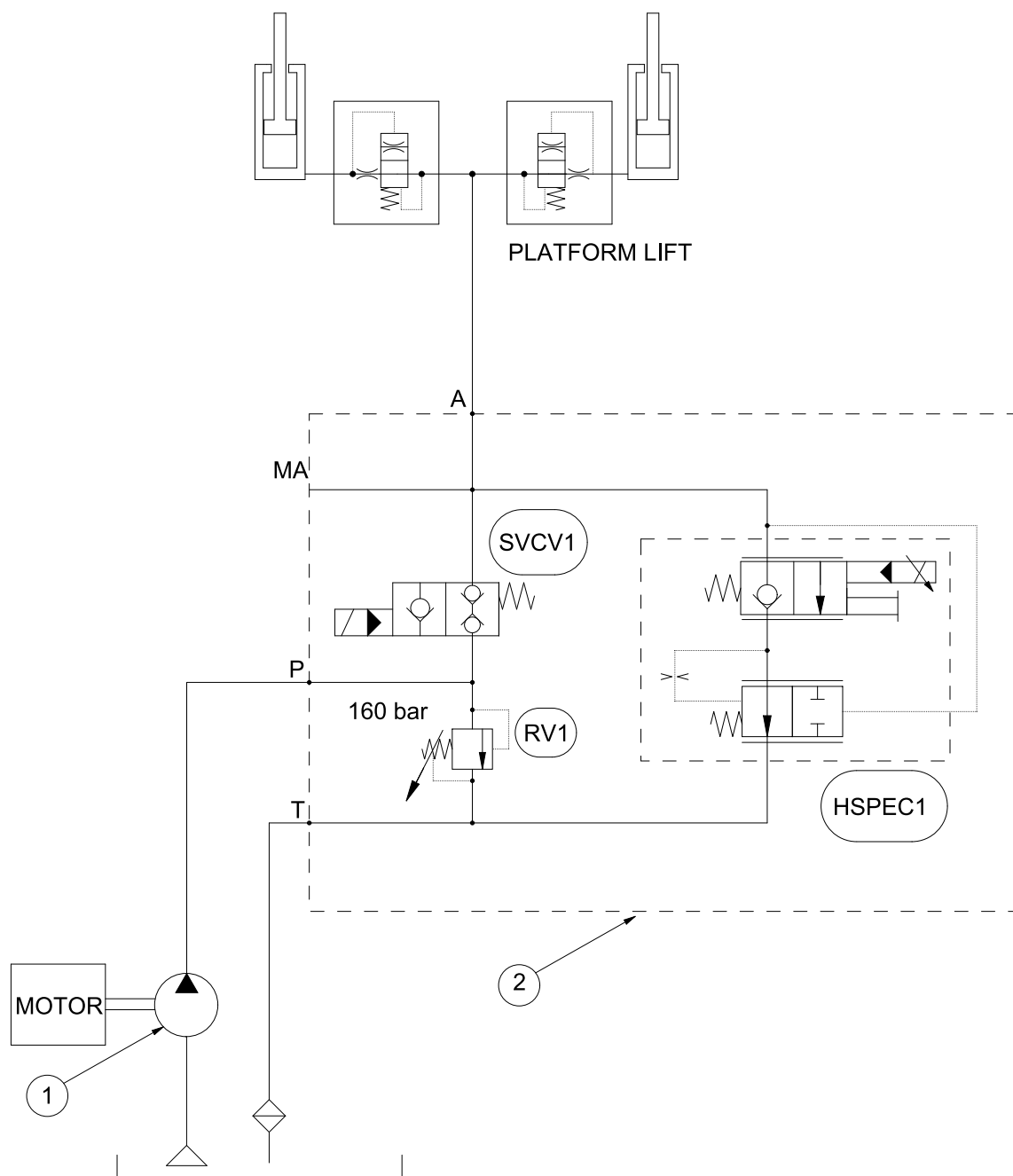


SECTION 6 HYDRAULIC SYSTEM

Group 1	Structure and function	6-1
Group 2	Operational checks and troubleshooting	6-12
Group 3	Disassembly and assembly	6-16

GROUP 1 STRUCTURE AND FUNCTION

1. HYDRAULIC CIRCUIT (PLATFORM)

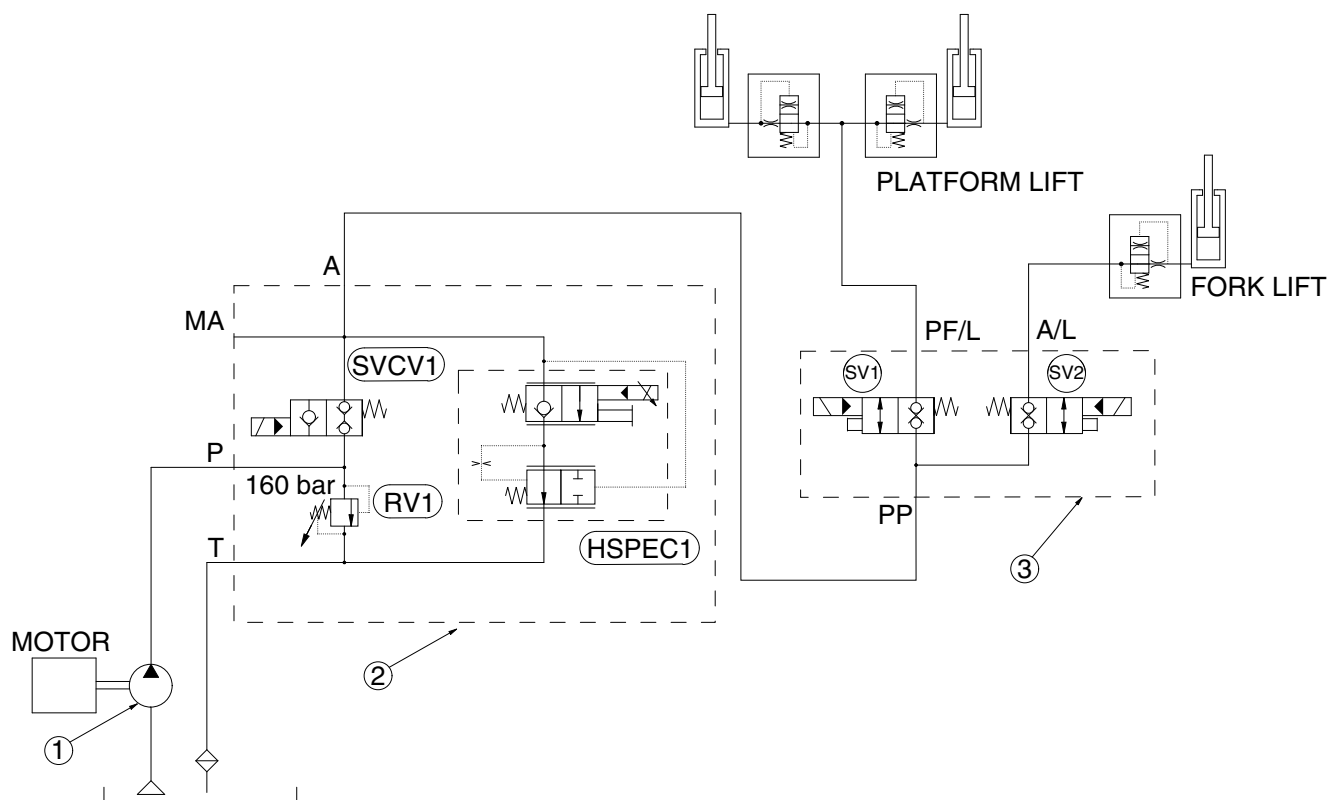


13BOP96HS07

1 Hydraulic pump 2 Manifold assy

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

HYDRAULIC CIRCUIT (ADDITIONAL LIFT)

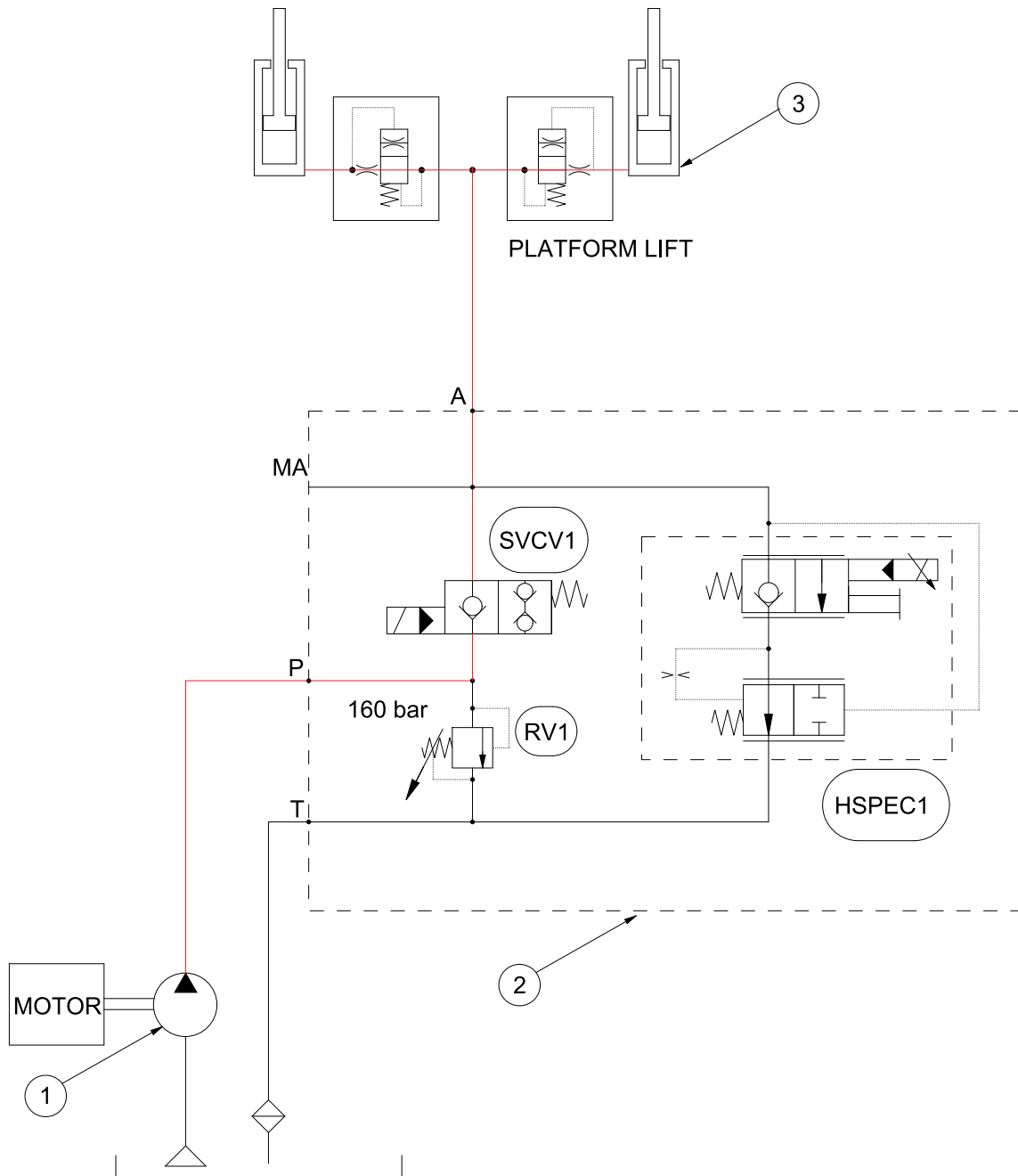


13BOP96HS08A

- 1 Hydraulic pump 2 Manifold assy 3 Manifold assy

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

1) WHEN THE MULTIFUNCTION LEVER IS IN THE LIFT POSITION (PLATFORM)

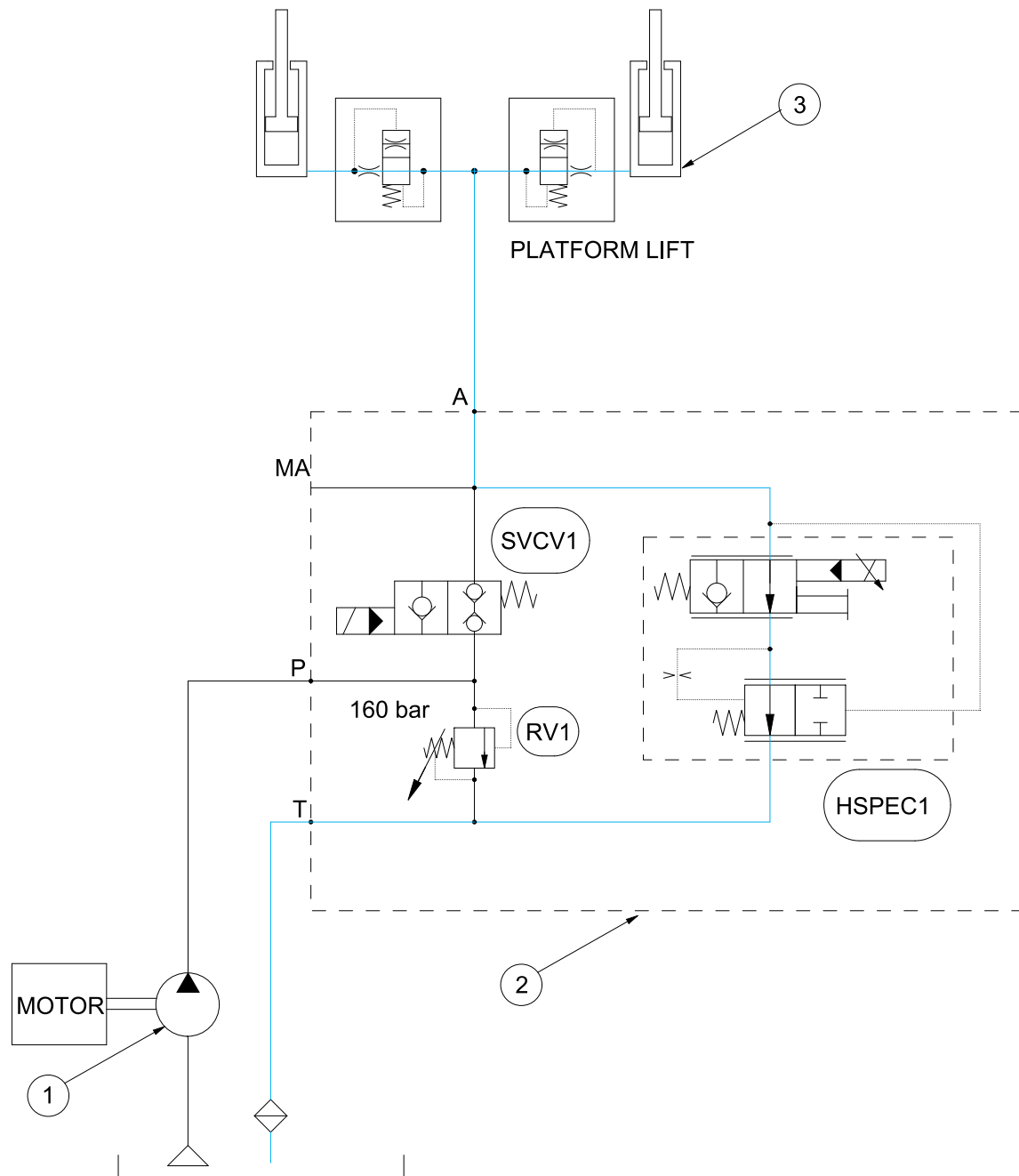


13BOP94HS09

When turning the the multifuction lever to clockwise, the solenoid valve(SVCV1) is energized. The oil from the hydraulic pump(1) flows into the manifold assy(2) and then get into the large chamber of the platform lift cylinder(3). The air of the small chamber of the platform lift cylinder(3) is compressed at the same time. When this happens, the platform goes up.

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

2) WHEN THE MULTIFUNCTION LEVER IS IN THE LOWER POSITION (PLATFORM)

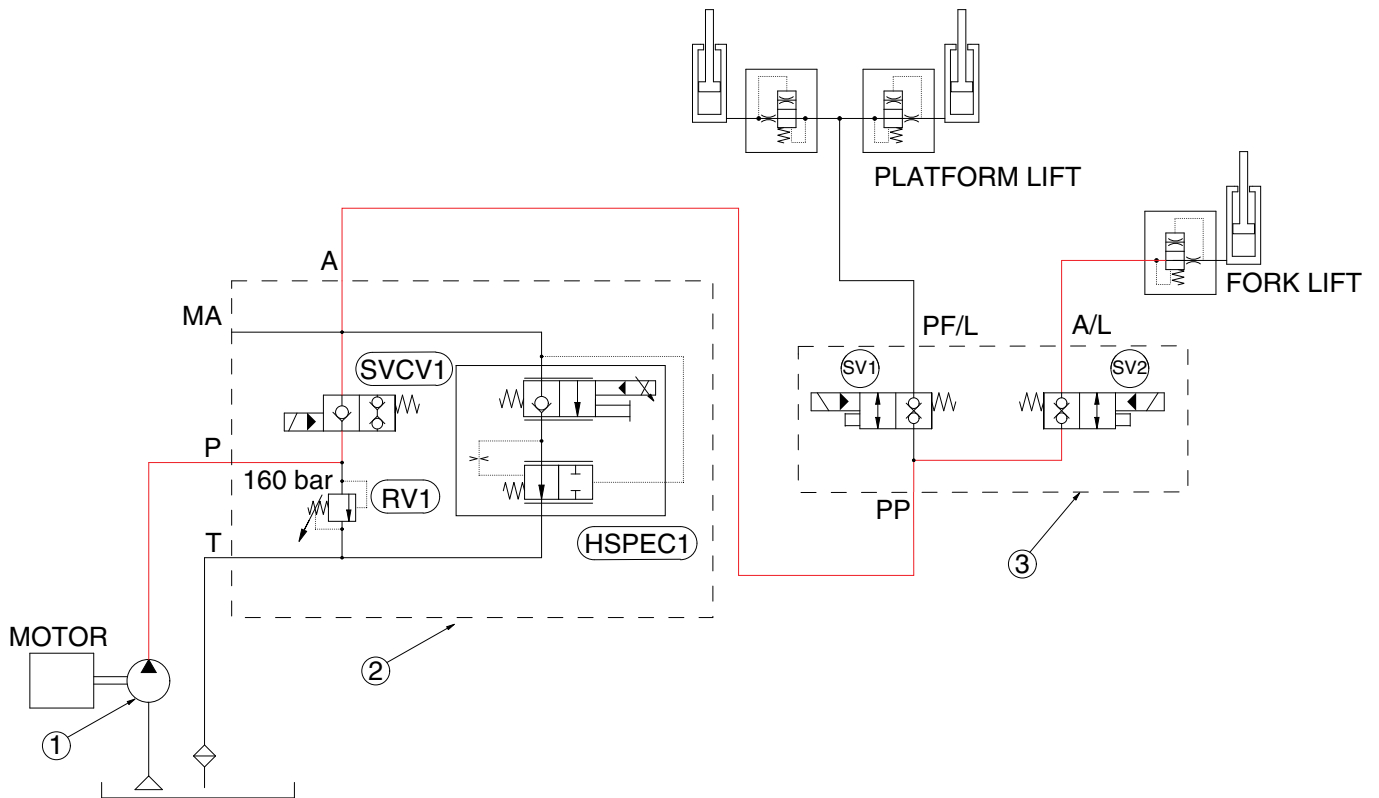


13BOP94HS10

When turning the multifunction lever to counterclockwise, the proportional valve(HSPEC1) is energized. The lift cylinder large chamber connected to (A) port on manifold and oil flows to the return (T) port. The lowering speed is adjusted according to the amount of turning the lever.

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

3) WHEN THE ADDITIONAL LIFT LEVER IS IN THE LIFT POSITION (ADDITIONAL LIFT)

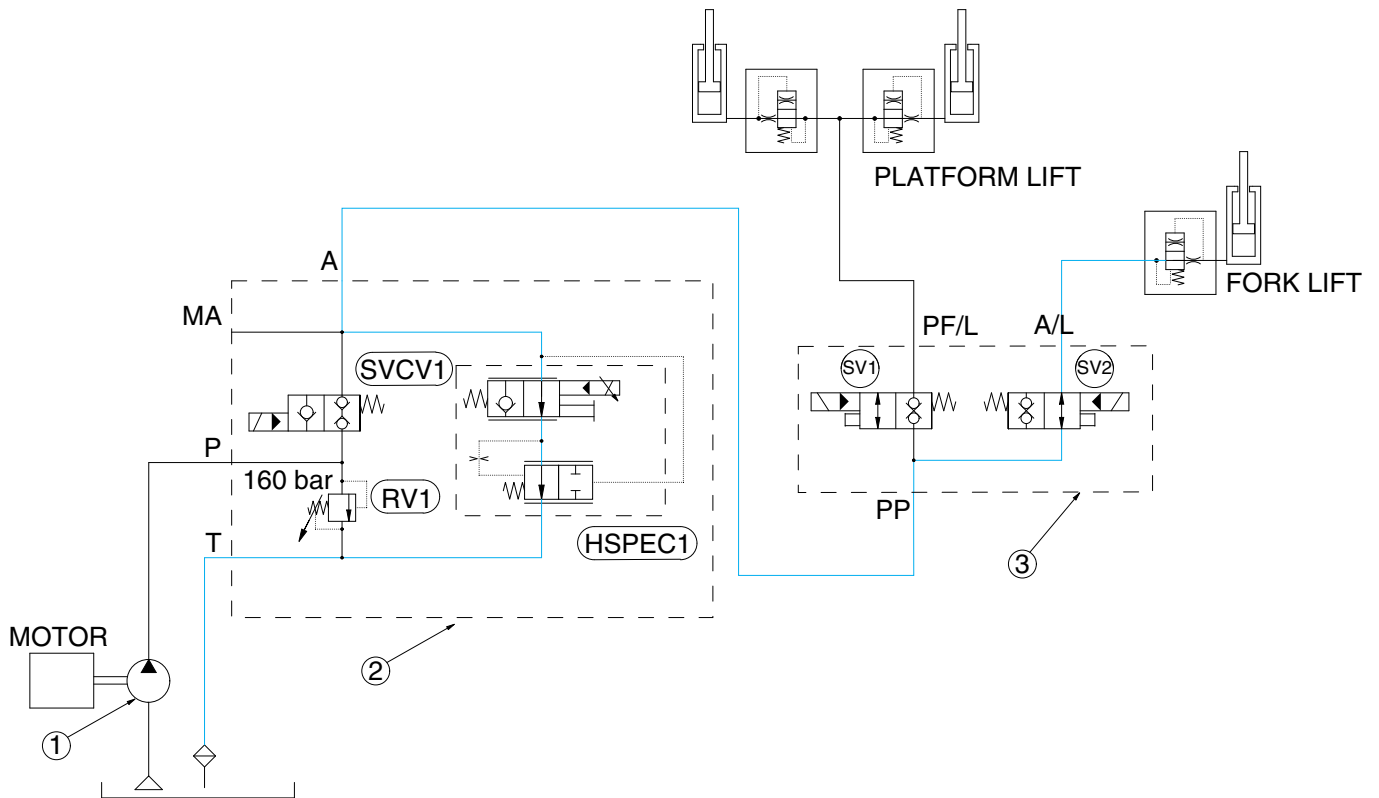


13BOP94HS11A

To lift the additional forks up , presss a switch and push up the fingertip lever for additional lift at the same time. The solenoid valves(SVCV1 and SV2) are energized. The hydraulic oil from the (A) port flows to (PP) port. The oil flows to (A/L) port and forks are lifted up.

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

4) WHEN THE ADDITIONAL LIFT LEVER IS IN THE LOWER POSITION (ADDITIONAL LIFT)



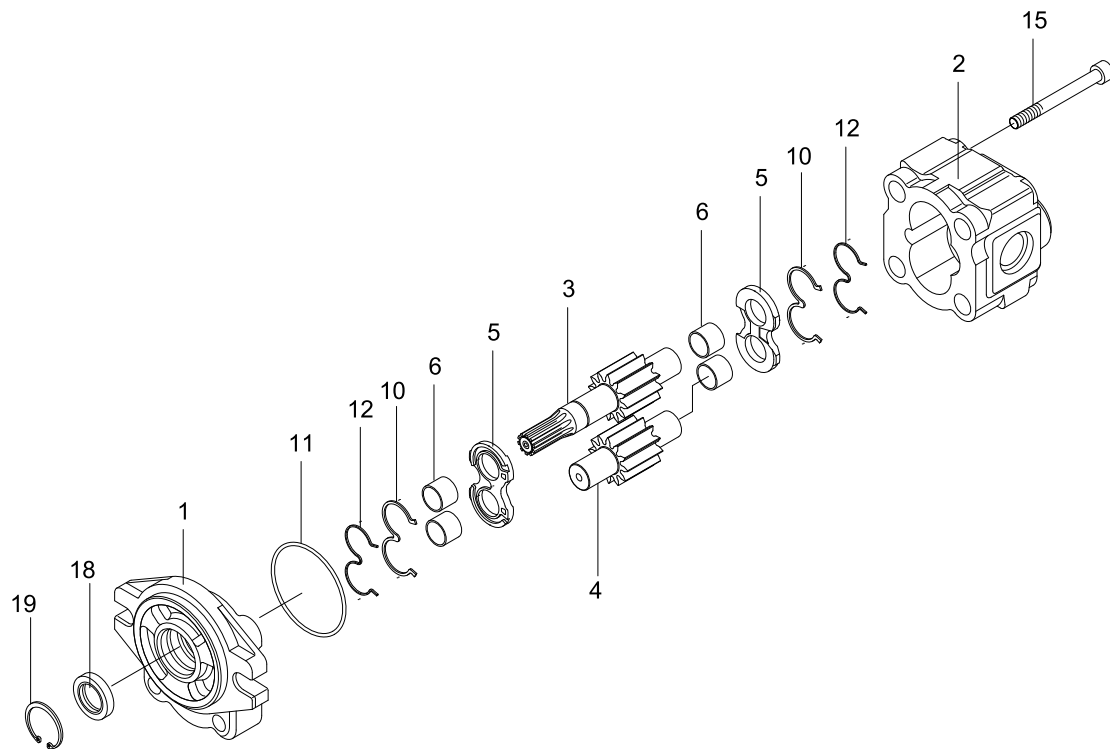
13BOP94HS12A

To lower the additional forks, press a switch and push down the fingertip lever for additional forks at the same time. The proportional valve and solenoid valve (HSPEC1 and SV2) are energized. The hydraulic oil from the Fork cylinder flows to (PP) port from (A/L) port. And then oil flows to (A) port and pass through proportional valves then return to tank.

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

2. HYDRAULIC GEAR PUMP

1) STRUCTURE



13BOP96HS13

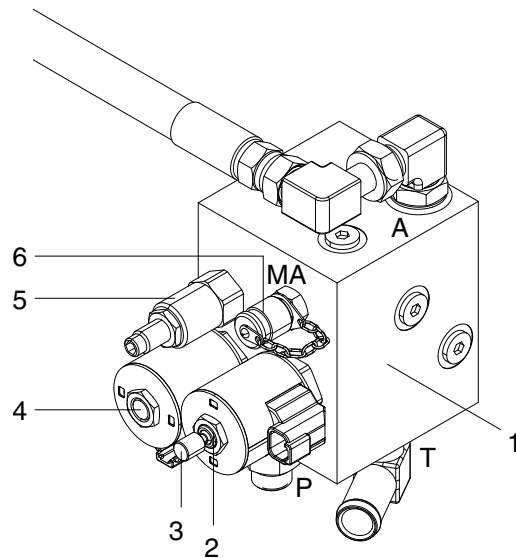
1	Front cover	5	Side plate	12	Back-up
2	Body	6	Bush	15	Bolt
3	Drive gear	10	Gasket (3-shaped)	18	Oil seal
4	Driven gear	11	O-ring	19	Retaining ring

2) OPERATION

This pump comprises of an rear cover, a body, bushings and a housing bolted together with bolts. The gear journals are supported in side plate within pressure balanced bushings to give high volumetric and mechanical efficiencies.

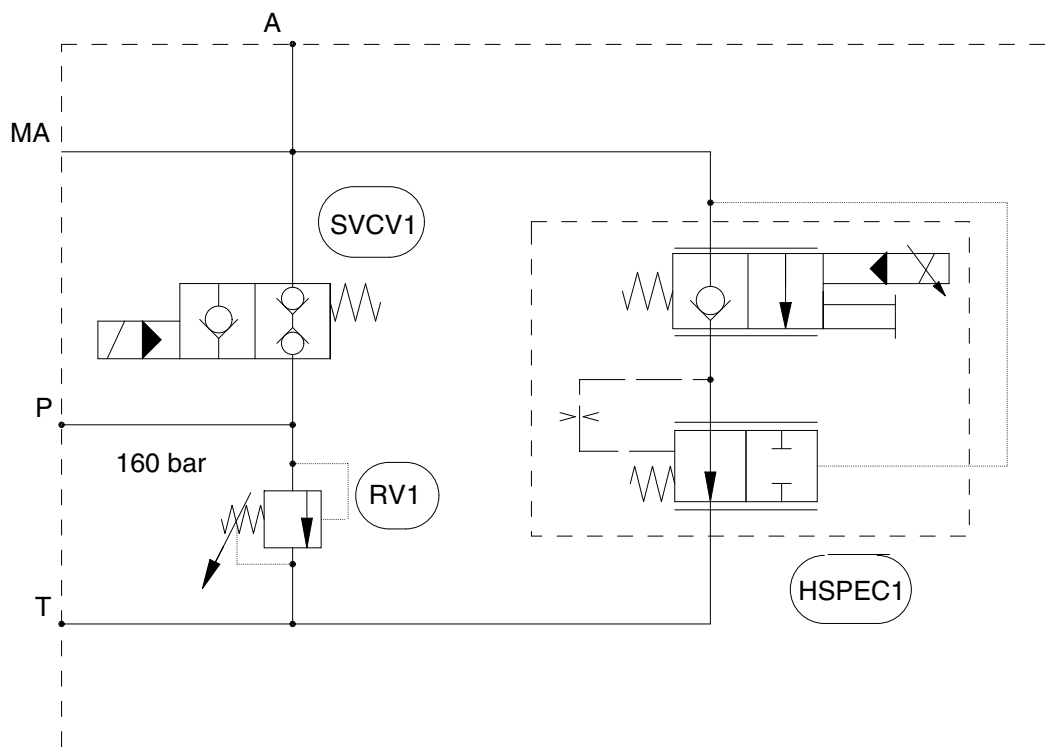
3. MANIFOLD VALVE

1) STRUCTURE



- 1 Block
- 2 Lowering proportional SOL.
- 3 Emergency lowering lever
- 4 Load holding SOL.
- 5 Main relief valve
- 6 Pressure check port

Port	Port size
T	7/8-14UNF
P	
A	
MA	9/16-18UNF



CIRCUIT

13BOP96HS02A

- (1) SVC1 : Multi-function valve to control On/Off the lifting cylinder passage and check valve for holding and reverse flow checking.
- (2) HSPEC1 : This is a multi-function valve to control lowering cylinder function. There is compensator inside of the valve so control the lowering flow smoothly regardless of load.
- (3) RV1 : Relief valve to limit system pressure.

2) EMERGENCY LOWERING

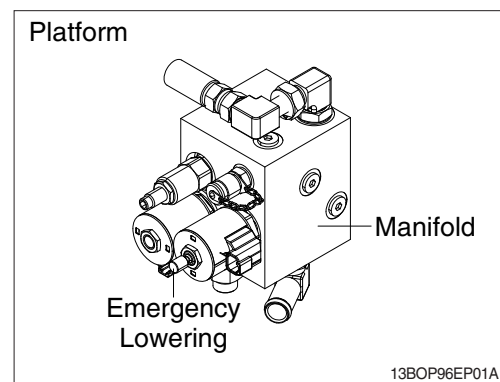
In case that the mast can not be lowered due to a problem in the controller, activate the emergency lowering valve on the manifold assy by rotating lever (emergency lowering lever).

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

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

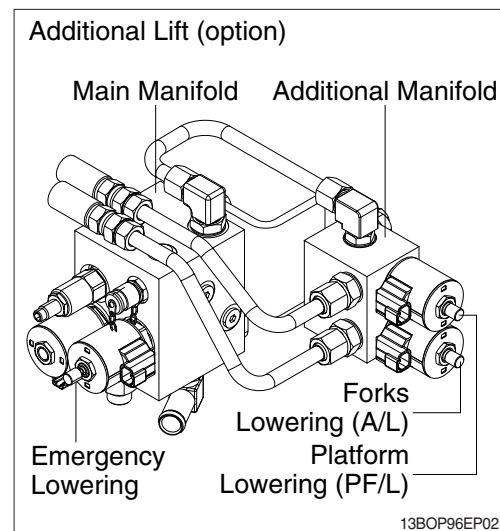
1) PLATFORM

- (1) Turn off the electric emergency switch.
- (2) In order to lower the platform, rotate the main manifold emergency lowering lever counter-clockwise to activate.

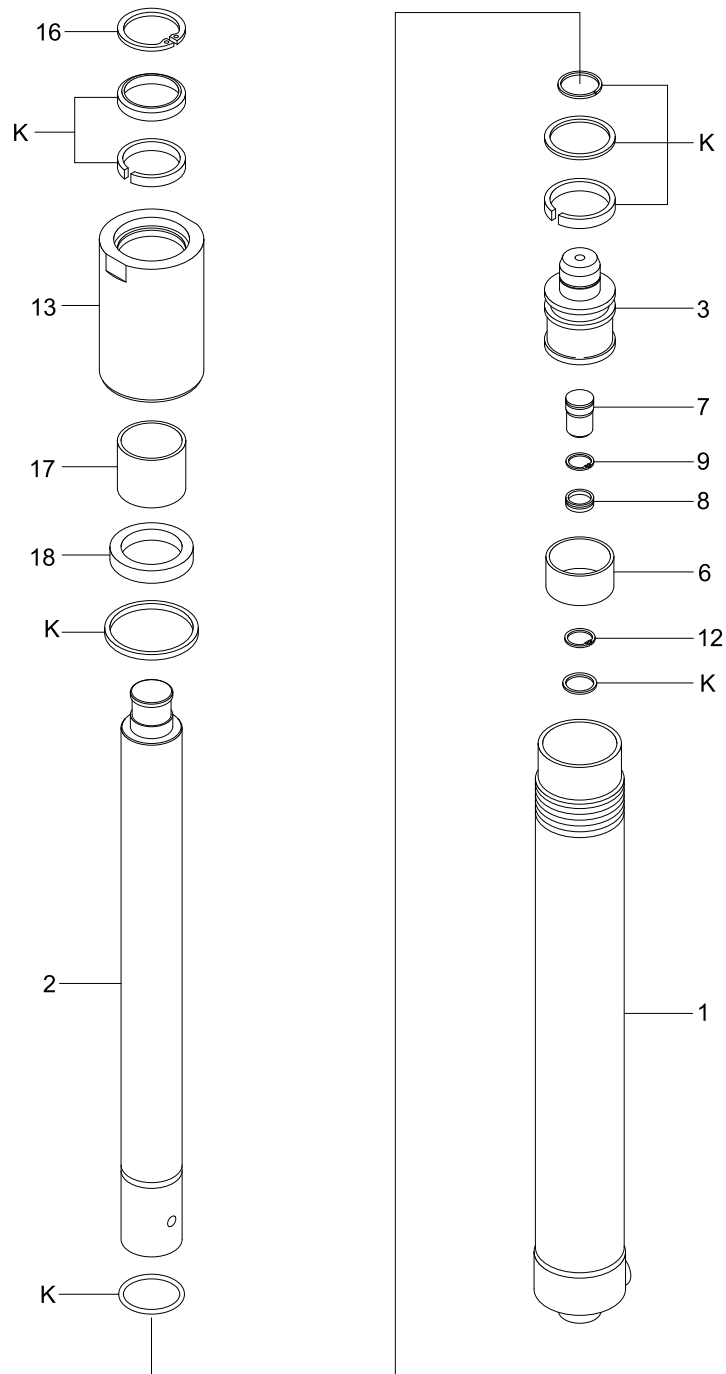


2) ADDITIONAL LIFT (OPTION)

- (1) Turn off the electric emergency switch.
- (2) In order to lower the platform, rotate additional manifold emergency lowering lever (PF/L) and then main manifold emergency lowering lever counter-clockwise to activate.
- (3) After landing the platform to ground, rotates additional manifold emergency lowering lever (A/L) counter-clockwise to lower forks.



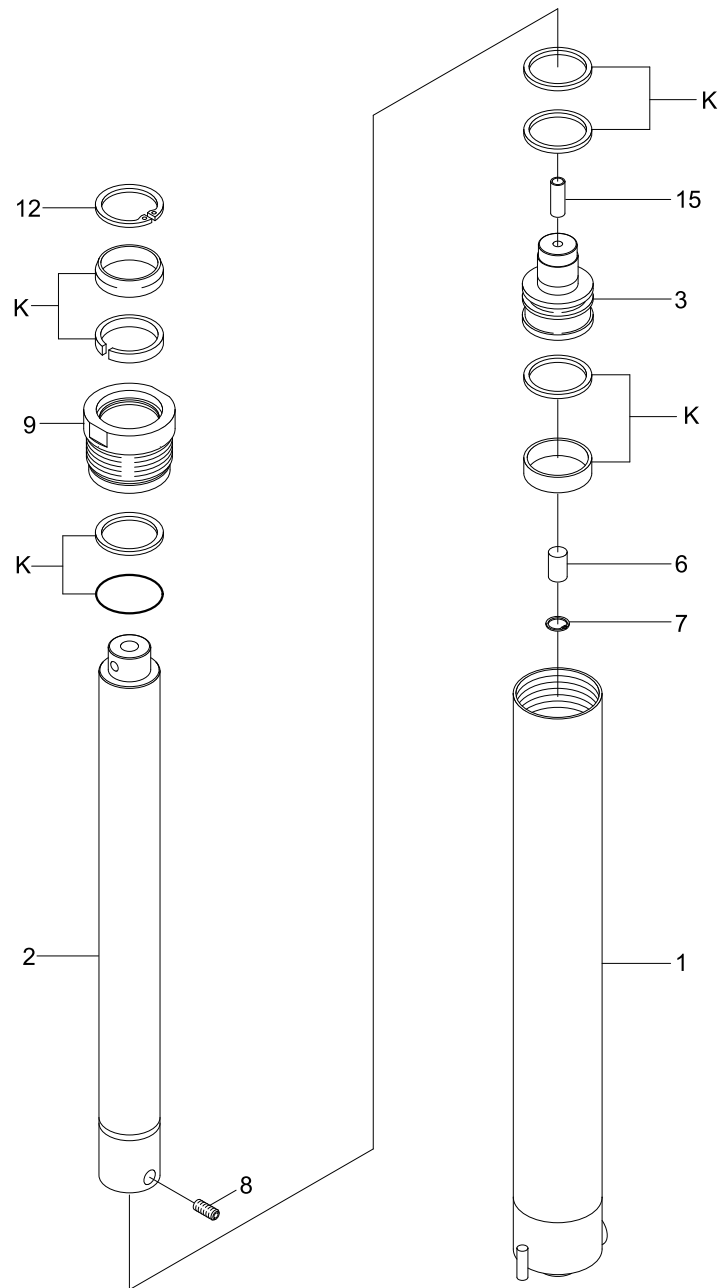
4. LIFT CYLINDER



13BOP96HS05

- | | | | | | |
|---|-------------|----|---------------|----|-------------|
| 1 | Rod piston | 8 | Spacer | 17 | Pin bushing |
| 2 | Tube assy | 9 | Retainer ring | 18 | Spacer |
| 3 | Piston | 12 | Retainer ring | K | Seal kit |
| 6 | Wear ring | 13 | Rod cover | | |
| 7 | Check valve | 16 | Retainer ring | | |

5. FREE LIFT CYLINDER



13BOP96HS06

- | | | | | | |
|---|-------------|----|----------------|----|-----------|
| 1 | Tube assy | 7 | Retainer ring | 15 | Pipe assy |
| 2 | Rod piston | 8 | Set bolt | K | Seal kit |
| 3 | Piston | 9 | Rod cover | | |
| 6 | Check valve | 12 | Retaining ring | | |

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

1) CHECK ITEM

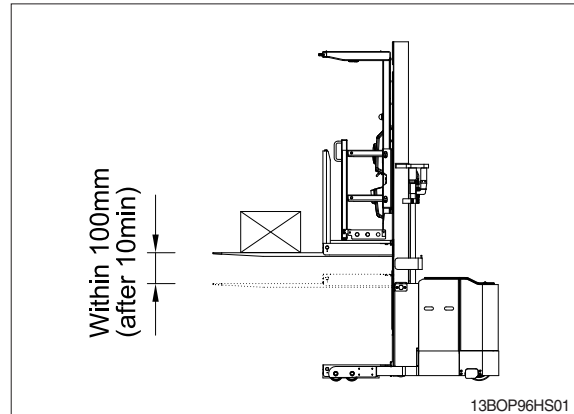
- (1) Check visually for deformation, cracks or damage of rod.
- (2) Load maximum load, set mast vertical and raise 1m from ground. Wait for 10 minutes and measure hydraulic drift (amount forks move down and amount mast tilts forward).

- Hydraulic drift

- Down (Downward movement of forks)

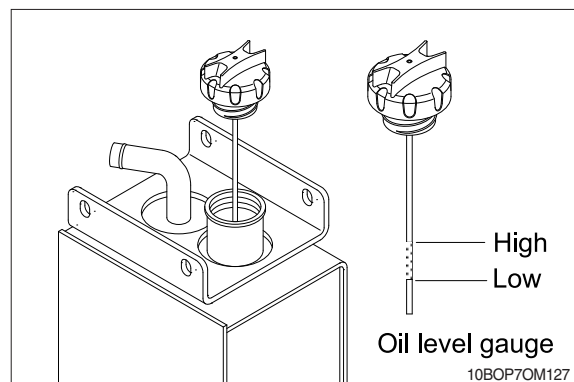
- : Within 100mm (3.9in)

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



2) HYDRAULIC OIL

- (1) Measure oil level using dipstick, and refill oil if necessary.
- (2) Before changing hydraulic oil, take out and clean strainer which is assembled with flange after loosening the bolts and replace the element of the return filter if necessary. (Change interval of the return filter : 2000 hours)



3) MANIFOLD ASSY

- (1) Raise forks to maximum height and measure oil pressure.
Check that oil pressure is 160 kgf/cm² (2276 psi).

2. TROUBLESHOOTING

1) SYSTEM

Problem	Cause	Remedy
Fast platform lowering speed	<ul style="list-style-type: none"> · Seal inside control valve defective. · Oil leaks from joint or hose. · Seal inside cylinder defective. 	<ul style="list-style-type: none"> · Replace spool or valve body. · Replace. · Replace packing.
Slow platform lifting speed	<ul style="list-style-type: none"> · 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. 	<ul style="list-style-type: none"> · Add oil. · Bleed air. · Replace. · Clean filter. · Adjust relief valve. · Replace packing. · Change to ISO VG 46. · Adjust roll to rail clearance. · Replace spool or valve body. · Replace spool or valve body.
Hydraulic system makes abnormal sounds	<ul style="list-style-type: none"> · Excessive restriction of oil flow pump suction side. · Gear or bearing in hydraulic pump defective. 	<ul style="list-style-type: none"> · Clean filter. · Replace gear or bearing.
High oil temperature	<ul style="list-style-type: none"> · Lack of hydraulic oil. · High oil viscosity. · Oil filter clogged. 	<ul style="list-style-type: none"> · Add oil. · Change to SAE80W-90LSD, class API GL-5 gear oil. · Clean filter.

2) HYDRAULIC GEAR PUMP

Problem	Cause	Remedy
Pump does not develop full pressure	<ul style="list-style-type: none"> · System relief valve set too low or leaking. · Oil viscosity too low. · Pump is worn out. 	<ul style="list-style-type: none"> · Check system relief valve for proper setting. · Change to proper viscosity oil. · Repair or replace pump.
Pump will not pump oil	<ul style="list-style-type: none"> · Reservoir low or empty. · Suction strainer clogged. 	<ul style="list-style-type: none"> · Fill reservoir to proper level. · Clean suction strainer.
Noisy pump caused by cavitation	<ul style="list-style-type: none"> · Oil too thick. · Oil filter plugged. · Suction line plugged or too small. 	<ul style="list-style-type: none"> · Change to proper viscosity. · Clean filters. · Clean line and check for proper size.
Oil heating	<ul style="list-style-type: none"> · Oil supply low. · Contaminated oil. · Setting of relief valve too high or too low. · Oil viscosity too low. 	<ul style="list-style-type: none"> · 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	<ul style="list-style-type: none"> · Low oil level. · Air leaking into suction line. · Wrong kind of oil. 	<ul style="list-style-type: none"> · Fill reservoir to proper level. · Tighten fittings, check condition of line. · Drain reservoir, fill with non-foaming oil.
Shaft seal leakage	<ul style="list-style-type: none"> · Worn shaft seal. · Worn shaft in seal area. 	<ul style="list-style-type: none"> · Replace shaft seal. · Replace drive shaft and seal.

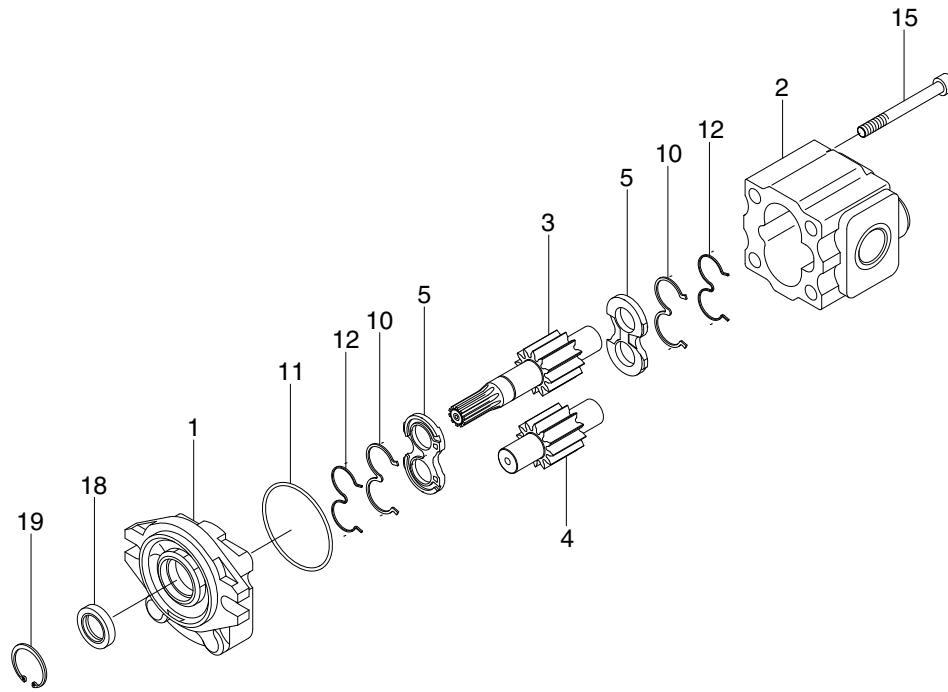
3) LIFT CYLINDER

Problem	Cause	Remedy
Oil leaks out from rod cover through rod	<ul style="list-style-type: none"> · Foreign matters on packing. · Unallowable score on rod. · Unusual distortion of dust seal. · Chrome plating is striped. 	<ul style="list-style-type: none"> · Replace packing. · Smooth rod surface with an oil stone. · Replace dust seal. · Replace rod.
Oil leaks out from cylinder rod cover thread	<ul style="list-style-type: none"> · O-ring damaged. 	<ul style="list-style-type: none"> · Replace O-ring.
Rod spontaneously retract	<ul style="list-style-type: none"> · Scores on inner surface of tube. · Unallowable score on the inner surface of tube. · Foreign matters in piston seal. 	<ul style="list-style-type: none"> · Smooth rod surface with an oil stone. · Replace cylinder tube. · Replace piston seal.
Wear (clearance between cylinder tube and wear ring)	<ul style="list-style-type: none"> · Excessive clearance between cylinder tube and wear ring. 	<ul style="list-style-type: none"> · Replace wear ring.
Abnormal noise is produced during tilting operation	<ul style="list-style-type: none"> · Insufficient lubrication of anchor pin or worn bushing and pin. · Bent tilt cylinder rod. 	<ul style="list-style-type: none"> · Lubricate or replace. · Replace.

GROUP 3 DISASSEMBLY AND ASSEMBLY

1. HYDRAULIC GEAR PUMP

1) STRUCTURE



15BRXHS26

1	Front cover	5	Side plate	12	Backup ring
2	Body	6	Bushing	15	Bolt
3	Driving gear	10	Gasket	18	Oil seal
4	Inverted gear	11	O-ring	19	Retaining ring

※ Seal kit : 10 (2EA), 11 (1EA), 12 (2EA), 18 (1EA), 19 (1EA)

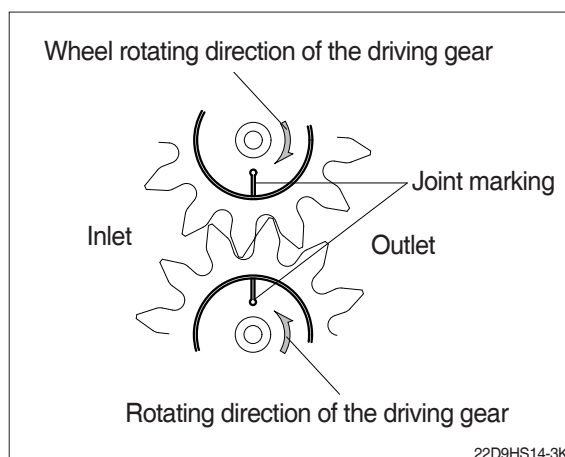
2) DISASSEMBLY AND ASSEMBLY

(1) Safety Precautions

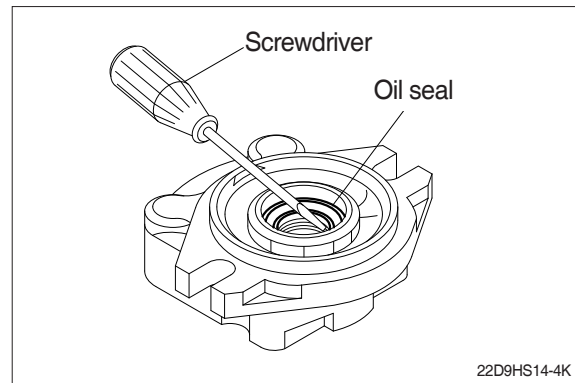
- ※ When pump installation, piping, disassembly for repair and inspection, etc. are required, they shall be performed by the technical expert or performed through instruction by the technical expert.
- ※ Stop the system operation including the pump for removing the pump, and remove the pipings and devices after the surface of the pump is cooled completely to approximately 40 °C or less. If not, there may be risk of oil leakage or burn.
- ※ Pump shall not be used when the appropriate performance is not shown after re-assembly. Use by force may damage the device or the system.
- ※ Discharge the oil when disposing the pump, and handle as industrial waste.
- ※ Follow the safety regulations for safe use of the pump.

(2) Disassembling

- ※ Check for oil leakage on the oil seal, pump body and cover joint before disassembling the pump.
 - ▲ Remove the rust, dust and foreign substances on the shaft end and pump body. If not, the parts may be damaged, or it may penetrate into the pump during reassembly for inappropriate diagnosis of the pump.
 - ※ Pump has a symmetrical part. For proper reassembly, the parts are marked through the method indicated on the disassembly procedure before disassembling the pump. Oil paint that does not damage the parts is used for this purpose.
 - ※ Disassembly is a method of discovering the cause of issues. The pump disassembly procedure is followed.
 - ※ Prepare the new packing, gasket and oil seal before the disassembly.
- ① Fix the front cover mounting part with a vice to enable the body side to be facing upwards.
 - ② Mark the contact section of the front cover (1) and body (2) before the disassembly.
 - ③ Loosen 4 bolts (15) and start the disassembly of the parts in order starting from the body. The following instructions shall be followed.
 - ④ Mark the shaft end on the body side.
 - ⑤ One pair of the side plate (5), type 3 gasket (10) and backup ring (12) is assembled on another direction, so each pair is attached with a tag to distinguish the place of use. (These are indicated as F and B on the diagram.)



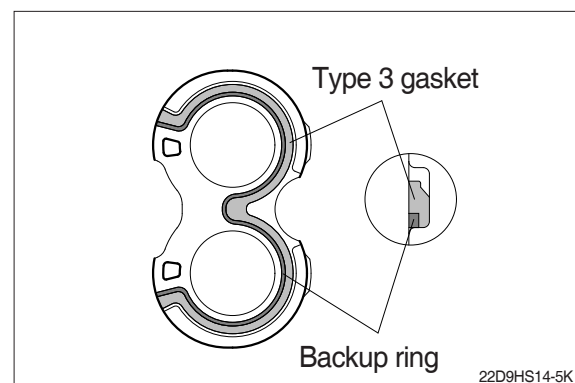
- ⑥ After disassembling the C-type retaining ring, the end of screwdriver is inserted into the oil seal for disassembly.



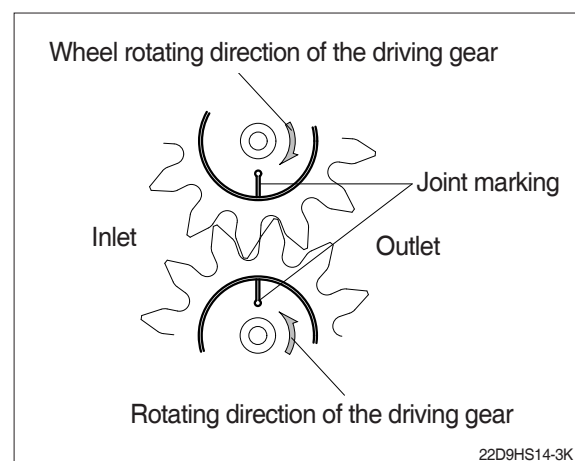
(3) Assembling

- ① These parts (10, 11, 12, 18, 19) are replaced with new parts.
 ② Each part must be removed with dust before the reassembly.
 ③ The body is placed on the work bench while the holes for the gear are facing upwards.

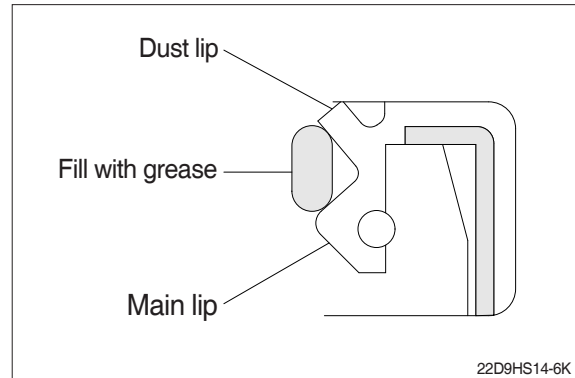
- ④ Parts are reassembled in order except for the oil seal, retaining ring and bolt.
 · Grease is used to fix the type 3 gasket (1) and backup ring (12) to the side plate (5) to prevent the twisting or interlocking.



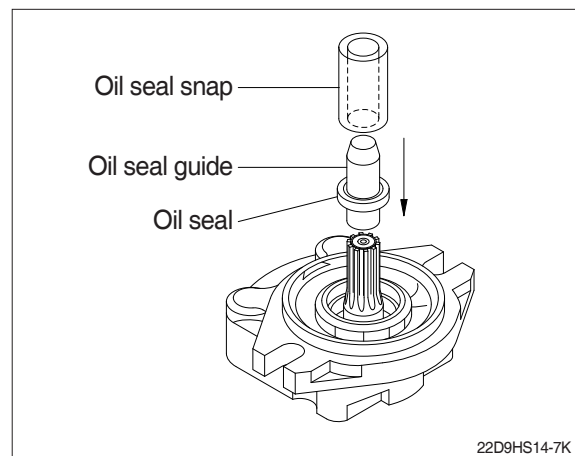
- Driving gear and inverted gear are fixed according to the joint mark.



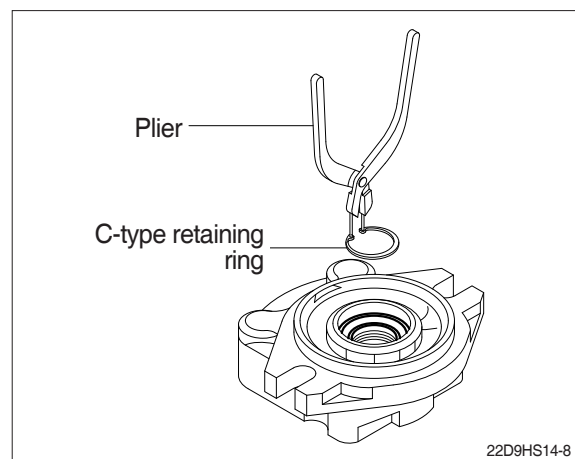
- ⑤ Turn the assembled pump to have the front cover facing down, and the mounting parts are fixed to the vice.
- ⑥ Fasten 4 bolts in 9.0~9.5 kgf·m torque.
- ⑦ Turn the assembled pump again to have the front cover facing up, and fix the body on the vice.
- ⑧ Fill with grease on the grooved part between the main lip and dust lip on the oil seal.



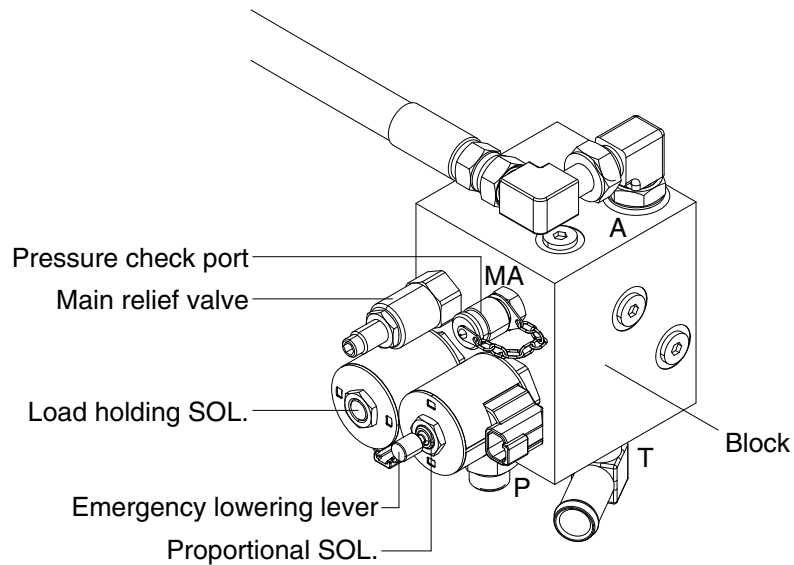
- ⑨ Use the oil seal guide and oil seal snap to assemble the oil seal on the body.



- ⑩ Insert the C-type retaining ring on the hole.



2. MANIFOLD VALVE



13BOP96HS04A

1) DISASSEMBLY INSTRUCTION

(1) Main relief valve

- ① Clean the valve installation surface.
- ② Disassemble with 1" size spanner.

(2) Load holding SOL.

- ① Clean the valve installation surface.
- ② Disassemble nut with 3/4" size spanner.
- ③ Take out electronic coil.
- ④ Disassemble valve with 1 1/4" spanner.

(3) Proportional SOL.

- ① Clean the valve installation surface.
- ② Disassemble nut with 3/4" size spanner.
- ③ Take out electronic coil.
- ④ Disassemble valve with 1 5/16" spanner.

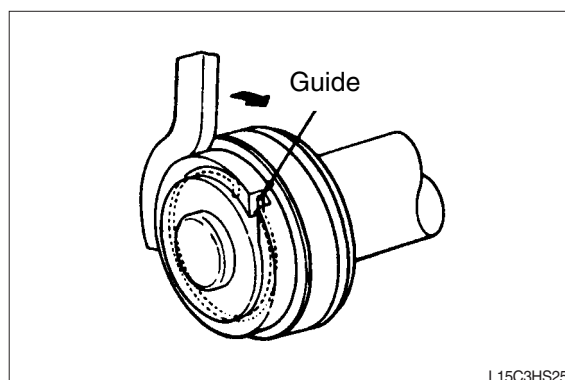
2) ASSEMBLY INSTRUCTION

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

3. LIFT CYLINDER

1) 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.



2) 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 piston ring & tube	0.05~0.030 (0.002~0.012)	0.5 (0.020)	Replace piston ring

3) ASSEMBLY

- (1) Soak the piston ring in hydraulic oil at a temperature of 40 to 50 °C, 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.

