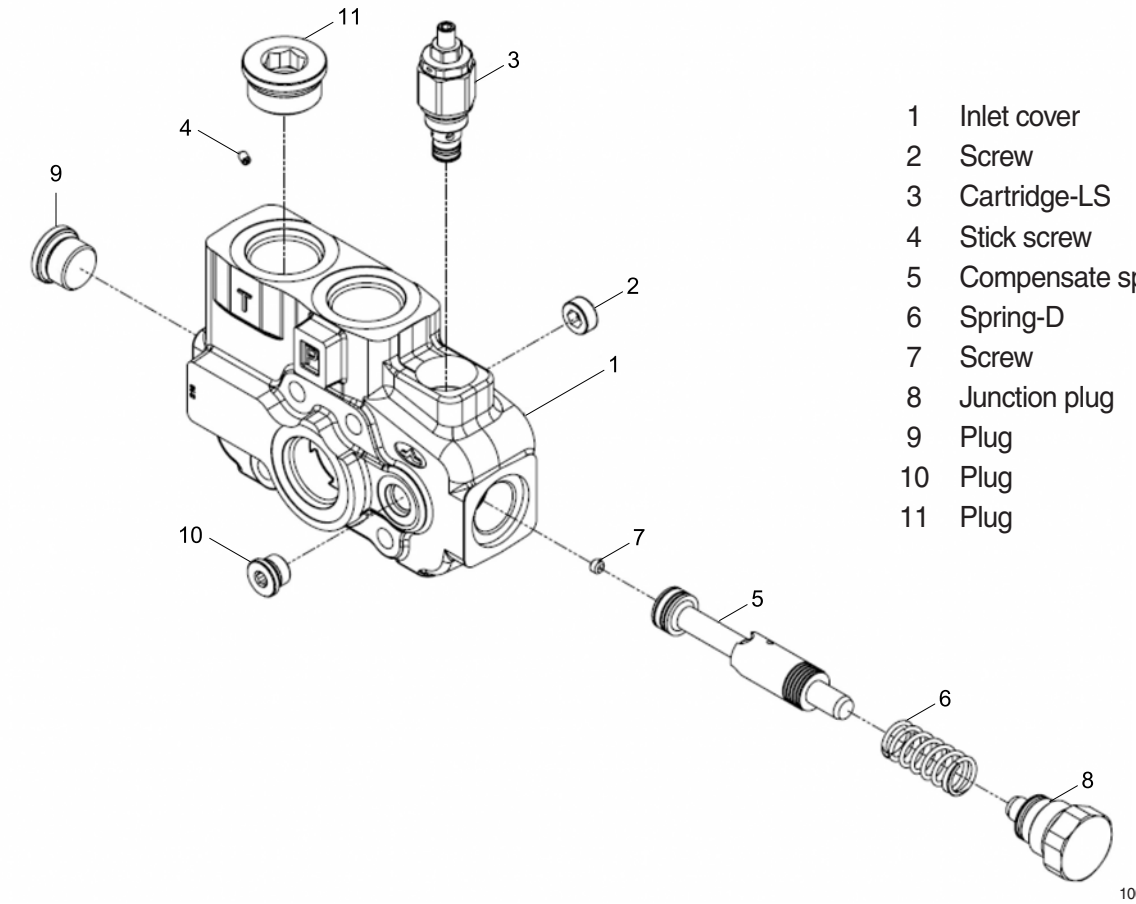
Torque configuration for hydraulic pump

100D9PMP22

2. MAIN CONTROL VALVE

1) STRUCTURE

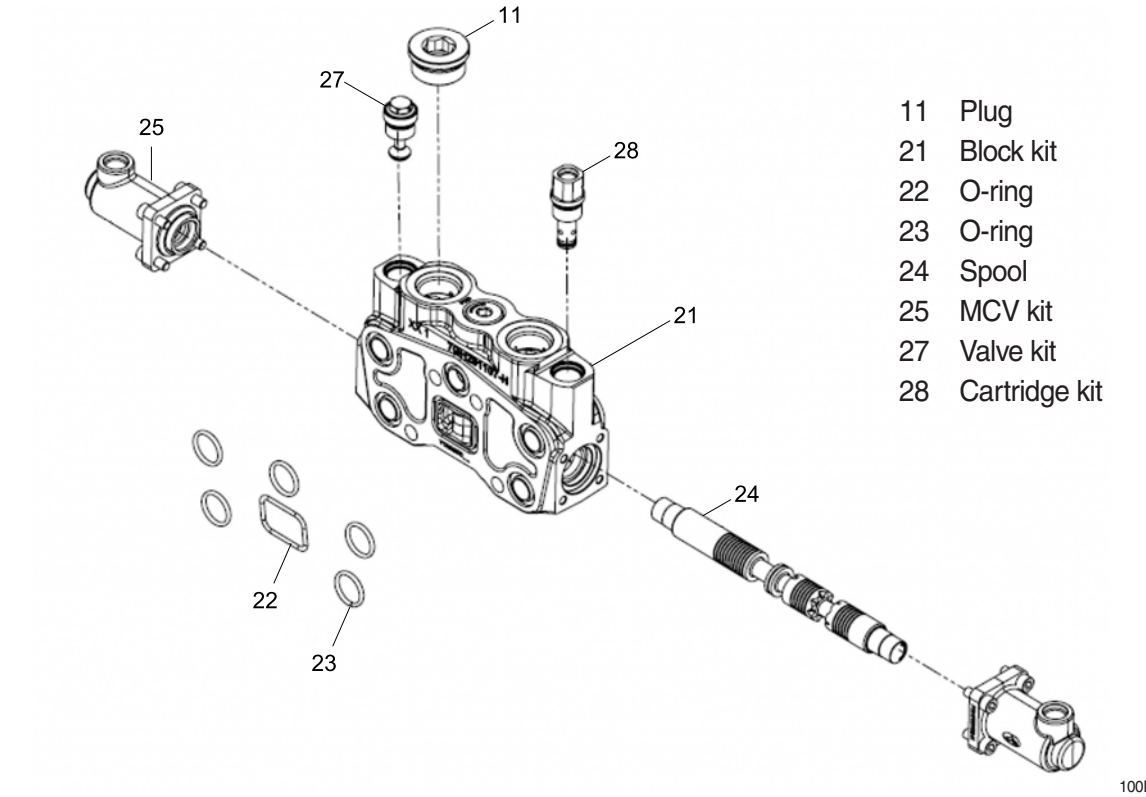
(1) Inlet section



1 Inlet cover
2 Screw
3 Cartridge-LS
4 Stick screw
5 Compensate spool
6 Spring-D
7 Screw
8 Junction plug
9 Plug
10 Plug
11 Plug

100D9MC20

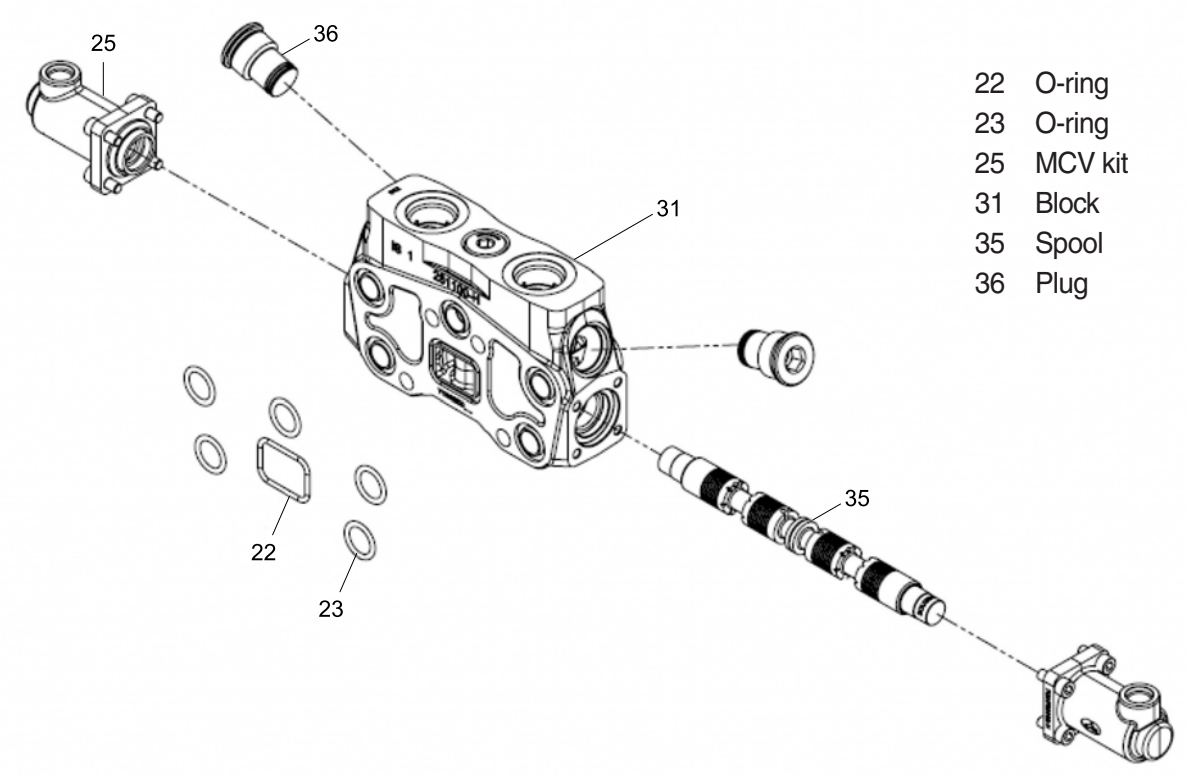
(2) Lift section



11 Plug
21 Block kit
22 O-ring
23 O-ring
24 Spool
25 MCV kit
27 Valve kit
28 Cartridge kit

100D9MC21

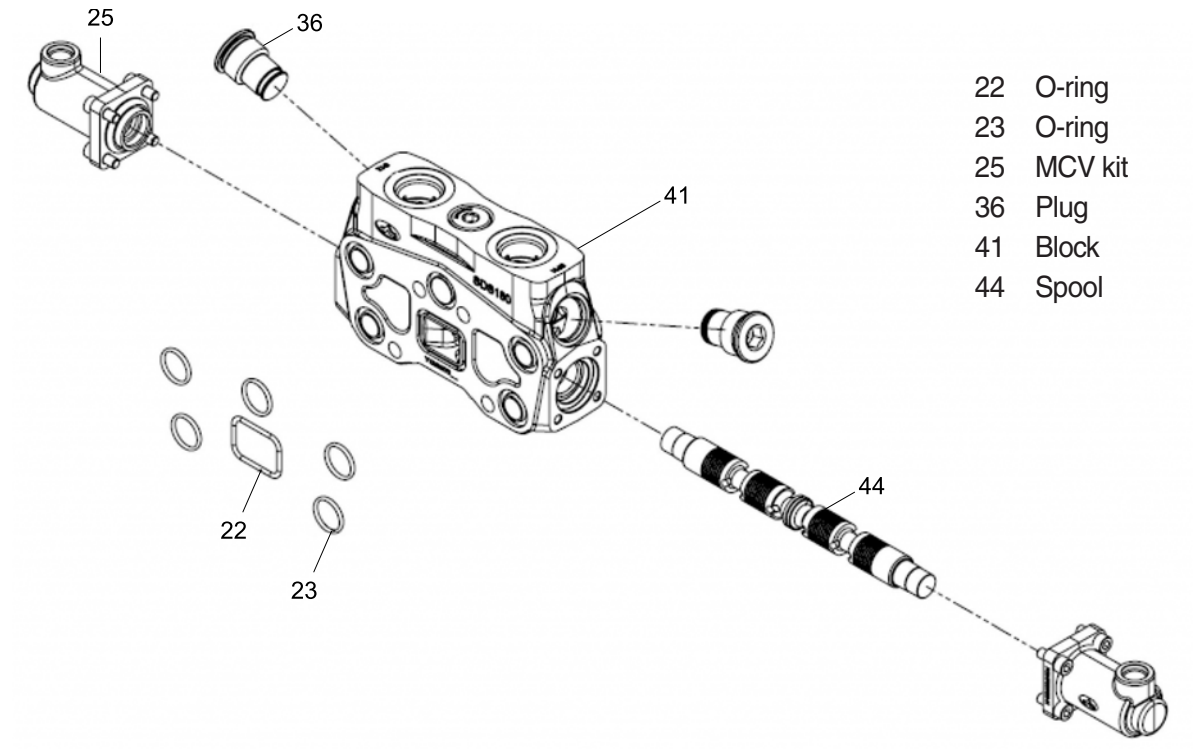
(3) Tilt section



22 O-ring
23 O-ring
25 MCV kit
31 Block
35 Spool
36 Plug

100D9MC22

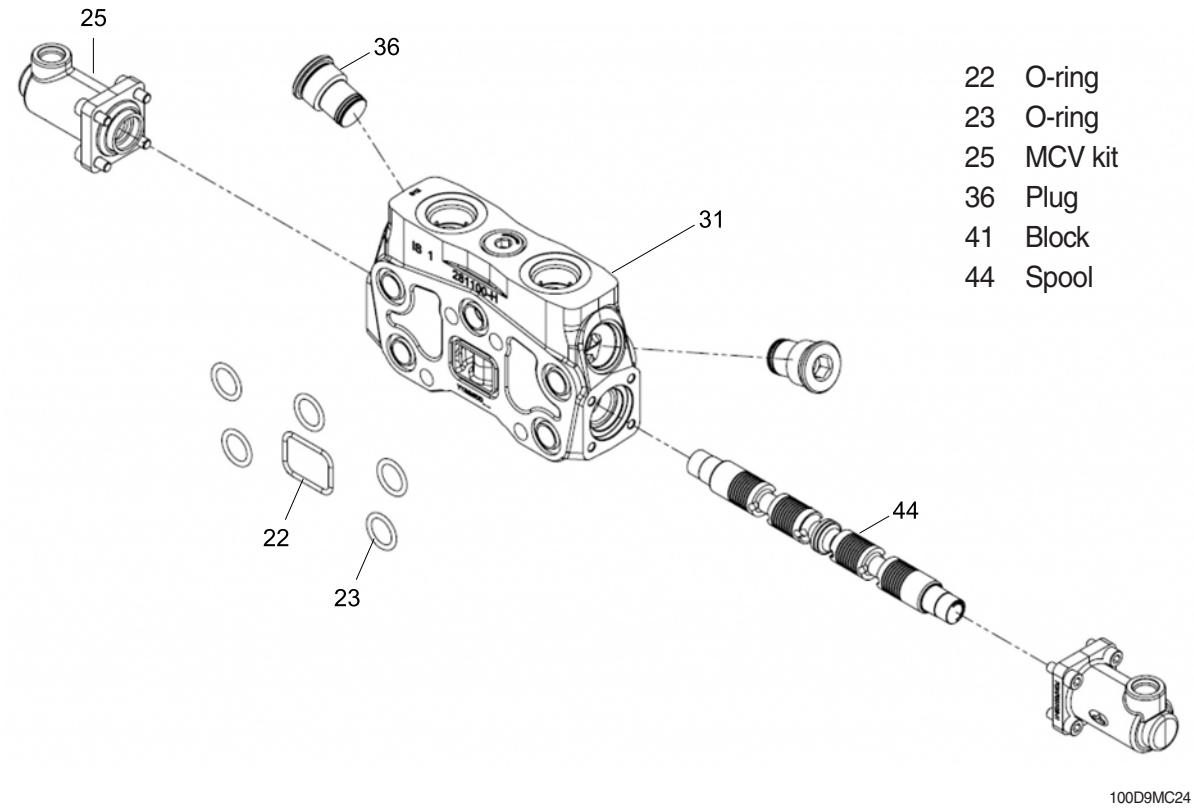
(4) Aux 1 section



22 O-ring
23 O-ring
25 MCV kit
36 Plug
41 Block
44 Spool

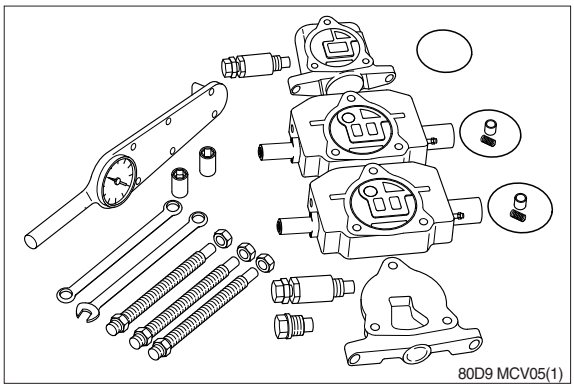
100D9MC23

(5) Aux 2, 3 section

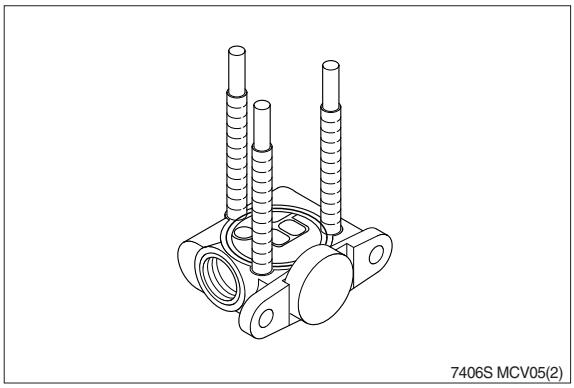


2) ASSEMBLY

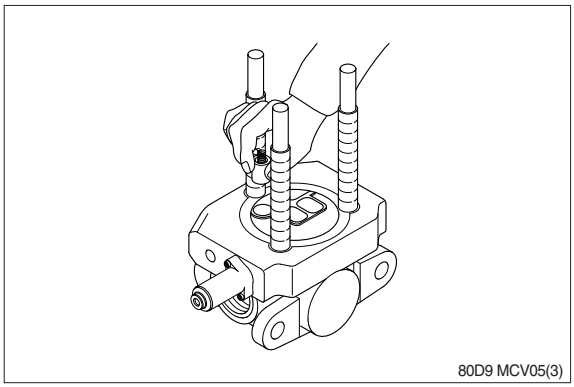
(1) Lay out valve components on a clean, flat working surface. The inlet assembly will include an O-ring, and the spool section (s) include an O-ring, a load check poppet and a load check spring. Tools required for basic valve assembly include 3/4 and 11/16 open or box end wrenches and a torque wrench with thin wall sockets.


80D9 MCV05(1)

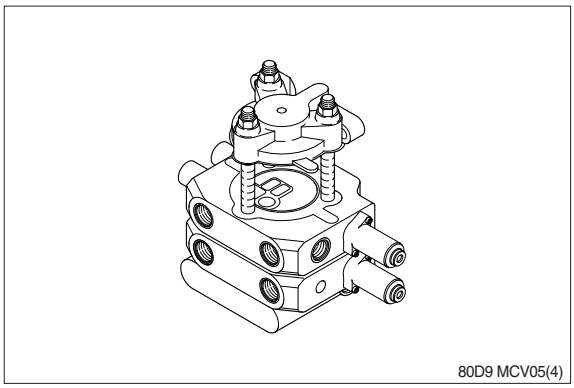
(2) Assemble tie rod nuts to one end of each tie rod with one or two threads showing. Insert tie rods through tie rod holes of inlet (Large tie rod at top). Lay inlet on end with tie rods up, place O-ring into position.


7406S MCV05(2)

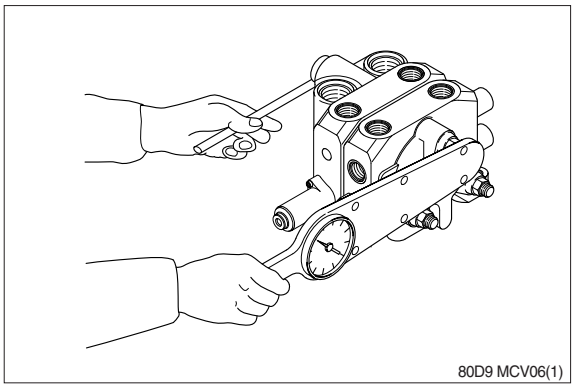
(3) Place first spool section (O-ring side up) on inlet section, position O-ring and insert load check poppet (Nose down) and spring (Behind poppet) into load check cavity as shown. Repeat this procedure for each spool section ; The load check springs are compressed by the following sections during assembly.


80D9 MCV05(3)

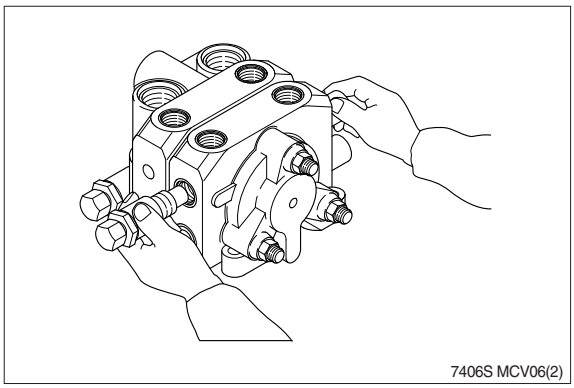
(4) Position end section on last spool section as shown and hand tighten tie rod nuts. The end section on picture is a "turn around" section without ports. Universal outlet /power beyond section and power beyond and closed center sections are also used as end sections. These end sections do not have O-ring grooves.


80D9 MCV05(4)

(5) Position valve assembly with the mounting pads of the end sections on a flat surface. To obtain proper alignment of end sections relative to the spool sections apply downward pressure to the end sections ; Snug tie rod nuts to about 10lbf · ft.
Final torque the two 11/16 nuts to 48±5 lbf·ft ; Final torque the 3/4 nut to 74±8 lbf·ft. Check for proper spool movement.


80D9 MCV06(1)

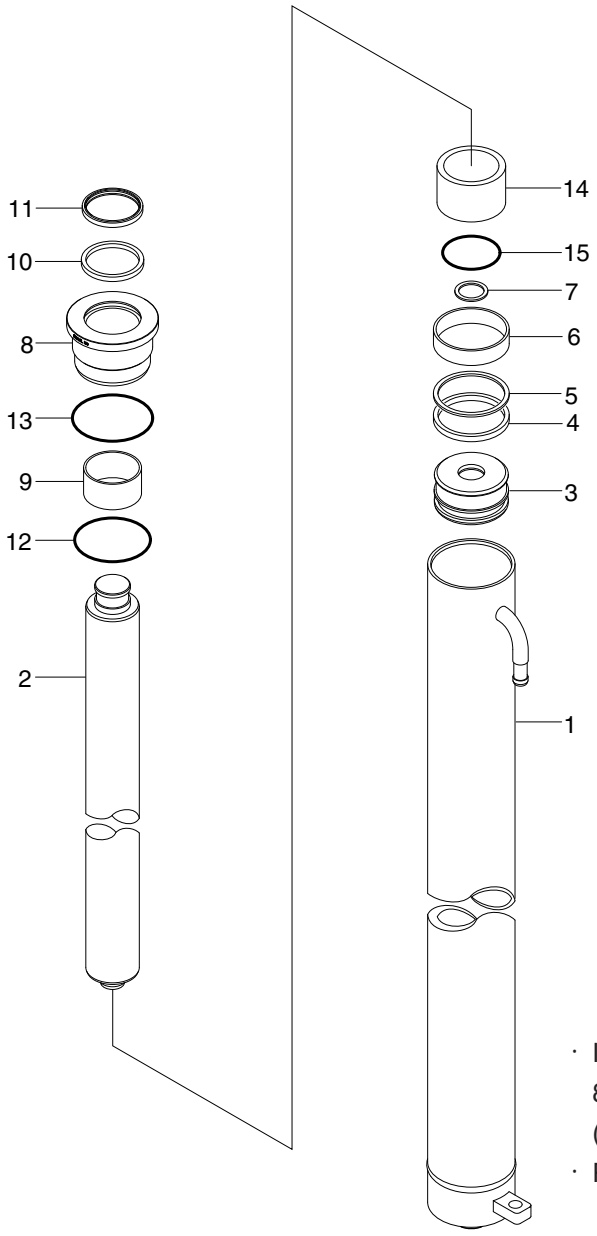
(6) Install auxiliary valves and plugs and torque to proper specifications.
General assembly notes:
A. Lever assemblies can be installed on section before or after complete valve assembly.
B. The load check and spring may be omitter from assembly in certain circuit conditions (i.e., motor spools).


7406S MCV06(2)

3. LIFT CYLINDER

1) STRUCTURE

(1) V-mast

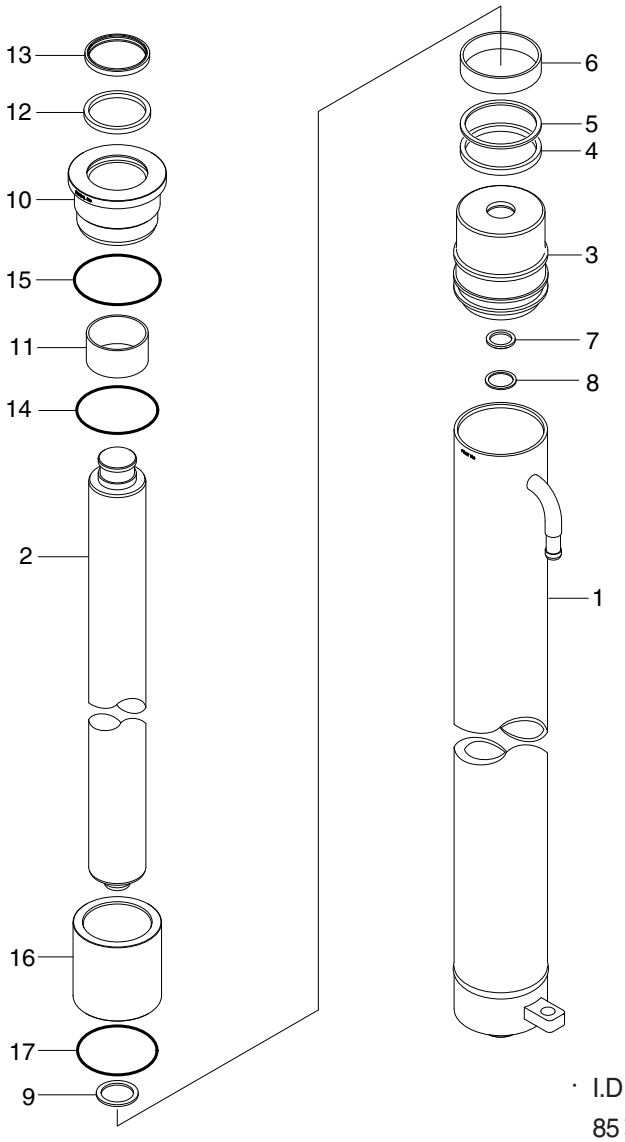


· I.D × O.D × stroke (standard)
85 × 98 × 1475 mm
(3.3 × 3.9 × 58.1 in)
· Rod O.D : 60 mm (2.4 in)

3YFJ-07020P

1	Tube assy	6	Wear ring	11	Wiper ring
2	Rod	7	Stop ring	12	O-ring
3	Piston	8	Rod cover	13	O-ring
4	U-packing	9	Rod bushing	14	Spacer
5	Back up ring	10	U-packing	15	O-ring

(2) TS-mast

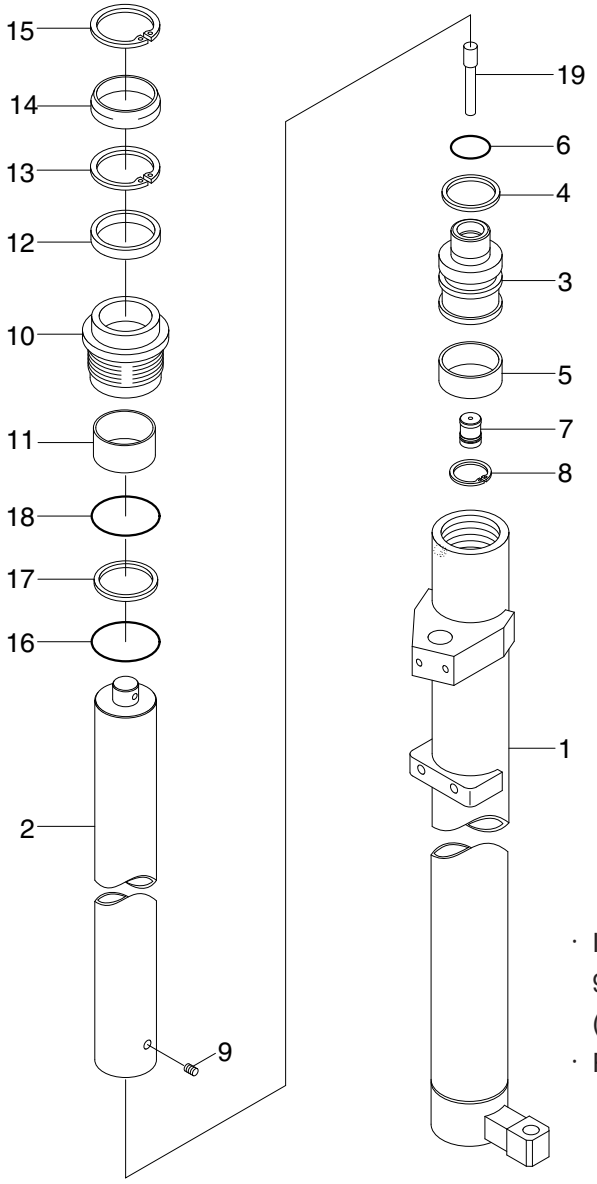


· I.D × O.D × stroke (standard)
85 × 98 × 1463 mm
(3.3 × 3.9 × 57.6 in)
· Rod O.D : 60 mm (2.4 in)

3YFJ-07210P

1	Tube assy	7	Cushion ring	13	Wiper ring
2	Rod	8	Retainer ring	14	O-ring
3	Piston	9	Stop ring	15	O-ring
4	U-packing	10	Rod cover	16	Spacer
5	Back up ring	11	Rod bushing	17	O-ring
6	Wear ring	12	U-packing		

(3) Free lift (TS-mast)



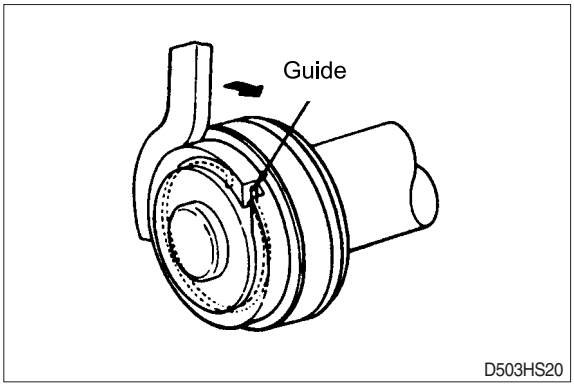
· I.D × O.D × stroke (standard)
95 × 108 × 767 mm
(3.7 × 4.3 × 30.2 in)
· Rod O.D : 70 mm (2.8 in)

3YFJ-17110P

1	Tube assy	8	Retaining ring	15	Retaining ring
2	Rod	9	Set screw	16	O-ring
3	Piston	10	Rod cover	17	Backup ring
4	Piston seal	11	Rod bushing	18	O-ring
5	Wear ring	12	U-packing	19	Pipe
6	O-ring	13	Backup ring		
7	Check valve	14	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.



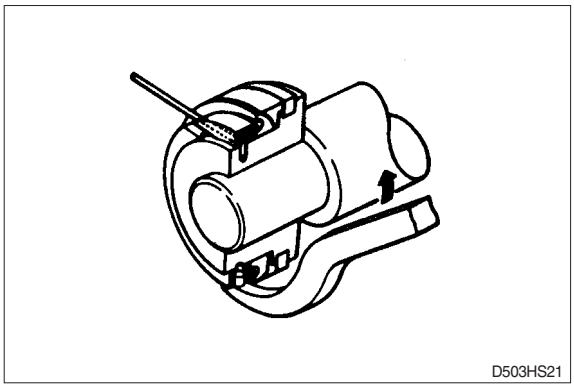
3) CHECK AND INSPECTION

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

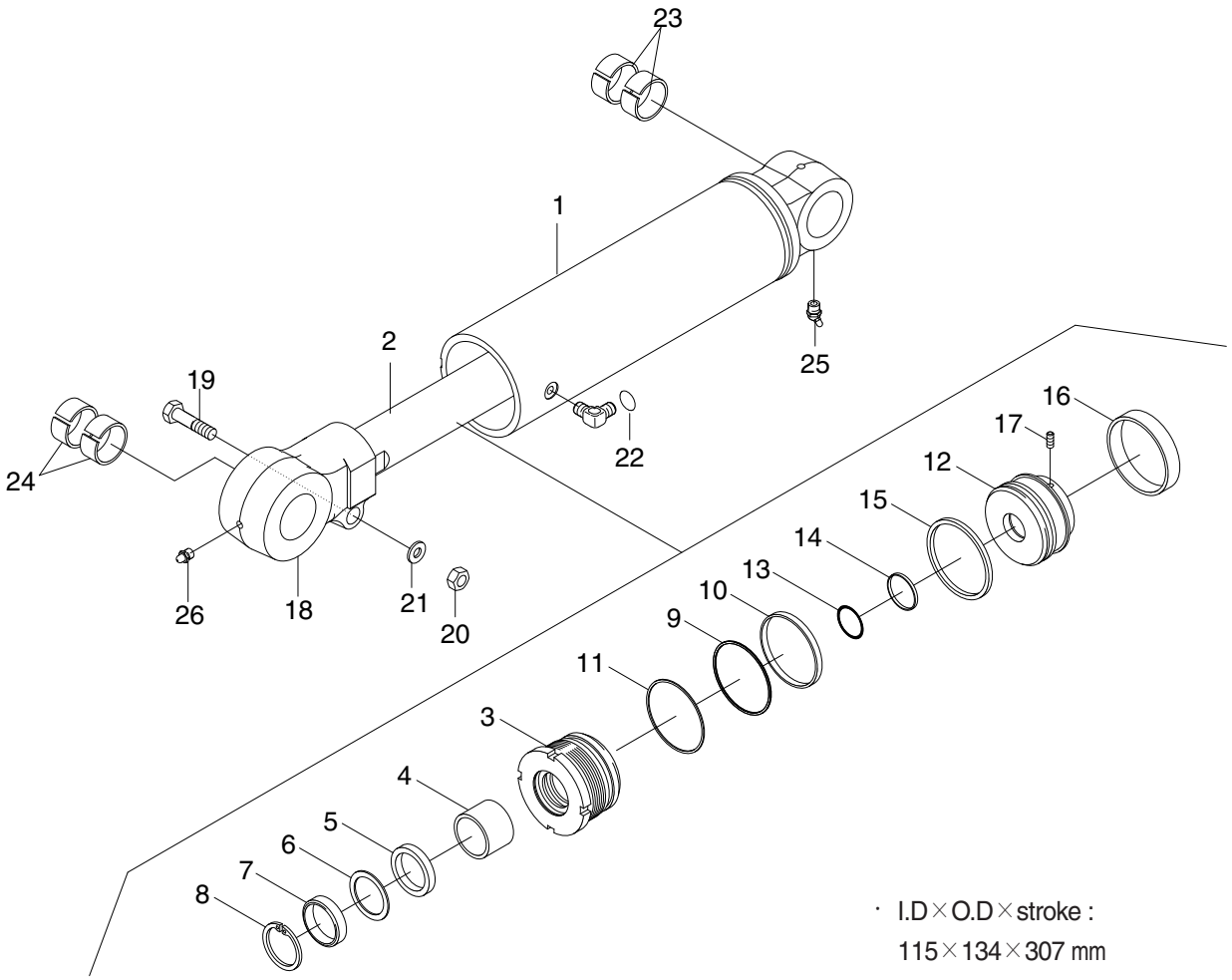
4) ASSEMBLY

(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.



4. TILT CYLINDER

1) STRUCTURE



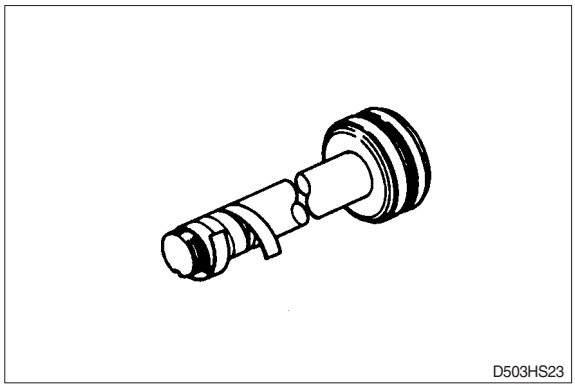
- I.D × O.D × stroke :
  115 × 134 × 307 mm
  (4.5 × 5.3 × 12.1 in)
- Rod O.D : 60 mm (2.36 in)

3YFJ-08500P

1	Tube assy	10	Back up ring	19	Hex bolt
2	Rod	11	O-ring	20	Hex nut
3	Rod cover	12	Piston	21	Spring washer
4	Pin bushing	13	O-ring	22	O-ring
5	U-packing	14	Back up ring	23	Pin bushing
6	Back up ring	15	Piston seal	24	Pin bushing
7	Wiper ring	16	Wear ring	25	Grease nipple
8	Stop ring	17	Set screw	26	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