SECTION 6 HYDRAULIC SYSTEM

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GROUP 1 STRUCTURE AND FUNCTION

1. HYDRAULIC SYSTEM OUTLINE

The hydraulic system is a pilot operated, closed center system which is supplied with flow from the variable displacement main hydraulic pump.
The pilot control system is a low pressure, system which is supplied with flow from the auxiliary pump.

The attachment system components are :

- Main pump
- Auxiliary pump
- Main control valve
- Lift cylinders
- Tilt cylinders
- Remote control valve (Pilot control valve)
- OPSS solenoid valve
- Cut-off valve

The oil from the B2 main pump via the priority spool built in the main control valve is combined with oil from the B1 main pump by parallel passage and flows the main control valve.

The main control valve is a parallel circuit type, closed center valve which routes flow to the lift, tilt and or auxiliary cylinders when the respective spools are shifted.

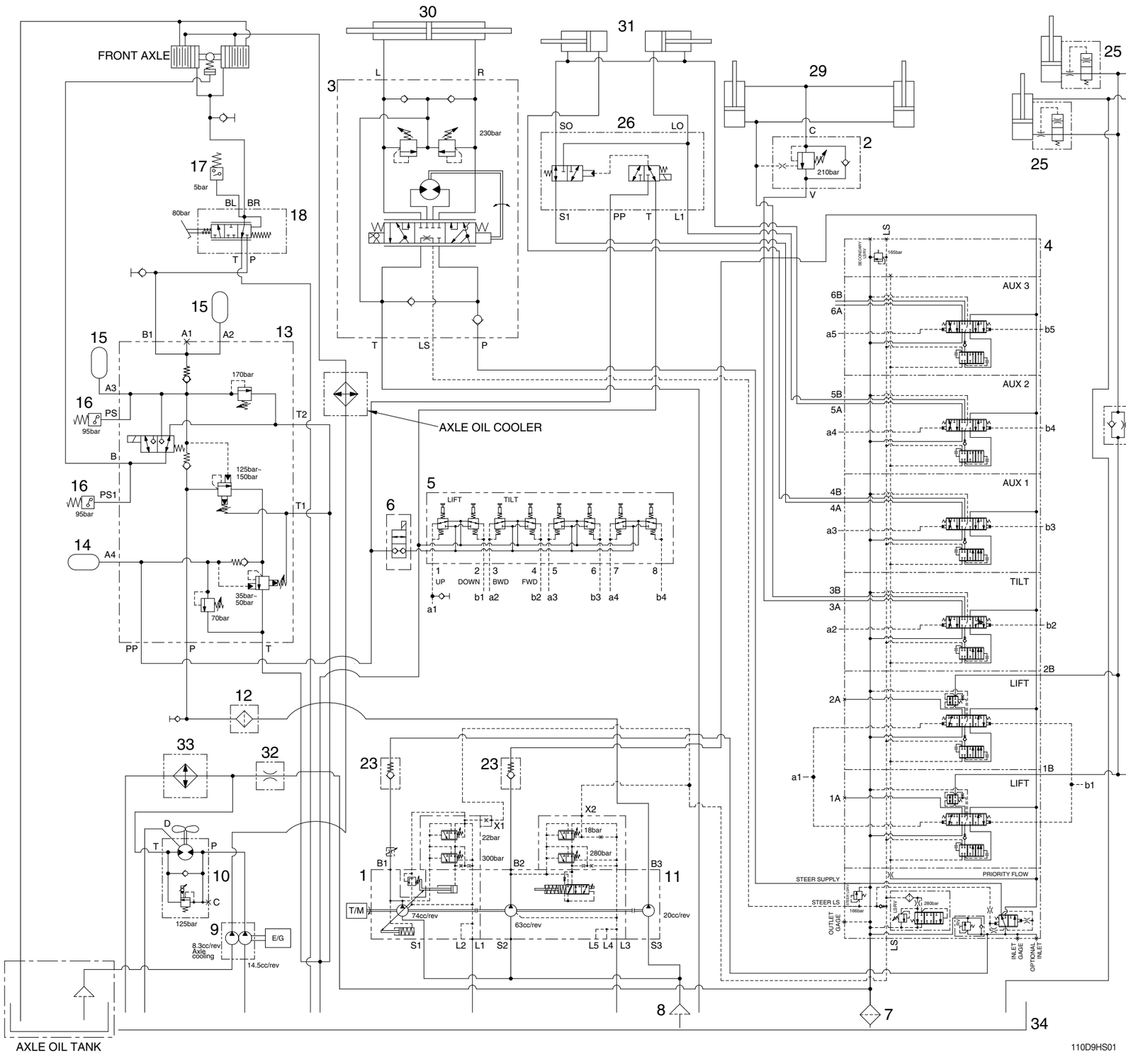
Flow from the brake pump is routed to the cut-off valve that charges the pressure in accumulators. After charging the pressure in accumulators for braking, the flow gose to accumulators for RCV. The cut-off valve flow either to the brake valve or to the remote control valve.
The remote control valve routed flow to either end of each spool valve section in the main control valve to control spool stroke.

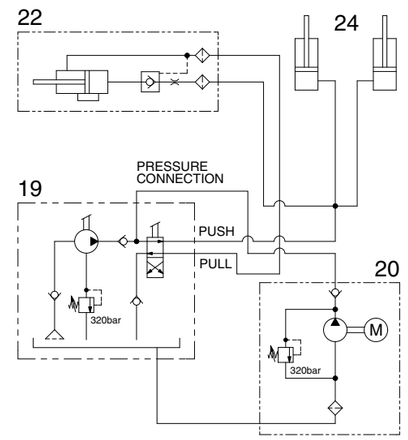
A accumulator mounted on the cut-off valve supplies a secondary pressure source to operate remote control valve so the mast can be lowered if the engine is off.

The return circuit for the main hydraulic system have return filter inside the hydraulic tank.
The return filter uses a filter element and a bypass valve.

2. HYDRAULIC CIRCUIT

· REMOTE CONTROL LEVER TYPE

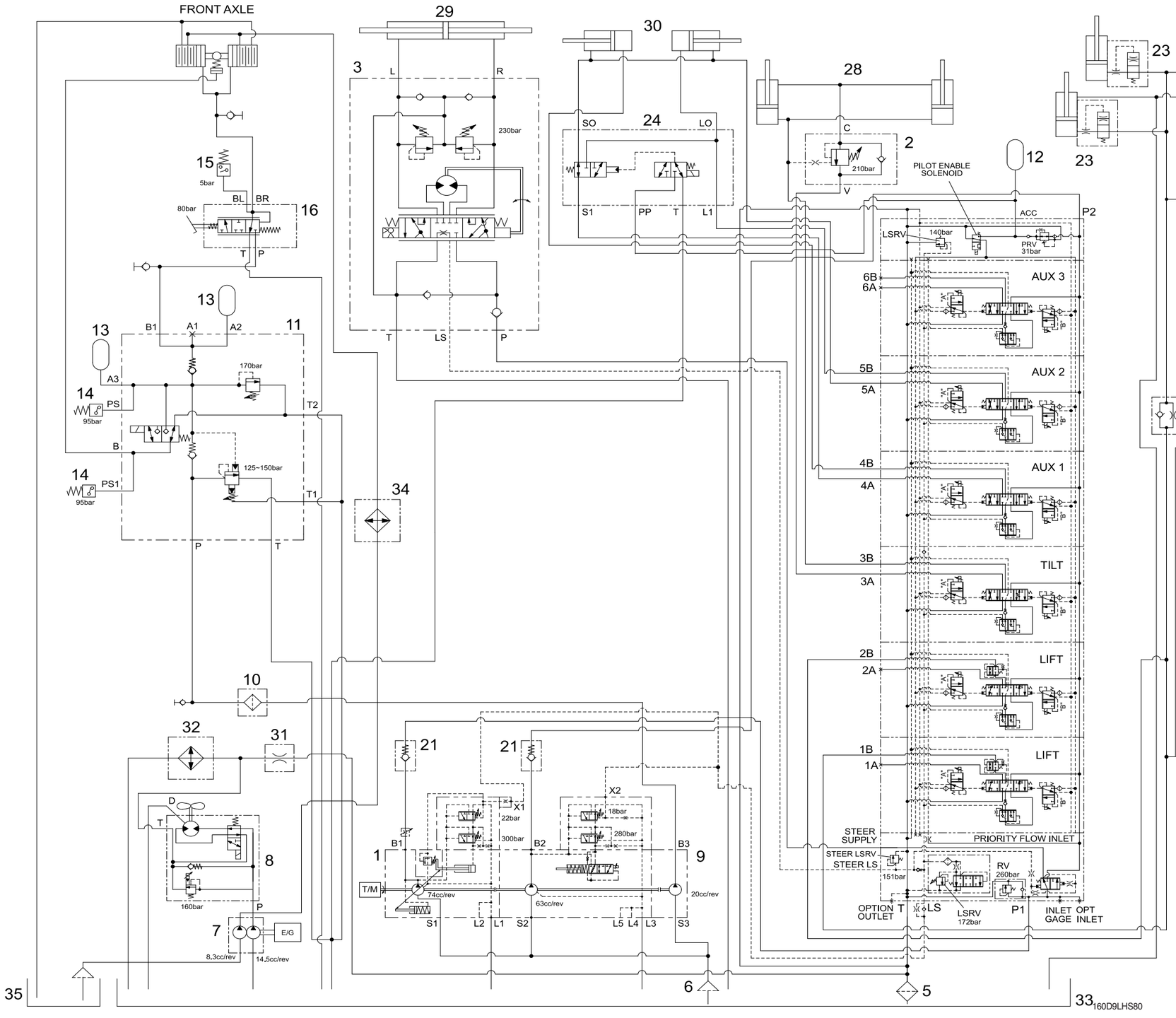




TILTING CABIN HYDRAULIC CIRCUIT

1	Main pump	19	Cabin tilt hand pump
2	Tilt lock valve	20	Cabin tilt electric pump
3	Steering unit	21	Down control valve
4	Main control valve	22	Cabin tilt cylinder
5	Remote control valve	23	Check valve
6	OPSS solenoid valve	24	Latch
7	Return filter	25	Down safety valve
8	Suction strainer	26	Solenoid valve
9	Fan drive pump	27	Lift cylinder
10	Fan drive motor	28	Free lift cylinder
11	Brake pump	29	Tilt cylinder
12	Line filter	30	Steering cylinder
13	Cut-off valve	31	Fork positioner cylinder
14	Accumulator	32	Orifice
15	Accumulator	33	Hydraulic oil cooler
16	Pressure switch	34	Hydraulic oil tank
17	Pressure switch		
18	Brake valve		

· FINGERTIP TYPE

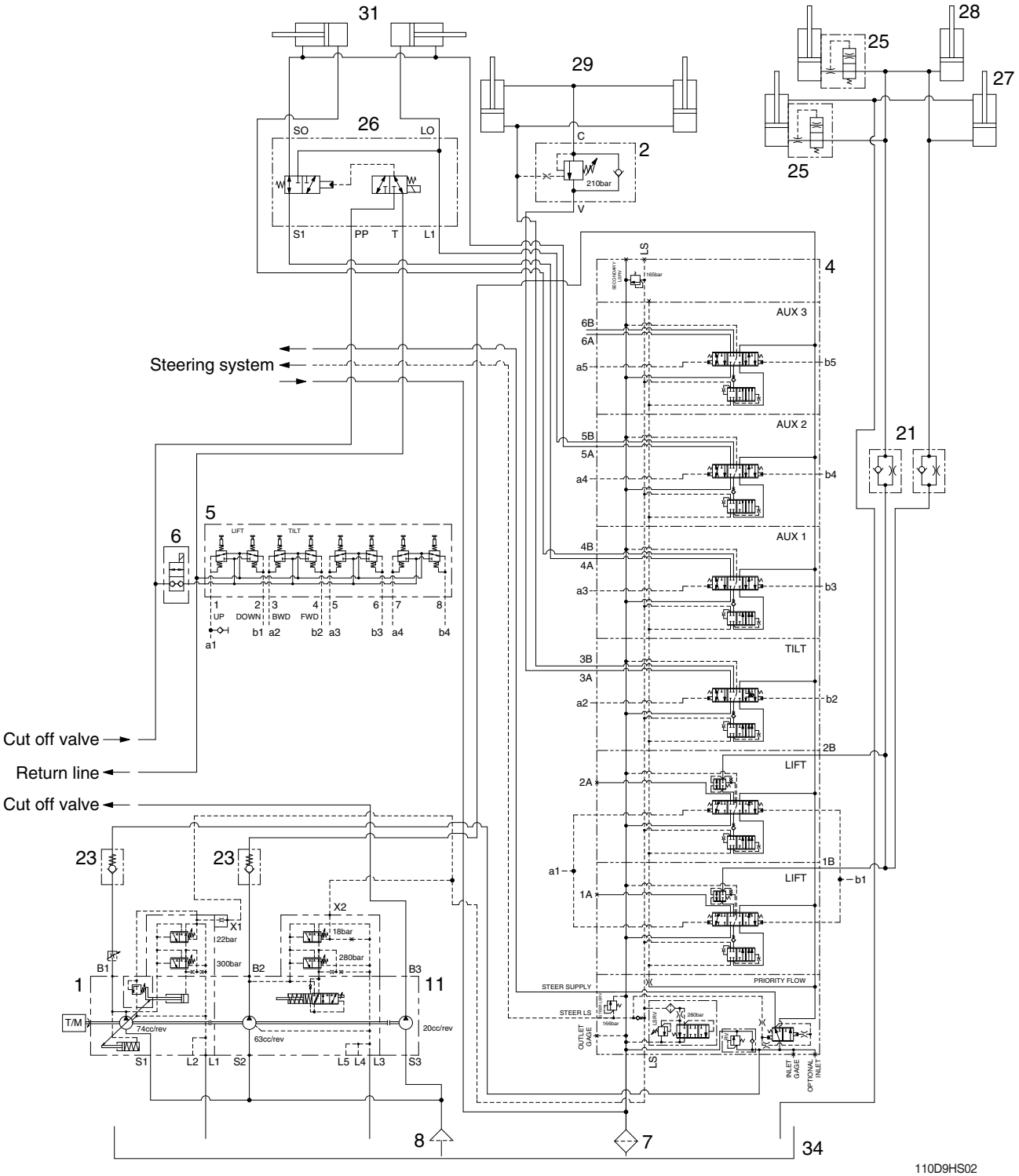


CABIN TILTING HYDRAULIC CIRCUIT

1	Main pump	19	Down control valve
2	Tilt lock valve	20	Cabin tilt cylinder
3	Steering unit	21	Check valve
4	Main control valve	22	Latch
5	Return filter	23	Down safety valve
6	Suction strainer	24	Side shift Solenoid valve
7	Fan drive pump	25	Accumulator
8	Fan drive motor	26	Lift cylinder
9	Brake pump	27	Free lift cylinder
10	Line filter	28	Tilt cylinder
11	Cut-off valve	29	Steering cylinder
12	Accumulator	30	Fork positioner cylinder
13	Accumulator	31	Orifice
14	Pressure switch	32	Hydraulic oil cooler
15	Pressure switch	33	Hydraulic oil tank
16	Brake valve	34	Axle oil cooler
17	Cabin tilt hand pump	35	Axle oil tank
18	Cabin tilt electric pump		

3. WORK EQUIPMENT HYDRAULIC CIRCUIT

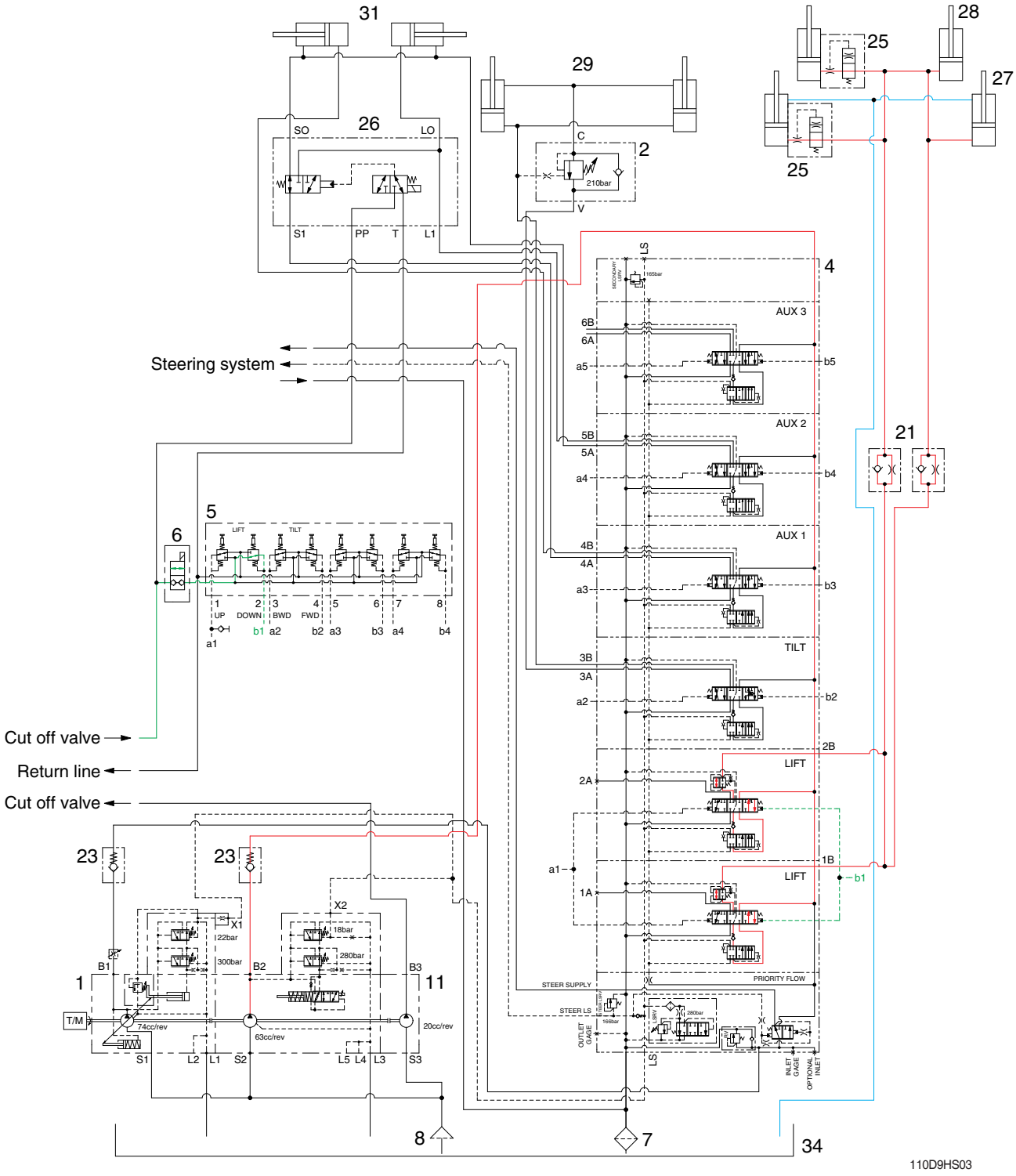
※ The operating explain is based on the remote control lever type.



1	Main pump	11	Brake pump	27	Lift cylinder
2	Tilt lock valve	21	Down control valve	28	Free lift cylinder
4	Main control valve	23	Check valve	29	Tilt cylinder
5	Remote control valve	25	Down safety valve	31	Fork positioner cylinder
6	OPSS solenoid valve	26	Side shift solenoid valve (160D-9 only)	34	Hydraulic oil tank
7	Return filter				
8	Suction strainer				

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

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



110D9HS03

When the lift control lever is pulled back, the spool is moves to lift position by the pilot oil pressure from the remote control valve (5).

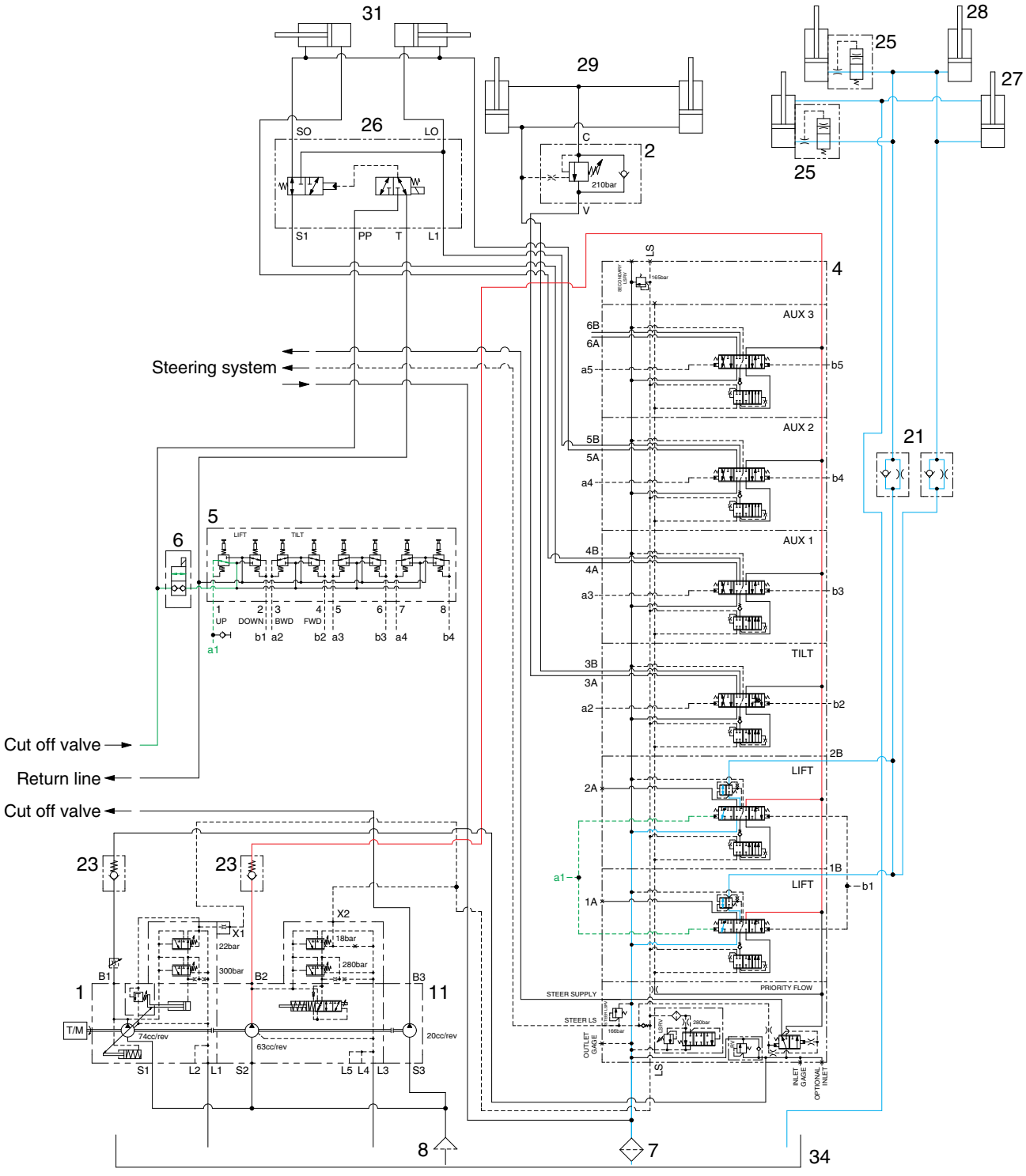
The oil from hydraulic main pump (1) flows into main control valve (4) and then goes to the large chamber of lift cylinder (27) by pushing the load check valve of the spool.

The oil from the small chamber of lift cylinder (27) returns to hydraulic oil tank (34) 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



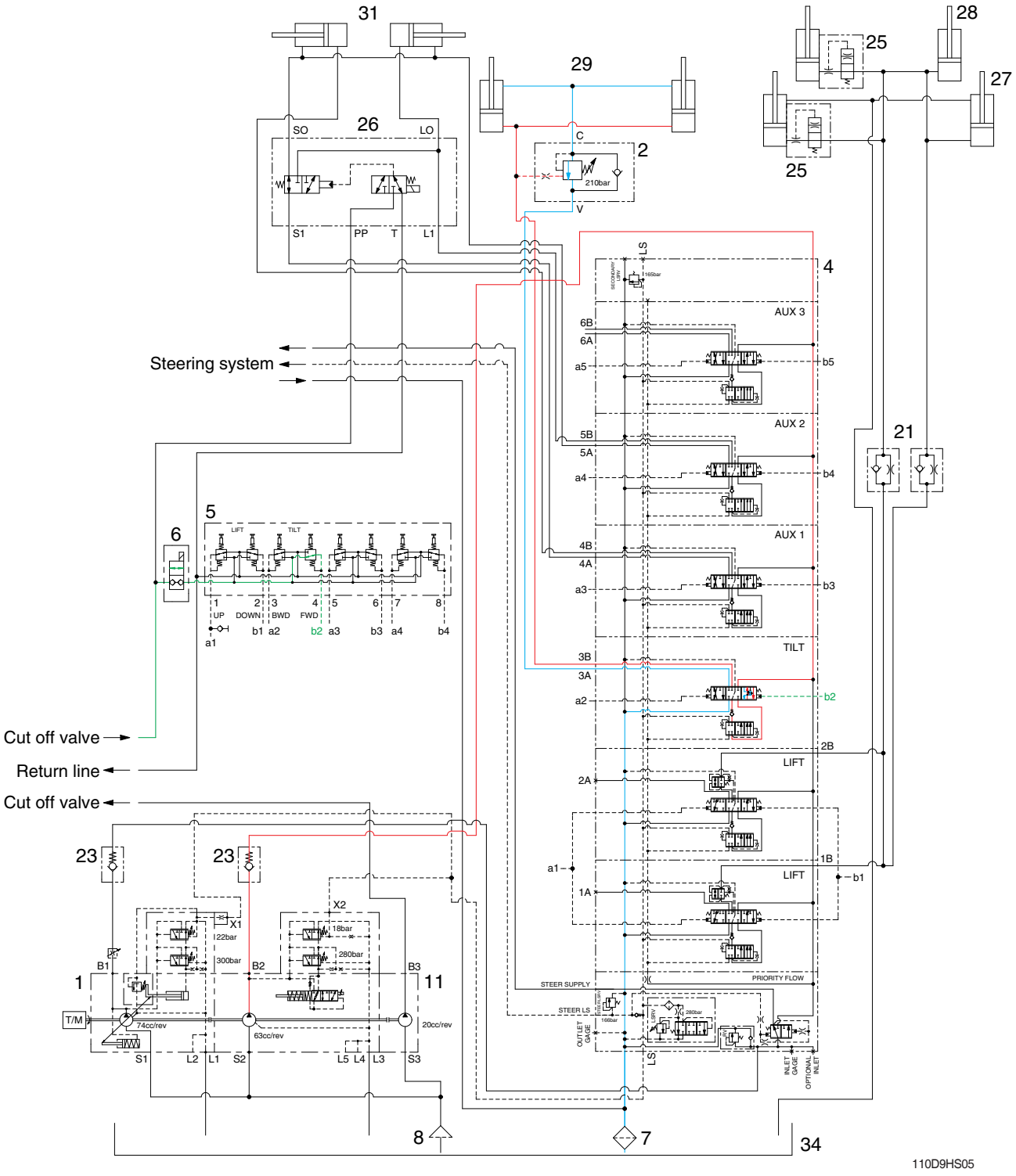
110D9HS04

When the lift control is pushed forward, the spool is moved to lower position by the pilot oil pressure from the remote control valve (5).

The work ports (1B, 2B) 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.

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



When the tilt control lever is pushed forward, the spool is moved to tilt forward position by the pilot oil pressure from the remote control valve (5).

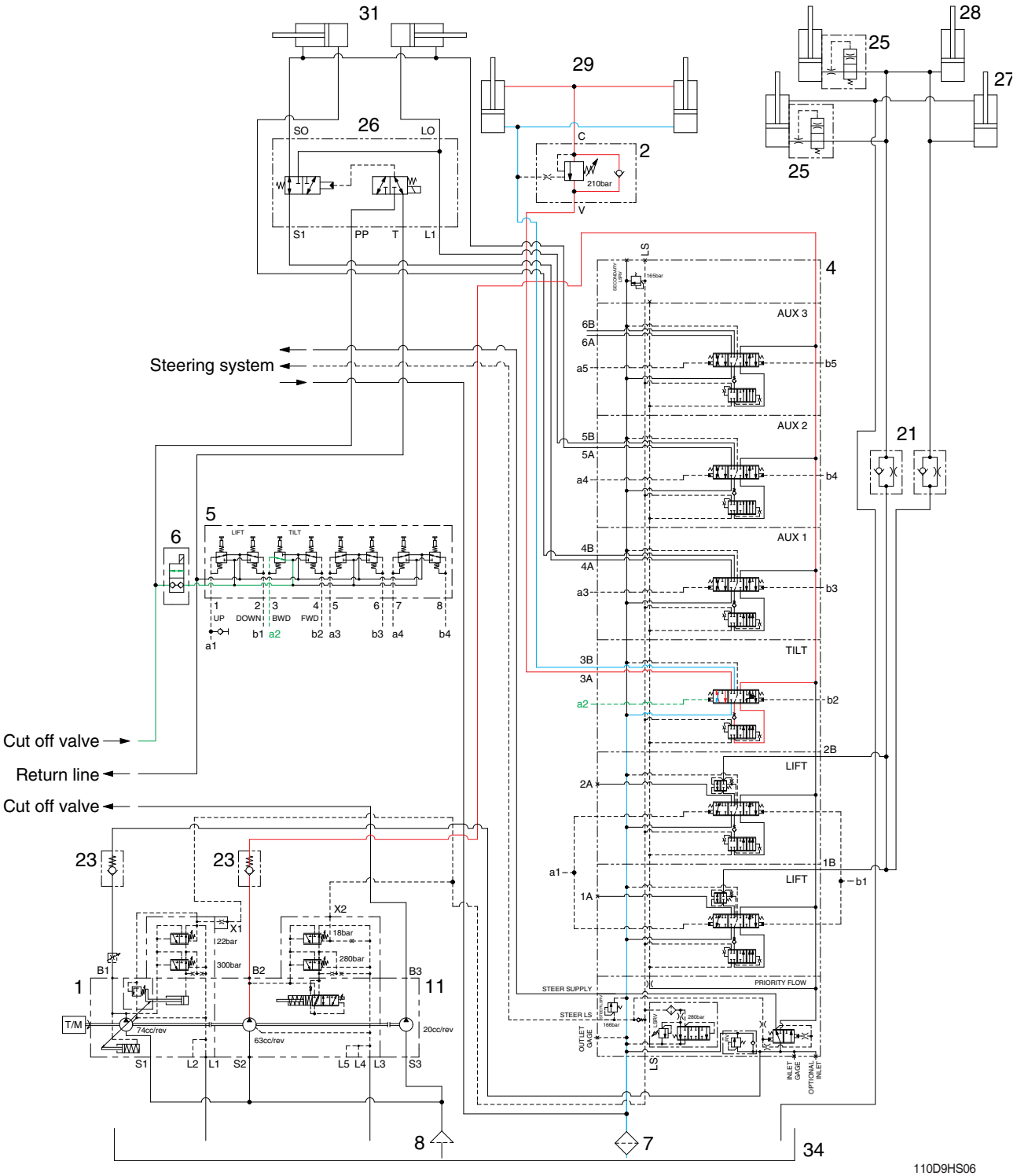
The oil from hydraulic main pump (1) flows into main control valve (4) and then goes to the large chamber of tilt cylinder (29) by pushing the load check valve of the spool.

The oil at the small chamber of tilt cylinder (29) returns to hydraulic tank (34) 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 is moved to tilt backward position by the pilot oil pressure from the remote control valve (5).

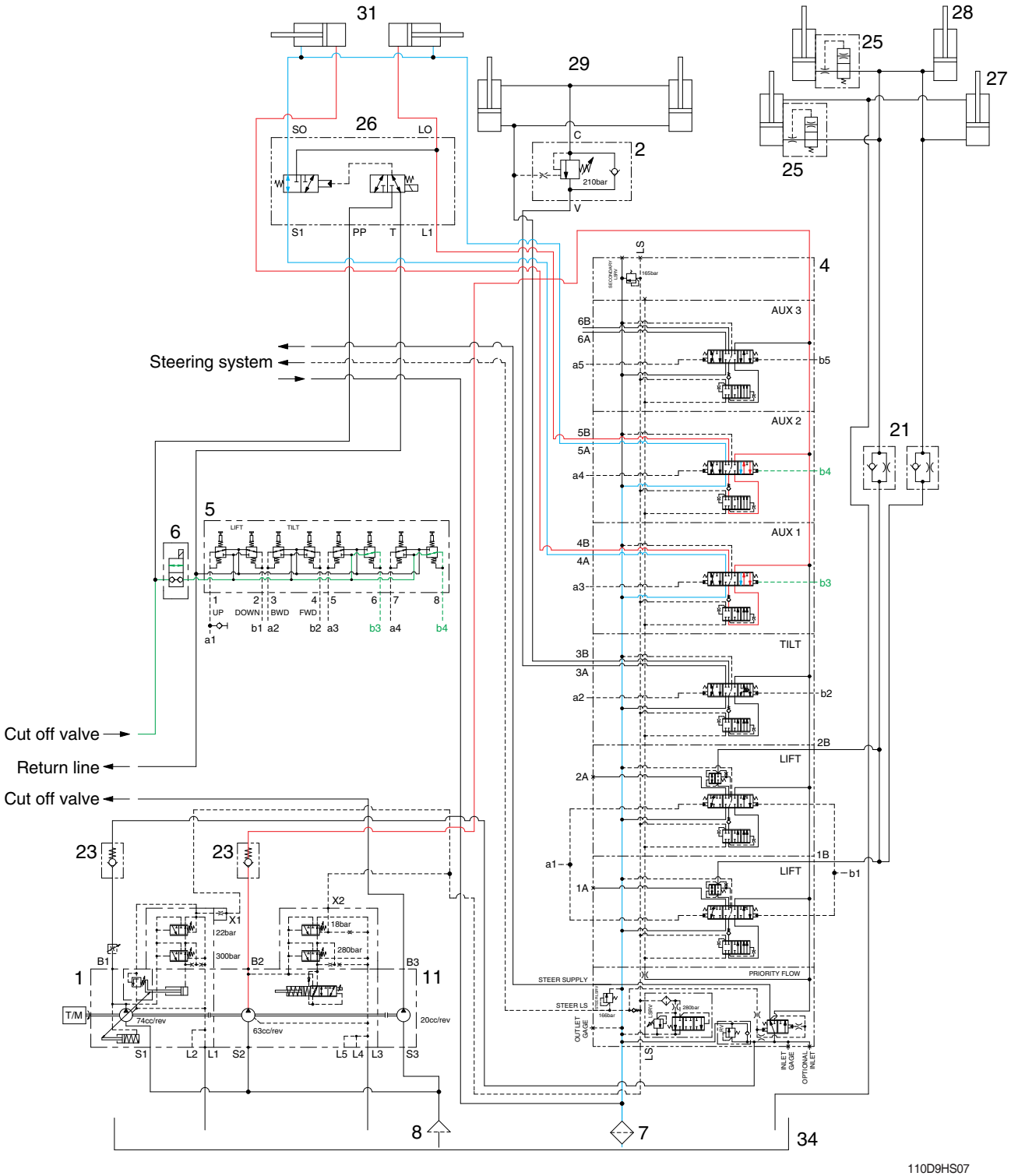
The oil from hydraulic main pump (1) flows into main control valve (4) and then goes to the small chamber of tilt cylinder (29) by pushing the load check valve of spool.

The oil at the large chamber of tilt cylinder (29) returns to hydraulic tank (34) 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)

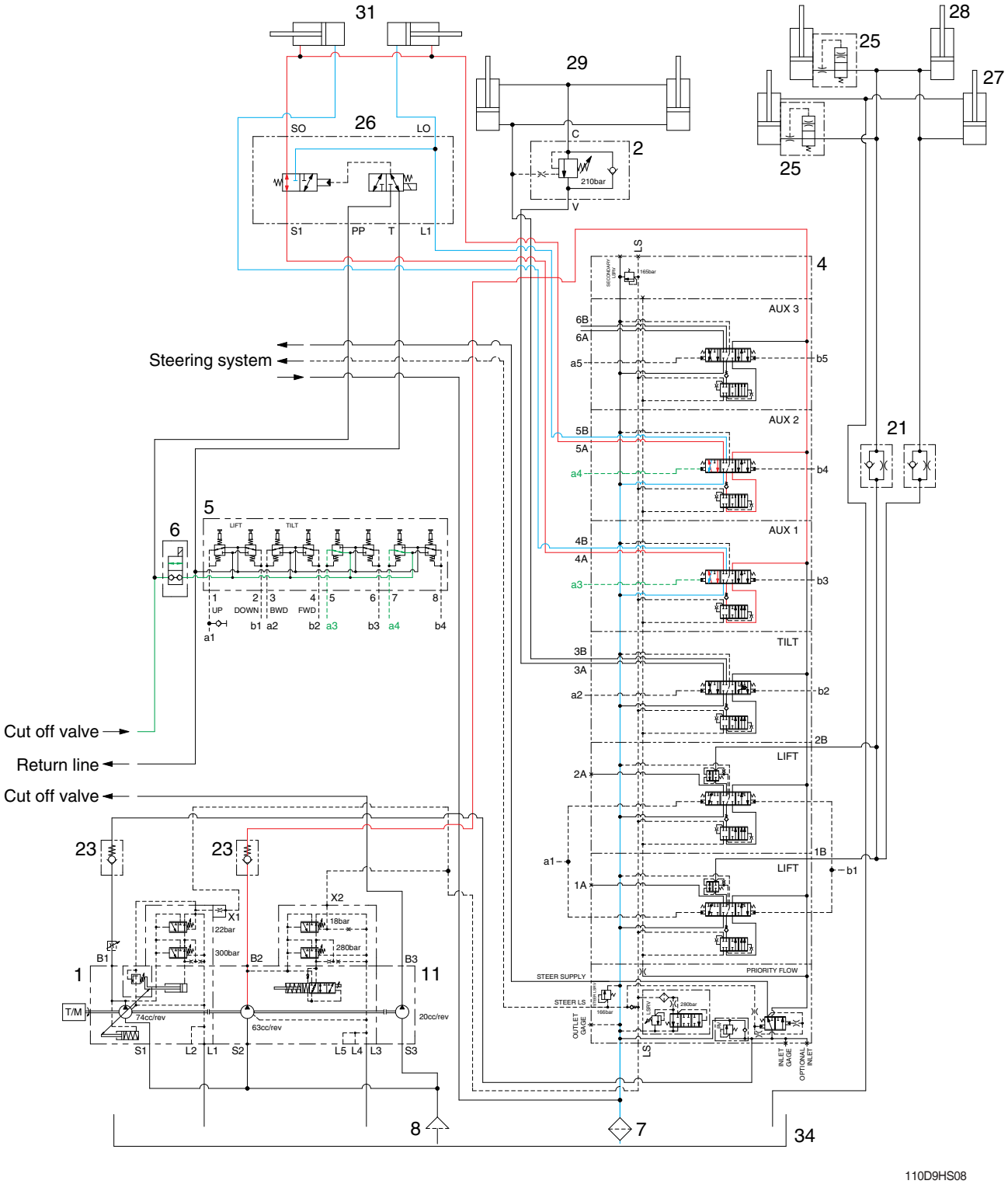


110D9HS07

When the fork positioner lever is pulled back, the spool is moved to fork spread-out position by the pilot oil pressure from the remote control valve (5). The oil from hydraulic main pump (1) flows into main control valve (4) and then goes to the large chamber of fork positioner cylinder (31) by pushing the load check valve of the spool. The oil from small chamber of the cylinder (31) returns to hydraulic oil tank (34) 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)



110D9HS08

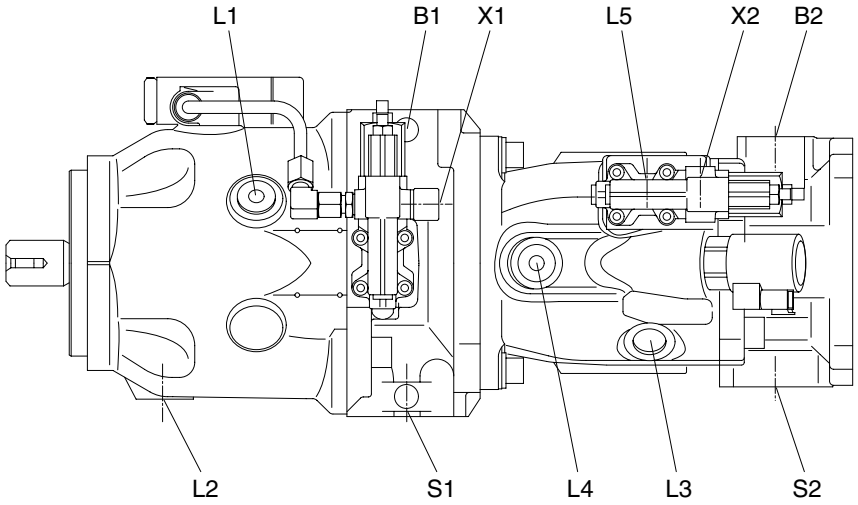
When the fork positioner lever is pushed forward, the spool is moved to fork close position by the pilot oil pressure from the remote control valve (5). The oil from hydraulic main pump (1) flows into main control valve (4) and then goes to the small chamber of fork positioner cylinder (31) by pushing the load check valve of the spool. The oil from large chamber of the cylinder (31) returns to hydraulic oil tank (34) at the same time. When this happens, the forks are close each other.

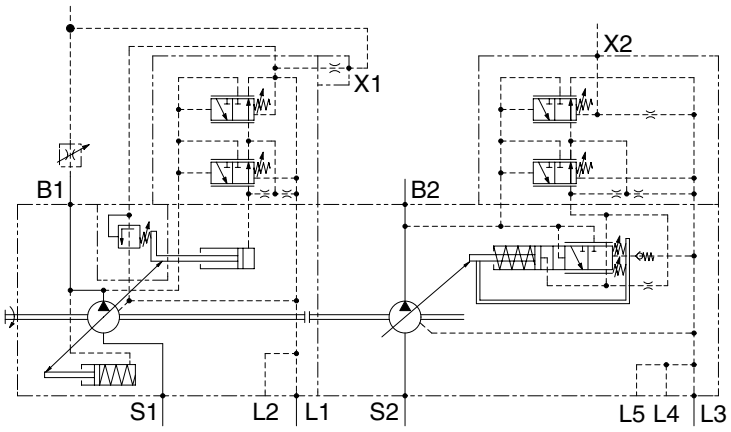
※ The circuit diagram may differ from the equipment, so please check before a repair.

4. MAIN PUMP

1) STRUCTURE (1/2)

This variable displacement piston pump consists of steering pump and working pump.

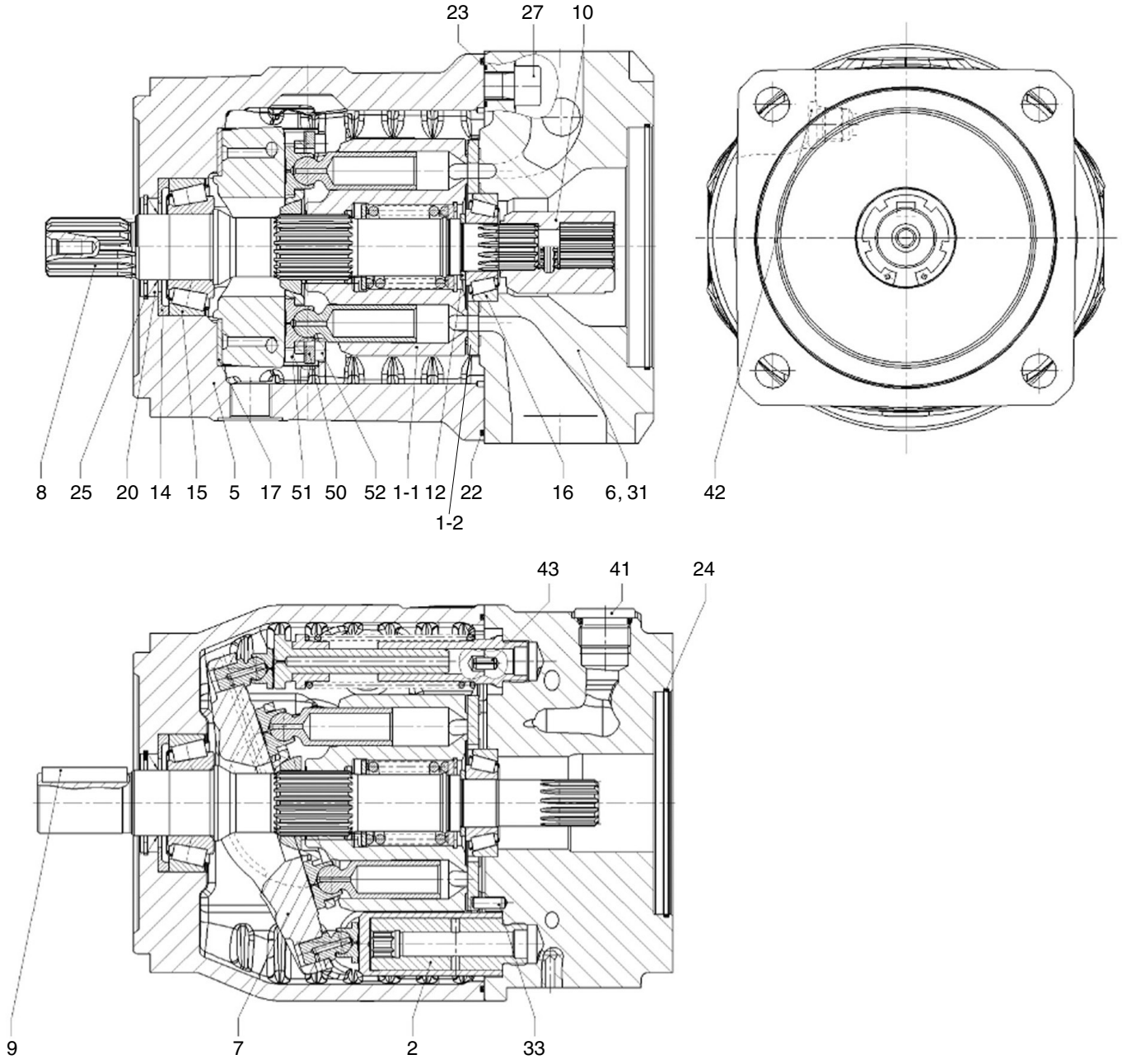




110D9MP04

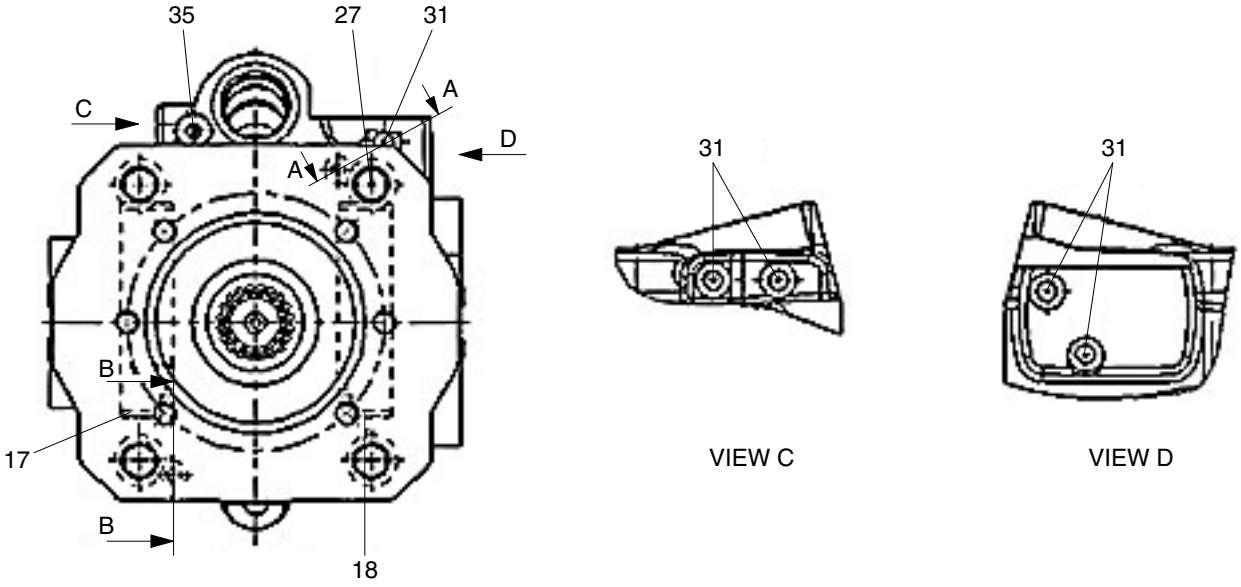
Port	Port name	Size
B1	Pressure port	SAE 1"
B2	Pressure port	SAE 1"
S1	Suction port	SAE 2"
S2	Suction port	SAE 2"
L1, L2	Case drain port	7/8-14UNF-28
L3, L4	Case drain port	7/8-14UNF-28
X1, X2	Pilot pressure port	7/16-20UNF-28

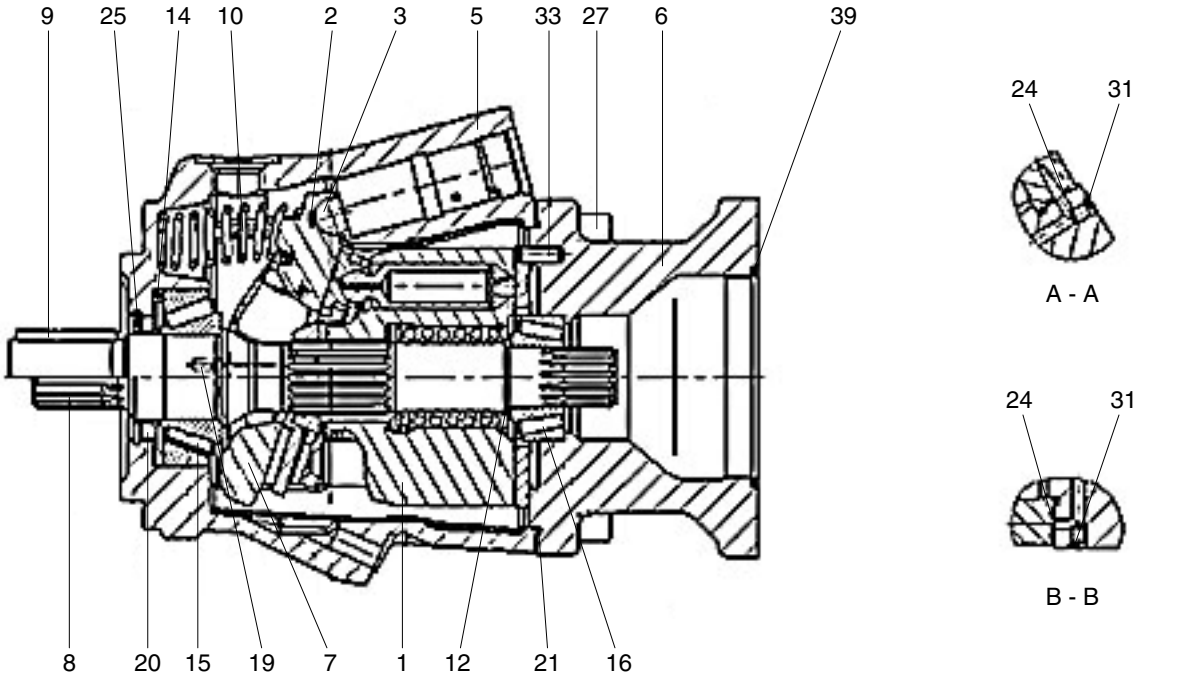
· FRONT PUMP



1-1	Rotary group	14	Stop ring	31	Double break off pin
1-2	Control plate	15	Taper roller bearing	33	Cylinder pin
2	Adjusting piece	16	Taper roller bearing	41	Plug
5	Pump housing	17	Bearing liner	42	Plug
6	Port plate	20	Shaft seal ring	43	Plug
7	Swash plate	22	O-ring	50	Segment
8	Drive shaft	23	O-ring	51	Spacer sleeve
9	Key	24	O-ring	52	Socket screw
10	Splined hub	25	Retaining ring		
12	Shim	27	Socket screw		

· REAR PUMP

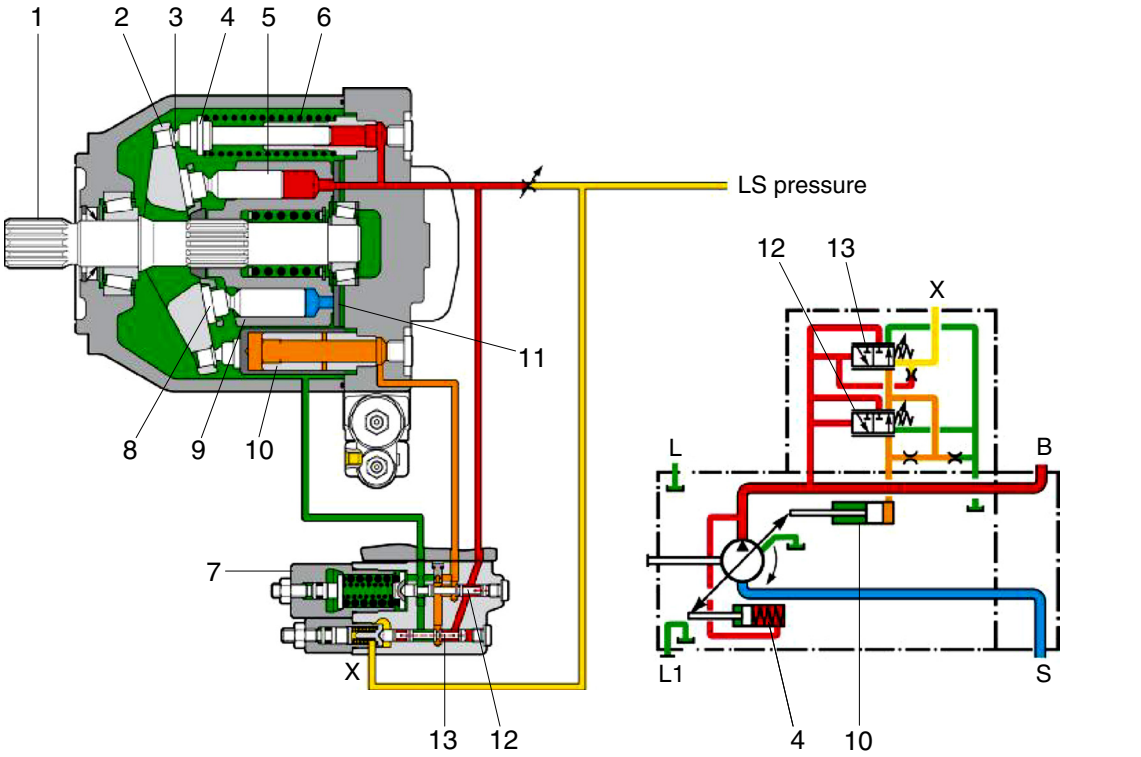




110D9MP02

1	Rotary group	12	Shim	21	O-ring
2	Pressure spring	14	Stop ring	24	Seal ring
3	Stop	15	Taper roller bearing	25	Retaining ring
5	Pump housing	16	Taper roller bearing	27	Socket screw
6	Port plate	17	Bearing liner	31	Double break off pin
7	Swash plate	18	Bearing liner	33	Cylinder pin
8	Drive shaft	19	Socket screw	35	Locking screw
10	Spring	20	Shaft seal ring	39	O-ring

2) FUNCTION



75796WE33

1	Drive shaft	6	Counter spring	11	Control plate
2	Swash plate	7	Pressure & flow compensator valve	12	Pressure compensator spool
3	Shoe plate	8	Piston shoe	13	Flow compensator spool
4	Counter piston	9	Cylinder		
5	Piston	10	Control piston		

The steering pump and attachment pump are variable displacement piston pump. The steering pump and attachment pump are flow controlled by LS signal. When the steering and attachment are not being used, the pumps are at low pressure standby.

The load sensing pressure that is sensed from steering and attachment hydraulic systems flows to flow compensator spool (13). This spool keeps the pump output at a level that is necessary to fulfill the requirements for the system flow and for the pressure.

The pressure compensator spool (12) also limits maximum system pressure. The pressure compensator spool (12) prevents damage to the steering and attachment hydraulic components from excessive pressure.

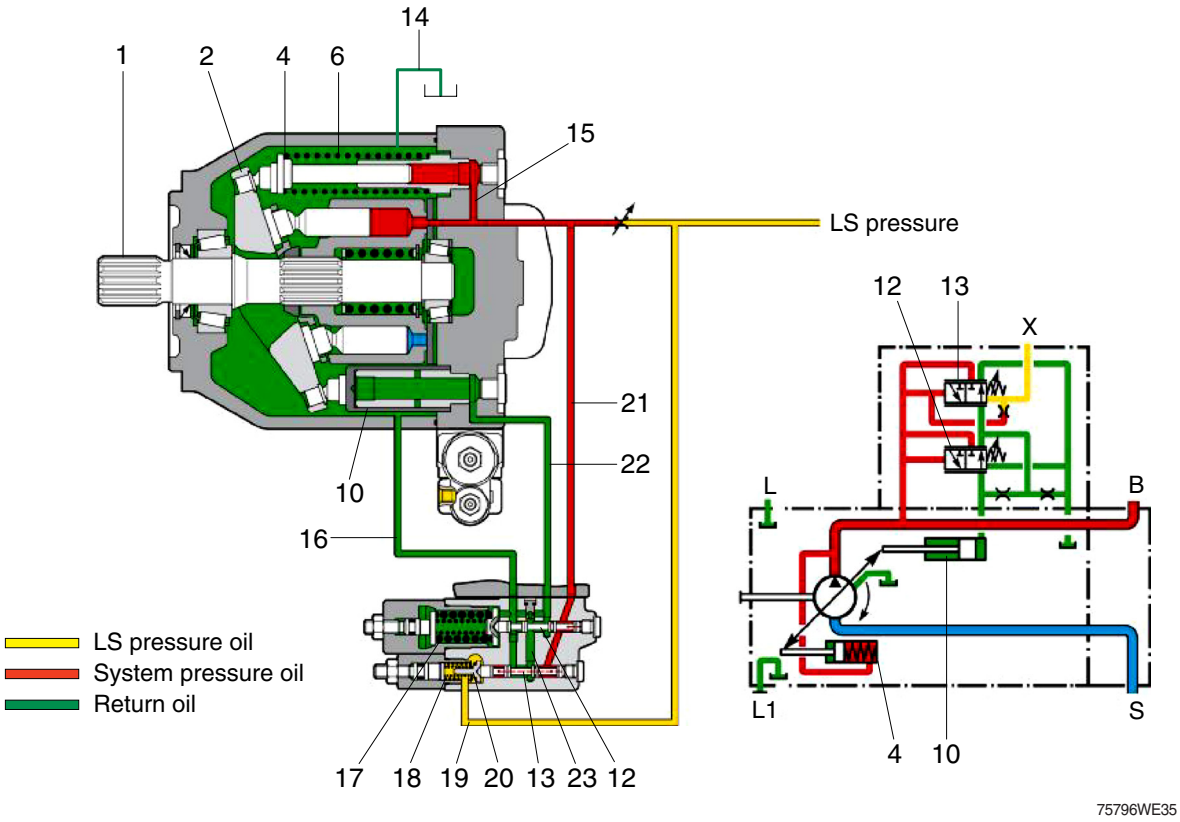
The swivel angle of the pumps is controlled by counter piston (4) and control piston (10). Counter spring (6) cause swash plate (2) to move at maximum displacement or causes swash plate (2) to upstroke.

Control piston (10) has a larger area (diameter) than counter piston (4). Control piston (10) causes swash plate (2) to destroke the pump.
Flow compensator spool (13) and/or pressure compensator spool (12) changes pump output by regulating the pump discharge pressure that is acting on control piston (10).

Control piston (10) diameter is larger than counter piston (4) diameter, the oil pressure that is acting against control piston (10) overcomes the force of counter spring (6). The oil pressure than causes the pump to destoke.

Pressure and flow compensator valve (7) also controls the maximum output of pump pressure. When steering and loader pressure rises above pressure compensator setting, pressure compensator spool (12) overrides flow compensator spool (13). This causes the pump to destroke.

(1) Upstroking



1	Drive shaft	13	Flow compensator spool	19	LS line from the metering pump
2	Swash plate	14	Case drain	20	Cavity
4	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		

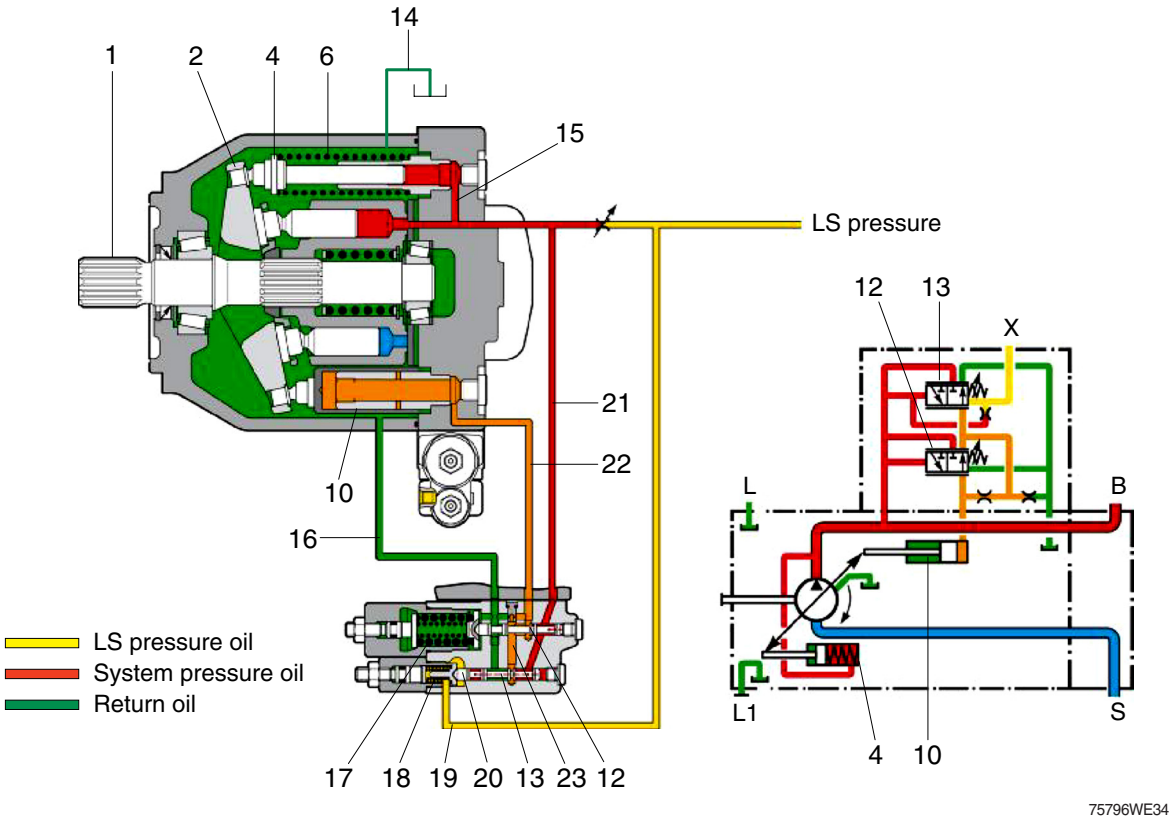
Upstroking of the pump occurs as flow demand from attachment and steering system.
The increased flow demand causes a LS pressure in LS line (19). The LS pressure in LS line (19) combines with the force of spring (18) in cavity (20).
The force of spring (18) causes pump pressure to be higher than the 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.
¡¤Pump discharge pressure = force of spring (18) + LS pressure (19)

(2) Destroking



1	Drive shaft	13	Flow compensator spool	19	LS line from the metering pump
2	Swash plate	14	Case drain	20	Cavity
4	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		

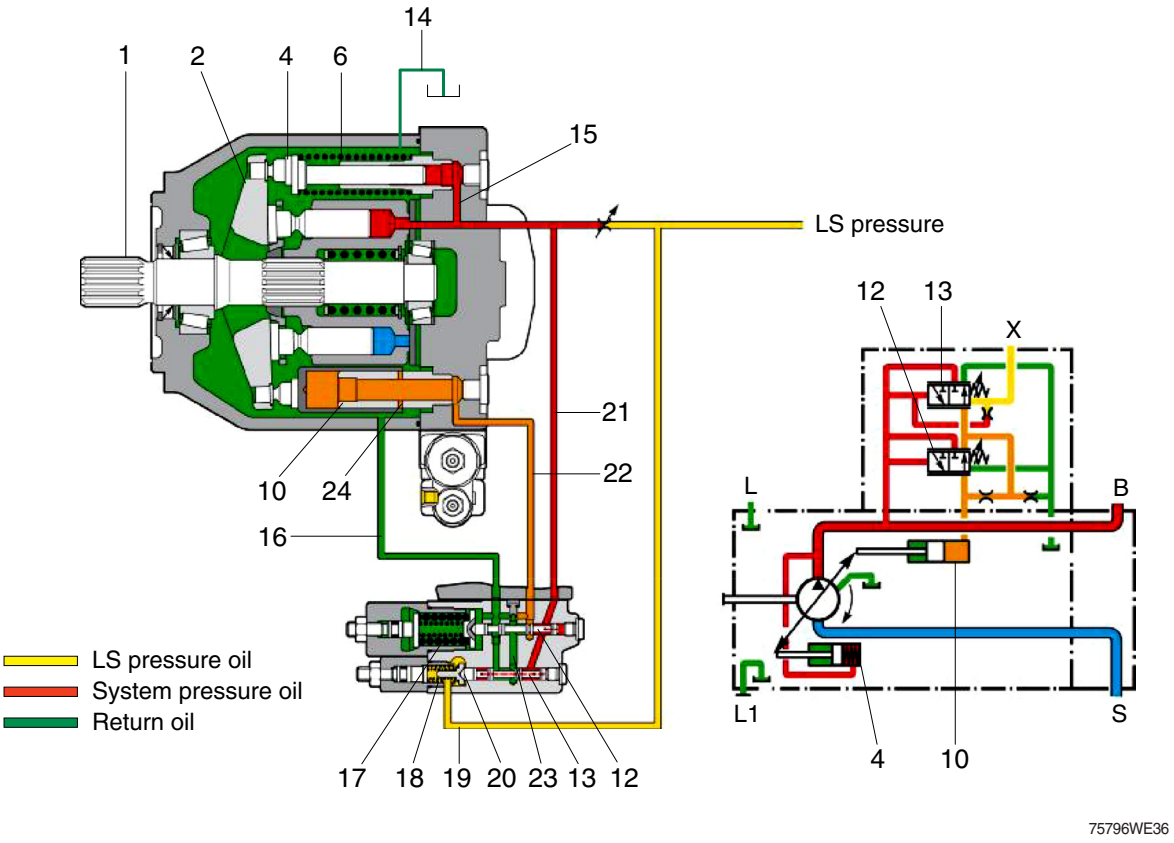
The decreased flow demand causes a LS pressure in line (19). The LS pressure in line (19) combines with the force of spring (18) in cavity (20).
This combination of LS pressure and of spring force is less than the pump pressure in passage (21). This causes flow compensator spool (13) to move left.
Pump 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 RCV, then the pump will return to low pressure standby.

※ Control piston ¡æ Changes pump displacement ; influenced by controller.
Counter piston ¡æ Helps to change pump displacement but no possible to control this piston.

(3) Low pressure standby



1	Drive shaft	13	Flow compensator spool	19	LS line from the metering pump
2	Swash plate	14	Case drain	20	Cavity
4	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	24	Cross-drilled hole

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 control valve and close centered loader hydraulic system.

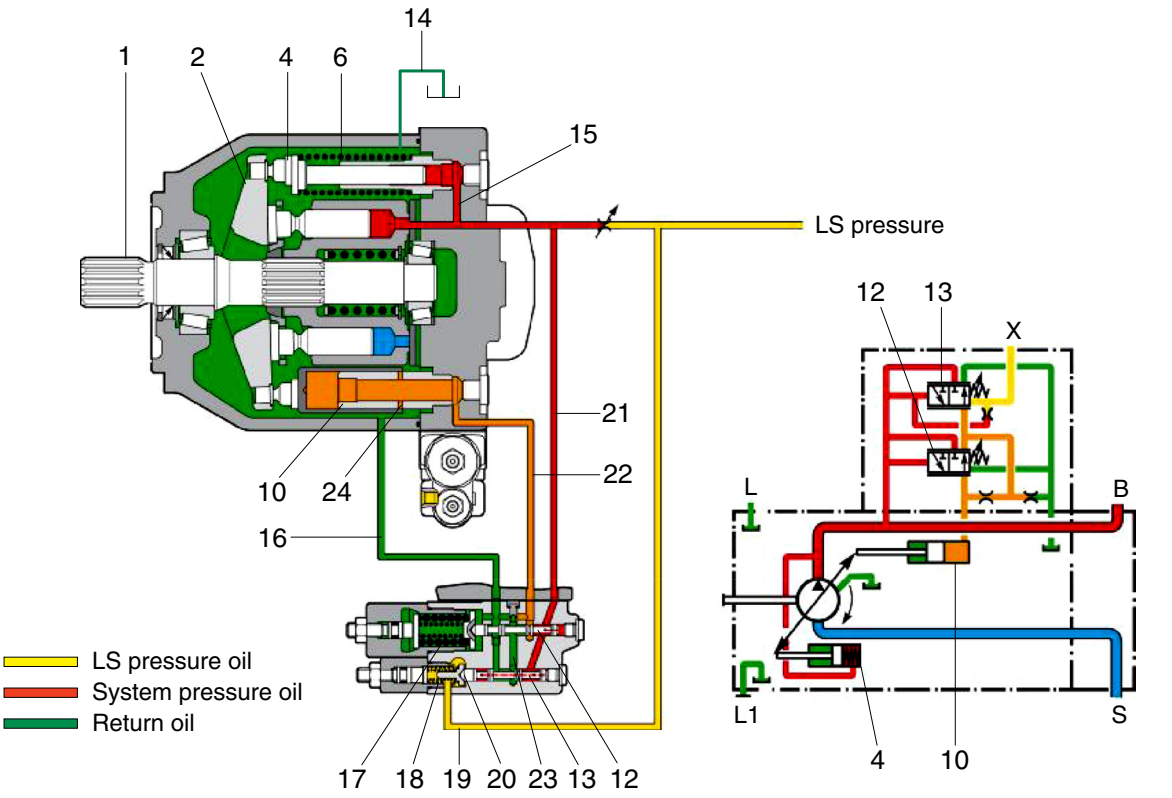
As this pressure increase, the pressure pushes flow compensator spool (13) against spring (18). This causes flow compensator spool (13) to move left. This opens passage (23) in order to allow pressure oil to flow to control piston (10).

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 standby. Low pressure standby pressure should not exceed 40 bar (580 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.

(4) High pressure stall



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1	Drive shaft	13	Flow compensator spool	19	LS line from the metering pump
2	Swash plate	14	Case drain	20	Cavity
4	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 attachment 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 RCV, then the pump will return to low pressure standby.

(5) Adjustment of flow control

Flow compensator setting must be carried out following procedures and conditions.

① Conditions

- Engine is running (at high or low idle).
- RCV is operated slowly (example : Boom up).
- Pressure gauges are installed.

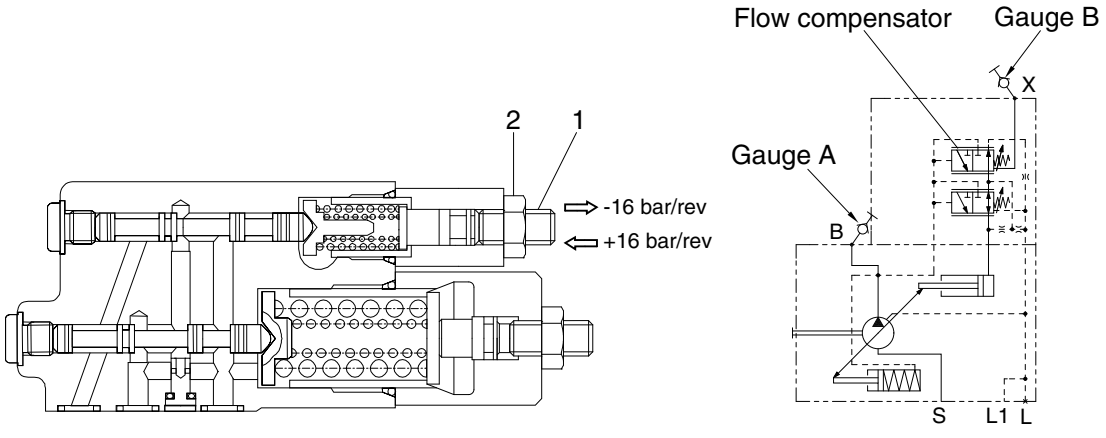
※ Discharge pump flow should be less than max pump flow.

② Procedures

- Loosening the hexagon nut (2).
- Adjusting screw (1) of flow controller by tightening or loosing the screw (1).

Flow setting : P = Gauge A - Gauge B

Specification : Steering pump (22 bar) / Attachment pump (18 bar)



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(6) Adjustment of pressure control

Pressure compensator setting must be carried out following procedures and conditions.

① Conditions

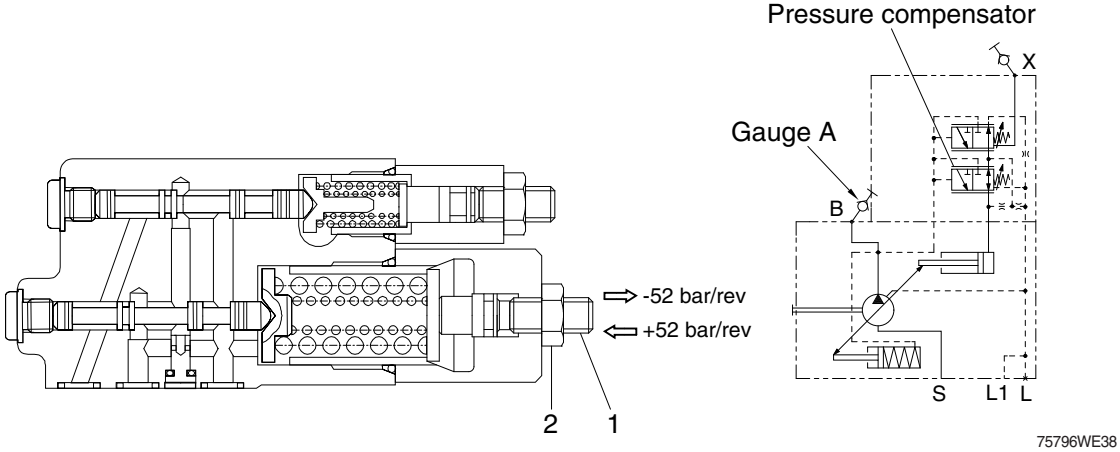
- Engine is running.
- System is at relief condition.

② Procedures

- Loosening the hexagon nut (2).
- Adjusting screw (1) of pressure controller by tightening or loosing the screw (1).

Maximum pressure setting = Gauge A

Specification : Steering pump (300 bar) / Attachment pump (280 bar)



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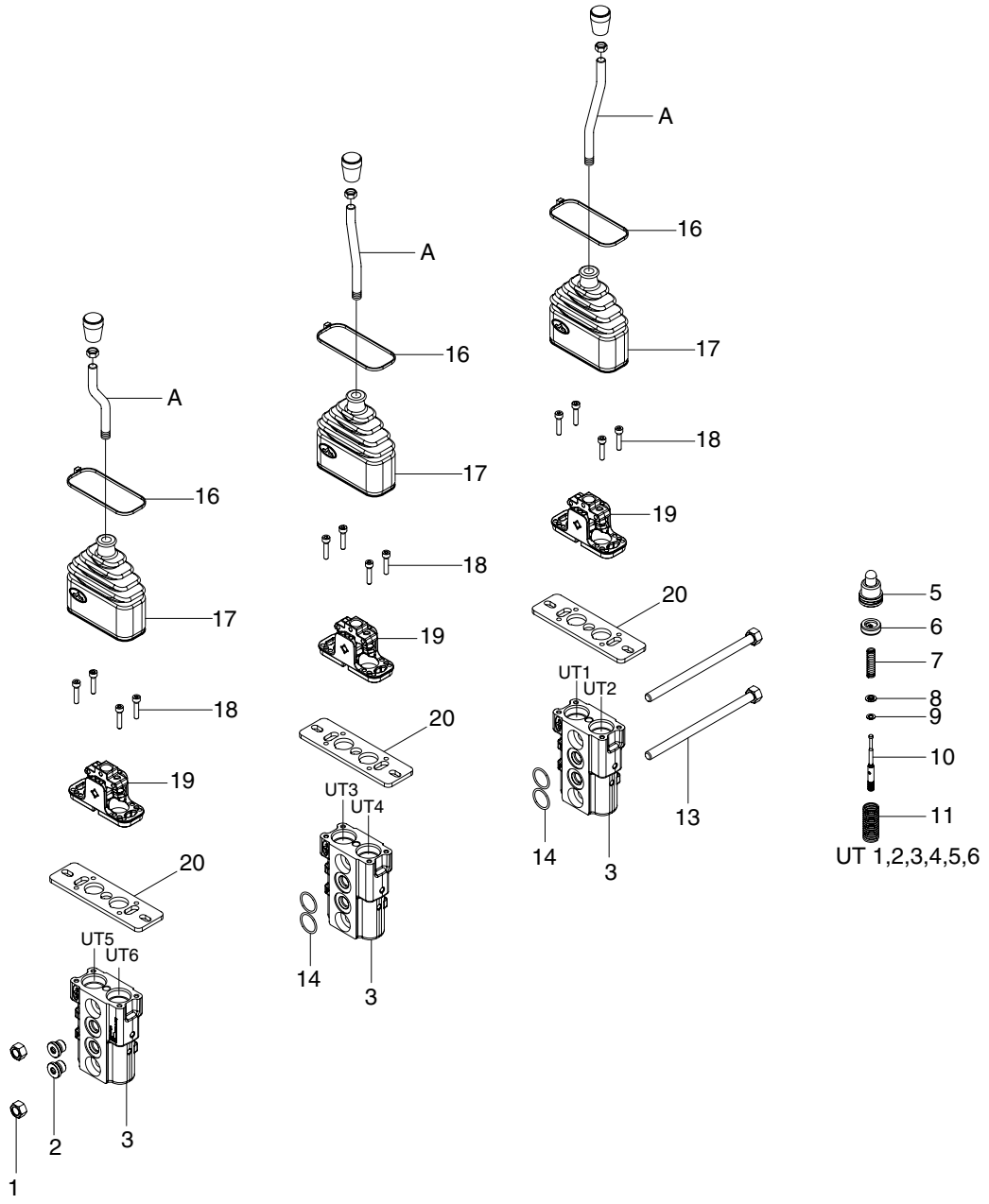
5. REMOTE CONTROL VALVE

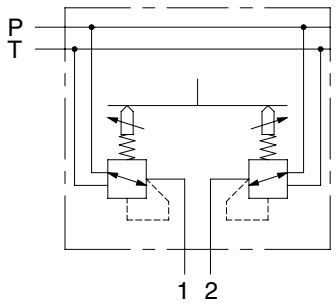
1) STRUCTURE



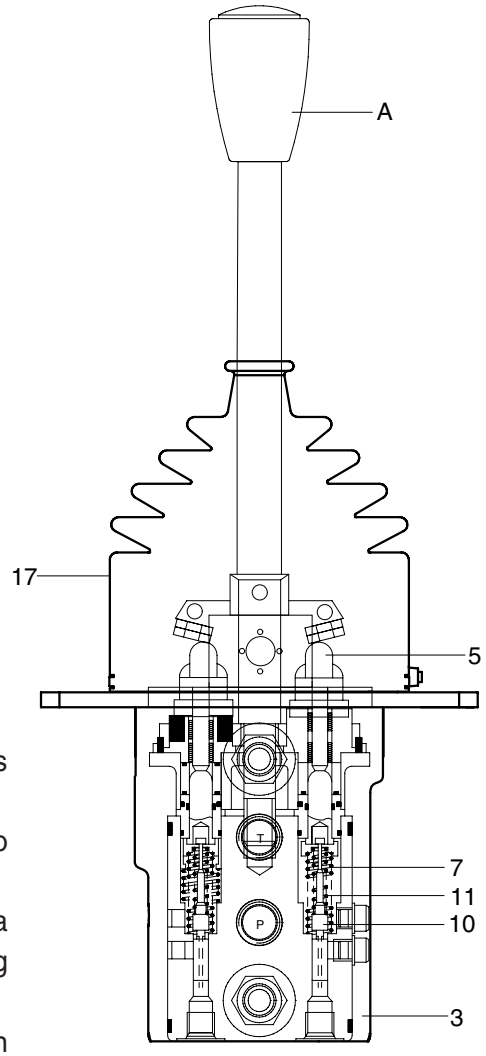
100D7RCV00

A	Lever	7	Metering spring	14	O-ring
1	Nut	8	Seeger ring	15	Kit 3
2	Plug	9	Seeger ring	16	Clamp
3	Body	10	Docking rod	17	Rubber bellows
4	Kit 1	11	Spring	18	Screw
5	Plunger kit	12	Kit 2	19	Support kit
6	Spring guide	13	Tie rod with nut	20	Flange

2) OPERATION



HYDRAULIC CIRCUIT



(1) Hydraulic functional principle

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

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

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

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

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

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

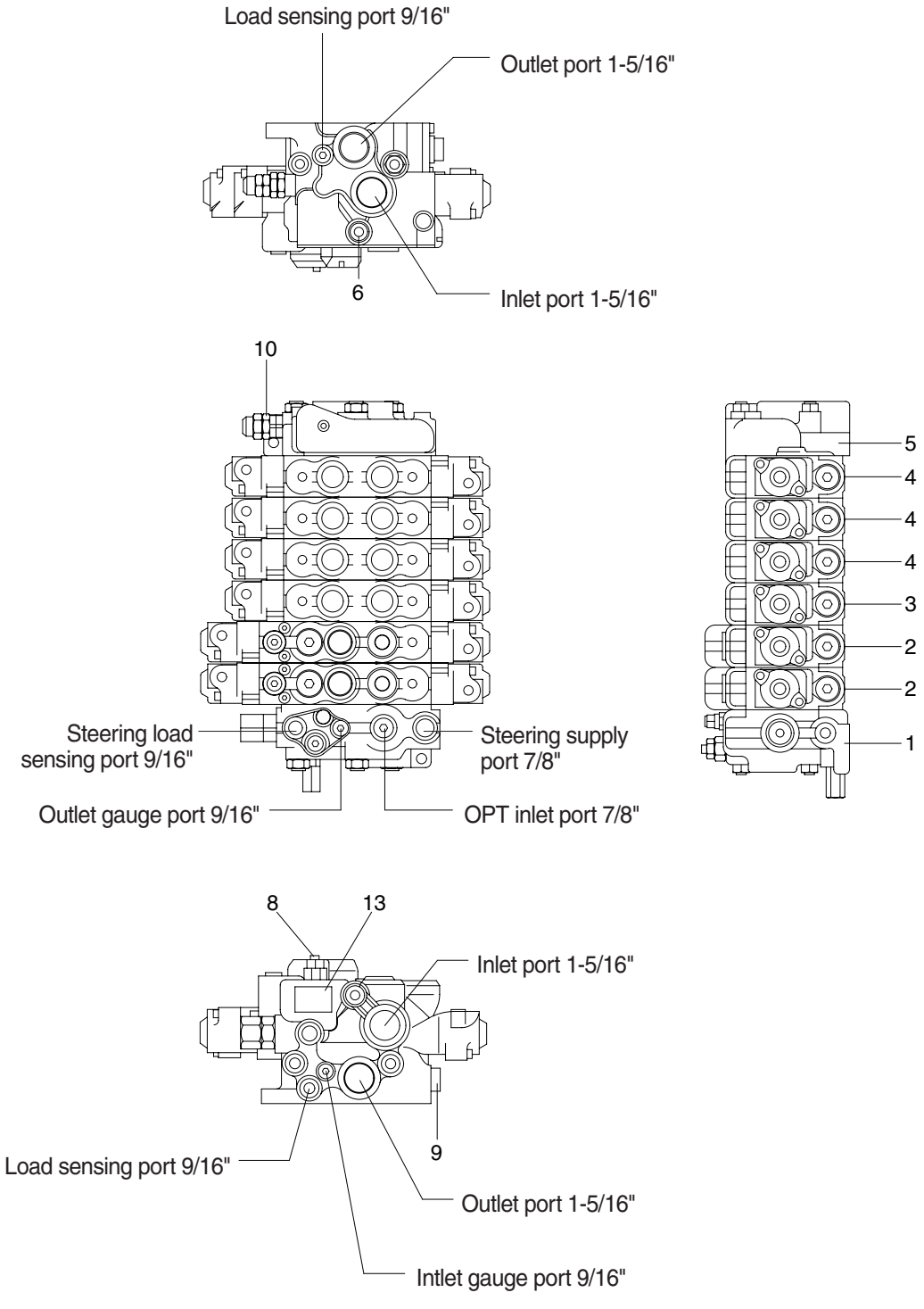
Due to the interaction between docking rod (10) and metering spring (7) the pressure in the relevant port is proportional to the stroke of plunger (5) and hence to the position of control lever (A).

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

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

6. MAIN CONTROL VALVE (LEVER TYPE)

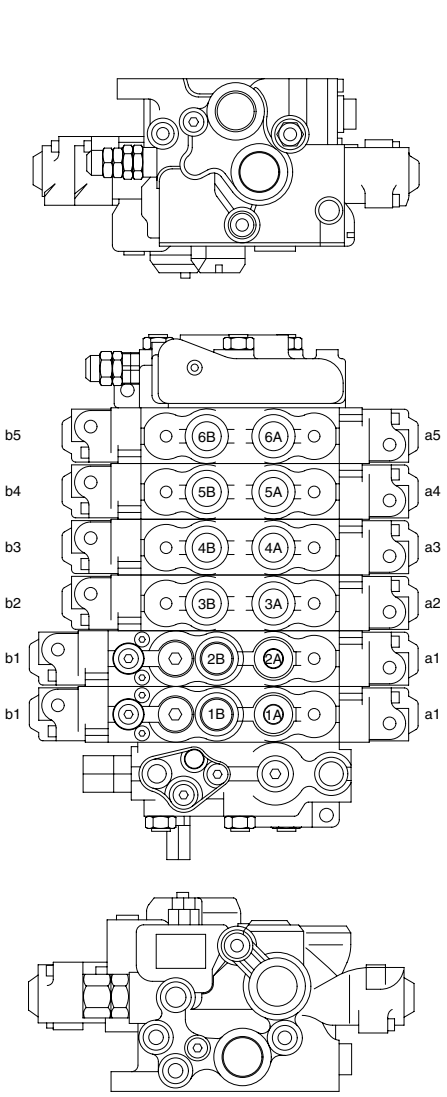
1) STRUCTURE

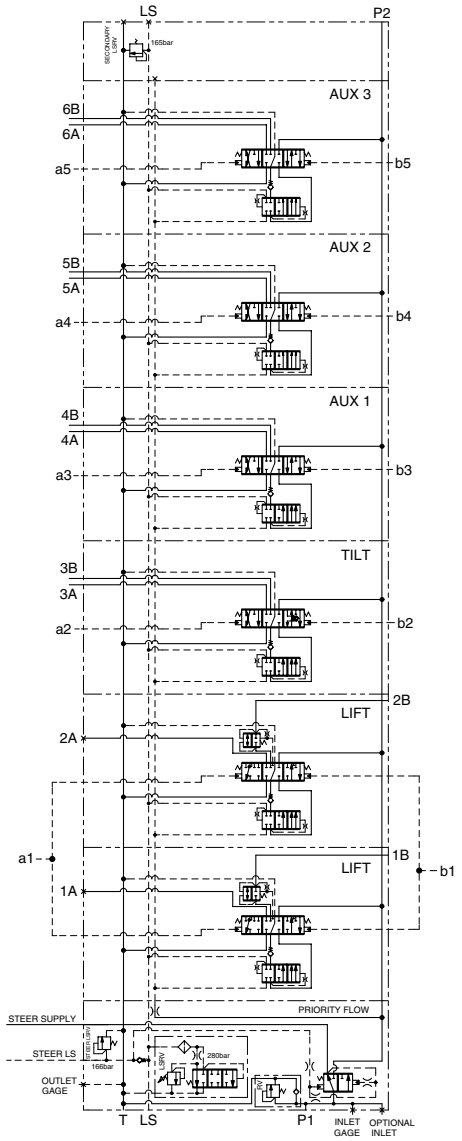


110DEHS09

1	Inlet section	5	Outle section	10	Aux relief Valve
2	Lift section	6	Tie rod	13	Name plat
3	Tilt section	8	Drain regulator		
4	Aux section	9	Main relief Valve		

STRUCTURE



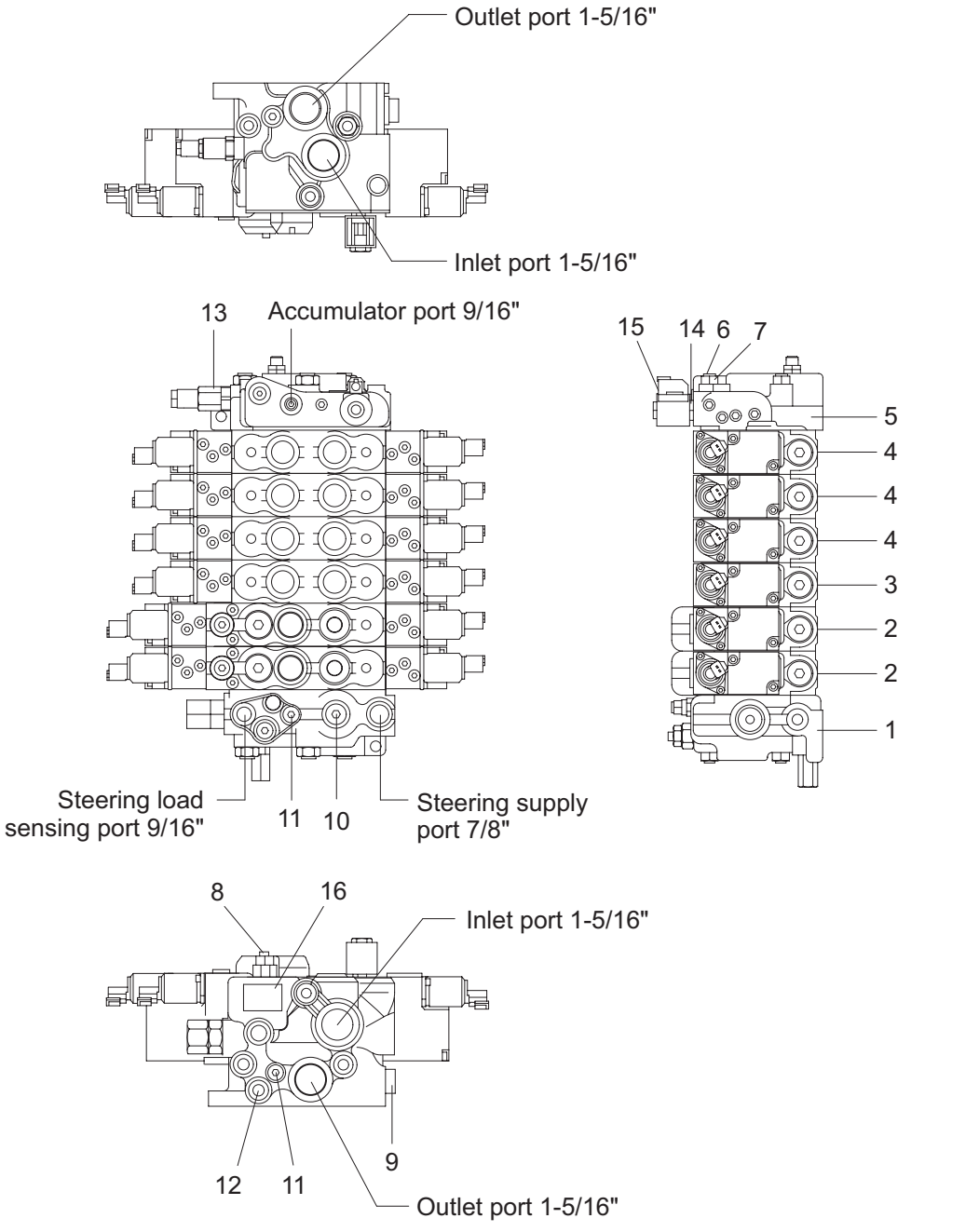


110D9HS10

Port	Port name	Size	Port	Port name	Size
P1, P2	Inlet port	1 5/16" - 12UNF	6A, 6B	To aux port	1 1/16" - 12UNF
T	Outlet port	1 5/16" - 12UNF	a1, b1	To lift pilot prot	9/16" - 18UNF
1A, 2B	To lift cylinder port	1 1/16" - 12UNF	a2, b2	To tilt pilot port	9/16" - 18UNF
3A, 3B	To tilt cylinder port	1 1/16" - 12UNF	a3, b3	To aux pilot port	9/16" - 18UNF
4A, 4B	To aux cylinder port	1 1/16" - 12UNF	a4, b4	To aux pilot port	9/16" - 18UNF
5A, 5B	To aux cylinder port	1 1/16" - 12UNF	a5, b5	To aux pilot port	9/16" - 18UNF

7. MAIN CONTROL VALVE (FINGERTIP)

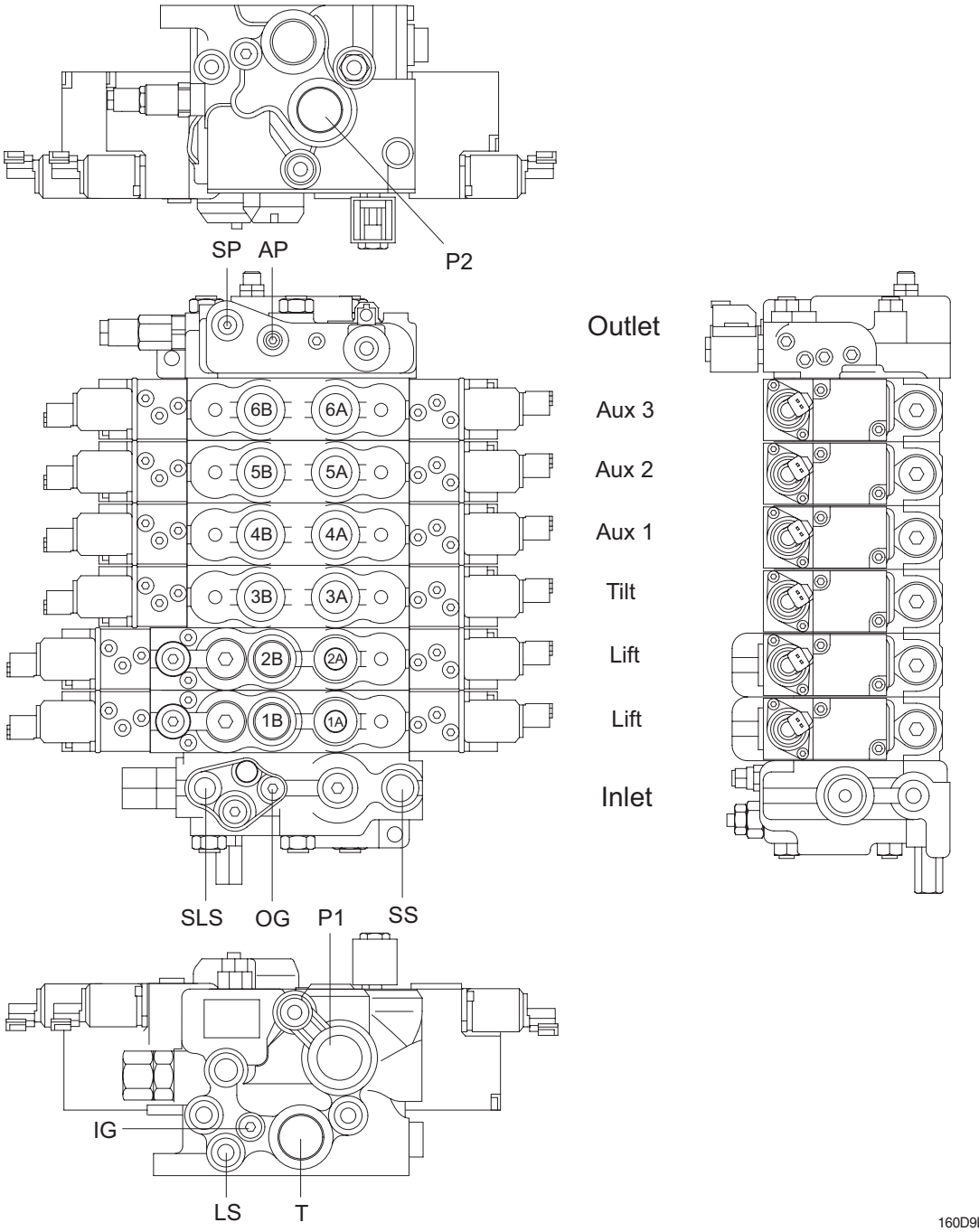
1) STRUCTURE (1/2)



160D9LHS81

1	Inlet section assy	7	Nut	13	Pressure regulator valve assy
2	Spool section assy	8	Drain regulator assy	14	Solenoid body assy
3	Spool section assy	9	Relief valve assy	15	Solenoid coil
4	Spool section assy	10	Plug assy	16	Name plate
5	Outlet section assy	11	Plug assy		
6	Tie rod	12	Check valve assy		

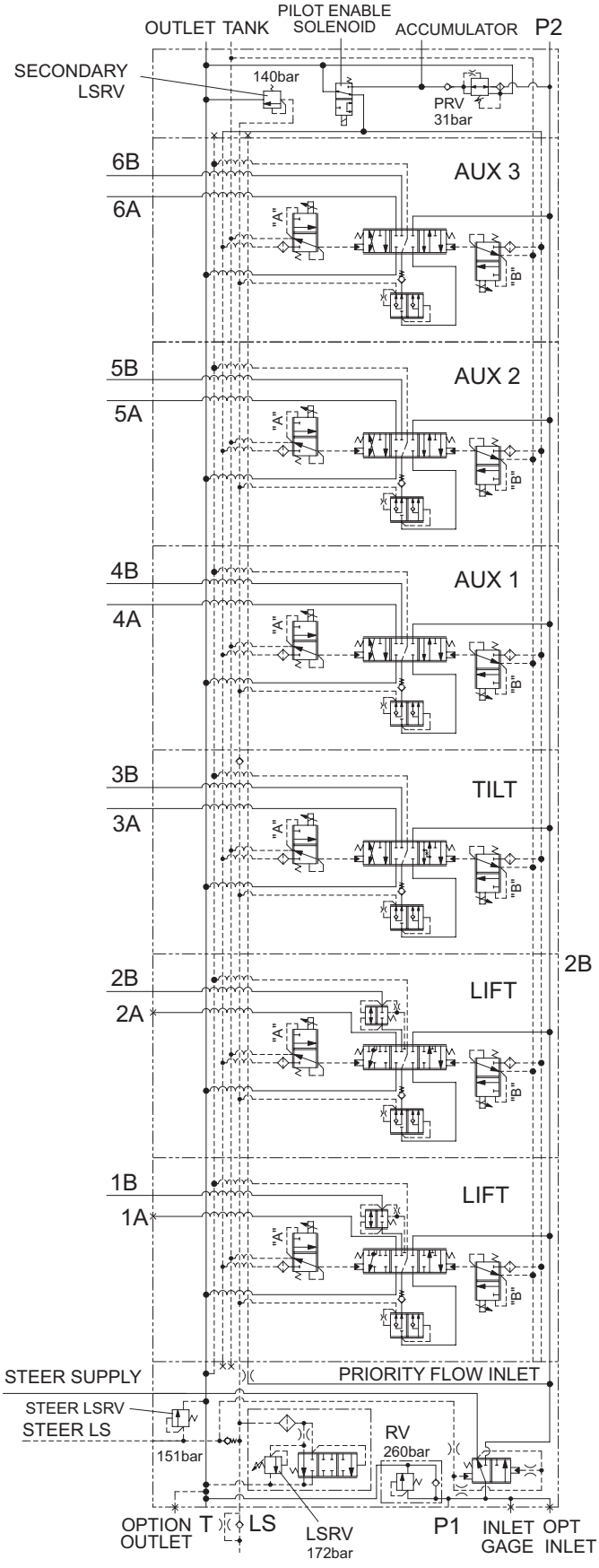
STRUCTURE (2/2)



160D9LHS82

Port	Port name	Size	Port	Port name	Size
P1, P2	Inlet port	1-5/16" - 12UN-2B	SP	Tank port	9/16" - 18UNF-2B
T	Outlet port	1-5/16" - 12UN-2B	AP	Accumulator port	9/16" - 18UNF-2B
1A, 1B	To lift cylinder port	1-1/16" - 12UN-2B	LS	Load sense port	9/16" - 18UNF-2B
2A, 2B	To tilt cylinder port	1-1/16" - 12UN-2B	SS	Steer supply port	7/8" - 14UNF-2B
3A, 3B	To tilt cylinder port	1-1/16" - 12UN-2B	SLS	Steer load sense port	9/16" - 18UNF-2B
4A, 4B	To aux cylinder port	1-1/16" - 12UN-2B	IG	Inlet gauge port	9/16" - 18UNF-2B
5A, 5B	To aux cylinder port	1-1/16" - 12UN-2B	OG	Outlet gauge port	9/16" - 18UNF-2B
6A, 6B	To aux cylinder port	1-1/16" - 12UN-2B	-	-	-

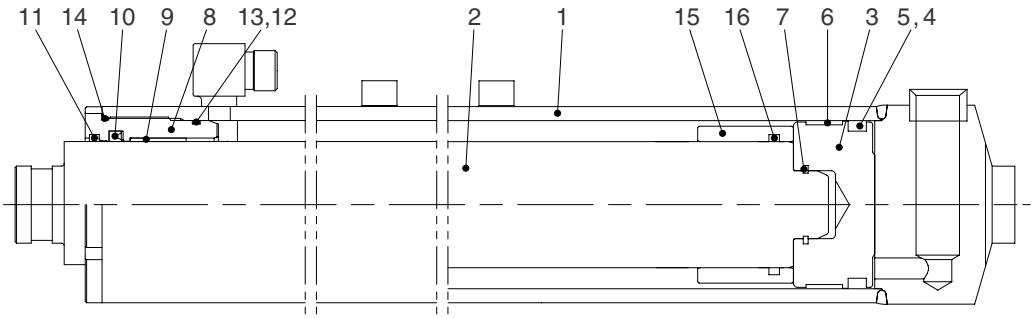
2) HYDRAULIC CIRCUIT



160D9LHS83

7. LIFT CYLINDER

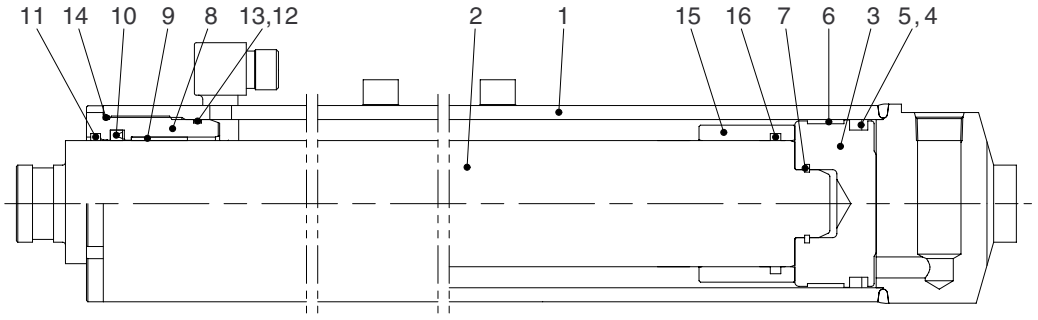
1) 110/130D-9



110D9CYL01

1	Tube assembly	8	Set screw	15	Dust wiper
2	Rod assembly	9	Set screw	16	Retaining ring
3	Piston	10	Plug	17	O-ring
4	Wear ring	11	Rod cover	18	Back up ring
5	Set screw	12	Rod bushing	19	O-ring
6	Guide	13	U-packing	20	Bleeder
7	Cushion ring	14	Back up ring	21	Spacer

2) 160D-9

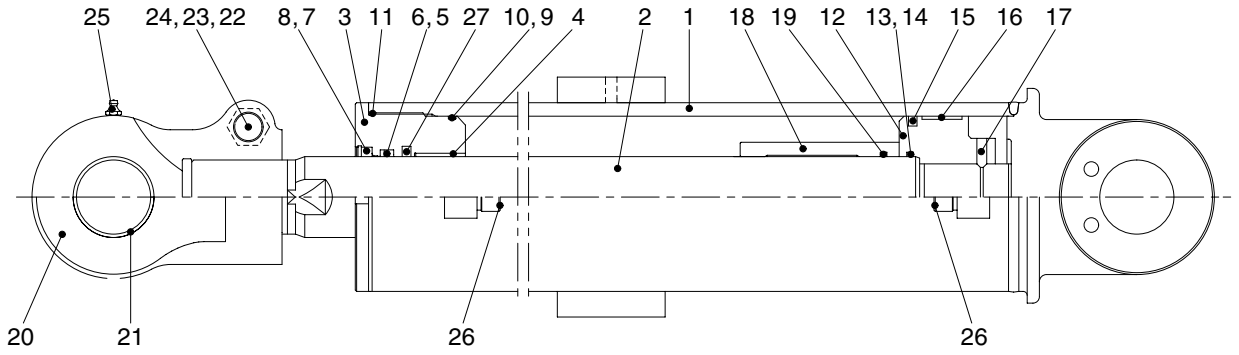


110D9CYL02

1	Tube assembly	8	Rod cover	15	Cushion ring
2	Rod assembly	9	Rod bushing	16	Guide
3	Piston	10	U-packing	17	Set screw
4	U-packing	11	Dust wiper	18	Set screw
5	Back up ring	12	O-ring	19	Plug
6	Wear ring	13	Back up ring	20	Spacer
7	Stop ring	14	O-ring	21	O-ring

8. TILT CYLINDER

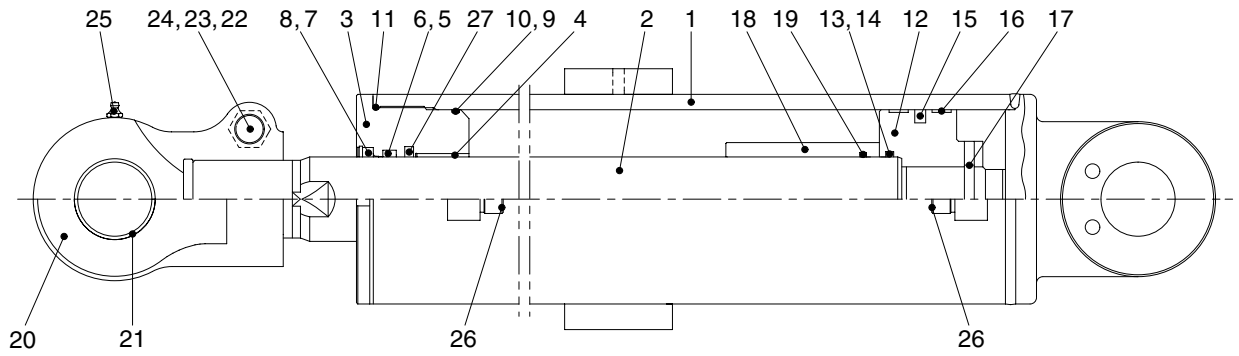
1) 110/130D-9



110D9CYL03

1	Tube assembly	10	Back-up ring	19	O-ring (10/10° only)
2	Rod	11	O-ring	20	Eye
3	Rod cover	12	Piston	21	Rod bushing
4	Rod bushing	13	O-ring	22	Hexagon bolt
5	U-packing	14	Back-up ring	23	Hexagon nut
6	Back up ring	15	Piston seal	24	Spring washer
7	Dust wiper	16	Wear ring	25	Grease nipple
8	Stop ring	17	Set screw	26	O-ring
9	O-ring	18	Spacer (10/10° only)		

2) 160D-9

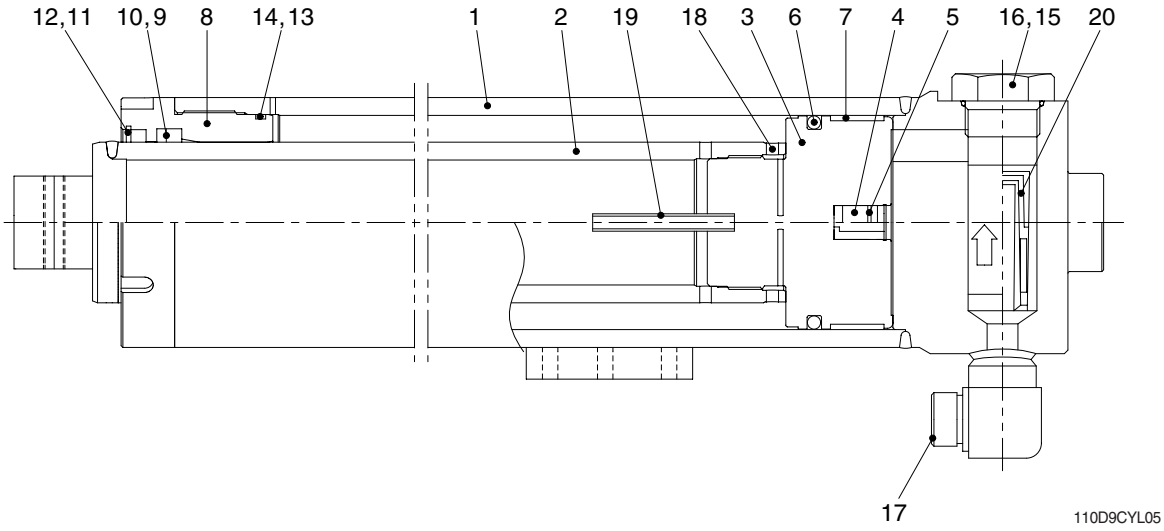


110D9CYL04

1	Tube assembly	10	Back-up ring	19	O-ring (10/10° only)
2	Rod	11	O-ring	20	Eye
3	Rod cover	12	Piston	21	Rod bushing
4	Rod bushing	13	O-ring	22	Hexagon bolt
5	U-packing	14	Back-up ring	23	Hexagon nut
6	Back up ring	15	Piston seal	24	Spring washer
7	Dust wiper	16	Wear ring	25	Grease nipple
8	Stop ring	17	Set screw	26	O-ring
9	O-ring	18	Spacer (10/10° only)	27	Buffer seal

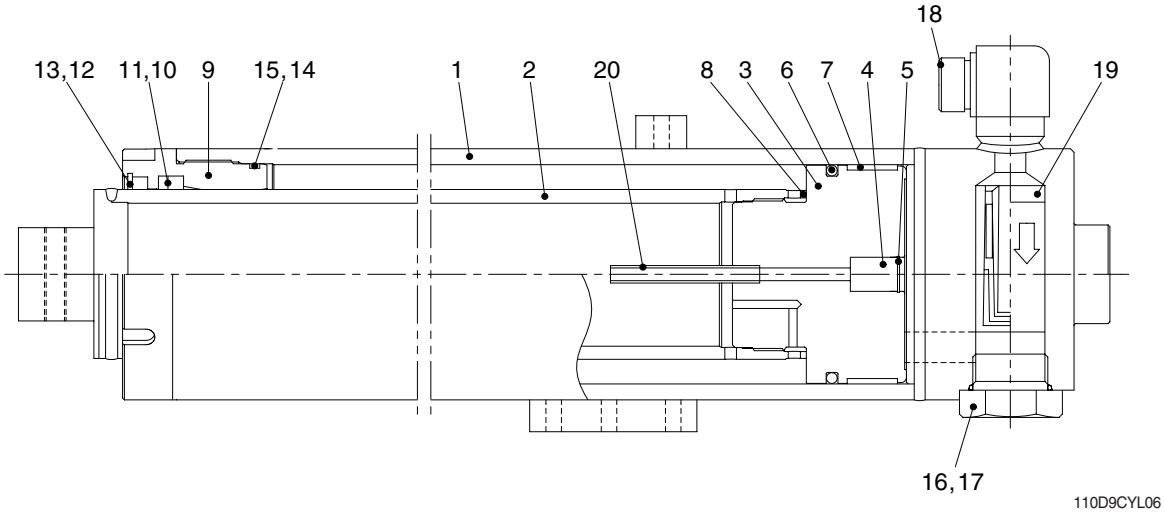
9. FREE CYLINDER

1) 110/130D-9



1	Tube assembly	8	Rod cover	15	Plug
2	Rod assembly	9	U-packing	16	O-ring
3	Piston	10	Back up ring	17	O-ring
4	Check valve	11	Dust wiper	18	Set screw
5	Retaining ring	12	Retaining ring	19	Pipe
6	Piston seal	13	O-ring	20	Down safety valve
7	Wear ring	14	Back up ring		

2) 160D-9

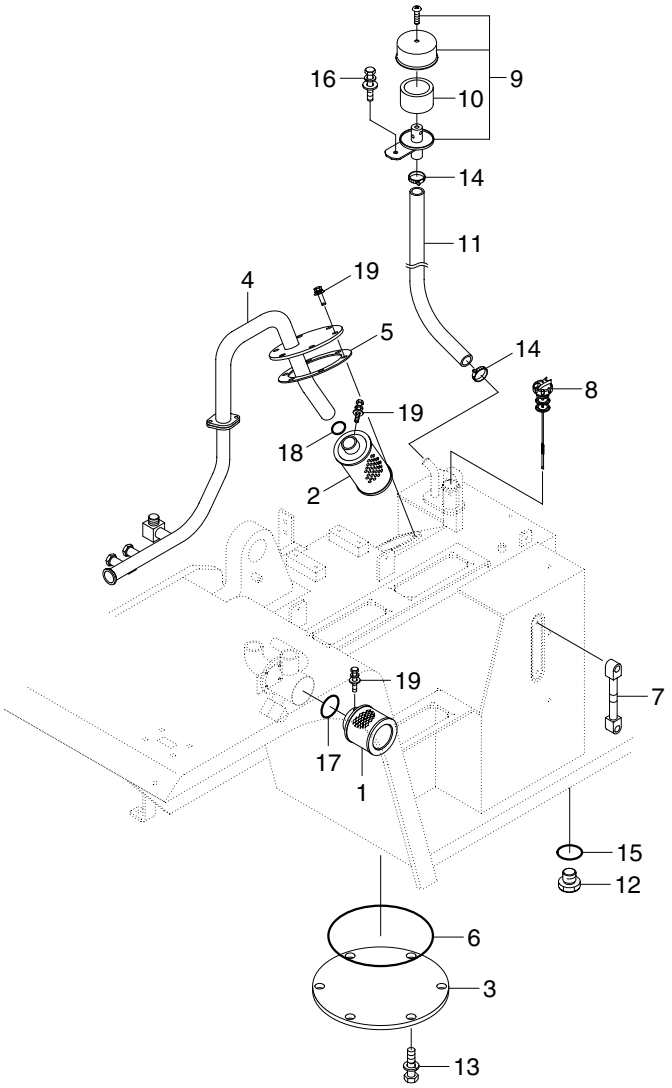


1	Tube assembly	8	Set screw	15	Back up ring
2	Rod assembly	9	Rod cover	16	O-ring
3	Piston	10	U-packing	17	Plug
4	Check valve	11	Back up ring	18	O-ring
5	Retaining ring	12	Dust wiper	19	Down safety valve
6	Piston seal	13	Retaining ring	20	Pipe
7	Wear ring	14	O-ring		

10. HYDRAULIC OIL TANK

1) STRUCTURE

- The oil from the hydraulic tank is sent from the pump through main control valve to the cylinders. In the return circuit, the oil from various parts merges.
- A part of oil is cooled in the oil cooler, passes through the hydraulic filter and returns to the hydraulic tank.



110D9HS13

1	Suction filter	8	Hydraulic oil cap	15	O-ring
2	Return filter	9	Air breather cap	16	Hexagon bolt
3	Suction flange	10	Air breather filter	17	O-ring
4	Return flange	11	Rubber hose	18	O-ring
5	Gasket	12	Magnet plug	19	Hexagon bolt
6	O-ring	13	Bolt with washer		
7	Level gauge	14	Clamp		

2) AIR BREATHER

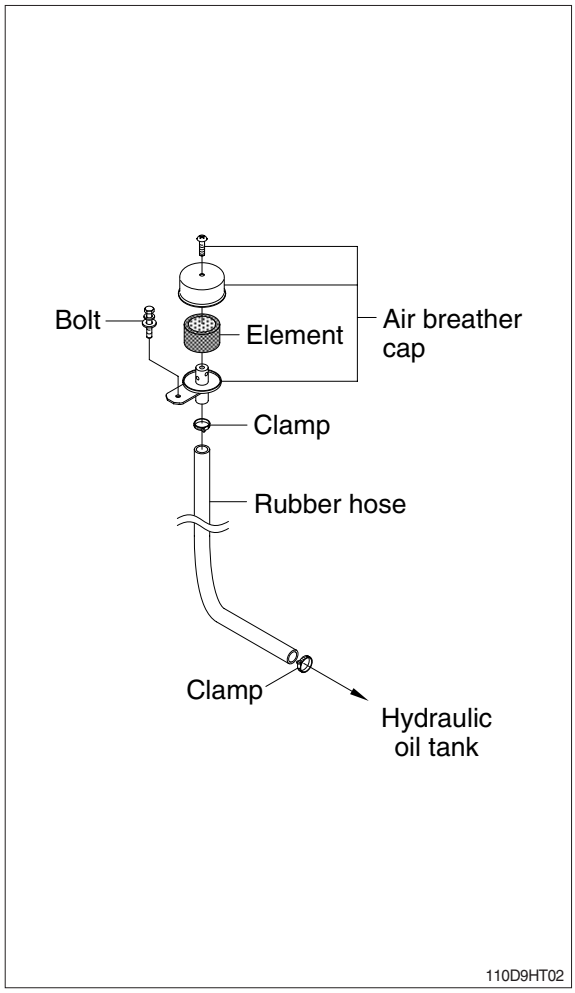
The air breather is equipped with the capacity to perform two functions simultaneously-as an air filter and as a breathing valve.

(1) Preventing negative pressure inside the tank

The tank is a pressurized sealed type, so negative pressure is formed inside the hydraulic tank when the oil level drops during operations. When this happens, the difference in pressure between the tank and the outside atmospheric pressure opens the puppet in the breather, and air from the outside is let into the tank or prevent negative pressure.

(2) Preventing excessive pressure inside the tank

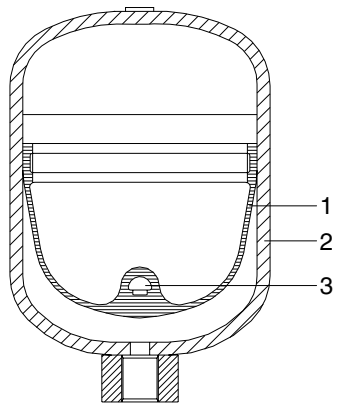
When the hydraulic cylinder is being used, the oil level in the hydraulic system increases and as temperature rises. If the hydraulic pressure rises above the set pressure, breather is actuated to release the hydraulic pressure inside the tank.



11. ACCUMULATOR

The accumulator is installed at the cut off valve. When the mast is left the raised position, and the control levers are operated with the engine stopped the pressure of the compressed nitrogen gas inside the accumulator sends pilot pressure to the control valve to actuate it and allow the boom and bucket to come down under their own weight.

Type of gas	Nitrogen gas (N_2)
Volume of gas	0.35 ℓ (0.1 U.S.gal)
Charging pressure of gas	15kg/cm^2 (213psi)
Max actuating pressure	170kg/cm^2 (2420psi)



1 Diaphragm
2 Steel pressure vessel
3 Closure button

7803AWE56

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 from ground. Wait for 10 minutes and measure hydraulic drift (amount forks move down and amount mast tilts forward).

· **Check condition**

- Hydraulic oil : Normal operating temp
- Mast substantially vertical.
- Rated capacity load.

· **Hydraulic drift**

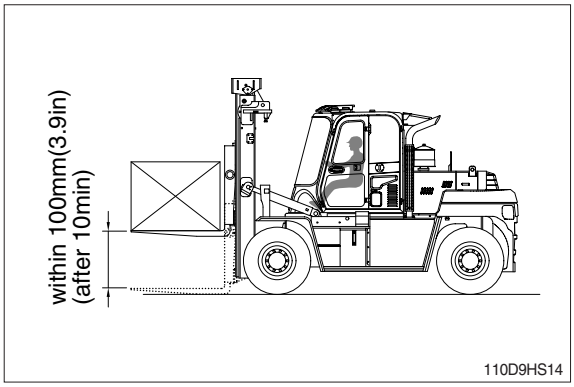
- Down (Downward movement of forks)
  : Within 100 mm (3.9 in)
- Forward (Extension of tilt cylinder)
  : Within 5°

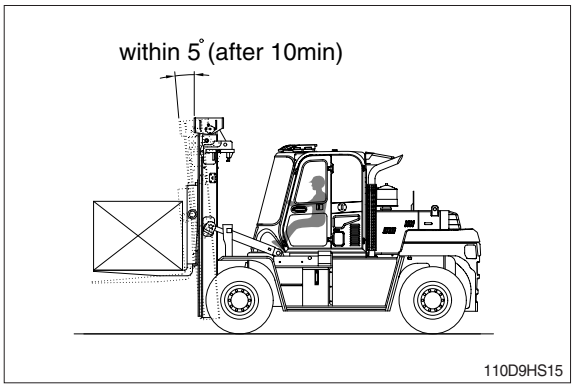
(3) If the hydraulic drift is more than the specified value, replace the control valve or cylinder packing.

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

mm (in)

Standard	Under 0.6 (0.02)

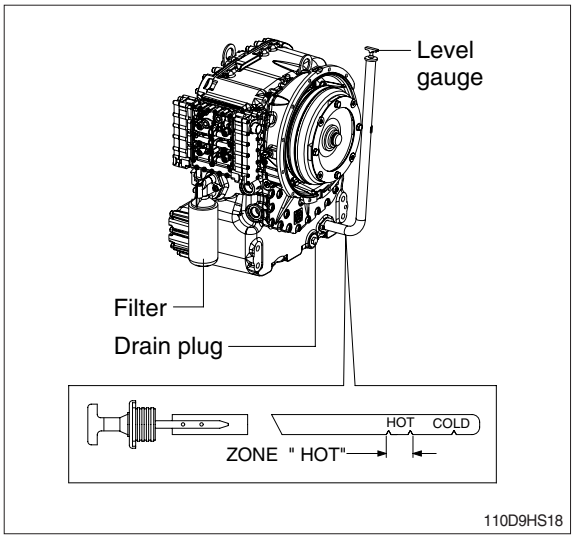




2) HYDRAULIC OIL

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

(2) When changing hydraulic oil, clean suction strainer (screwed into outlet port pipe) and line filter (screwed into inlet pipe). Line filter uses paper element, so replace periodically (every 6 months or 1000 hours)



3) CONTROL VALVE

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

Check that oil pressure is 210 kgf/cm^2.

(2990 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 tempera-ture. · 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) HYDRAULIC PISTON PUMP

Problem	Cause	Remedy
Pump does not develop full pressure.	· System relief valve set too low or leaking. · Oil viscosity too low. · Pump is worn out.	· Check system relief valve for proper setting. · Change to proper viscosity oil. · Repair or replace pump.
Pump will not pump oil.	· Reservoir low or empty. · Suction strainer clogged.	· Fill reservoir to proper level. · Clean suction strainer.
Noisy pump caused by cavitation.	· Oil too thick. · Oil filter plugged. · Suction line plugged or too small.	· Change to proper viscosity. · Clean filters. · Clean line and check for proper size.
Oil heating.	· Oil supply low. · Contaminated oil. · Setting of relief valve too high or too low. · Oil viscosity too low.	· Fill reservoir to proper level. · Drain reservoir and refill with clean oil. · Set to correct pressure. · Drain reservoir and fill with proper viscosity.
Foaming oil.	· Low oil level. · Air leaking into suction line. · Wrong kind of oil.	· Fill reservoir to proper level. · Tighten fittings, check condition of line. · Drain reservoir, fill with non-foaming oil.
Shaft seal leakage.	· Worn shaft seal. · Worn shaft in seal area.	· Replace shaft seal. · Replace drive shaft and seal.

3) MAIN RELIEF VALVE

Problem	Cause	Remedy
Can't get pressure	· Poppet stuck open or contamination under seat.	· Check for foreign matter between puppets and their mating parts. Parts must slide freely.
Erratic pressure	· Pilot poppet seat damaged.	· Replace the relief valve. · Clean and remove surface marks for free movement.
Pressure setting not correct	· Normal wear. Lock nut & adjust screw loose.	· See *How to set pressure on work main relief.
Leaks	· Damaged seats. · Worn O-rings. · Parts sticking due to contamination.	· Replace the relief valve. · Install seal and spring kit. · Disassemble and clean.

★ A good pressure gauge must be installed in the line which is in communication with the main relief. A load must be applied in a manner to reach the set pressure of the main relief unit.
Then, follow these steps:

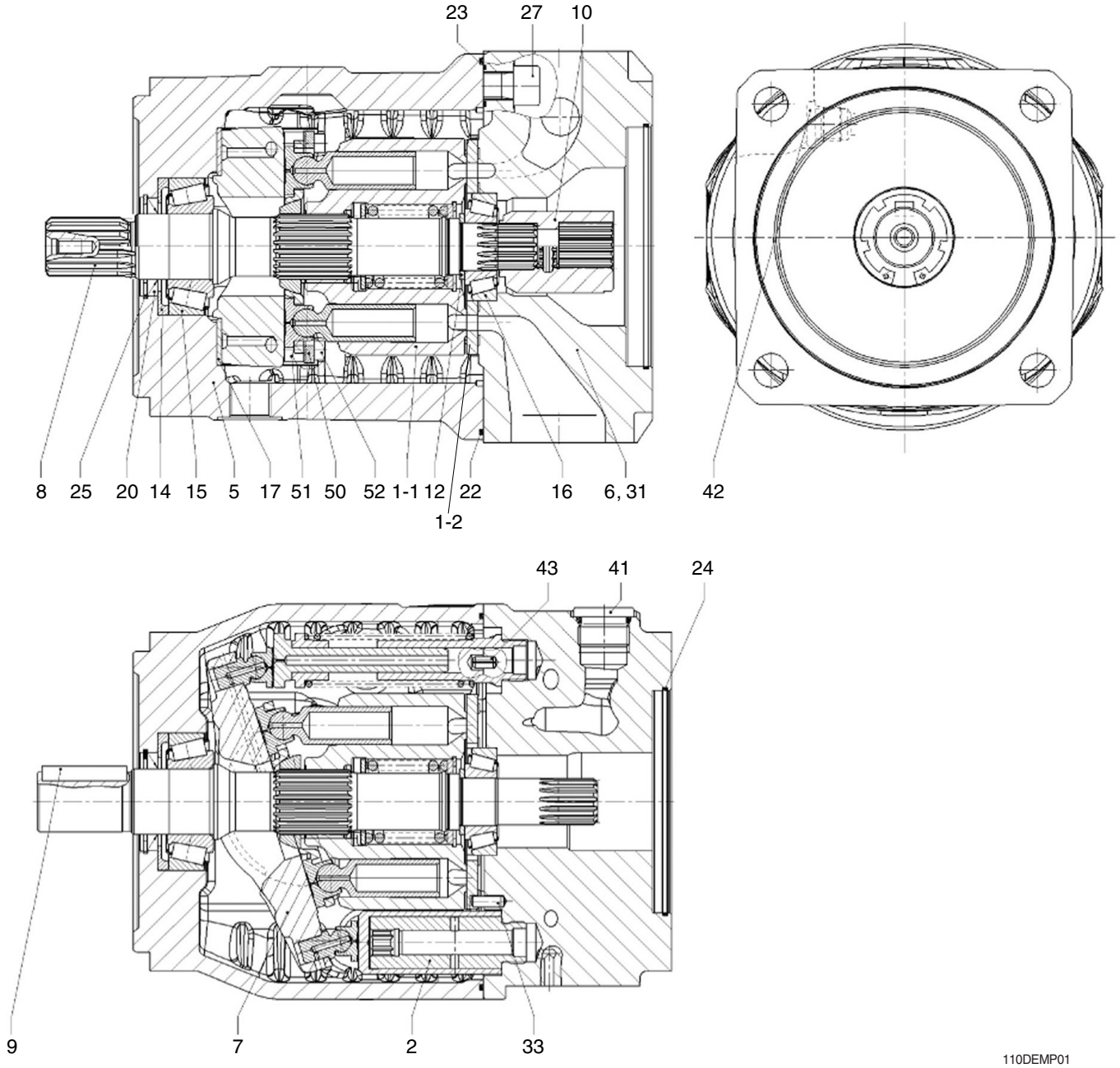
- Loosen lock nut.
- Set adjusting nut to desired pressure setting.
- If desired pressure setting cannot be achieved, add or remove shims as required.
- Tighten lock nut.
- Retest in similar manner as above.

4) CYLINDER

Problem	Cause	Remedy
Oil leaks out from gland 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 gland thread.	· O-ring damaged.	· Replace O-ring.
Rod spontaneously retract.	· Scores on inner surface of tube. · Unallowable score on the inner surface 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.

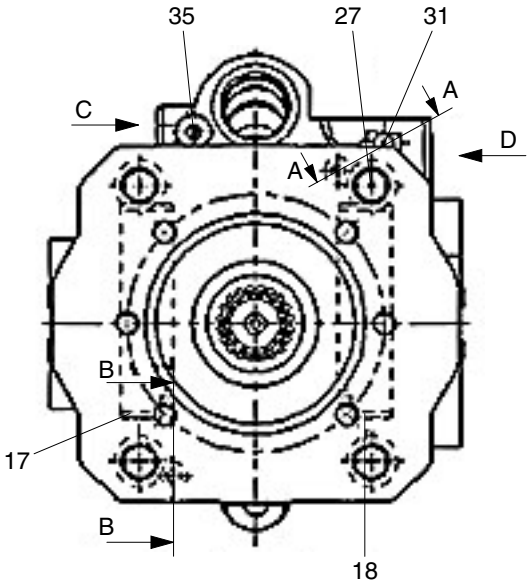
1. MAIN PUMP

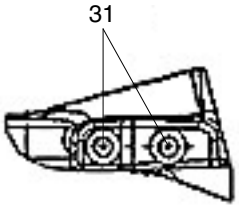
1) STRUCTURE (front)



110DEMP01

1-1	Rotary group	14	Stop ring	31	Double break off pin
1-2	Control plate	15	Taper roller bearing	33	Cylinder pin
2	Adjusting piece	16	Taper roller bearing	41	Plug
5	Pump housing	17	Bearing liner	42	Plug
6	Port plate	20	Shaft seal ring	43	Plug
7	Swash plate	22	O-ring	50	Segment
8	Drive shaft	23	O-ring	51	Spacer sleeve
9	Key	24	O-ring	52	Socket screw
10	Splined hub	25	Retaining ring		
12	Shim	27	Socket screw		





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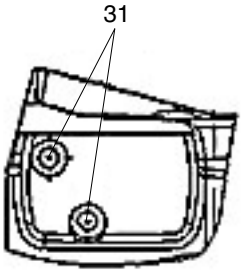
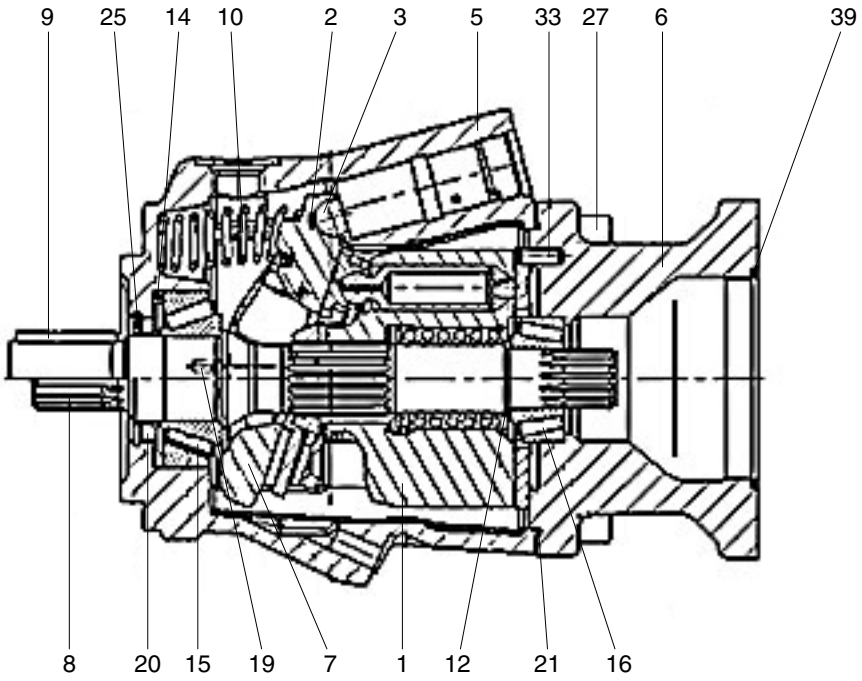
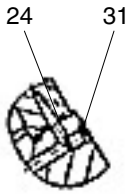
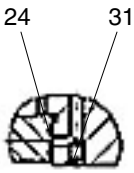


VIEW D





A - A



B - B

110D9MP02

1	Rotary group	12	Shim	21	O-ring
2	Pressure spring	14	Stop ring	24	Seal ring
3	Stop	15	Taper roller bearing	25	Retaining ring
5	Pump housing	16	Taper roller bearing	27	Socket screw
6	Port plate	17	Bearing liner	31	Double break off pin
7	Swash plate	18	Bearing liner	33	Cylinder pin
8	Drive shaft	19	Socket screw	35	Locking screw
10	Spring	20	Shaft seal ring	39	O-ring

2) GENERAL REPAIR GUIDE LINES

※ Observe the following guidelines when carrying out repairs on hydraulic pumps.

(1) Close off all openings of the hydraulic unit.

(2) Replace all of the seals.
Use only original spare parts.

(3) Check all sealing and sliding surfaces for wear.

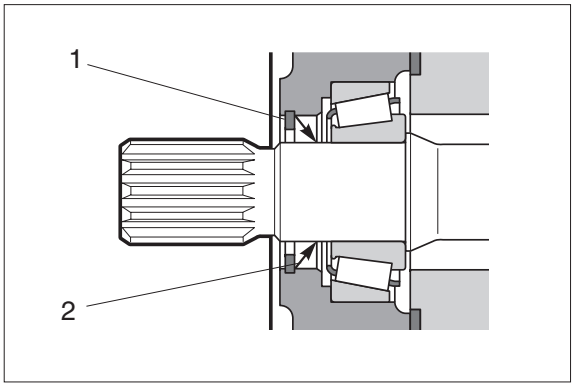
※ Re-work of the sliding surfaces by using, for example abrasive paper, can damage the surface.

(4) Fill the hydraulic pump with hydraulic oil before commissioning.

3) SEALING THE DRIVE SHAFT

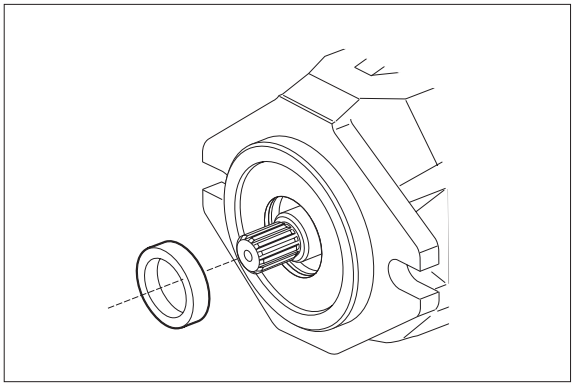
(1) Protect the drive shaft.
Remove the circlip.
Remove the shaft seal.

1 Circlip 2 Shaft seal

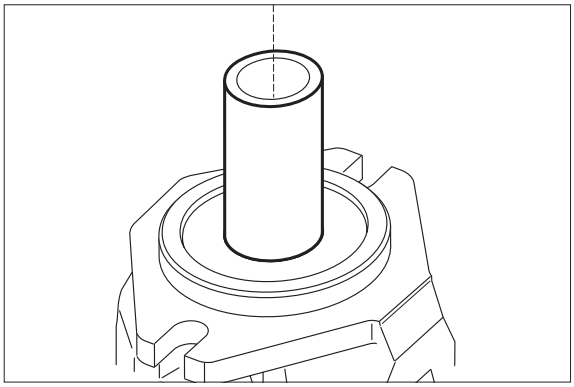


75796WE60

(2) Change the shaft seal and check its sliding surface (drive shaft) and housing, grease the sealing ring.


75796WE58

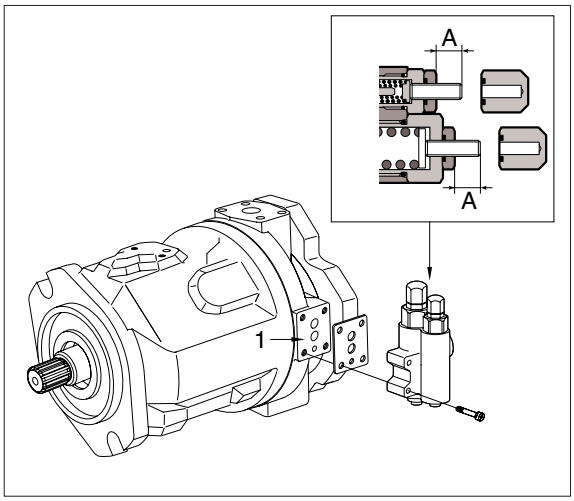
(3) Assemble the sealing ring, fitting tool holds the correct position of the sealing ring in the pump housing.
Assemble the circlip in the correct position.


75796WE59

4) SEALING / CLEANING THE CONTROL VALVE

(1) Disassemble the control valve.

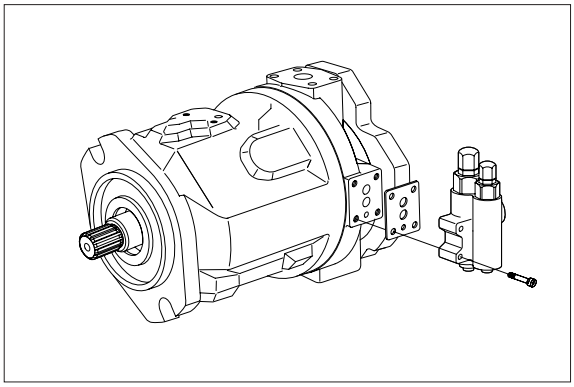
※ Measure dimension A and note down. Check sealing surface (1).



75796WE62

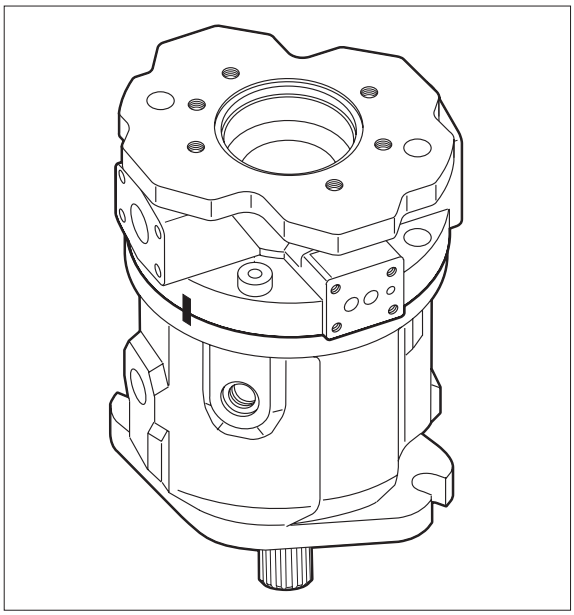
5) DISASSEMBLE THE PUMP

(1) Remove the control valve.



75796WE63

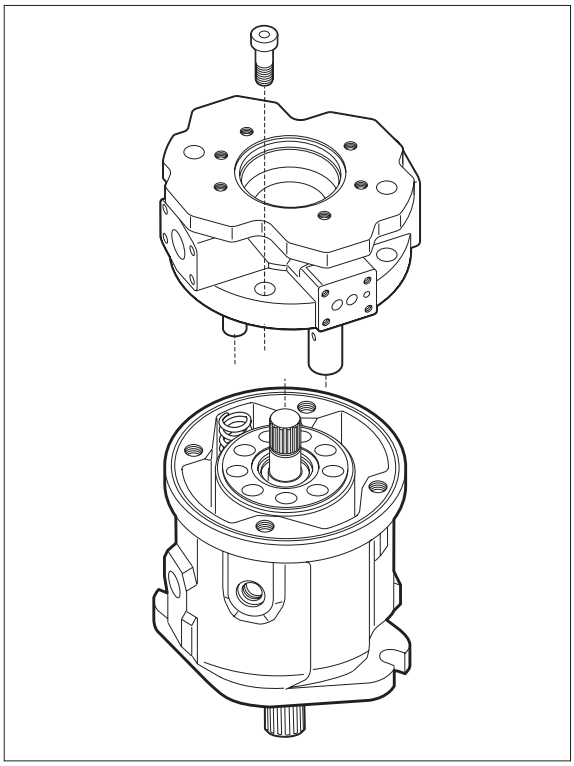
(2) Mark the location of the connection plate on the housing.



75796WE64

(3) Remove the connection plate fixing bolts and the connection plate.

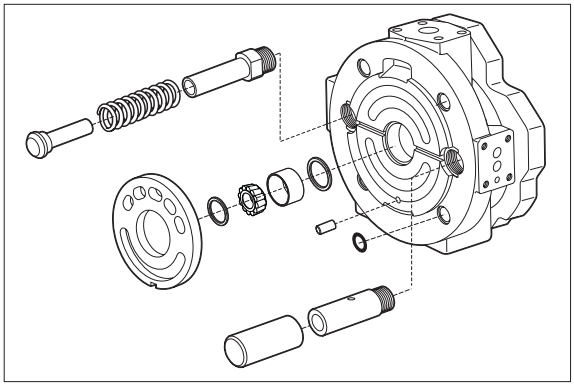
※ Distributor plate and adjustment piston can drop down.



75796WE65

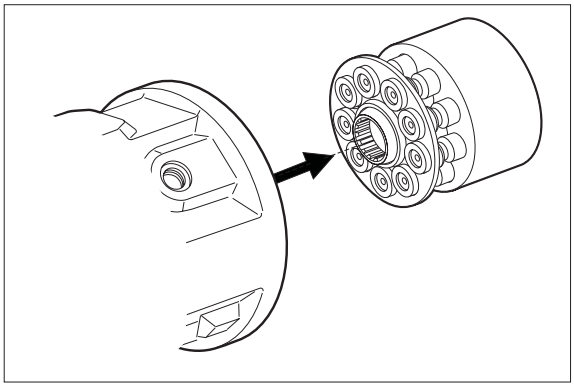
(4) Remove distributor plate.
Take note of the orientation.

※ Remove bearing with withdrawal tool.
Do not damage the sealing surface.



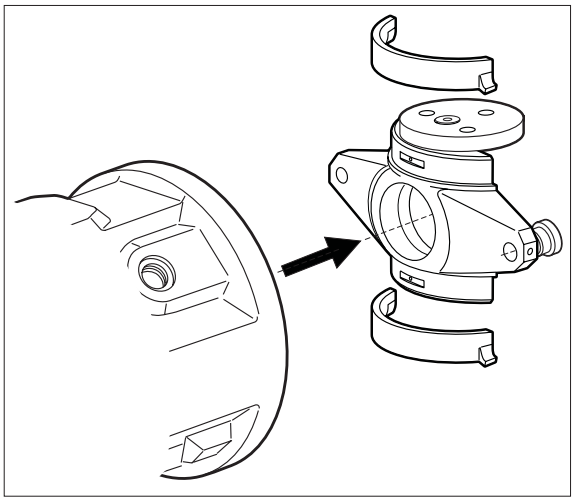
75796WE66

(5) Remove the rotary group in a horizontal position.



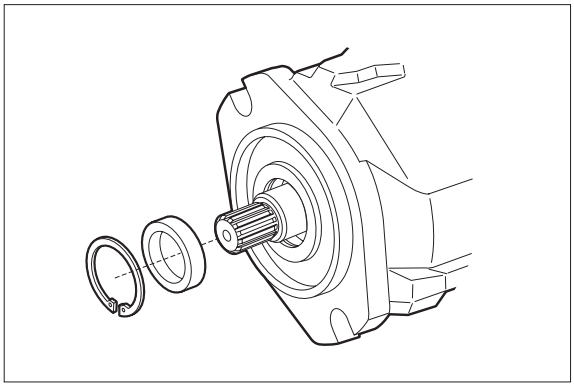
75796WE67

(6) Remove swash plate and bearing shells.



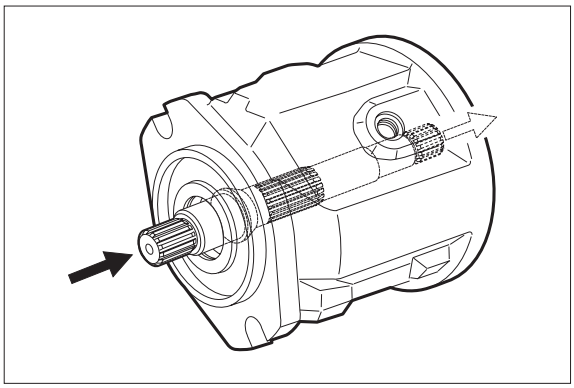
75796WE68

(7) Remove the circlip and the shaft seal.



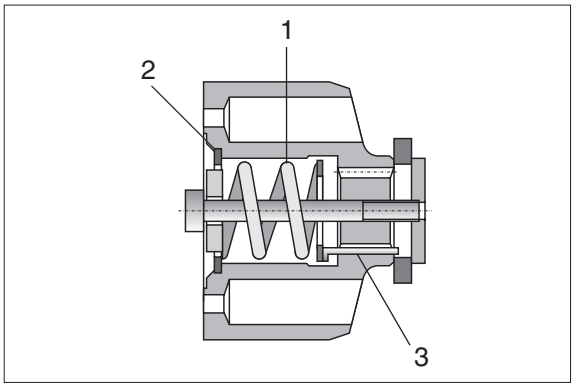
75796WE69

(8) Remove the drive shaft through rear side.



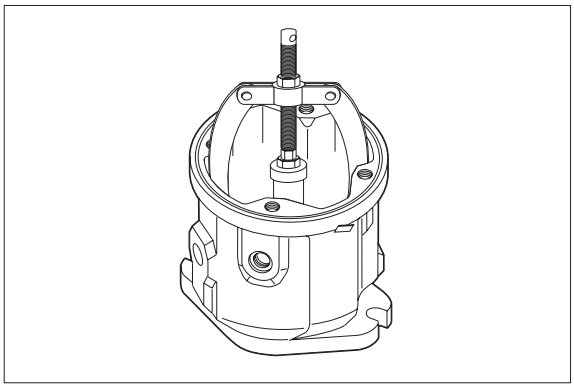
75796WE70

(9) Pre-tension the spring (1) using a suitable device.
Remove circlip (2).
Remove spring (1) and pressure pins (3).



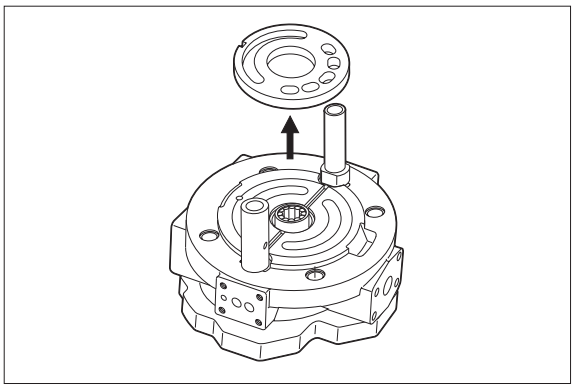
75796WE72

(10) Use bearing puller to remove outer bearing race of front bearing out of housing press seat.



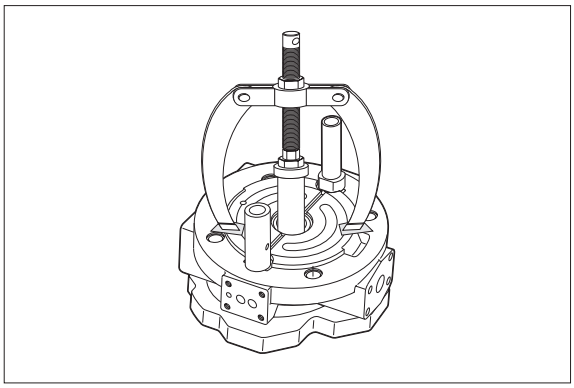
75796WE74

(11) Remove the control plate.



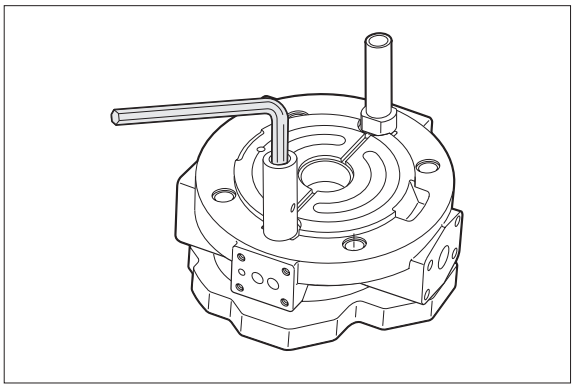
75796WE75

(12) Use bearing puller to remove outer bearing race of rear bearing - press seat.



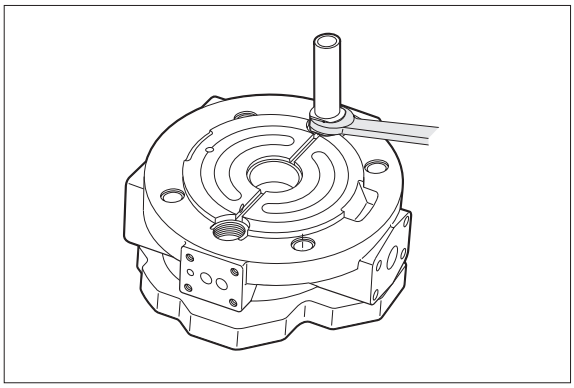
75796WE76

(13) Disassemble the guide of control piston (Mounting position: pilot valve side).



75796WE77

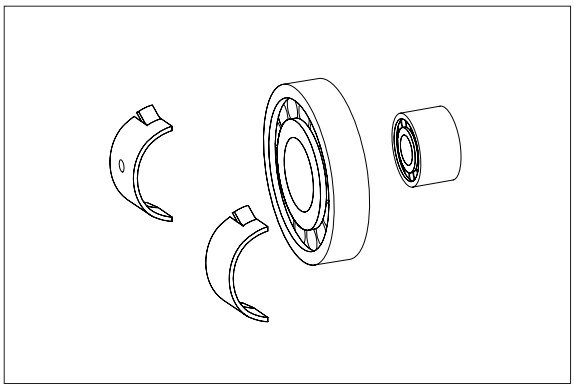
(14) Disassemble the guide of the opposite piston.



75796WE78

6) INSPECT HINTS

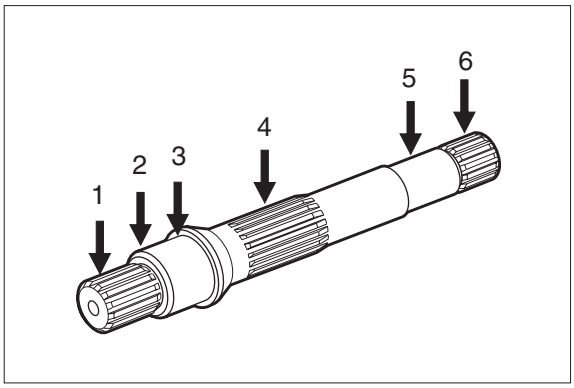
(1) Renew all bearings.



75796WE79

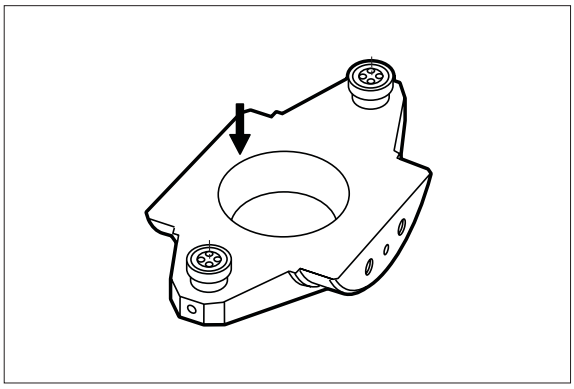
(2) Check :

1 Wear on splines, rust
2 Drive shaft seal wear grooves
3 Bearing seat
4 Splines for cylinder drive
5 Bearing seat



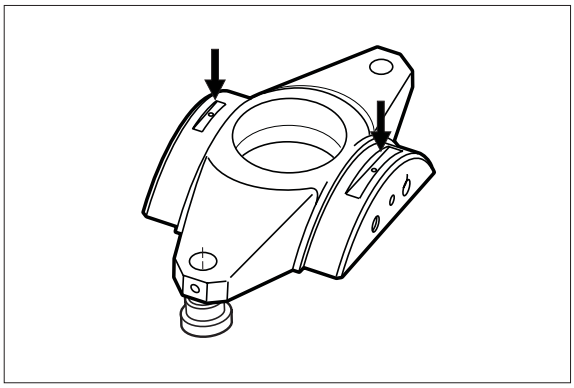
75796WE80

(3) Check :
Sliding surface free of grooves.



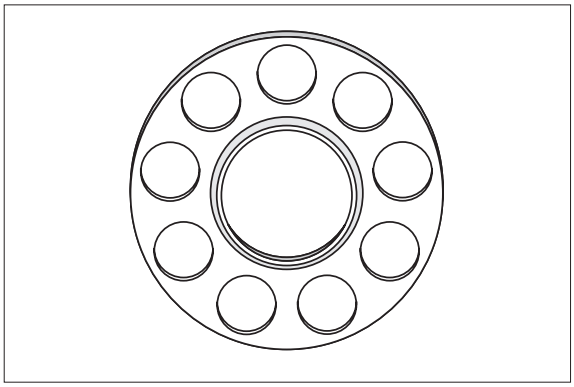
75796WE81

(4) Check :
Bearing surfaces.



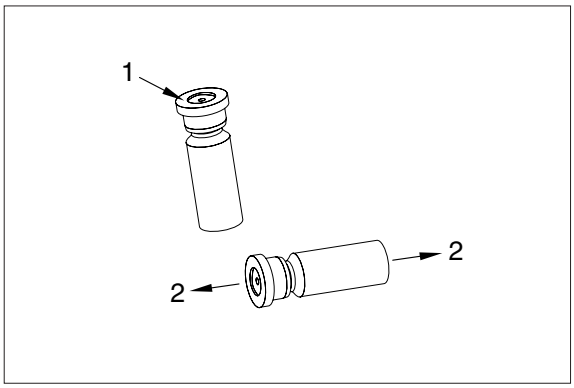
75796WE82

(5) Check :
That the retaining plate is free of grooves and that there is no wear in the slipper pad area.



75796WE83

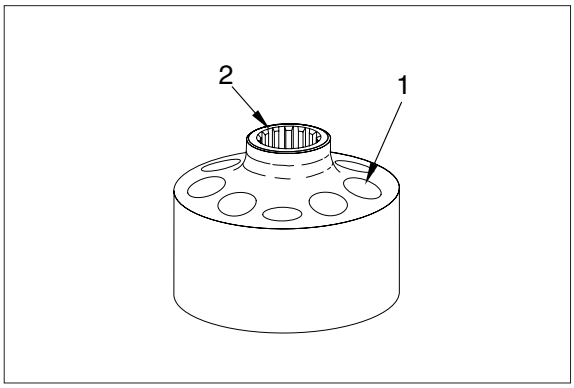
(6) Check :
Check to see that there are no scratches or metal deposits on the sliding surface (1) and that there is no axial play (2) (Pistons must only be replaced as a set).



75796WE84

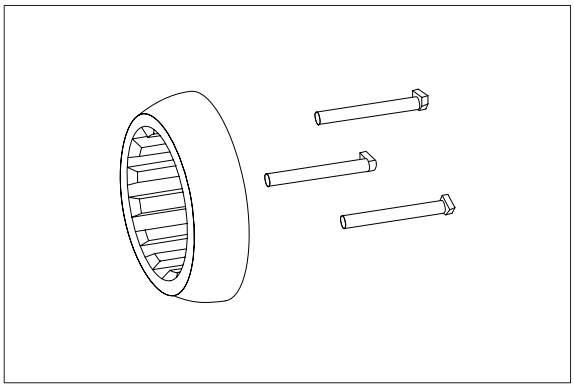
(7) Check :

1 Cylinder bores
2 Splines



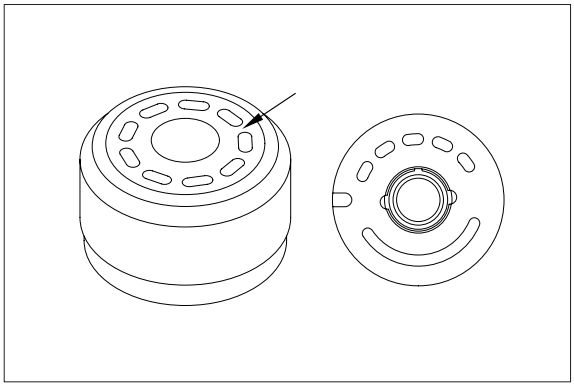
75796WE85

(8) Free of grooves, no signs of wear.



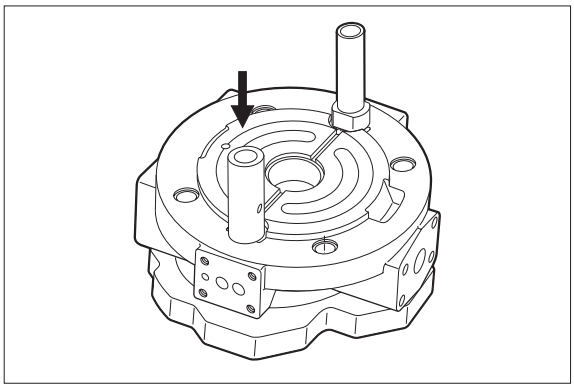
75796WE86

(9) 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).



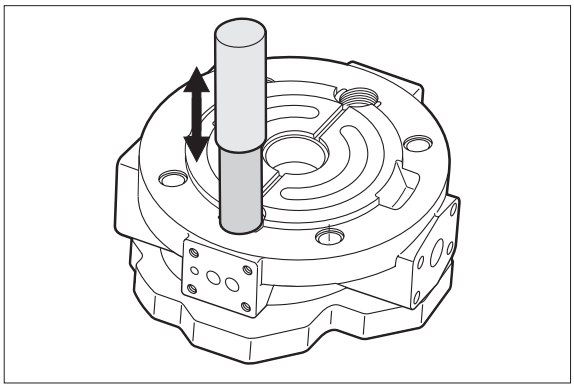
75796WE87

(10) Check :
Mounting surface - control plate undamaged.



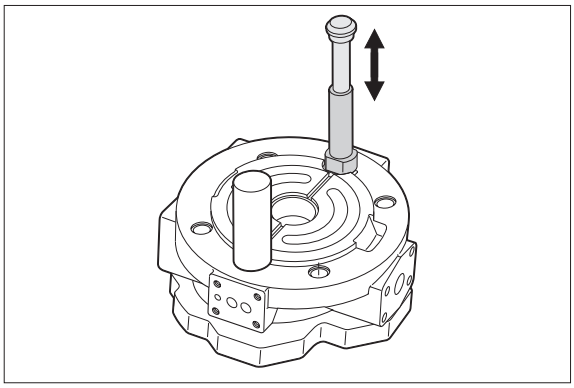
75796WE120

(11) Check :
Check running conditions of the control piston.



75796WE89

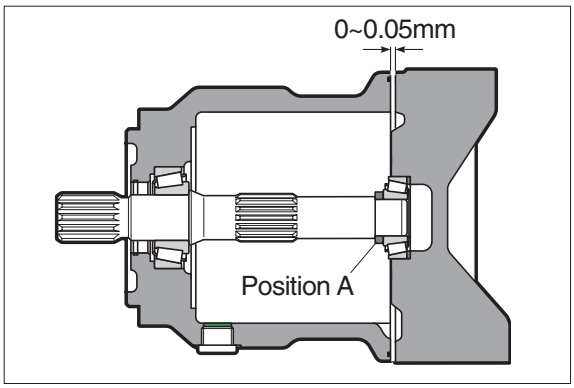
(12) Check :
Check running conditions of the opposite piston.



75796WE90

7) ADJUSTMENT OF TAPER ROLLER BEARING SET

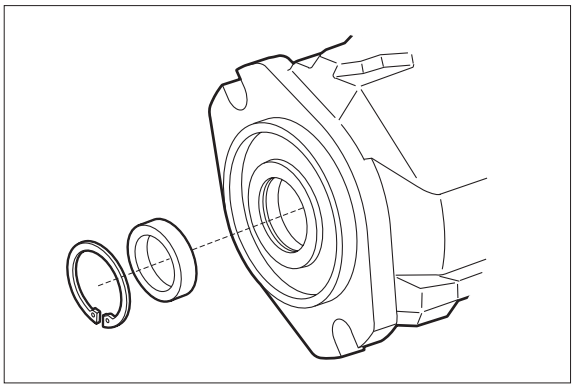
(1) Cast iron housing must have initial tension of the bearings : 0~0,05 ㎜, grind position A if necessary.



75796WE91

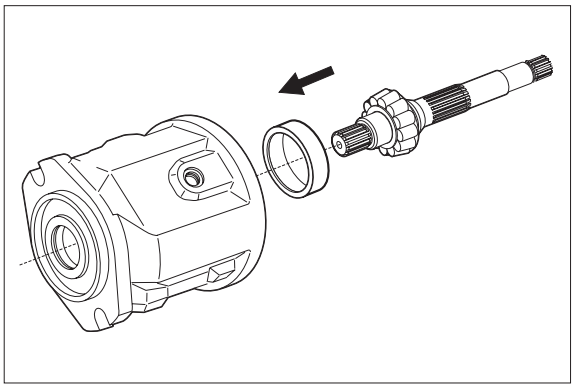
8) PUMP ASSEMBLY

(1) Fit the seal into the housing.
Fit the circlip.



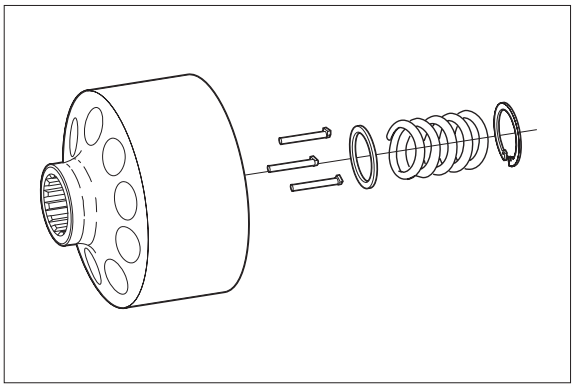
75796WE92

(2) Fit the drive with bearing from rear end.
※ Do not touch seal lip with edge of keyway or spline.



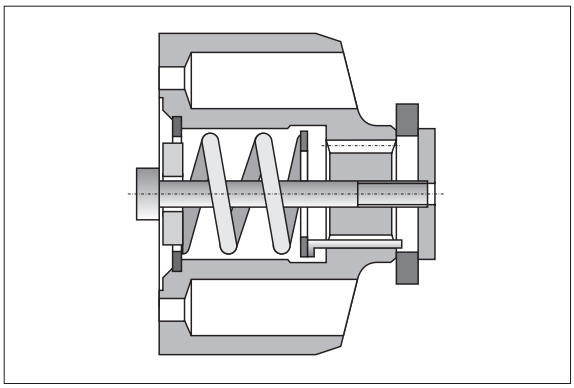
75796WE93

(3) Fit pressure pins using an assembly aid.



75796WE94

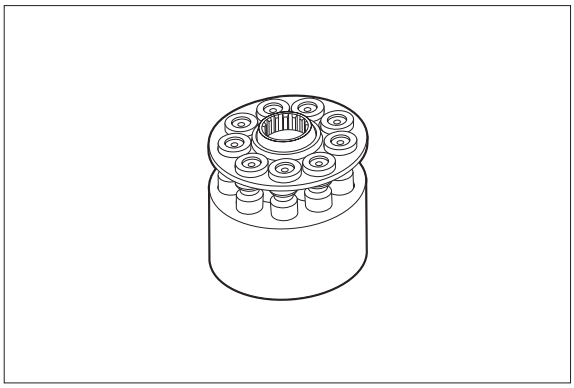
(4) Pre-tension the spring using a suitable device.



75796WE95

(5) Assemble piston with retaining plate.

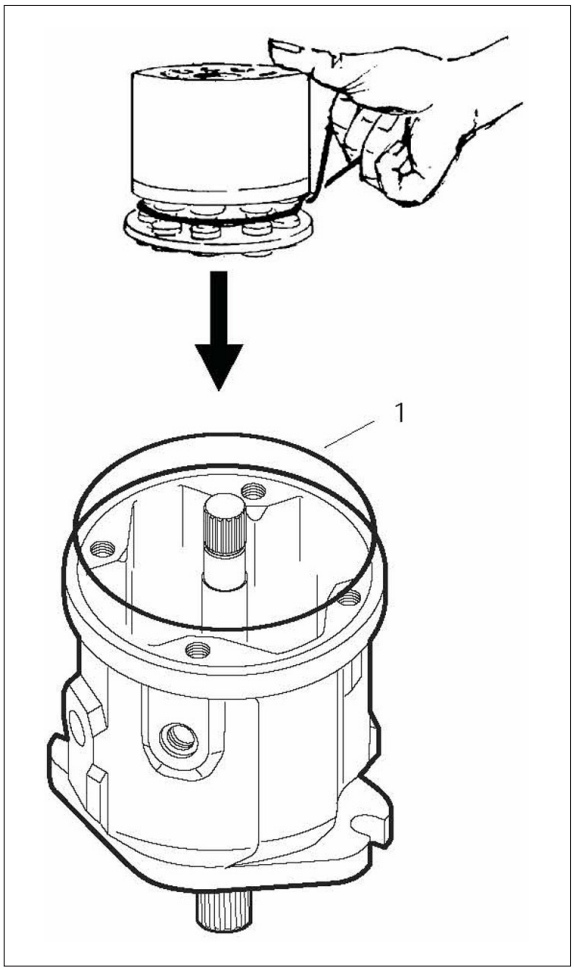
※ Oil piston and slipper pad.



75796WE97

(6) Fit rotary group.

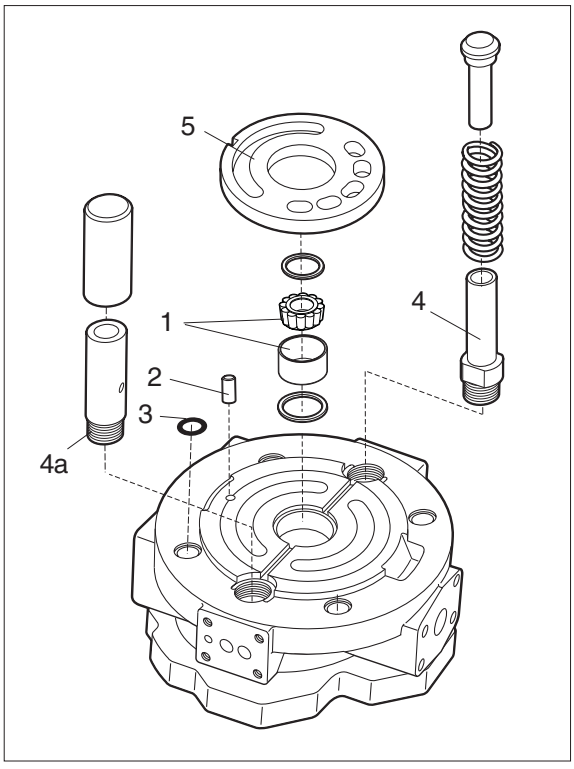
※ Hold the piston by using an O-ring.
Fit O-ring (1).



75796WE98

(7) Fit bearing (1) in connection plate.
Fit cyilindrical pin (2).
Fit O-rings (3) 4 pieces.
Fit adjustment spool (4) and guide piston (4a).
Fit distributor plate (5) (direction of rotation dependent)

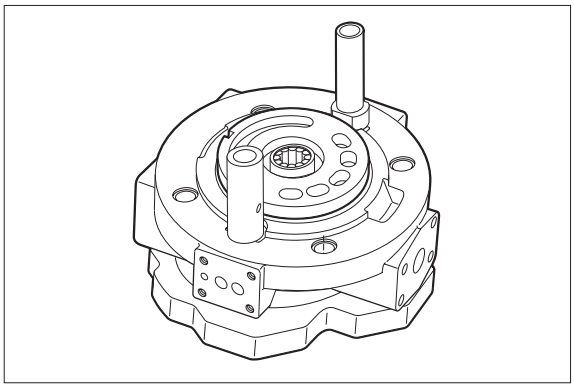
※ Assembly.
Hold the components in place with grease.



75796WE99

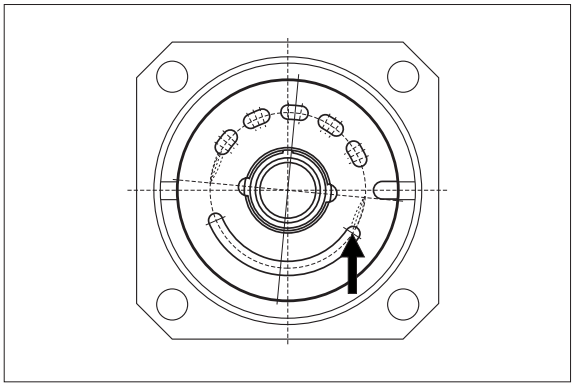
(8) Fit distributor plate.

※ Assembly aid : Grease



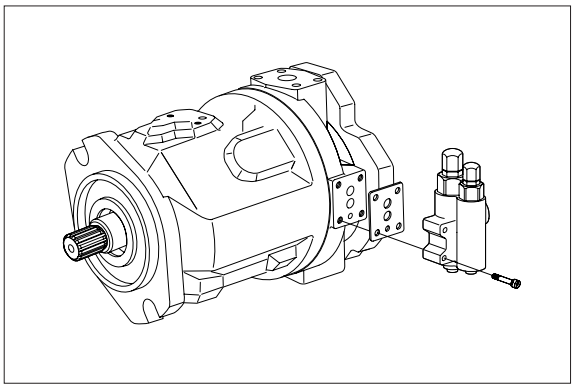
75796WE100

(9) For clockwise rotation pumps the distributor plate is off-set by 4 to the right from the centre position.
(Clockwise and anti-clockwise rotation distributor plates are not identical).



75796WE101

(10) Fit connection plate and control valve.



75796WE63

2. MAIN CONTROL VALVE (LEVER TYPE)

1) VALVE SECTION DISASSEMBLY / REASSEMBLY INSTRUCTIONS

(1) Clean valve assembly thoroughly to remove any dirt and debris.

(2) Remove nuts (10) and tie rods (9) from control valve (see Figure #4). Separate sections being careful not to lose section O-rings (A and B , Figure #1-3). Keep all components for each section together as a set.

(3) Lay out valve components on a clean, flat working surface. The inlet assembly will include o-rings, and the spool section(s) will include o-rings. Tools required for basic valve assembly include 19mm open or box end wrench and a torque wrench with thin wall sockets.

(4) Inspect parts for wear or damage. Replace as necessary.

(5) Restack valve as shown in Figure #4. Care should be taken to assure that the mating section surfaces are absolutely free of contamination (dirt, paint, paint chips, etc.). Care should be taken to not pinch the section O-ring when restacking the valve.
Using the following procedure for stacking the valve assembly will help eliminate the possibility of damaged seals and will allow easy examination of the surfaces for debris.
Tie rods (9) are threaded to different lengths on each end. Install nuts (10) fully onto the short thread end of each tie rod. Lay inlet section on its outside face with tie rods up. Install O-rings (A and B) in grooves on inlet face. Slide spool section (2) over tie rods and install O-rings (A and B, Figure #1). Repeat for the remaining spool sections.
After stacking all spool sections and inlet / outlet sections onto tie rods (9) and nuts (10) onto tie rods and hand tighten so valve assembly can be placed on its mounting feet before torquing tie rods.

(6) 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 ends to approximately 1.38 kgf·m (10 lbf·ft). Final torque the six 19 ㎜ nuts (10) to 9.3 kgf·m (67 lbf·ft). Check for proper spool movement.

(7) Install auxiliary valves and/or port plugs into all sections and torque to proper specifications.

2) SPOOL SECTION

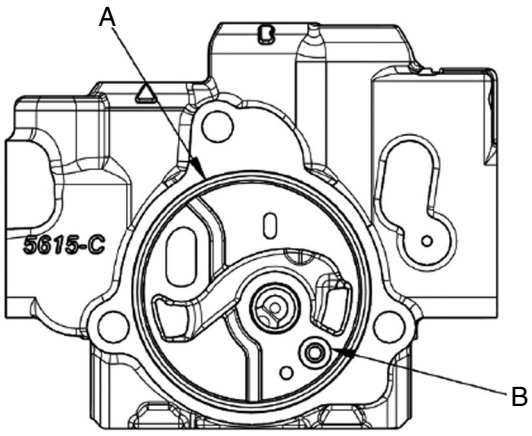


FIGURE #1 - SPOOL SECTION VIEW
A - Large O-ring
B - Small O-ring

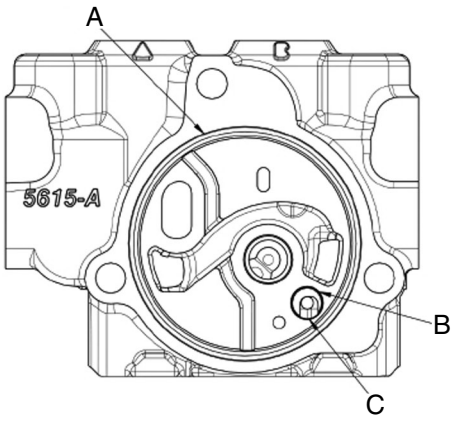


FIGURE #2 - SPOOL SECTION VIEW
A - Large O-ring
B - Seat assy (CV Valve)
C - Small O-ring

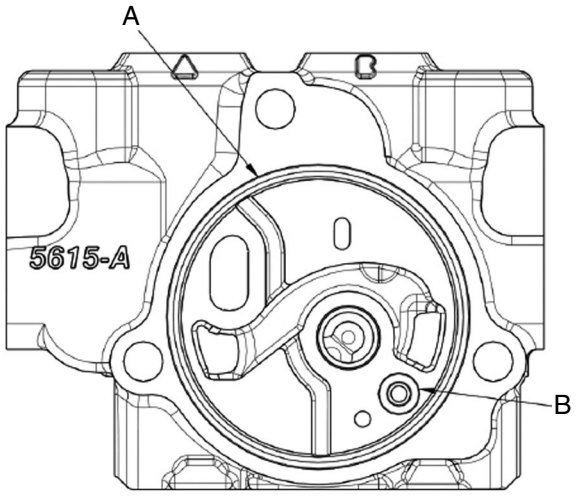


FIGURE #3 - SPOOL SECTION VIEW
A - Large O-ring
B - Small O-ring

110DEMCV01

3) VALVE ASSEMBLY

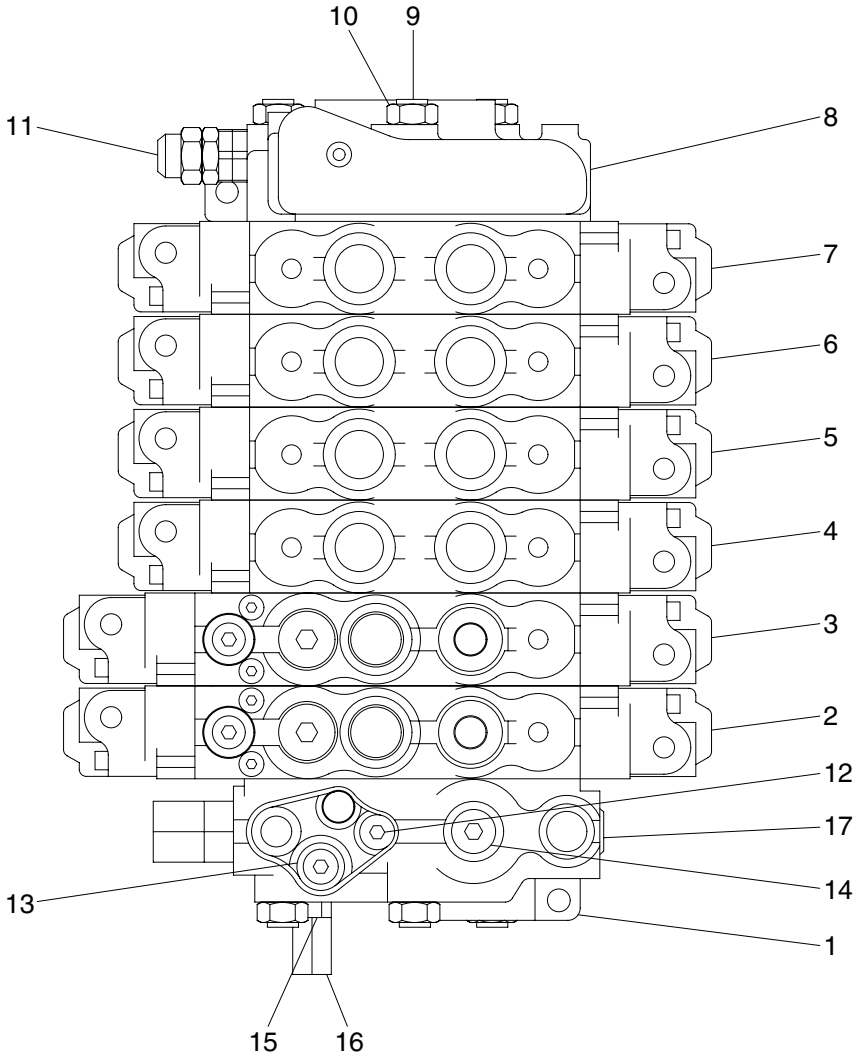
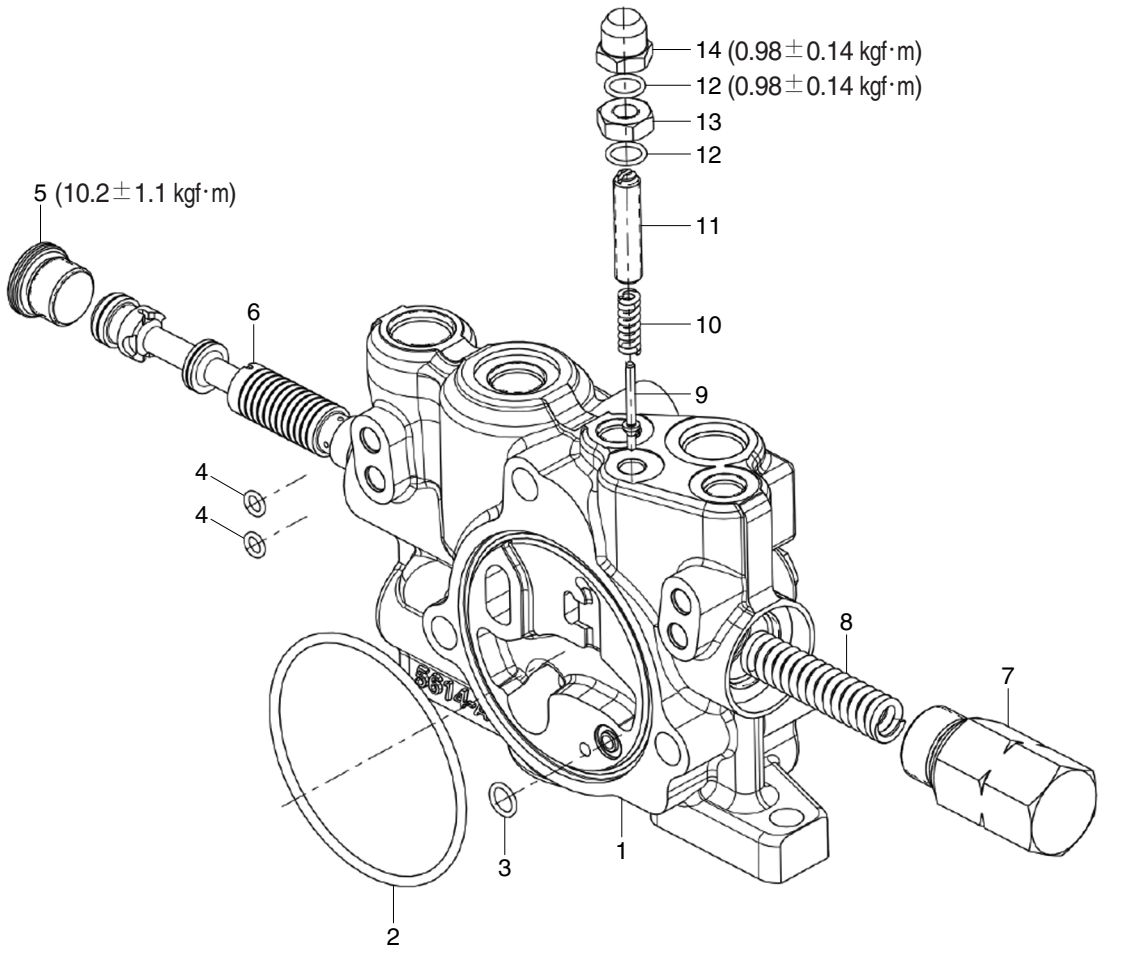


FIGURE #4 - VALVE ASSEMBLY

110DEMCV02

1	Inlet section	7	Aux section	13	LSRV
2	Lift section	8	Outlet section	14	Plug
3	Lift section	9	Tie rod(3)	15	Plug
4	Tilt section	10	Special nut(6)	16	Check valve
5	Aux section	11	Relief valve	17	Relief valve
6	Aux section	12	Plug		

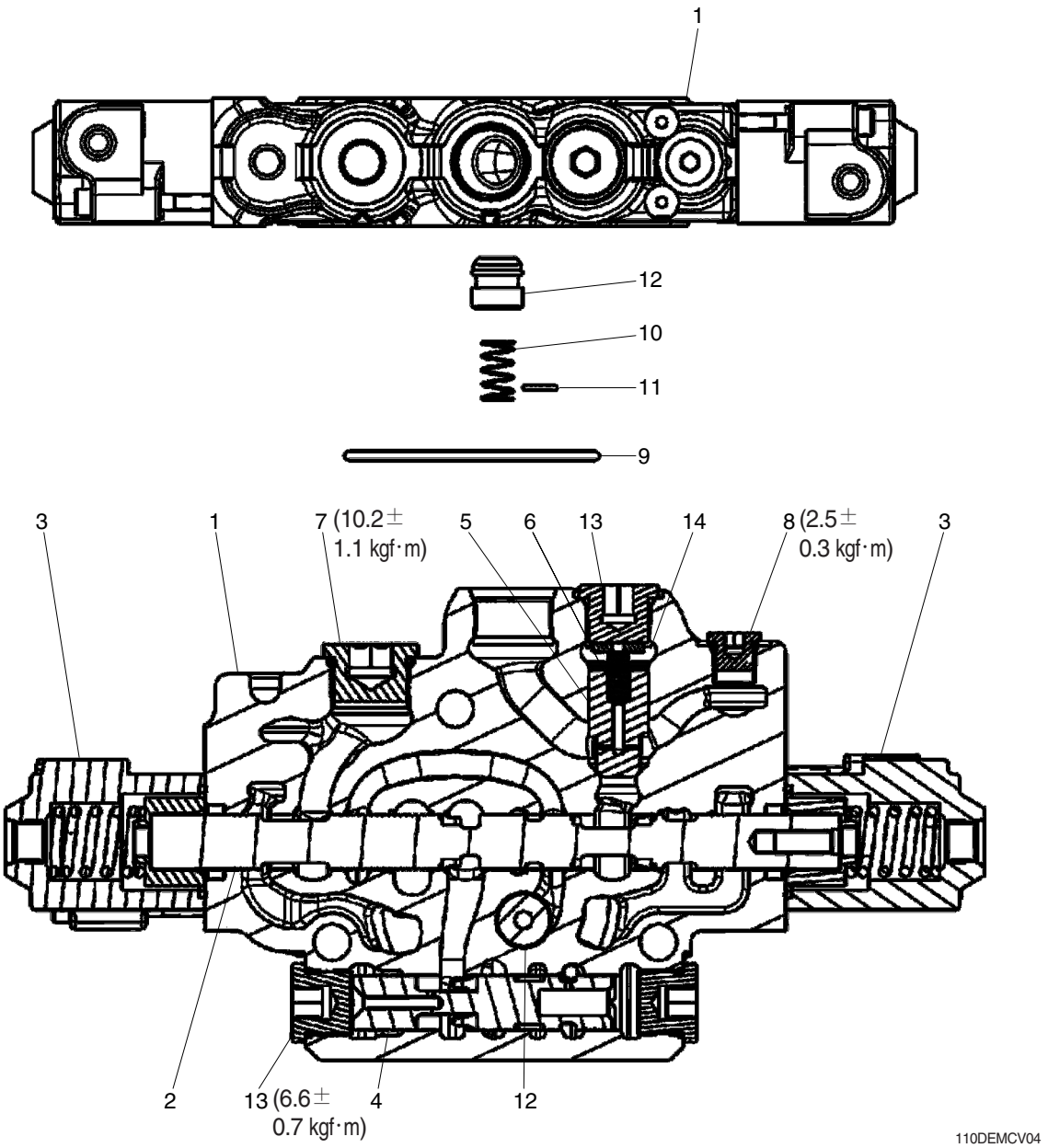
4) INLET SECTION



110DEMCV03

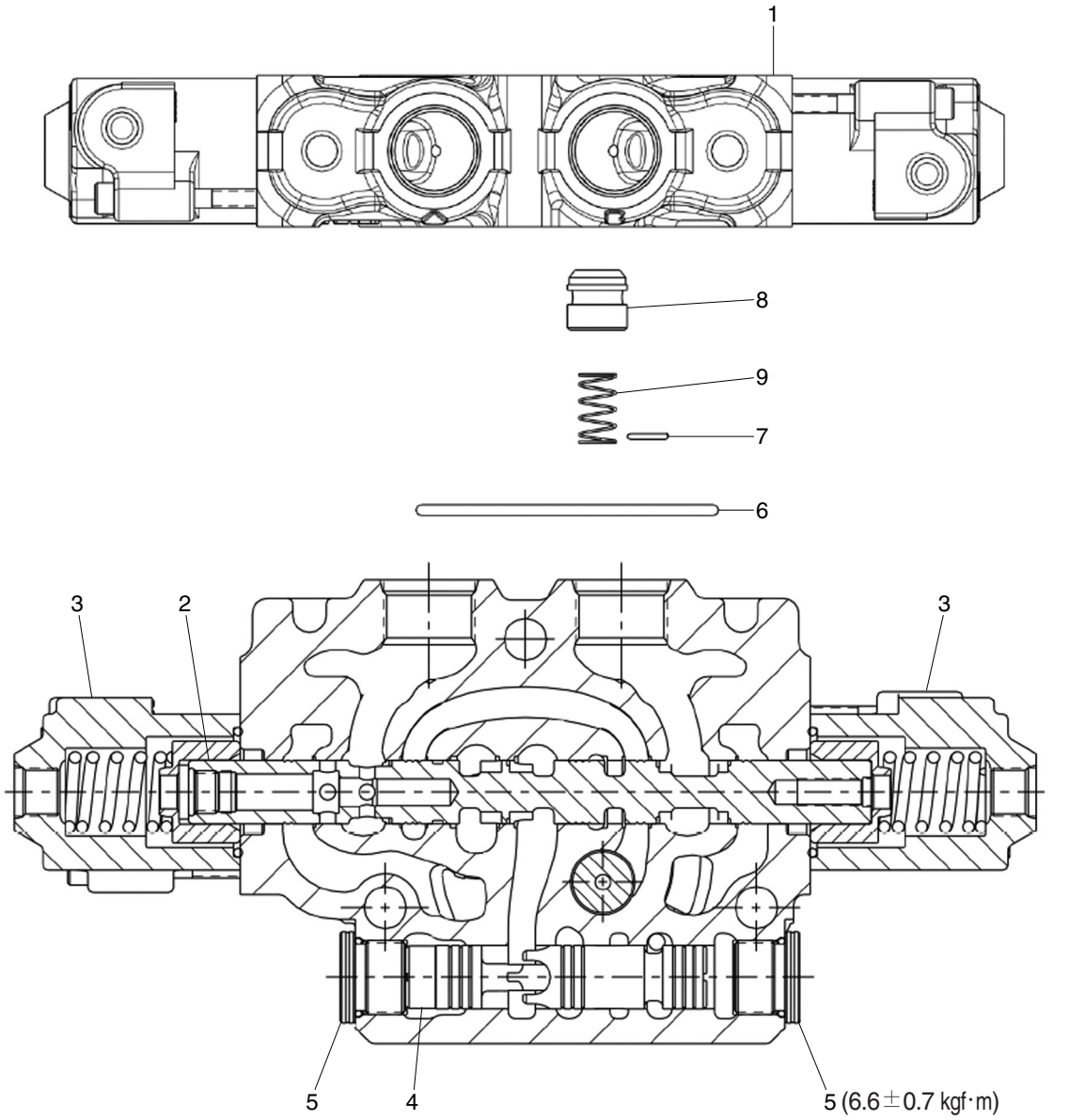
1	Inlet housing	6	Spool	11	Adjust screw
2	O-ring	7	Cap	12	O-ring
3	O-ring	8	Spring	13	Special nut
4	O-ring	9	Poppet	14	Special nut
5	Plug	10	Spring		

5) LIFT SECTION



1	Lift spool housing	6	Spring	11	O-ring
2	Spool	7	Plug	12	Poppet
3	End cap	8	Plug	13	Plug
4	Spool	9	O-ring	14	Washer
5	Lockout valve poppet	10	Spring		

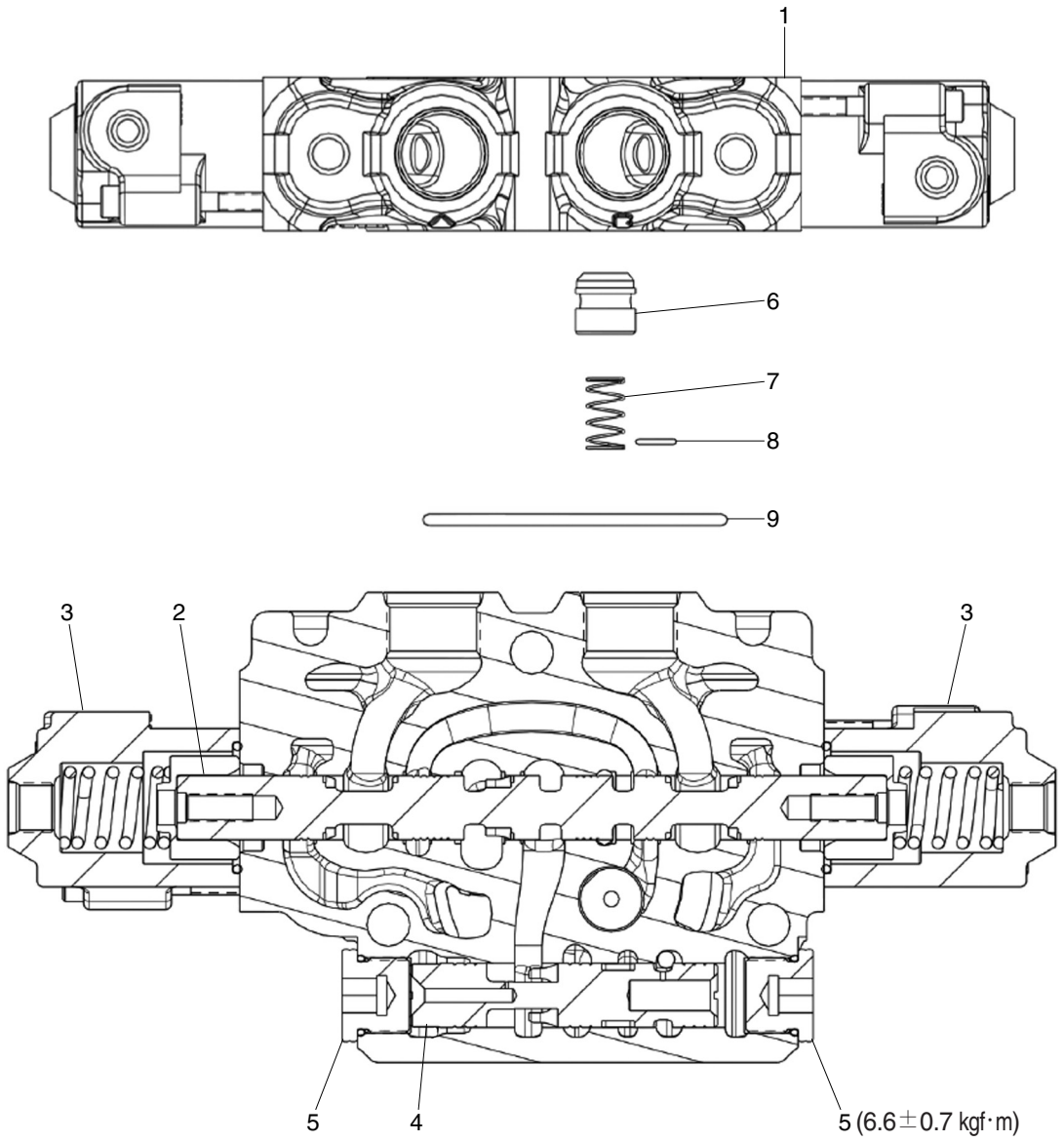
6) TILT SECTION



110DEMCV05

1	Tilt spool housing	4	Spool	7	O-ring
2	Spool	5	Plug	8	Poppet
3	End cap	6	O-ring	9	Spring

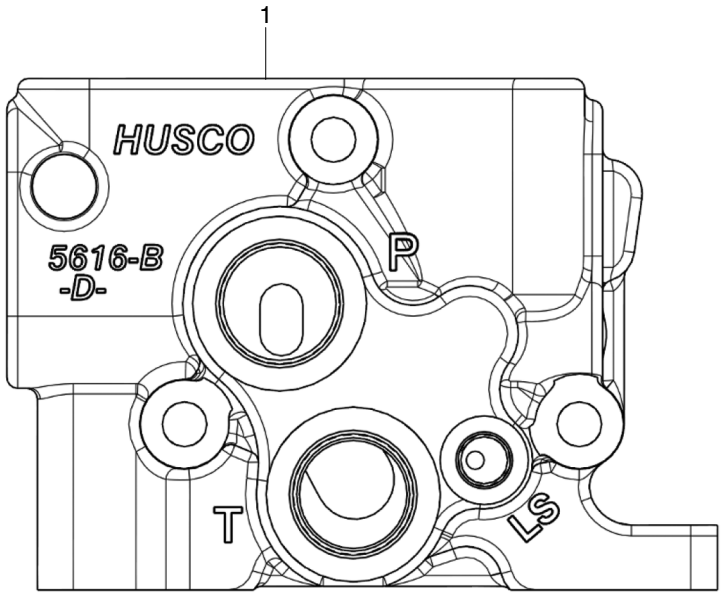
7) AUX SECTION



110DEMCV06

1	Aux spool housing	4	Spool	7	Spring
2	Spool	5	Plug	8	O-ring
3	End cap	6	Poppet	9	O-ring

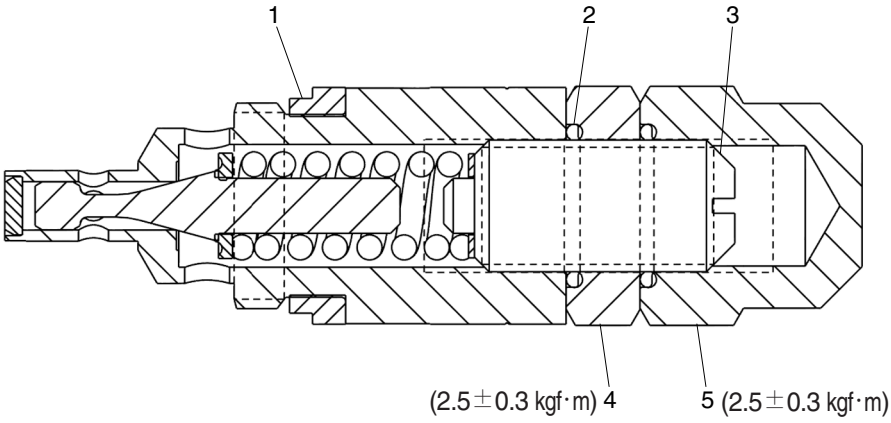
8) OUTLET SECTION



110DEMCV07

1 Outlet housing

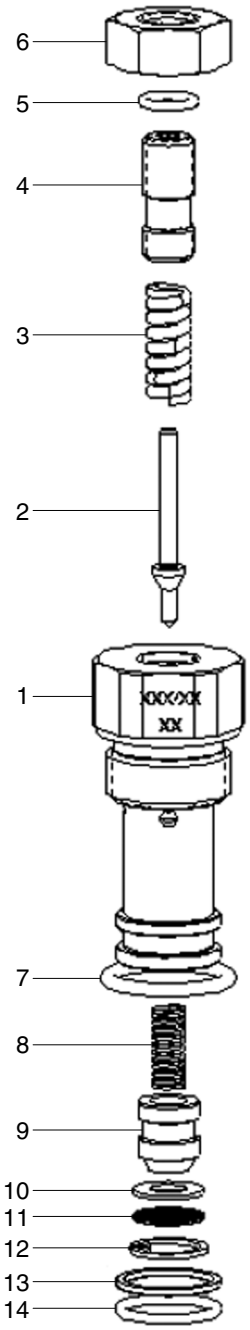
9) RELIEF VALVE

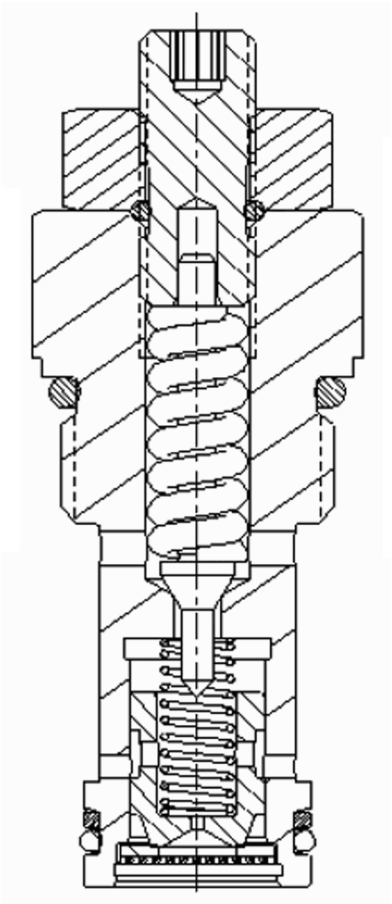


110DEMCV08

1 Special seal
2 O-ring
3 Adjust screw
4 Jam nut
5 Special nut

10) DRAIN REGULATOR

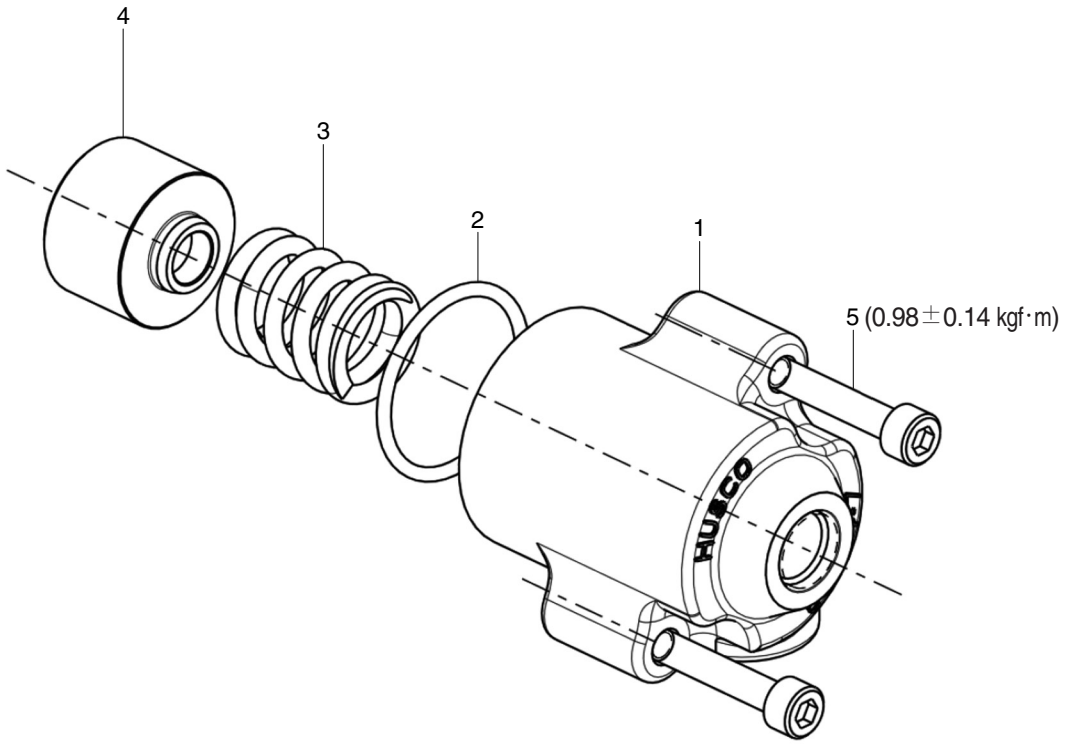




110DEMCV09

1	Body	6	Special nut	11	Filter
2	Poppet	7	O-ring	12	Retaining ring
3	Spring	8	Spring	13	Backup ring
4	Adjust screw	9	Piston	14	O-ring
5	O-ring	10	Washer		

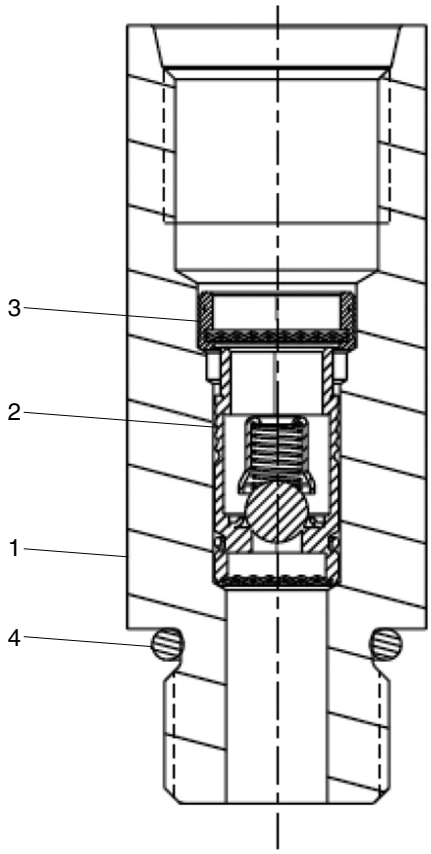
11) END CAP



110DEMCV10

1	Spool cap	3	Spring	5	Cap screw
2	O-ring	4	Spring seat		

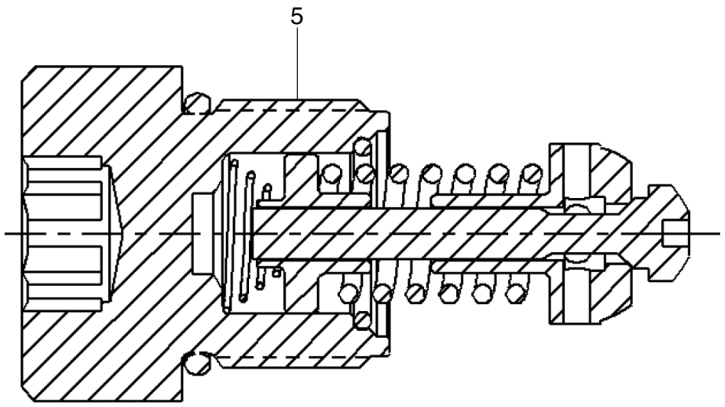
12) CHECK VALVE



110DEMCV11

1 Body
2 Flow control
3 Filter
4 O-ring

13) RELIEF VALVE



110DEMCV12

5 O-ring

3. MAIN CONTROL VALVE (FINGERTIP TYPE)

1) VALVE SECTION DISASSEMBLY / REASSEMBLY INSTRUCTIONS

(1) Clean valve assembly thoroughly to remove any dirt and debris.

(2) Remove nuts (10) and tie rods (9) from control valve (see Figure #4). Separate sections being careful not to lose section O-rings (A, B, C and D , Figure #1-3). Keep all components for each section together as a set.

(3) Lay out valve components on a clean, flat working surface. The inlet assembly will include O-rings, and the spool section(s) will include O-rings. Tools required for basic valve assembly include 19 ㎜ open or box end wrench and a torque wrench with thin wall sockets.

(4) Inspect parts for wear or damage. Replace as necessary.

(5) Restack valve as shown in Figure #4. Care should be taken to assure that the mating section surfaces are absolutely free of contamination (dirt, paint, paint chips, etc.). Care should be taken to not pinch the section O-ring when restacking the valve.
Using the following procedure for stacking the valve assembly will help eliminate the possibility of damaged seals and will allow easy examination of the surfaces for debris.
Tie rods (9) are threaded to different lengths on each end. Install nuts (10) fully onto the short thread end of each tie rod. Lay inlet section on its outside face with tie rods up. Install O-rings (A, B and C) in grooves on inlet face. Slide spool section (2) over tie rods and install O-rings (A, B and C, Figure #1). Repeat for the remaining spool sections.
After stacking all spool sections and inlet / outlet sections onto tie rods (9) and nuts (10) onto tie rods and hand tighten so valve assembly can be placed on its mounting feet before torquing tie rods.

(6) 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 ends to approximately 1.4 kgf·m (10 lbf·ft). Final torque the six 19 ㎜ nuts (10) to 9.3 kgf·m (67 lbf·ft). Check for proper spool movement.

(7) Install auxiliary valves and/or port plugs into all sections and torque to proper specifications.

2) SPOOL SECTION

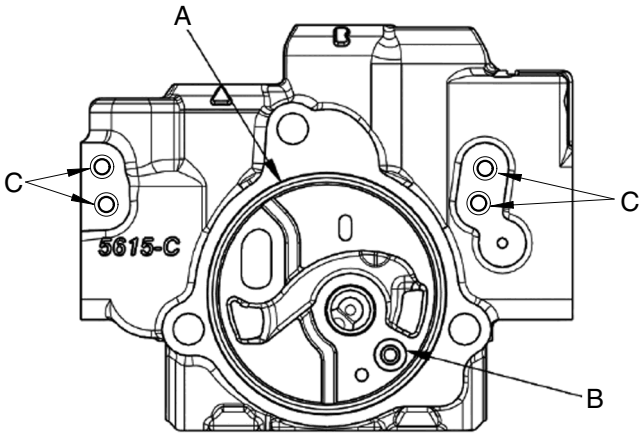


Figure #1 Spool section view

A Large O-ring
B Medium O-ring
C Small O-ring

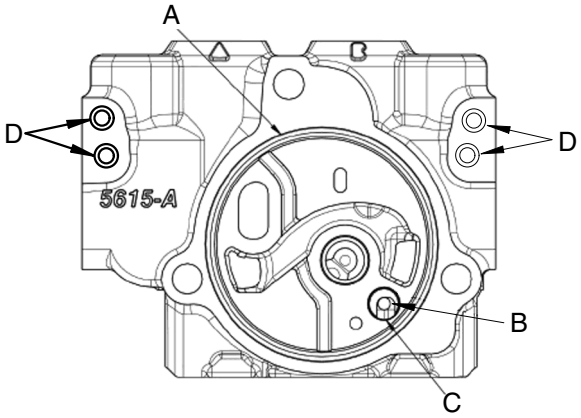


Figure #2 Spool section view

A Large O-ring
B Seat assy (CV valve)
C Medium O-ring
D Small O-ring

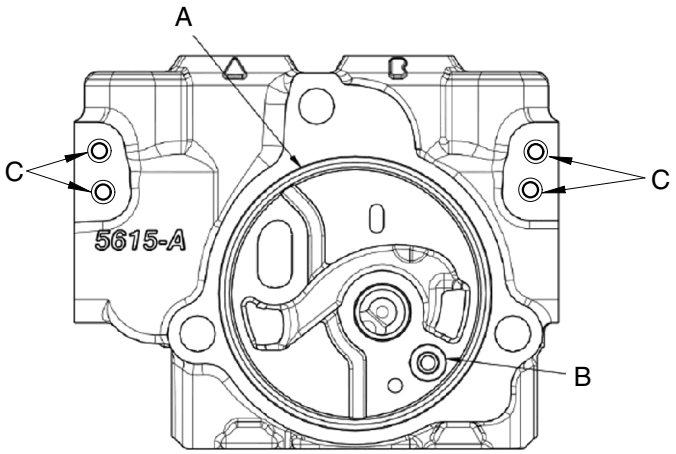


Figure #3 Spool section view

A Large O-ring
B Medium O-ring
C Small O-ring

160D9LMCV01

3) VALVE ASSEMBLY

※ The valve assembly pictured below is the 5 spool.

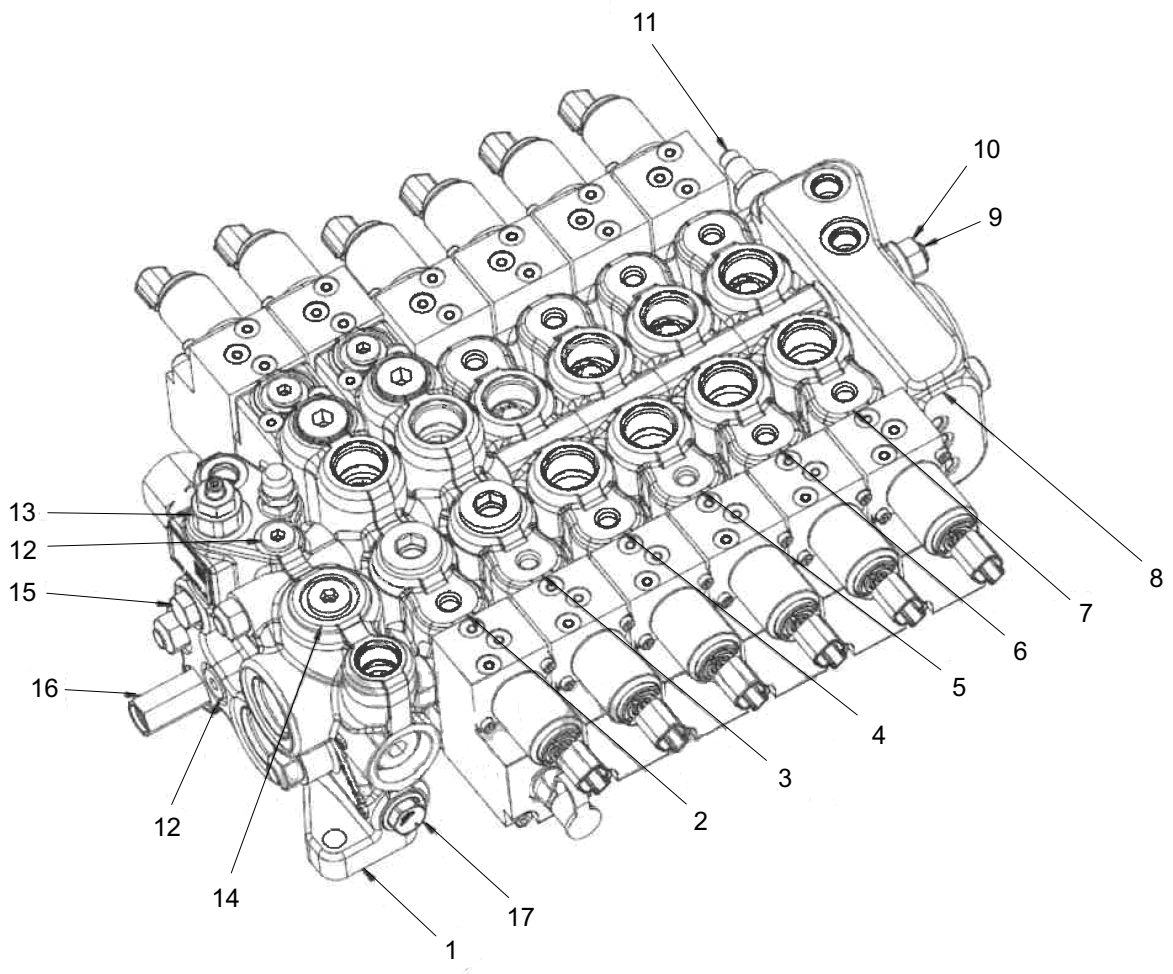


FIGURE #4 - VALVE ASSEMBLY

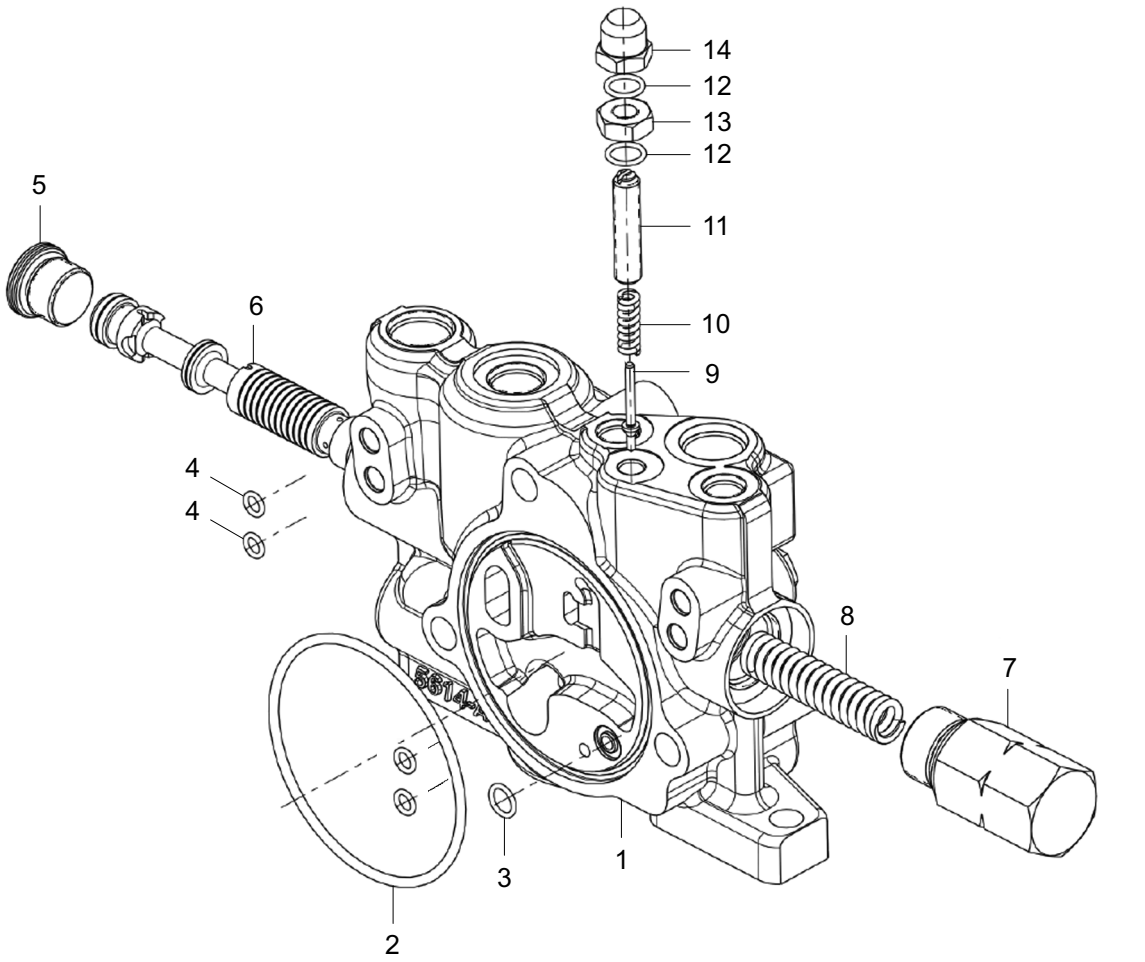
160D9LMCV02

※ Tightening torque

Item	Torque	Item	Torque
10	9.3 ± 0.7 kgf·m (67 ± 5 lbf·ft)	14	2.5 ± 0.3 kgf·ft (18 ± 2 lbf·ft)
11	2.5 ± 0.3 kgf·ft (18 ± 2 lbf·ft)	15	2.5 ± 0.3 kgf·ft (18 ± 2 lbf·ft)
12	4.6 ± 0.5 kgf·ft (33 ± 3.5 lbf·ft)	16	4.6 ± 0.5 kgf·ft (33 ± 3.5 lbf·ft)
13	4.6 ± 0.5 kgf·ft (33 ± 3.5 lbf·ft)	17	3.5 ± 0.35 kgf·ft (25 ± 2.5 lbf·ft)

1 Inlet section
2 Lift section 1
3 Lift section 2 (option)
4 Tilt section
5 Aux section
6 Aux section
7 Aux section
8 Outlet section
9 Tie rod
10 Special nut
11 Auxiliary relief valve assy
12 Plug
13 Load sensing relief valve (option)
14 Plug
15 Plug
16 Check valve assy
17 Main relief valve assy

4) INLET SECTION

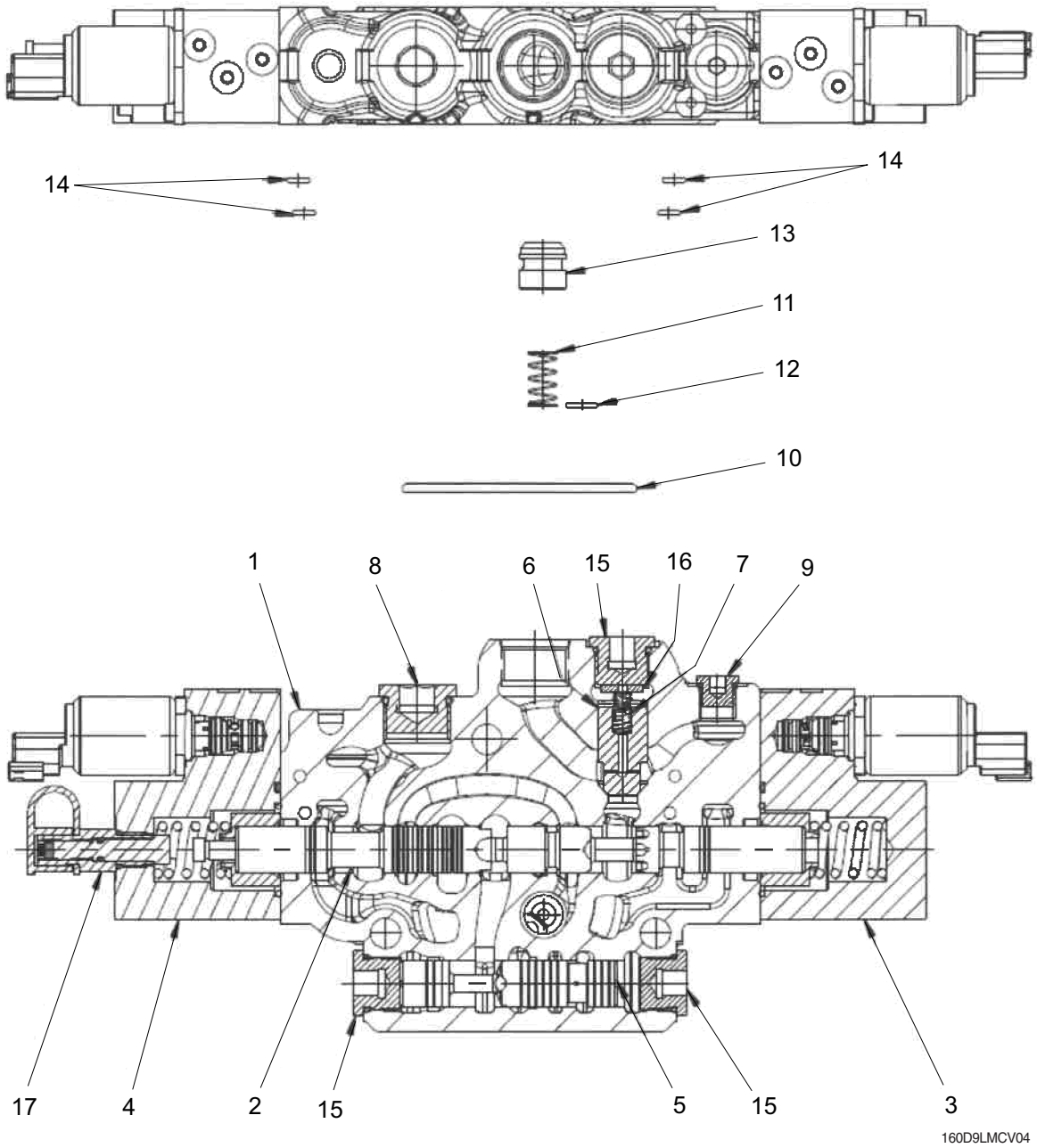


※ Tightening torque

Item	Torque	Item	Torque
5	6.6 ± 0.7 kgf·m (48 ± 5 lbf·ft)	14	0.97 ± 0.14 kgf·m (7 ± 1 lbf·ft)
7	10.2 ± 1.1 kgf·ft (74 ± 8 lbf·ft)	17	2.5 ± 0.3 kgf·m (18 ± 2 lbf·ft)
13	0.97 ± 0.14 kgf·m (7 ± 1 lbf·ft)	-	-

1 Inlet housing
2 O-ring
3 O-ring
4 O-ring
5 Plug assy
6 Spool
7 Cap assy
8 Spring
9 RV poppet
10 Spring
11 Adjust screw
12 O-ring
13 Special nut
14 Special nut
15 CV poppet (not shown)
16 Spring (not shown)
17 Plug assy (not shown)

5) LIFT SECTION 1

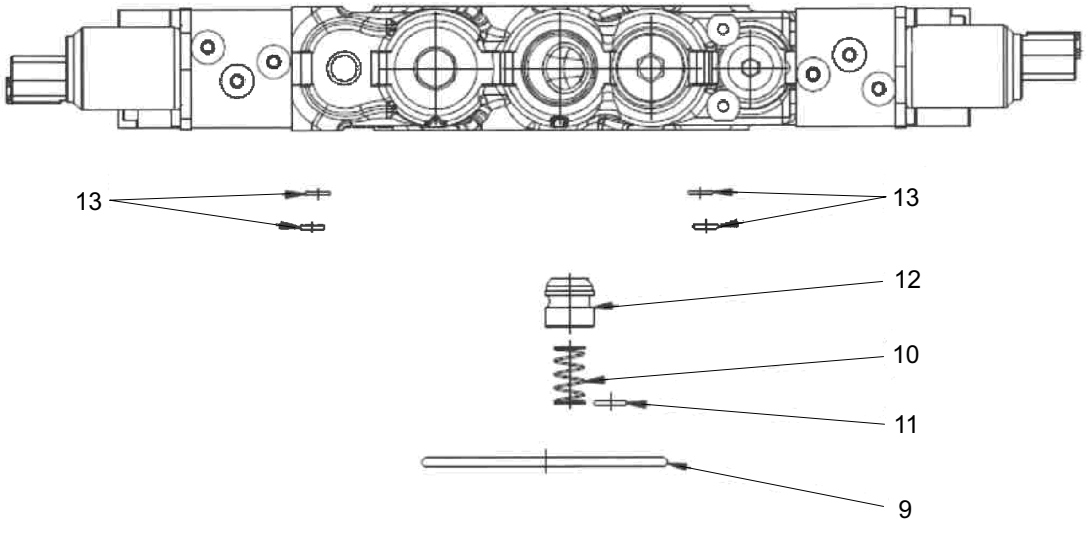


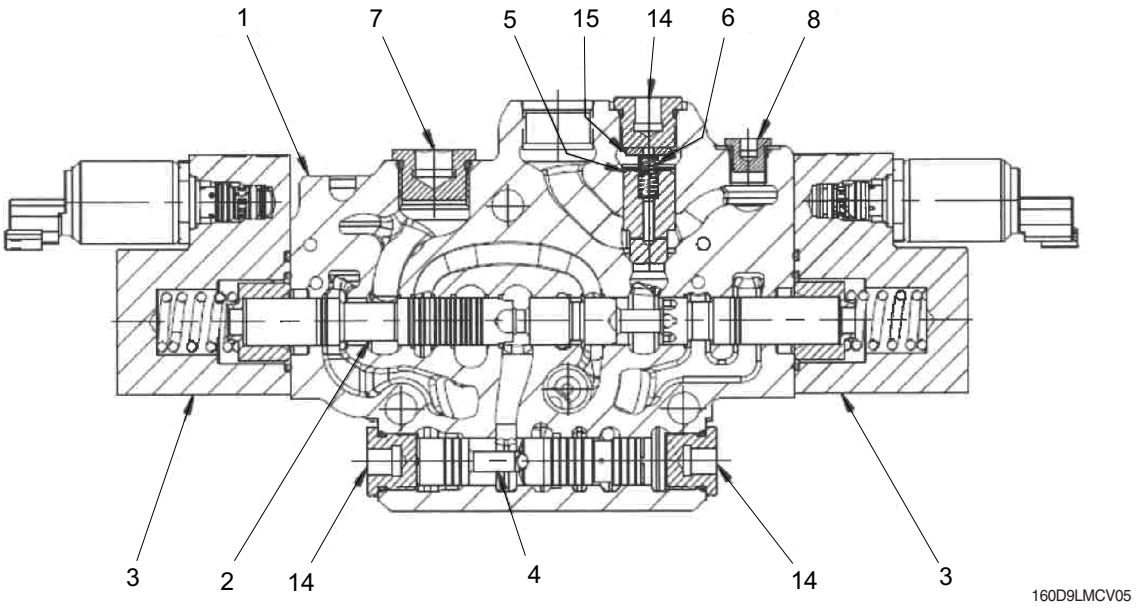
※ Tightening torque

Item	Torque	Item	Torque
8	10.2 ± 1.1 kgf·ft (74 ± 8 lbf·ft)	15	6.6 ± 0.7 kgf·m (48 ± 5 lbf·ft)
9	2.5 ± 0.3 kgf·m (18 ± 2 lbf·ft)	17	2.5 ± 0.3 kgf·m (18 ± 2 lbf·ft)

1	Lift spool housing	7	Spring	13	CV poppet
2	Spool assy	8	Plug assy	14	O-ring
3	End cap assy	9	Plug assy	15	Plug assy
4	End cap assy	10	O-ring	16	Flat washer
5	Spool assy	11	Spring	17	Adjust plug assy
6	Lockout valve poppet	12	O-ring		

6) LIFT SECTION 2 (OPTION)



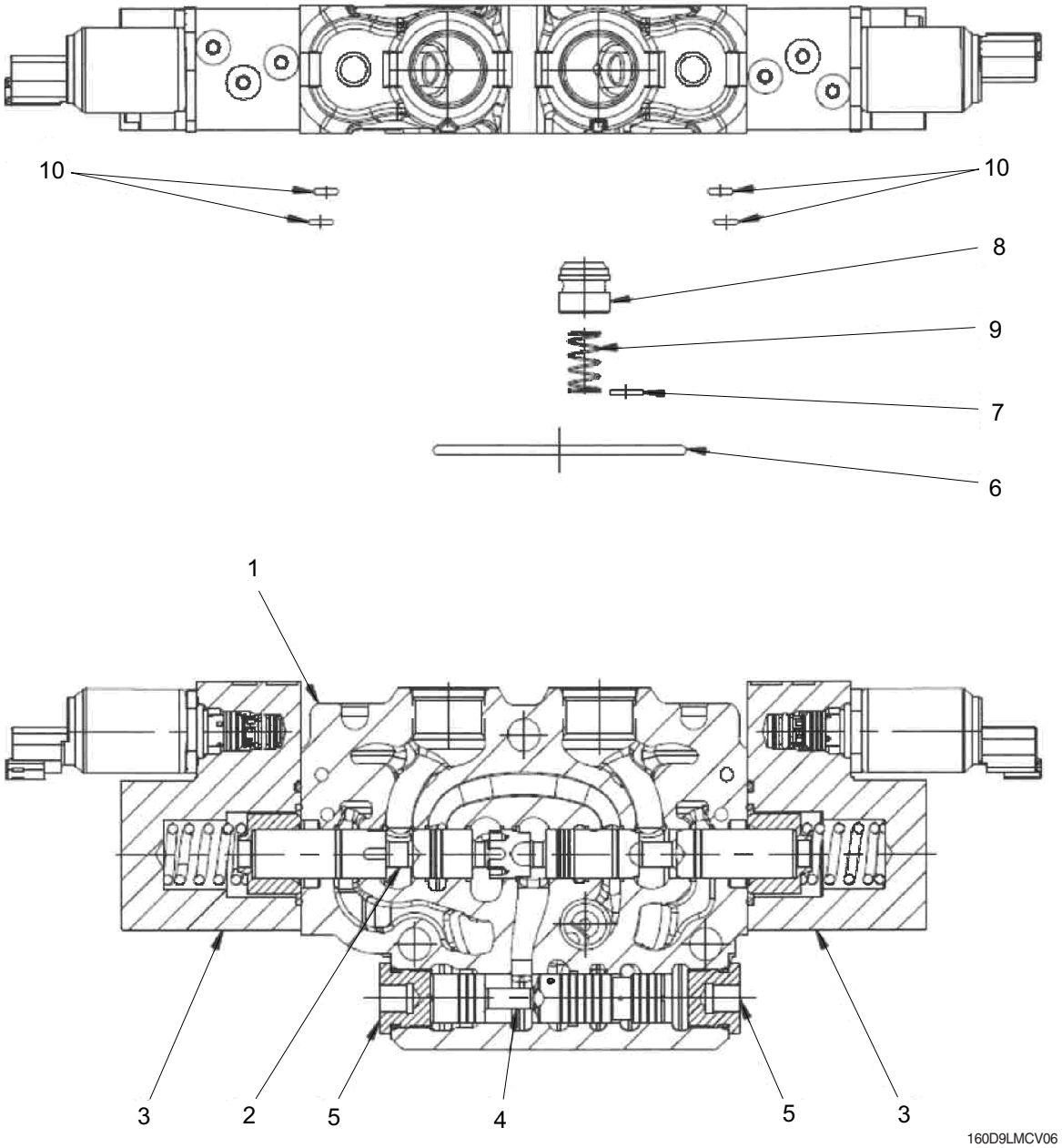


※ Tightening torque

Item	Torque	Item	Torque
7	10.2 ± 1.1 kgf·ft (74 ± 8 lbf·ft)	14	6.6 ± 0.7 kgf·m (48 ± 5 lbf·ft)
8	2.5 ± 0.3 kgf·m (18 ± 2 lbf·ft)	-	-

1	Lift spool housing	6	Spring	11	O-ring
2	Spool	7	Plug assy	12	CV poppet
3	End cap assy	8	Plug assy	13	O-ring
4	Compensator spool assy	9	O-ring	14	Plug assy
5	Lockout valve poppet	10	Spring	15	Flat washer

7) TILT SECTION

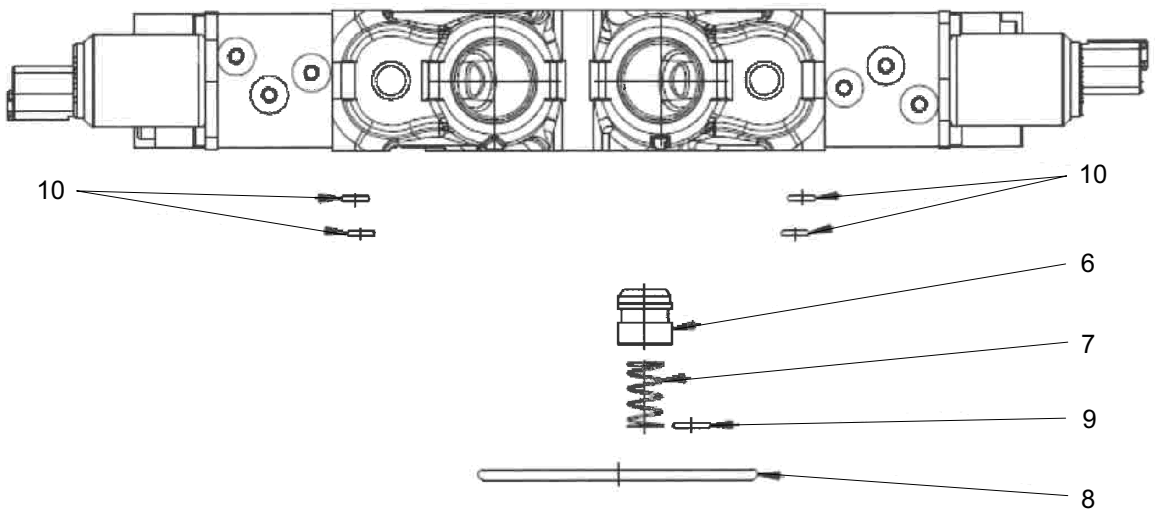


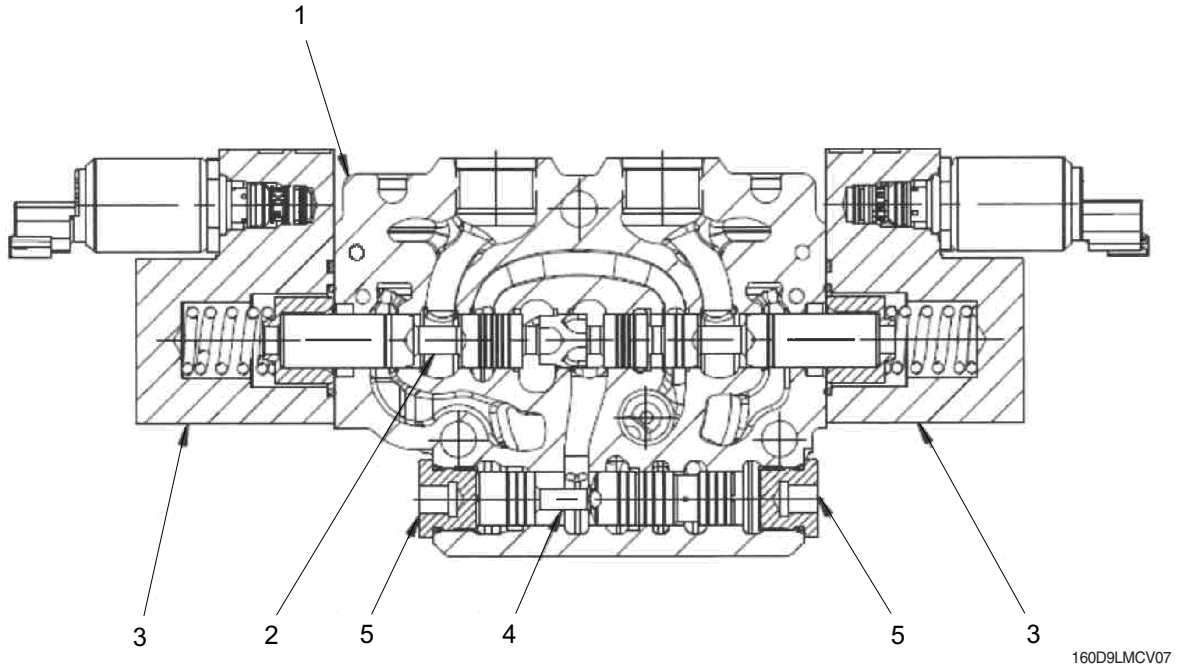
※ Tightening torque

Item	Torque
5	6.6 ± 0.7 kgf·m (48 ± 5 lbf·ft)

1	Tilt spool housing	4	Compensator spool assy	7	O-ring
2	Spool	5	Plug assy	8	CV poppet
3	End cap assy	6	O-ring	9	Spring
				10	O-ring

8) AUX SECTION



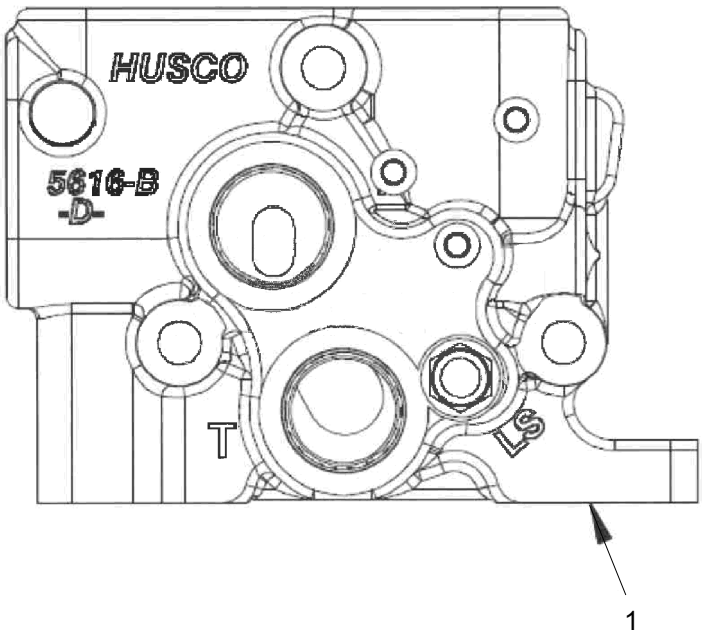


※ Tightening torque

Item	Torque
5	6.6 ± 0.7 kgf·m (48 ± 5 lbf·ft)

1	Aux spool housing	5	Plug assy	9	O-ring
2	Spool	6	CV poppet	10	O-ring
3	End cap assy	7	Spring		
4	Compensator spool assy	8	O-ring		

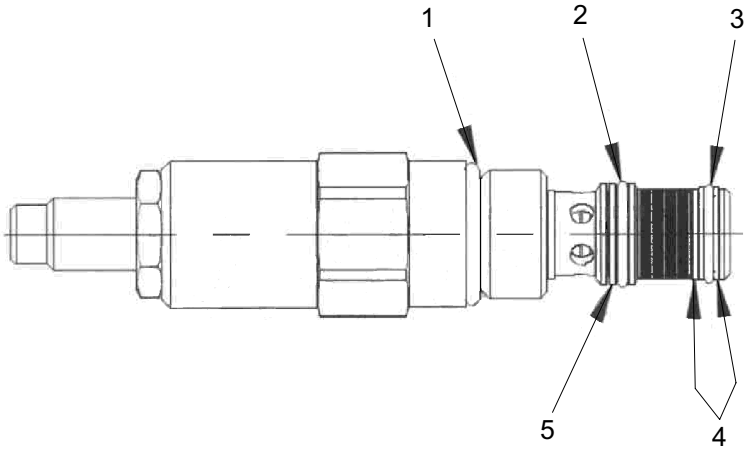
9) OUTLET SECTION



160D9LMCV08

1 Outlet housing

10) MAIN RELIEF VALVE ASSY (OPTION)

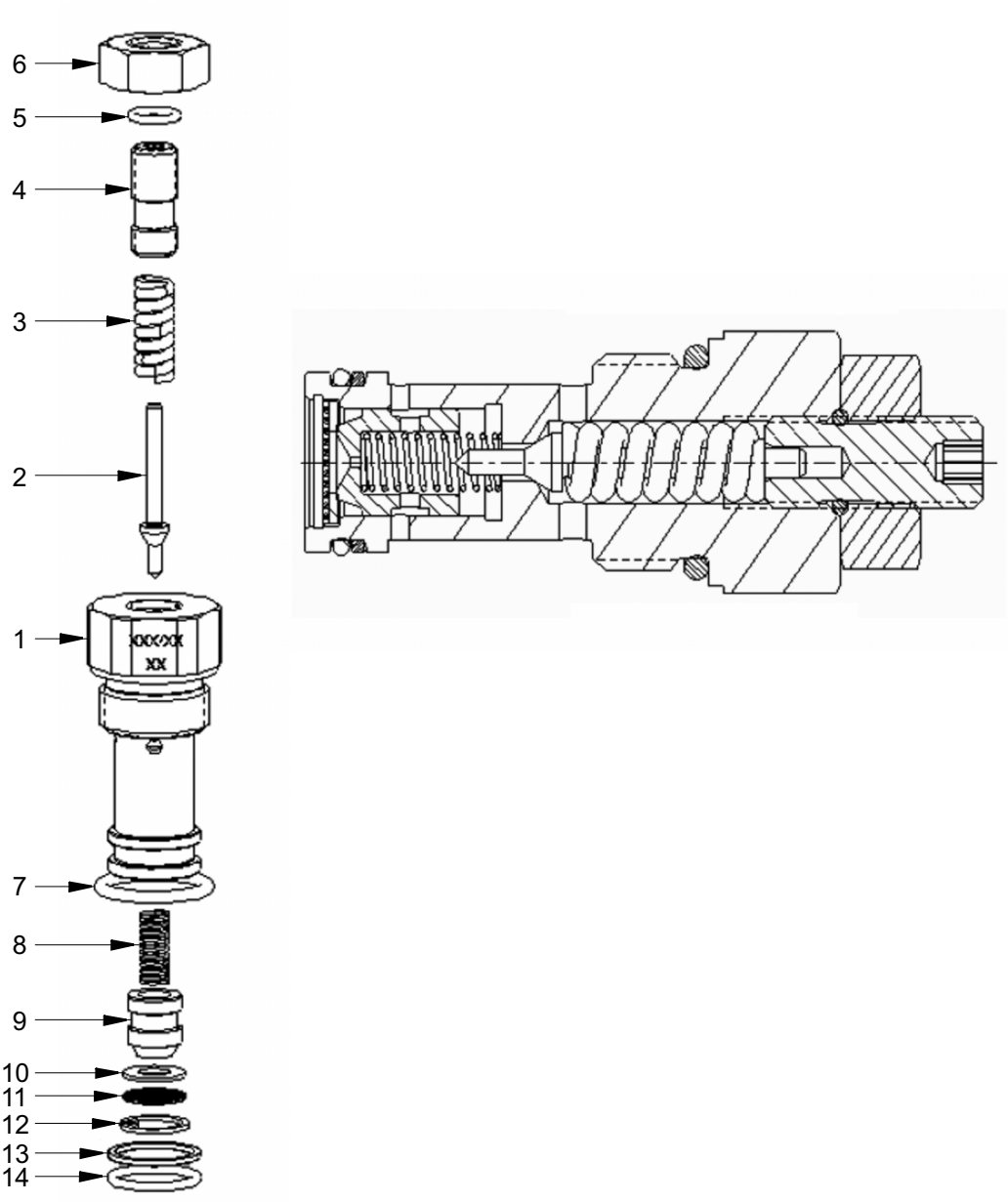


160D9LMCV09

※ If service other than external seal replacement is required replace entire assembly.

1 O-ring
2 O-ring
3 O-ring
4 Back up ring
5 Back up ring

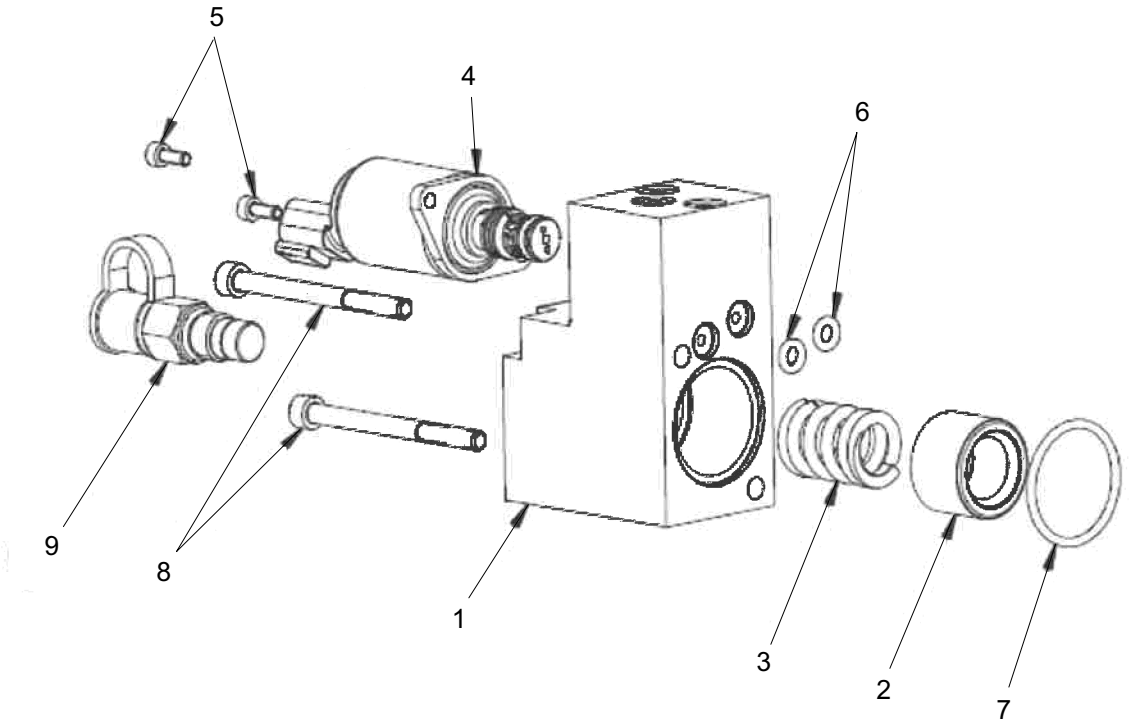
11) DRAIN REGULATOR ASSEMBLY



160D9LMCV10

1	Relief valve body	6	Special nut	11	Filter
2	Relief valve poppet	7	O-ring	12	Retaining ring
3	Spring	8	Spring	13	Backup ring
4	Adjust screw	9	Piston	14	O-ring
5	O-ring	10	Washer		

12) END CAP ASSEMBLY (OPTION)



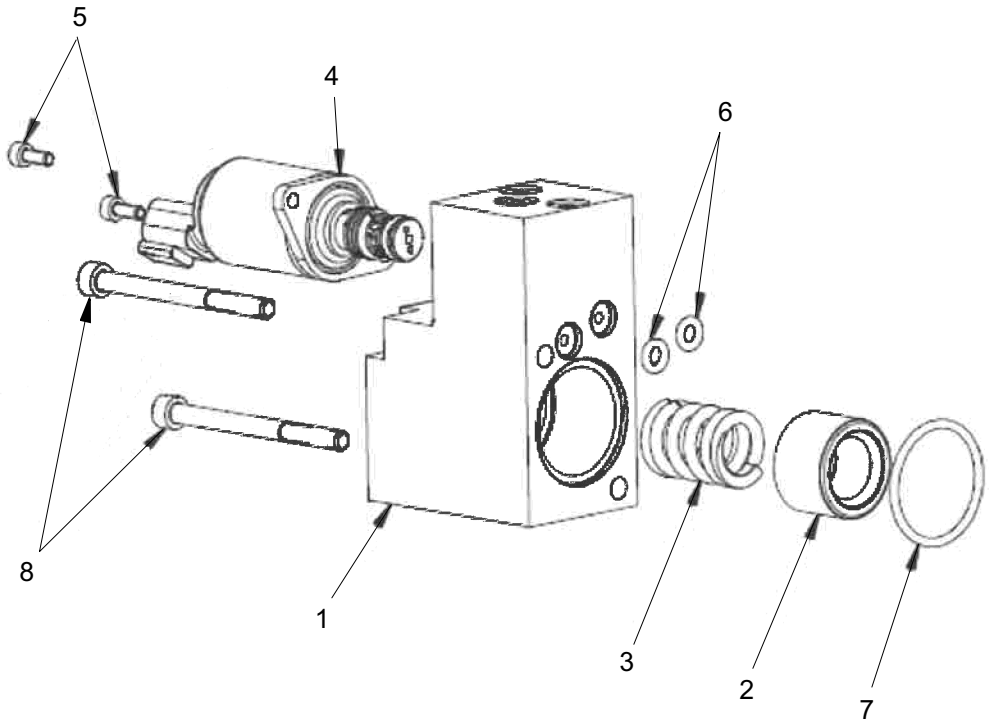
160D9LMCV11

※ Tightening torque

Item	Torque	Item	Torque
5	0.21 ± 0.03 kgf·m (1.5 ± 0.2 lbf·ft)	9	2.5 ± 0.3 kgf·m (18 ± 2 lbf·ft)
8	1.4 ± 0.14 kgf·m (10 ± 1 lbf·ft)	-	-

1	Solenoid spool cap assy	4	Solenoid cartridge valve	7	O-ring
2	Spring seat	5	Socket head cap screw	8	Socket head cap screw
3	Spring	6	O-ring	9	Adjust plug assy

13) END CAP ASSEMBLY



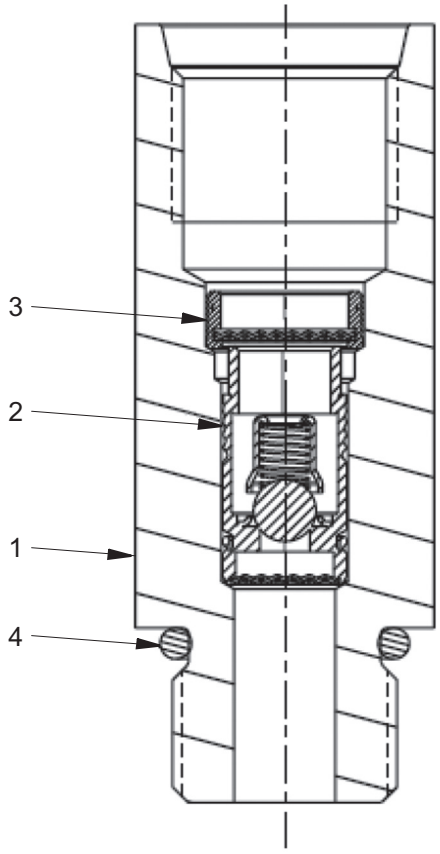
160D9LMCV12

※ Tightening torque

Item	Torque	Item	Torque
5	0.21 ± 0.03 kgf·ft (1.5 ± 0.2 lbf·ft)	8	1.4 ± 0.14 kgf·m (10 ± 1 lbf·ft)

1	Solenoid spool cap assy	4	Solenoid cartridge valve	7	O-ring
2	Spring seat	5	Socket head cap screw	8	Socket head cap screw
3	Spring	6	O-ring		

14) CHECK VALVE ASSEMBLY

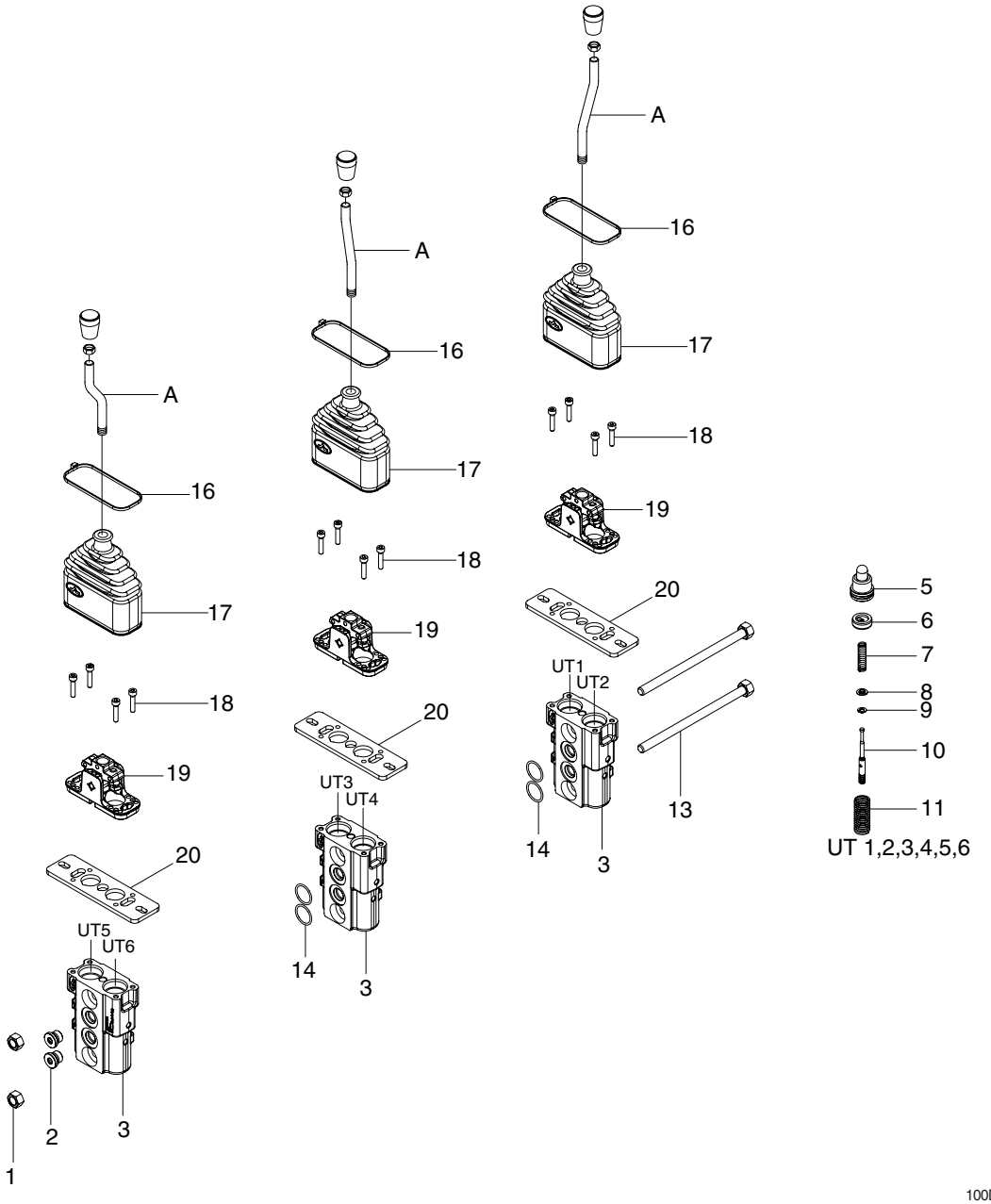


160D9LMCV13

1	CV body	3	Filter
2	Flow control assy	4	O-ring

3. REMOTE CONTROL VALVE

1) STRUCTURE



100D7RCV00

A	Lever	7	Metering spring	14	O-ring
1	Nut	8	Seeger ring	15	Kit 3
2	Plug	9	Seeger ring	16	Clamp
3	Body	10	Docking rod	17	Rubber bellow
4	Kit 1	11	Spring	18	Screw
5	Plunger kit	12	Kit 2	19	Support kit
6	Spring guide	13	Tie rod with nut	20	Flange

2) GENERAL PRECAUTIONS

(1) In the system, all of the pipes must be carefully cleaned before installation in order to remove dirt, rust, and deposits.
(2) The following cleaning procedures are recommended: Sanding, brushing, pickling, and flushing with a solvent to remove contaminating particles.
(3) The use of Teflon tape, hemp, or other "fillers" for joints is PROHIBITED
(4) Verify that the pipes, fittings and connections are not subjected to mechanical stress.
(5) Make sure that the pipes are not wound and that there are no abrasions on the surface.

3) PRECAUTION FOR DISASSEMBLY AND ASSEMBLY

(1) Valve piping joint should be tightened with the specified torque value. When piping, care should be taken not to apply excess pressure to the valve. If valve is installed with incorrect torque values, it might cause defect of spool operation, noise or vibration.
Recommended tightening torque of SAE 4 (7/16-20UNF) is 1.0 kgf·m (7.2 lbf·ft).
(2) Care must be taken not to damage the seals by excess temperature or spatter of welding, when welding near by the valve.
(3) During the installation, care must be taken not to damage spool. It might cause defect of operation such as the spool getting stuck in valve body.
(4) Fit the rubber hosepipe for the machine, which expected vibration.
(5) Until piping, don't remove the blinds from each port.

4) PRECAUTION FOR OPERATION

(1) Max input pressure range should be less than 30~100 bar (435~1450 psi).
(2) Back pressure of tank port should be less than 3 bar (43.5 psi).
(3) The oil temperature should be between -10~80˚C. And ambient temperature should be from -40 ~60˚C. because that very high viscosity of oil will be cause defect of spool operation, warm up the machine to avoid it.
(4) 15/12- ISO4406 level of filtration is required in the hydraulic circuit for long life cycle of each components without mechanical trouble.

5) SPECIAL TOOL

(1) 3 mm wrench.
(2) 13 mm socket spanner.
(3) Torque wrench adjustable from 1.02 ~ 3.06 kgf·m (7.4 ~ 22.1 lbf·ft).

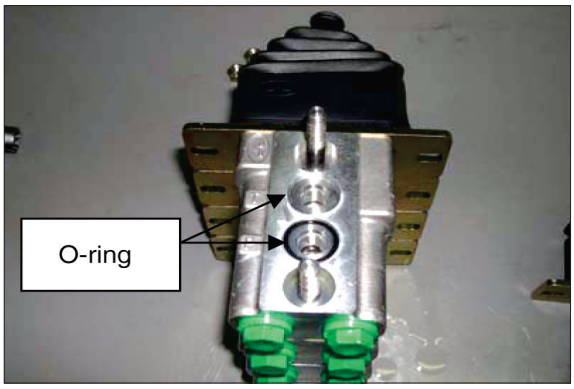
6) DISASSEMBLY & ASSEMBLY

(1) Replacing complete working section

Loosen two tightening bolts with 13 mm spanner.

100D7RCV02

Taking out the damaged section and insert new one. Pay attention 2 O-rings on the internal passage to be in right position.



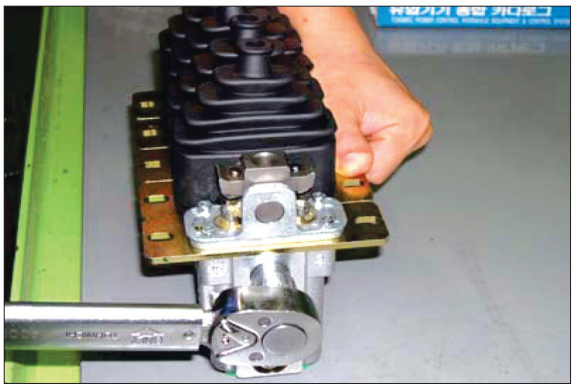
100D7RCV03

Tight M13 nut with proper torque 3.06 kgf·m (22.1lbf·ft).

100D7RCV04

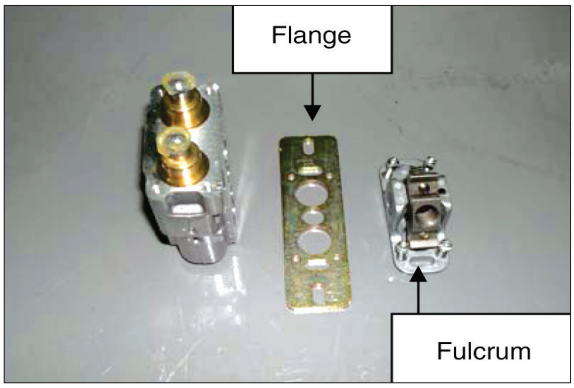
(2) Replacing pilot pressure spool

Loosen 4 screws holding upper part to the body with 3 mm wrench holding mounting plate no to spring up by return springs inside.



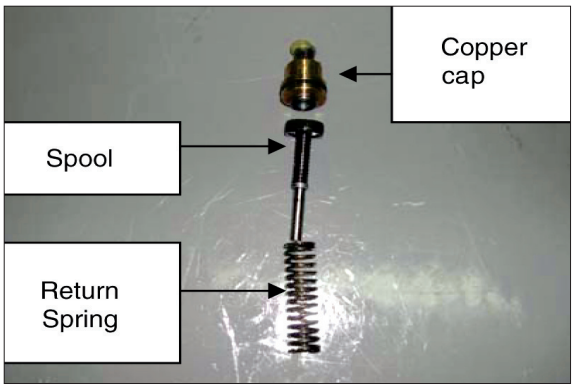
100D7RCV05

Take off the fulcrum and mounting flange very carefully keeping all components in their own positions.



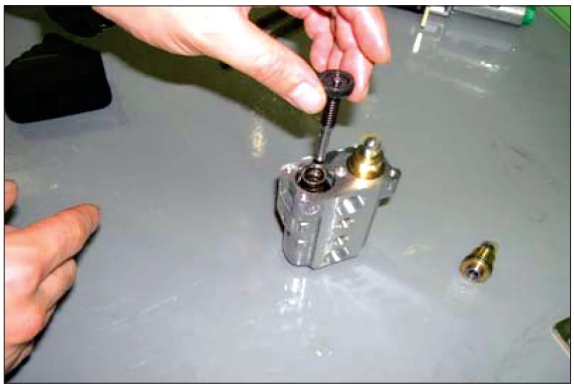
100D7RCV06

Take out the spool, return spring from the body. And replace any component if it is needed.



100D7RCV07

Reassemble the spool in opposite order mentioned above.
Insert spool as straight as possible not to give any damaged on it while inserting it into body.


100D7RCV08

Prepare copper cap in clean.
Apply some clean grease around the O-ring on the copper cap, in order to avoid any damage of O-ring while fitting it into body.


100D7RCV09

Hold tightly mounting flange and lay fulcrum on the flange and screw in clamp bolts in a crisscross pattern.
Clamp torque is 0.67 kgf·m (4.9 lbf·ft).

100D7RCV10