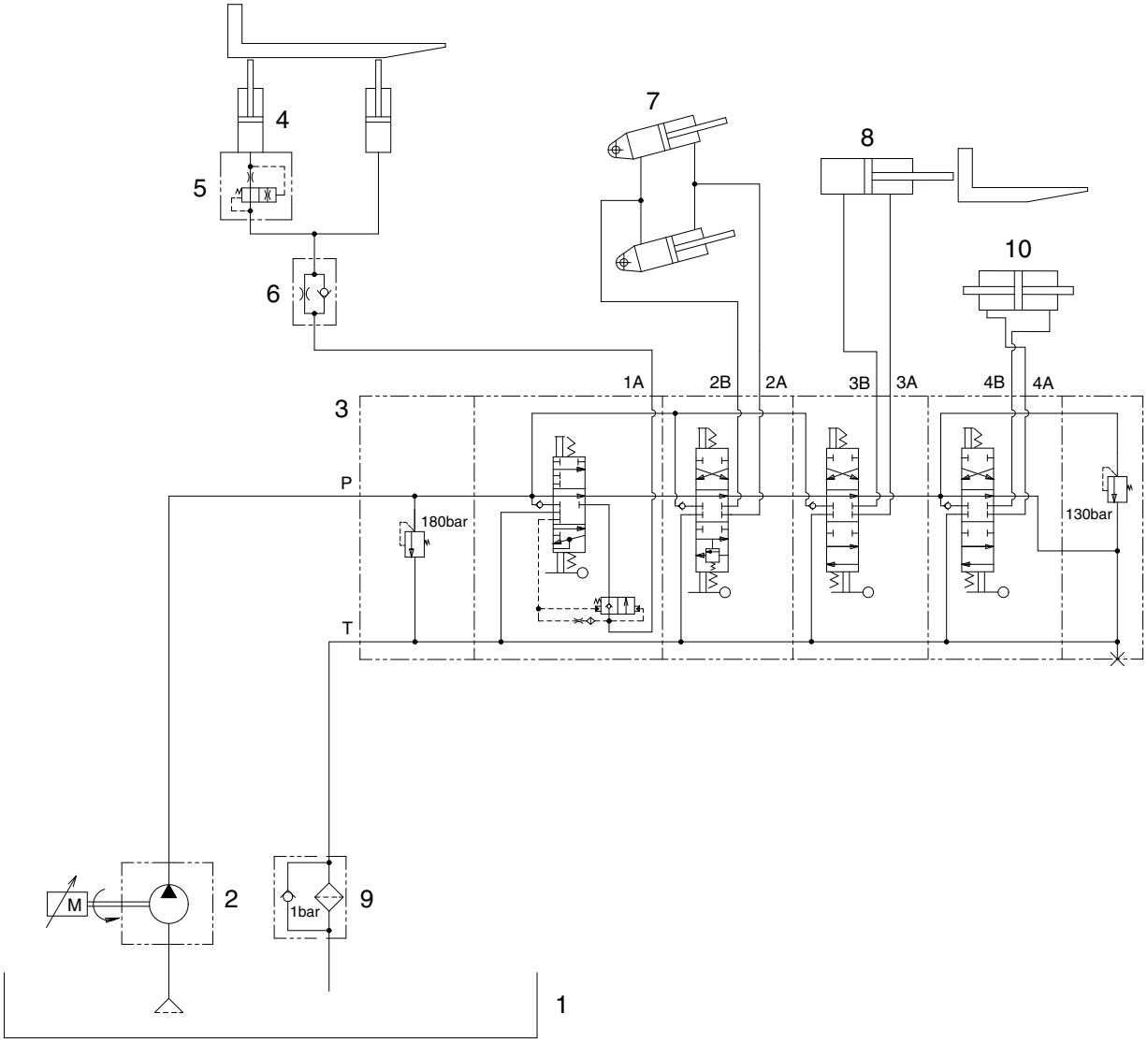
SECTION 6 HYDRAULIC SYSTEM

GROUP 1 STRUCTURE AND FUNCTIONS

1. HYDRAULIC CIRCUIT

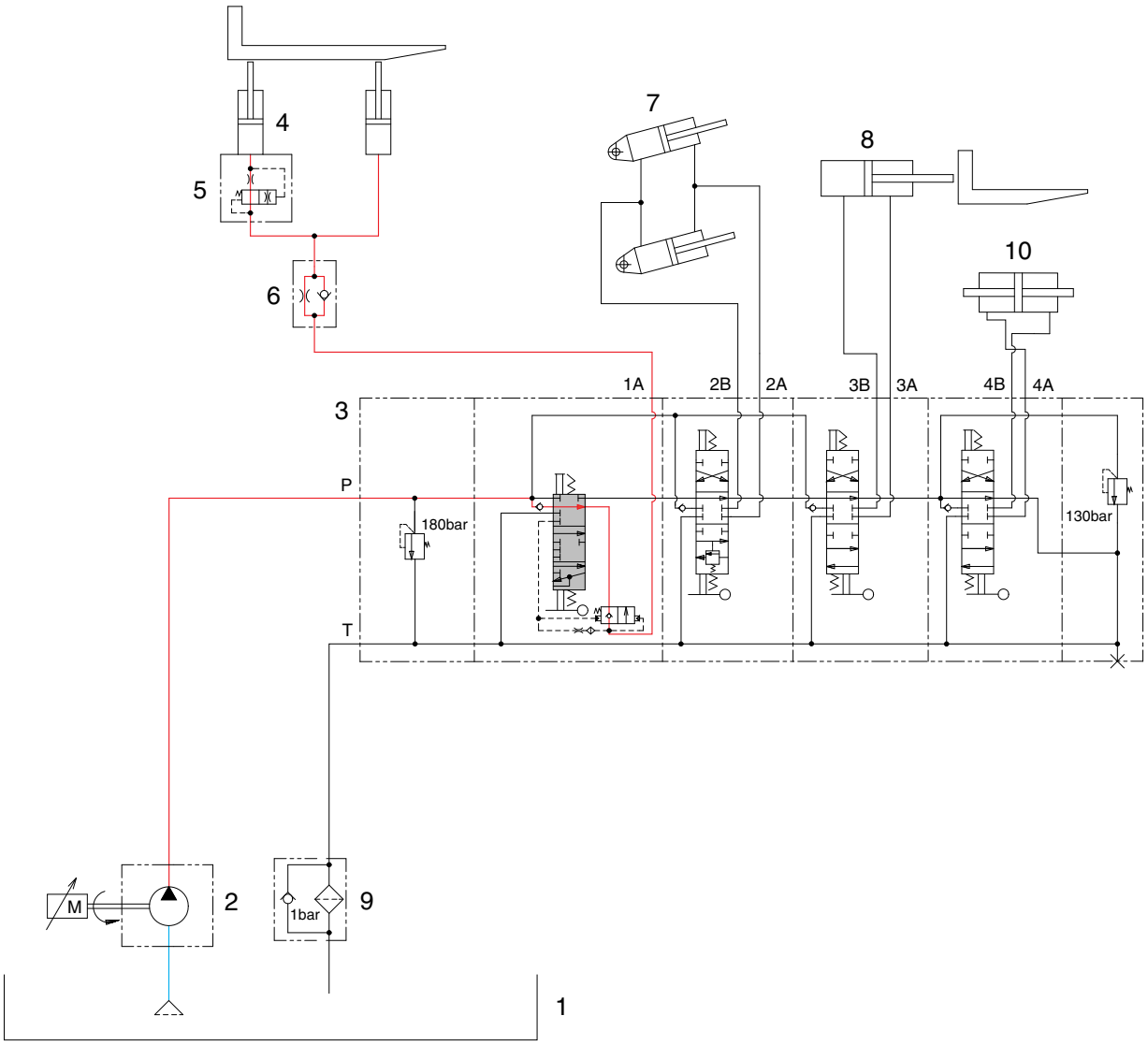


15BRXHS01

1	Hydraulic tank	6	Descending control valve
2	Hydraulic gear pump	7	Tilt cylinder
3	Main control valve	8	Reach cylinder
4	Lift cylinder	9	Return filter
5	Descending safety value	10	Preliminary cylinder

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

1) WHEN THE LIFT CONTROL LEVER IS PLACED ON THE LIFTING POSITION

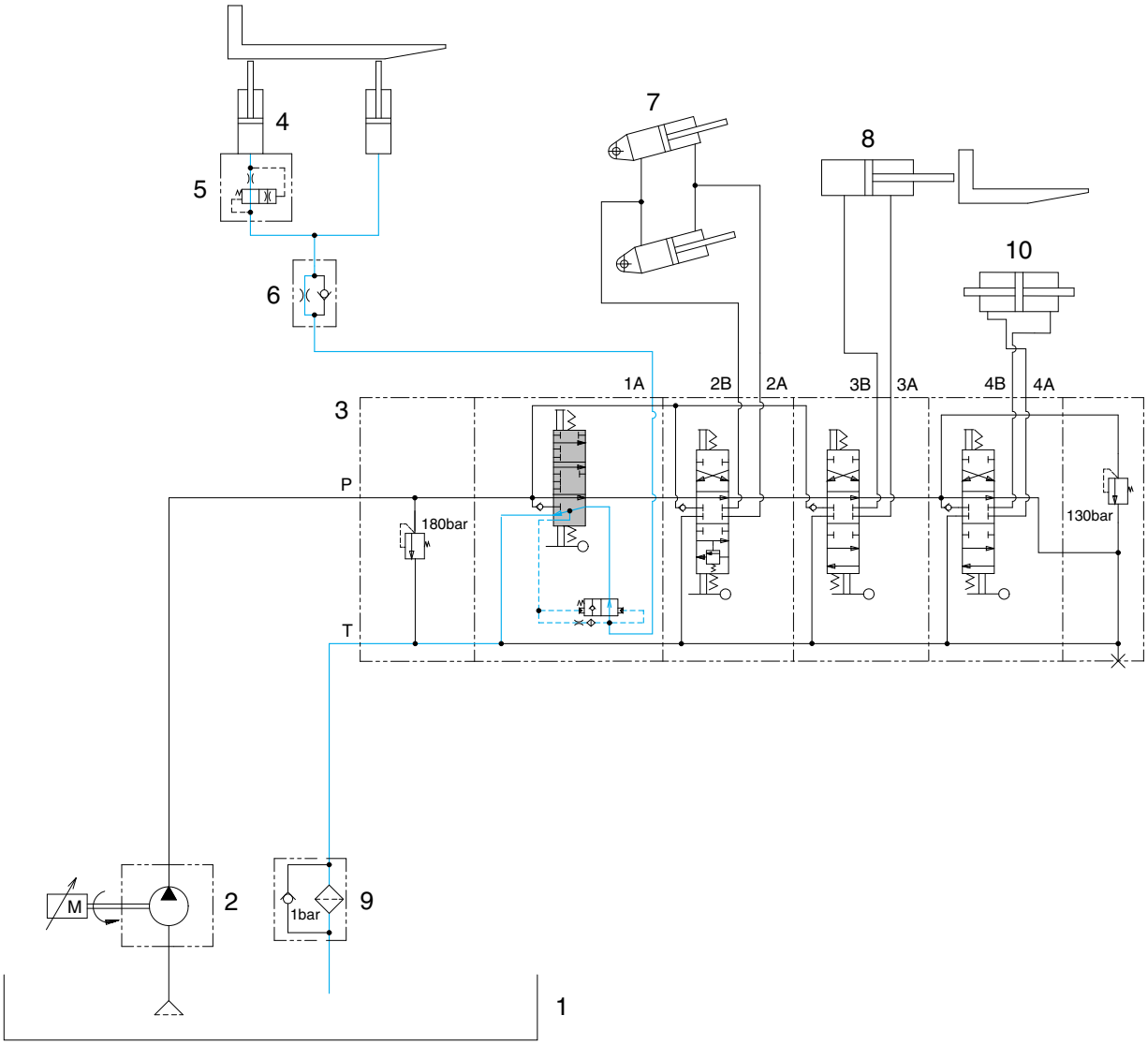


15BRXHS02

The spool on the first block is moved to the lifting position when the lift control level is pulled backwards.
The oil on the hydraulic gear pump (2) flows into the main control valve (3), and pushes the rod check valve on the spool to move into the large chamber of the lift cylinder (4).
The fork is lifted by this oil flow.

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

2) WHEN THE LIFT CONTROL LEVER IS PLACED ON THE LOWERING POSITION



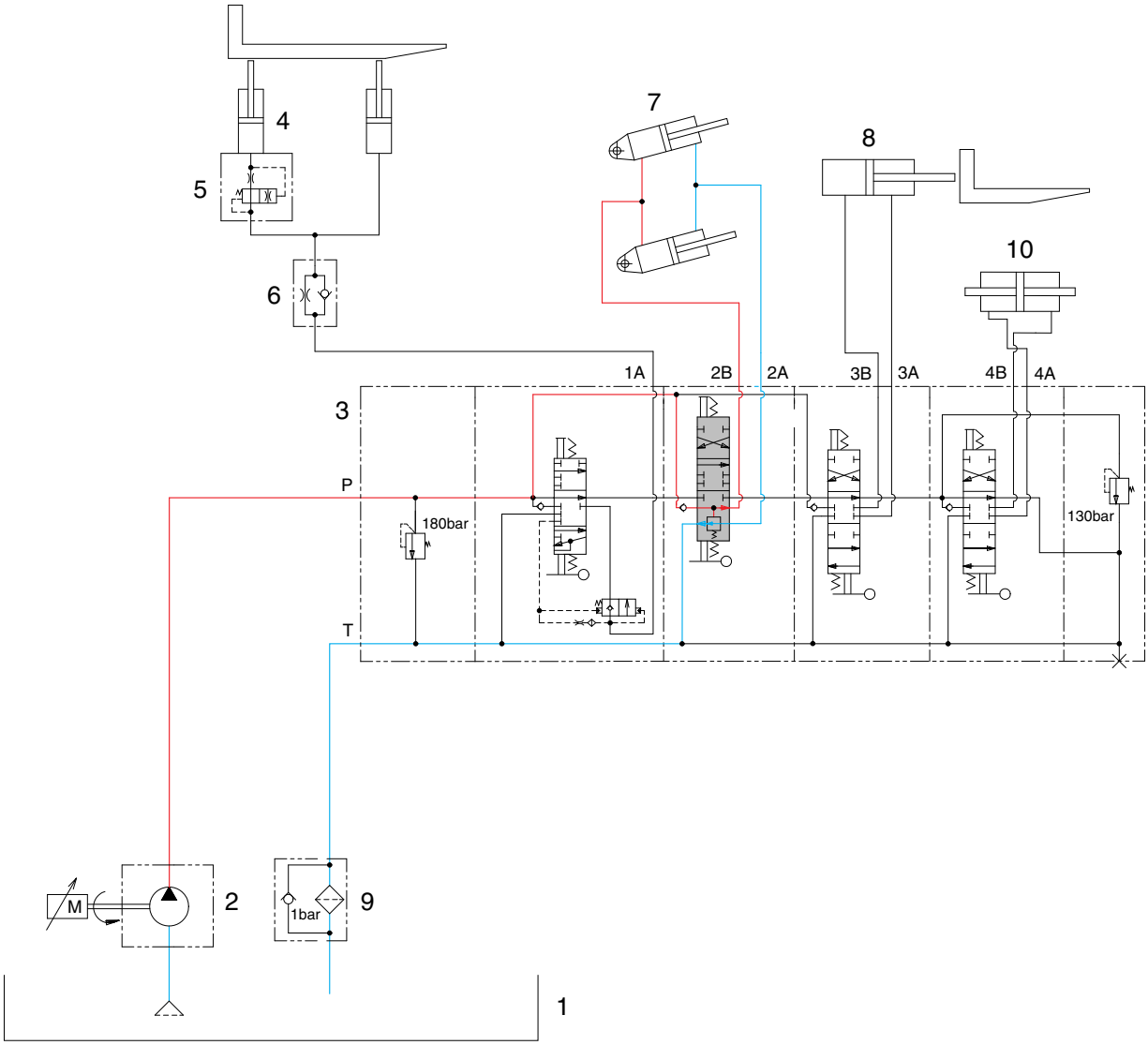
15BRXHS03

The spool on the first block is moved to the lowering position when the lift control level is pushed forward.

The large chamber passes through the descending safety valve (5) and descending control valve (6) to connect to the return passage, and the lift is lowered by the weight.

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

3) WHEN THE TILT CONTROL LEVER IS PLACED ON THE REAR POSITION

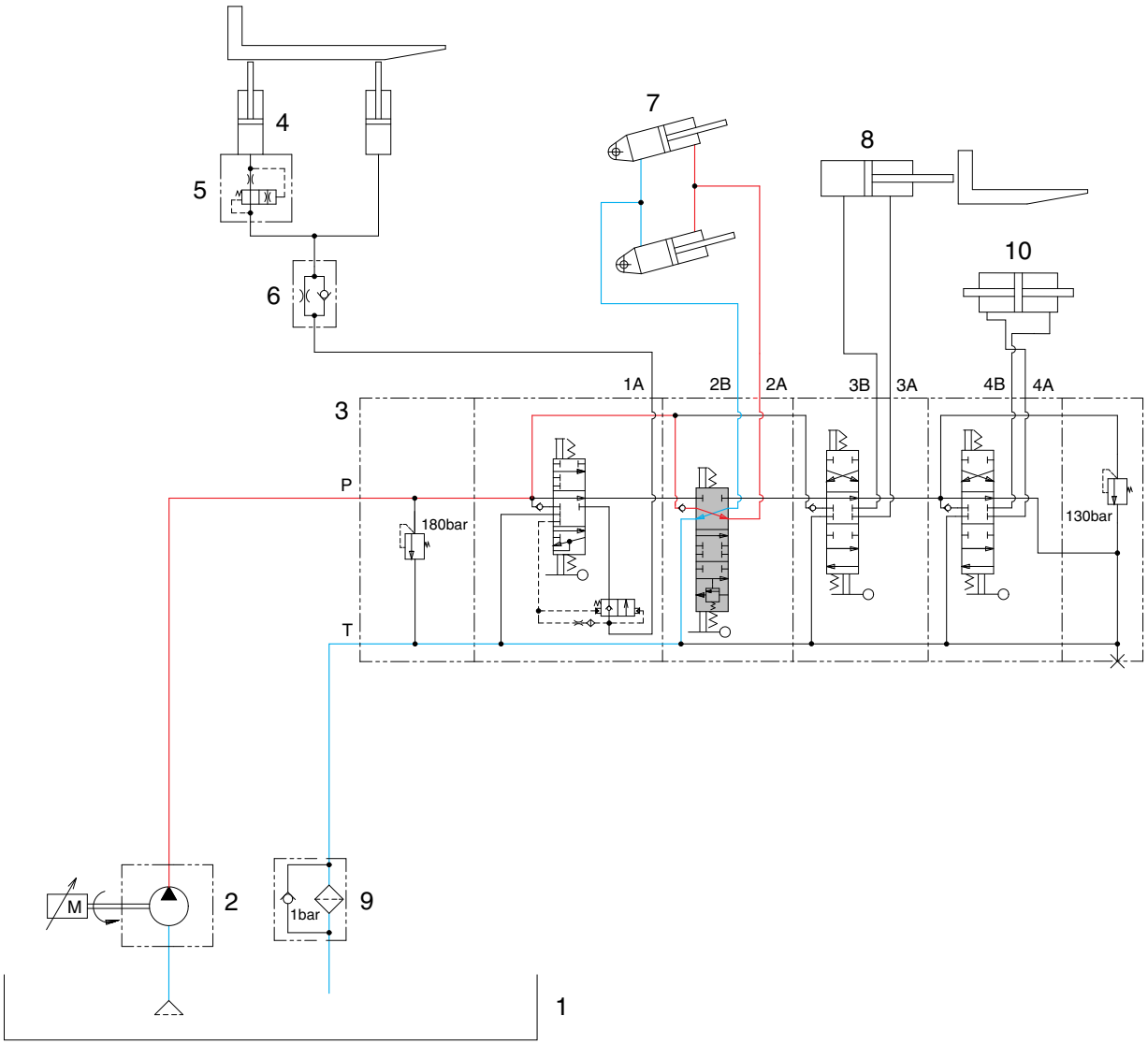


15BRXHS04

The spool of the second block is moved to the rear tile position when the tilt control lever is pulled backwards.
The oil from the hydraulic gear pump (2) flows into the main control valve (3), and pushes the rod check valve on the spool to move into the large chamber of the tilt cylinder (7).
At the same time, the oil from the small chamber of the tilt cylinder (7) passes through the return filter (9) to return to the hydraulic oil tank (1).
The mast is tilted backwards by this oil flow.

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

4) WHEN THE TILT CONTROL LEVER IS PLACED ON THE FORWARD POSITION

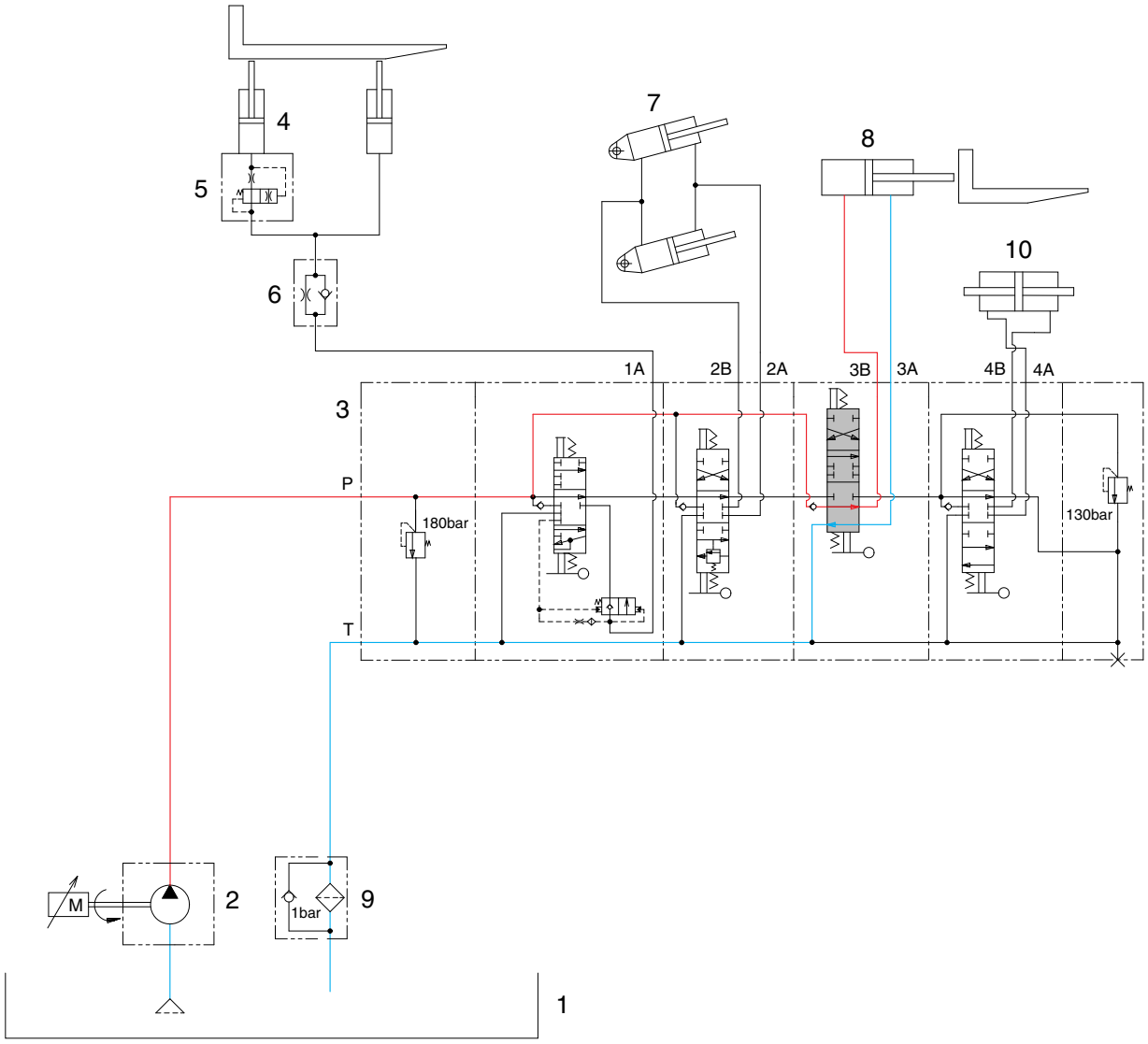


15BRXHS05

The spool of the second block is moved to the forward tilt position when the tilt control lever is pushed forward.
The oil on the hydraulic gear pump (2) flows into the main control valve (3), and pushes the rod check valve on the spool to move into the small chamber of the tilt cylinder (7).
At the same time, the oil from the large chamber of the tilt cylinder (7) passes through the return filter (9) to return to the hydraulic oil tank (1).
The mast is tilted forward by this oil flow.

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

5) WHEN THE REACH CONTROL LEVER IS PLACED ON THE FORWARD POSITION

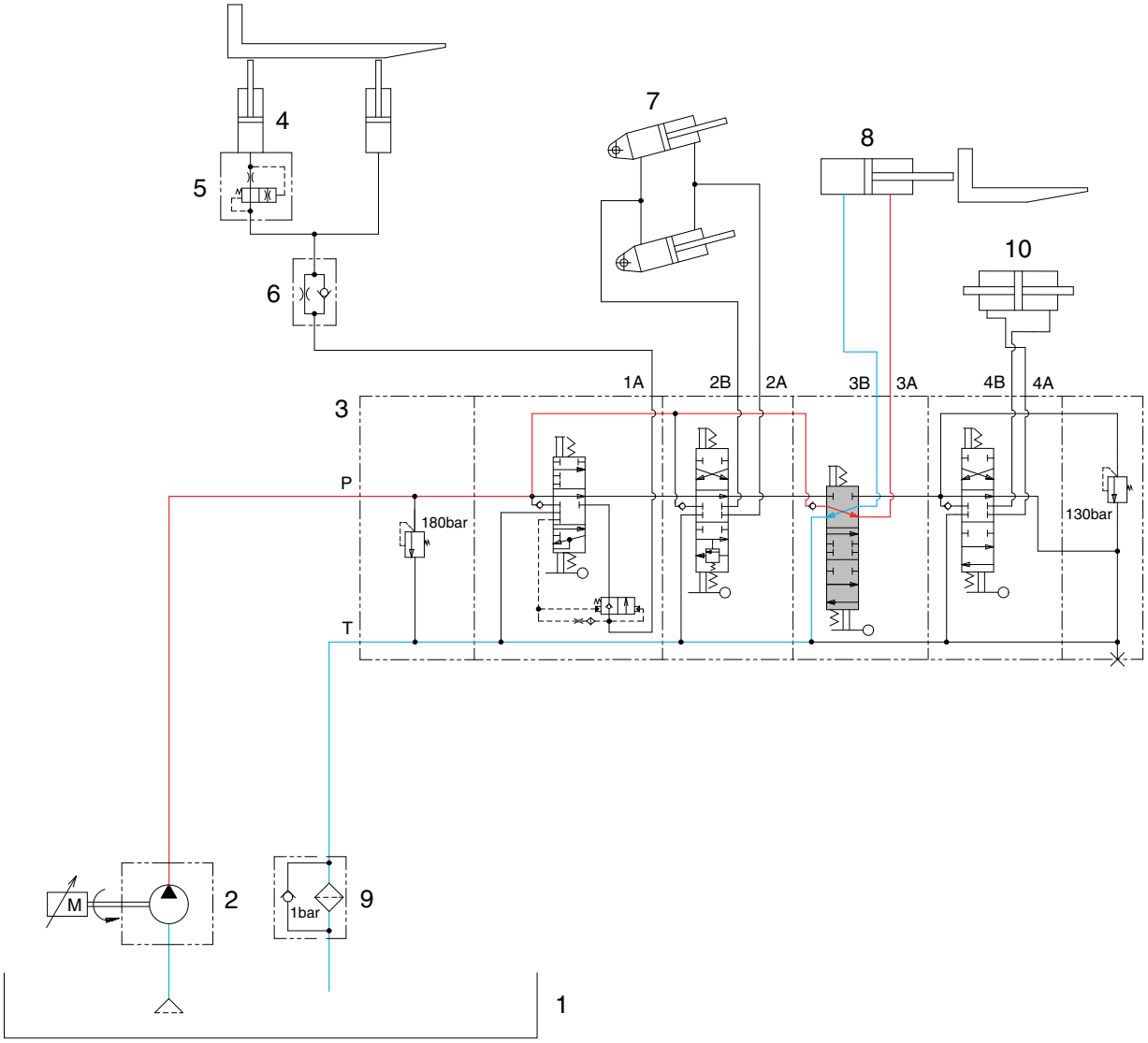


15BRXHS06

The spool of the third block is moved to the forward reach position when the reach control lever is pushed forward.
The oil on the hydraulic gear pump (2) flows into the main control valve (3), and pushes the rod check valve on the spool to move into the large chamber of the reach cylinder (8).
At the same time, the oil from the small chamber of the reach cylinder (8) passes through the return filter (9) to return to the hydraulic oil tank (1).
The mast is reached forward by this oil flow.

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

6) WHEN THE REACH CONTROL LEVER IS PLACED ON THE BACKWARD POSITION



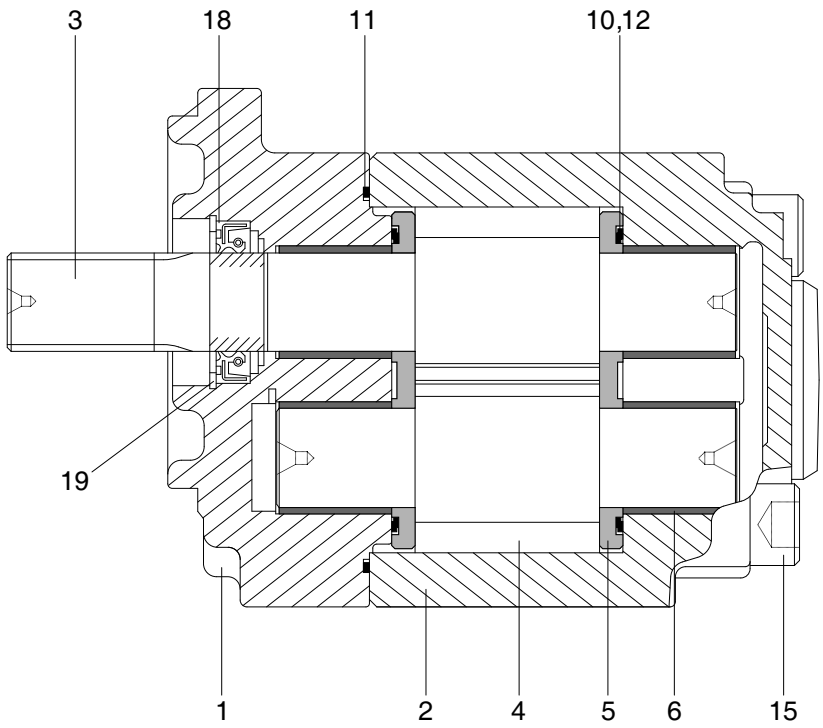
15BRXHS07

The spool of the third block is moved to the backward reach position when the reach control lever is pulled backwards.
The oil on the hydraulic gear pump (2) flows into the main control valve (3), and pushes the rod check valve on the spool to move into the small chamber of the reach cylinder (8)
At the same time, the oil from the large chamber of the reach cylinder (8) passes through the return filter (9) to return to the hydraulic oil tank (1).
The mast is reached backward by this oil flow.

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

2. HYDRAULIC GEAR PUMP

1) STRUCTURE



22D9HS14-1

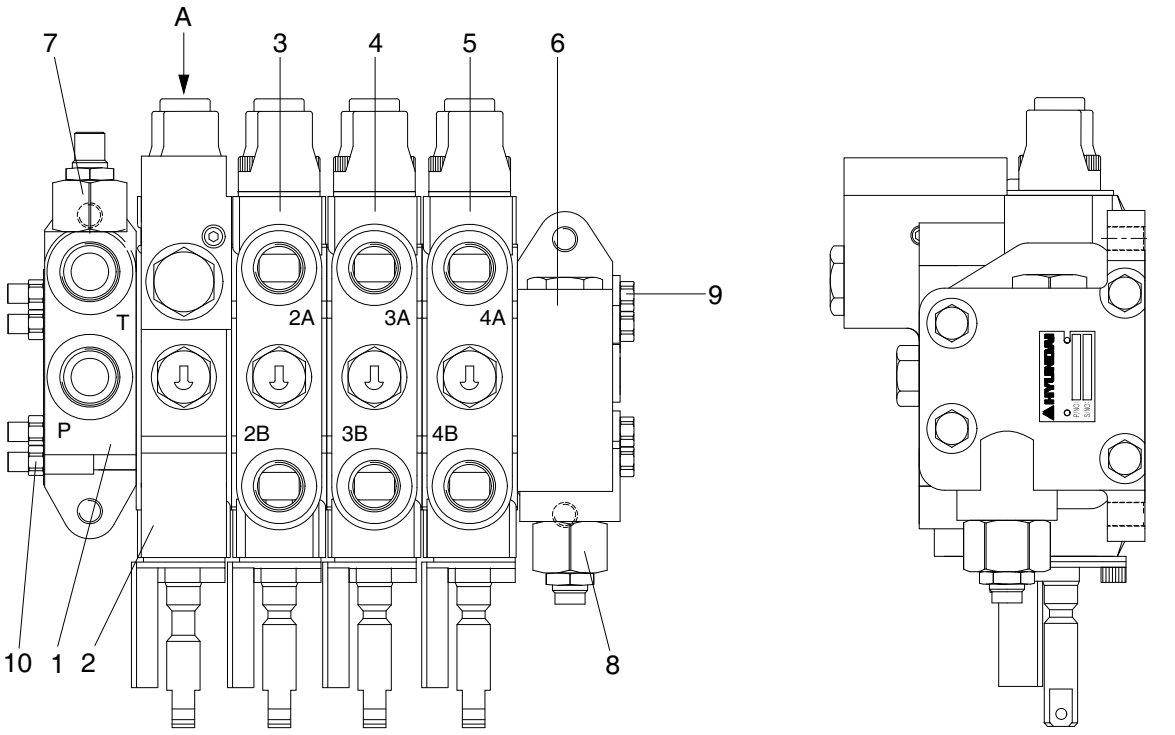
1	Front cover	5	Side plate	12	Backup ring
2	Body	6	Bushing	15	Bolt
3	Driving gear	10	Gasket	18	Oil seal
4	Inverted gear	11	O-ring	19	Retaining ring

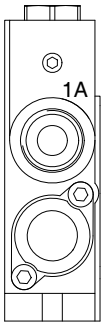
2) OPERATION

This pump is combined by the bolt (15) fastening on the front cover (1) and body (2). The gear journal is supported b ythe bushing (6) for high volume and mechanical efficiency.

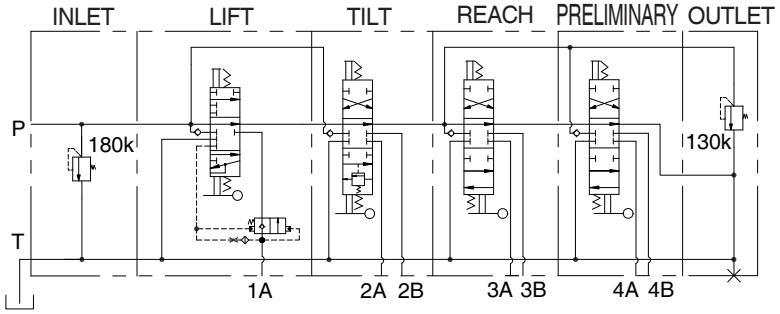
3. MAIN CONTROL VALVE

1) STRUCTURE (ISO TYPE, OPSS NOT APPLIED)





VIEW A

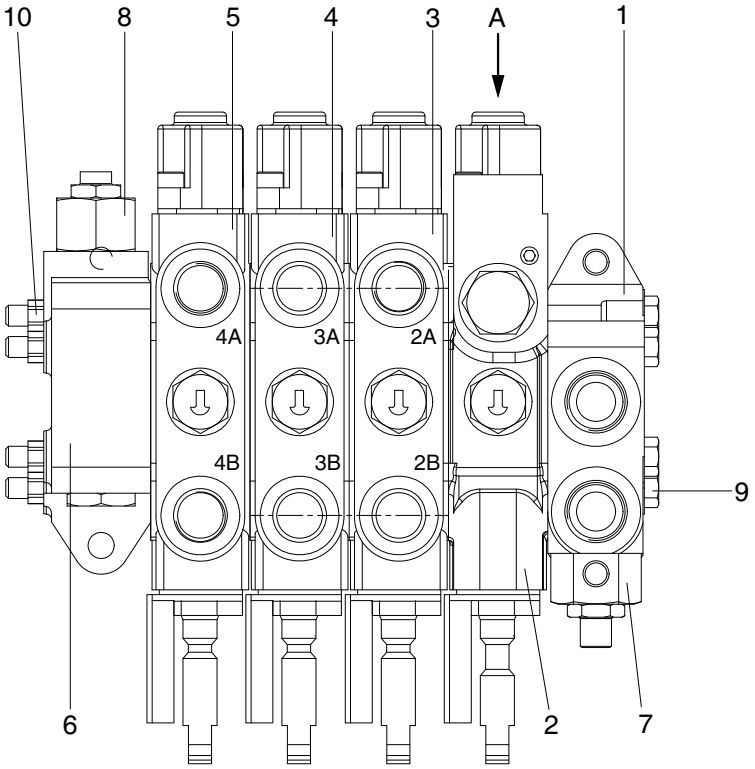


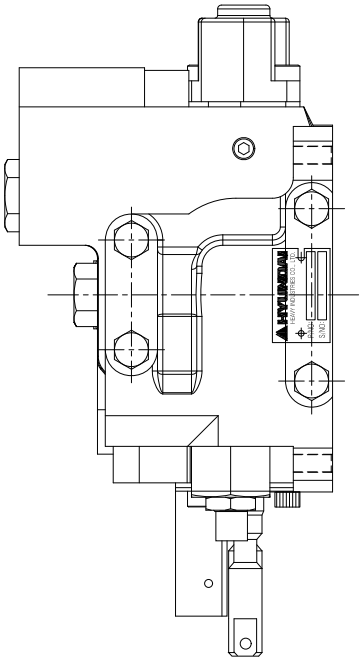
Port Name	Spec.	Port
Inlet Port	7/8-14UNF	P
Outlet Port	7/8-14UNF	T
Work Port	7/8-14UNF	1A
Work Port	3/4-16UNF	2A, 2B, 3A, 3B, 4A, 4B

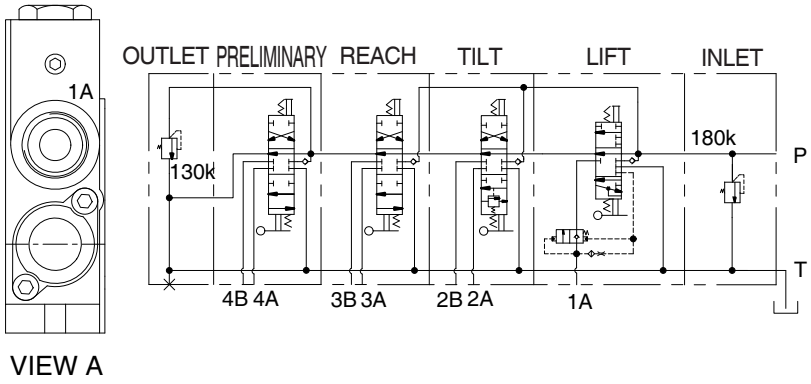
15BRXHS08

1 Inlet block
2 Lift Block
3 Tilt block
4 Reach block
5 Preliminary block
6 Outlet block
7 Main relief valve
8 Secondary relief valve
9 Long bolt
10 Nut

2) STRUCTURE (ASIA TYPE, OPSS REVERSE)







VIEW A

Port Name	Spec.	Port
Inlet Port	7/8-14UNF	P
Outlet Port	7/8-14UNF	T
Work Port	7/8-14UNF	1A
Work Port	3/4-16UNF	2A, 2B, 3A, 3B, 4A, 4B

15BRXHS09

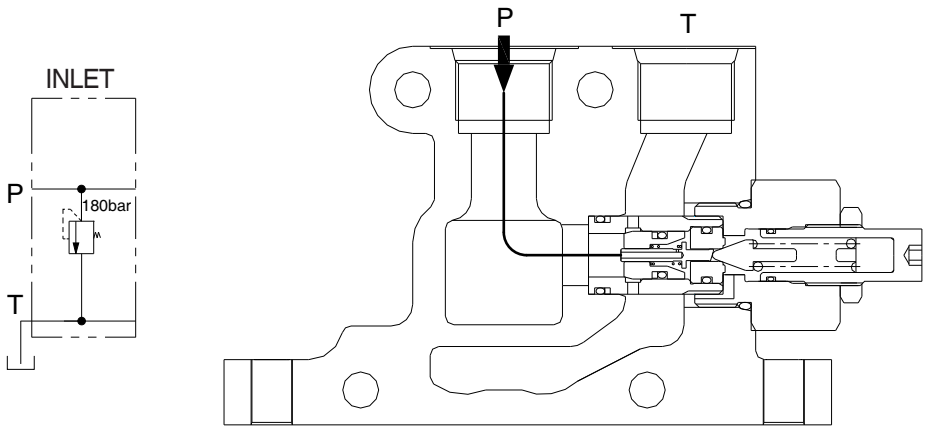
1 Inlet block
2 Lift block
3 Tilt block
4 Reach block
5 Preliminary block
6 Outlet block
7 Main relief valve
8 Secondary relief valve
9 Long bolt
10 Nut

3) INLET SECTION

(1) Operation

The hydraulic oil supplied from the hydraulic pump is flown in through the P port of the main control valve.

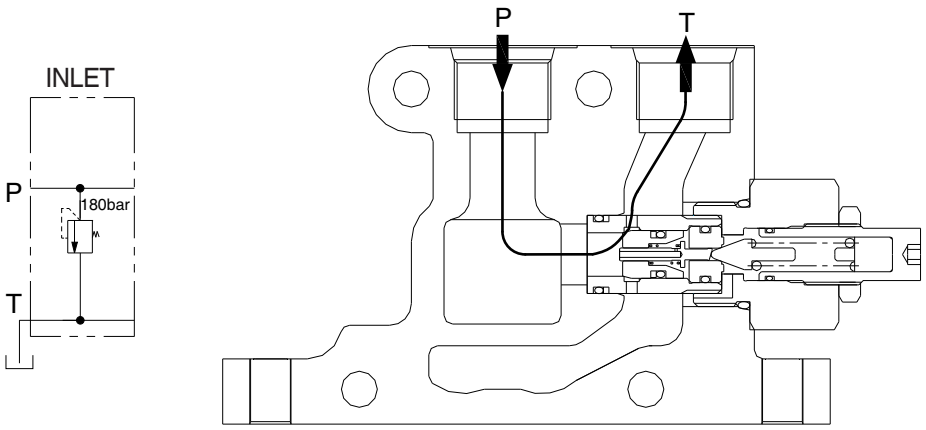
The inlet section is installed with the main relief valve.



15BRXHS10

(2) Main relief valve operation

When the pressure of the oil discharged from the hydraulic pump reaches the pressure set on the main relief valve, and main relief valve poppet is opened, and the discharged oil flows into the tank.



15BRXHS11

4) LIFT SECTION

(1) Operation

The lift section plays the role of flowing the oil supplied from the hydraulic pump to the lift cyliner, and from the lift cylinder to the tank. The port is configured with a single port (1A).

In the descending function, the load or mast is lowered by the weight.

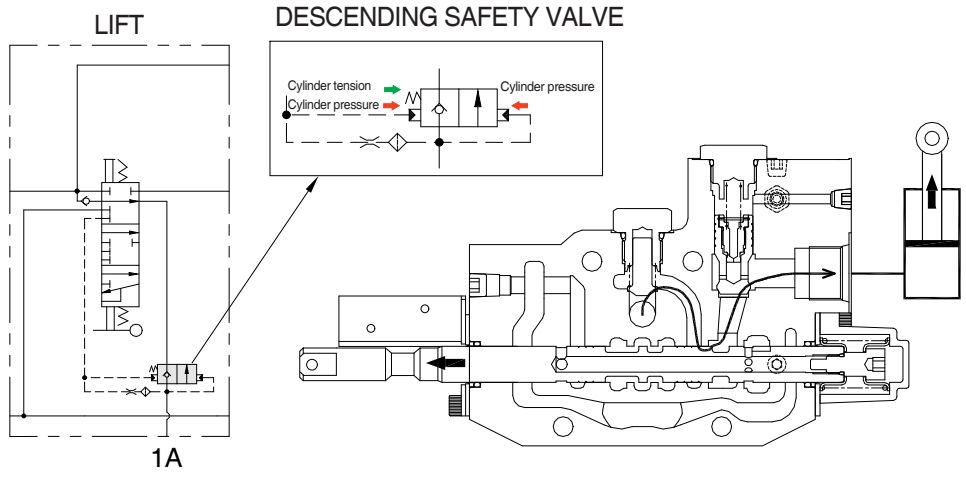
The descending safety valve is configured as a safety device for preventing the natural descending of the mast.

When the lever is in neutral, the cylinder pressure is applied on left and right sides of the descending safety valve, and the spring tension is applied additionally. Here, the position of the valve becomes the check valve due to the spring tension, and natural descending of the mast is prevented.

① Lifting

The fork is lifted when the operator pulls the lift lever backwards.

The high-pressure oil from the hydraulic pump is supplied to the large chamber of the lift cylinder.

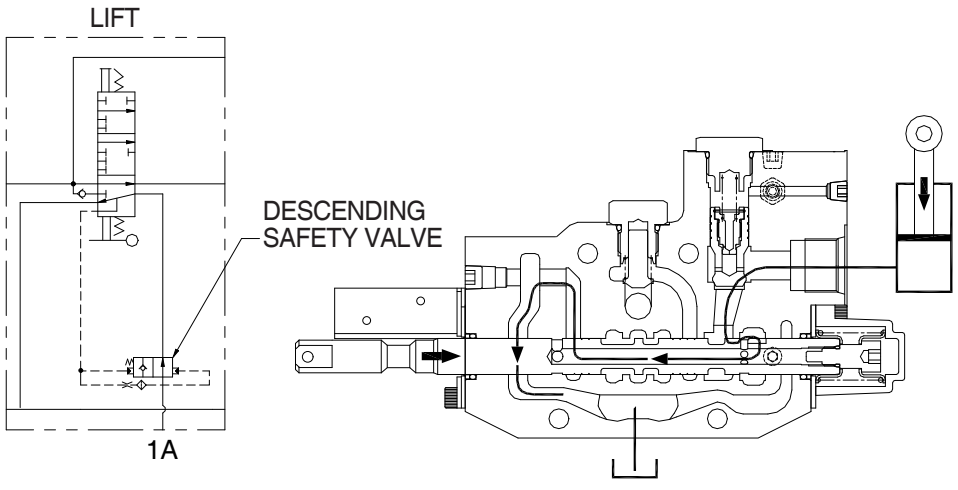


15BRXHS12

② Descending

The fork is descended when the operator pushes the lift lever forward.

The oil on the large chamber of the lift cylinder passes through the descending control valve to return to the tank.



15BRXHS13

Pressure is limited by the main relief valve.

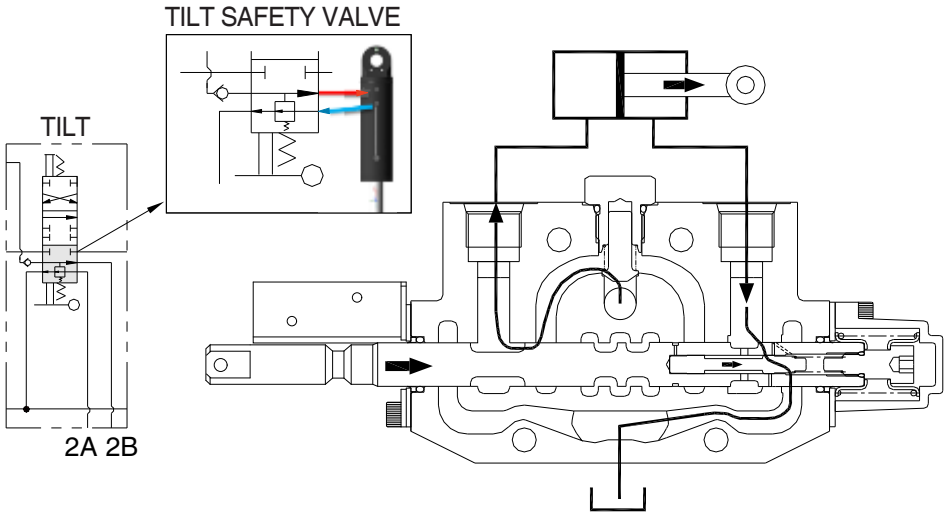
5) TILT SECTION

(1) Operation

The tilt spool is configured with the tilt safety valve to prevent the mast from tilting forward more than the lever operation by the mast or load weight during the front-tilt operation.

① **Front tilt**

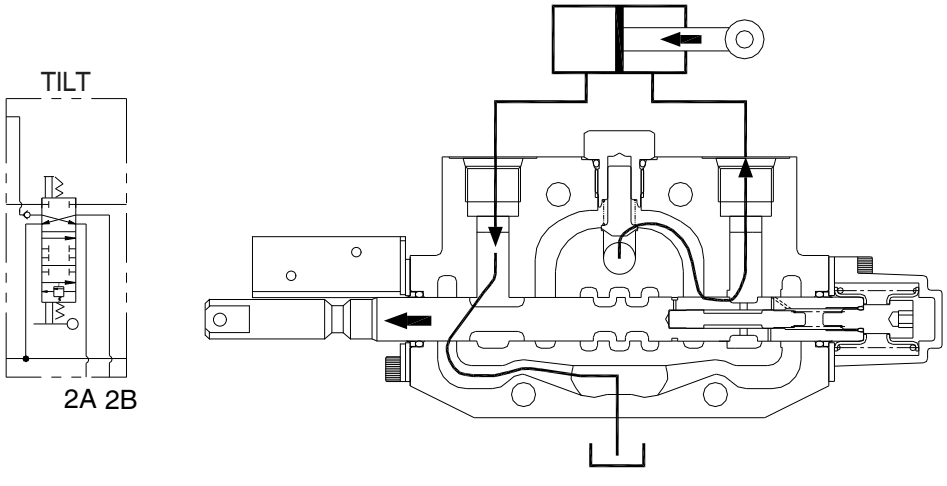
The carriage is tilted to the front of the lift truck when the tilt lever is pushed forward.
Here, high-pressure oil is flown into the large chamber of the tile cylinder, and the oil on the small chamber of the cylinder is flown into the tank.



15BRXHS14

② **Rear tilt**

The carriage is tilted to the back of the lift truck when the tilt lever is pulled backwards.
Here, high-pressure oil is flown into the small chamber of the tile cylinder, and the oil on the large chamber of the cylinder is flown into the tank.



15BRXHS15

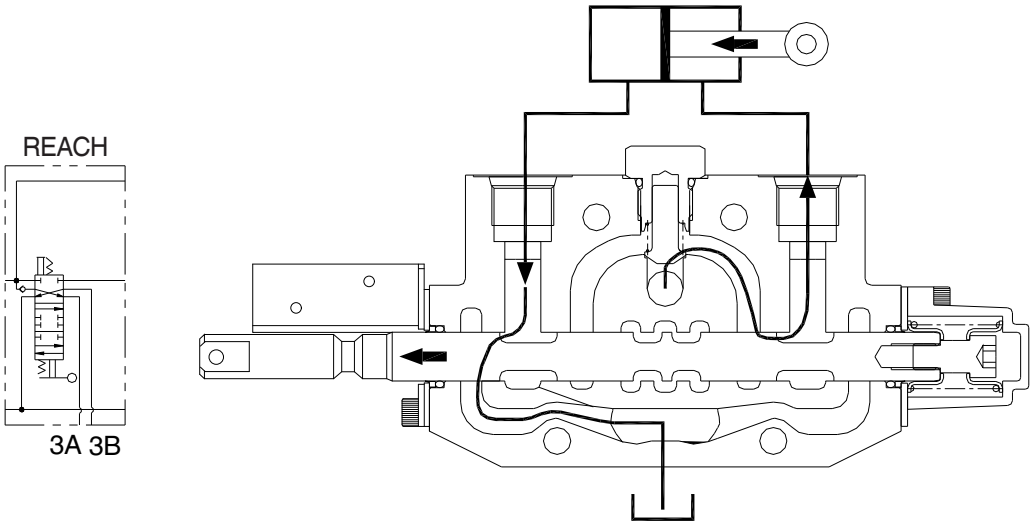
Pressure is limited by the main relief valve.

6) REACH SECTION

(1) Operation

① Reach backward

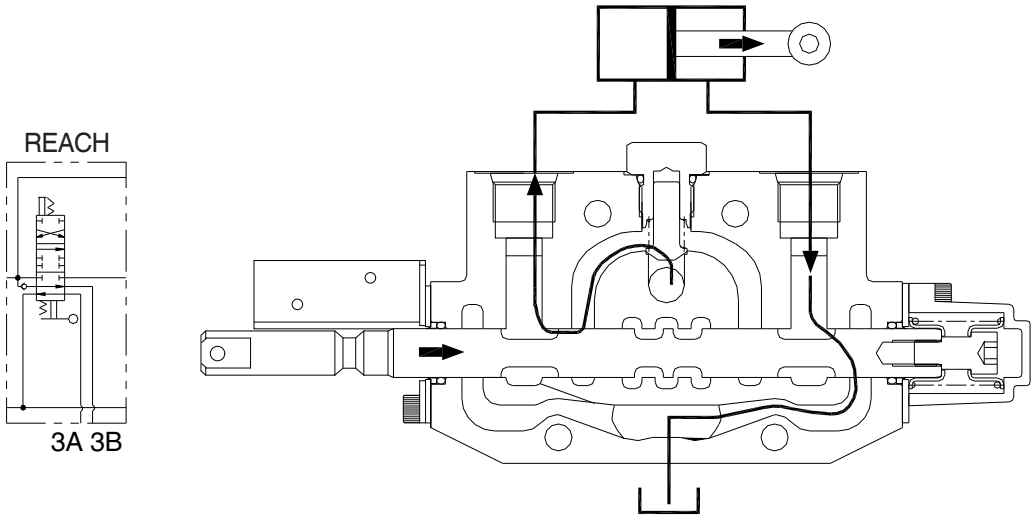
The mast is moved towards the lift truck when the operator pulls the reach lever backwards.
Here, high-pressure oil supplied from the hydraulic pump flows into the small chamber of the reach cylinder, and the oil on the large chamber of the cylinder flows to the tank.



15BRXHS16

② Reach forward

The mast is moved to the front of the lift truck when the operator pushes the reach lever foward.
Here, high-pressure oil supplied from the hydraulic pump flows into the large chamber of the reach cylinder, and the oil on the small chamber of the cylinder flows to the tank.



15BRXHS17

Pressure is limited by the main relief valve.

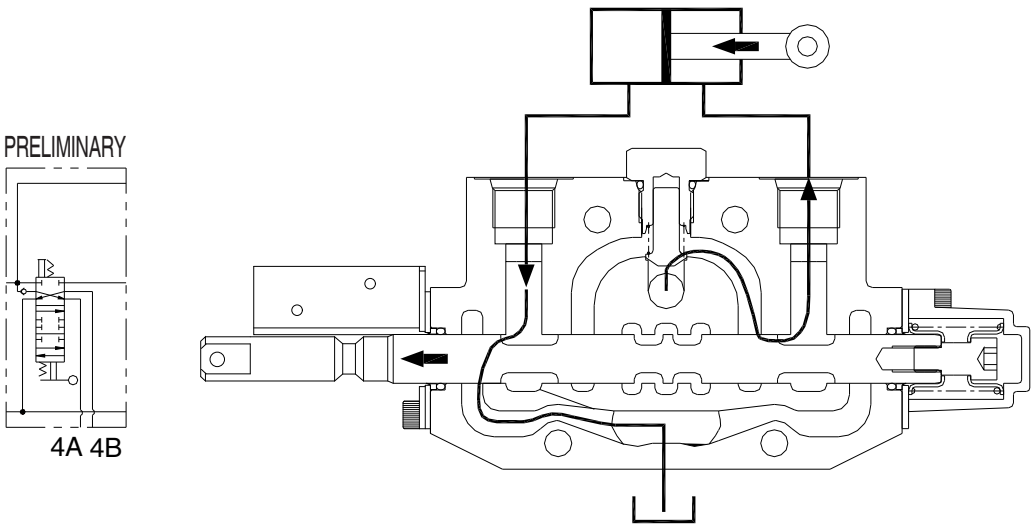
7) PRELIMINARY SECTION

(1) Operation

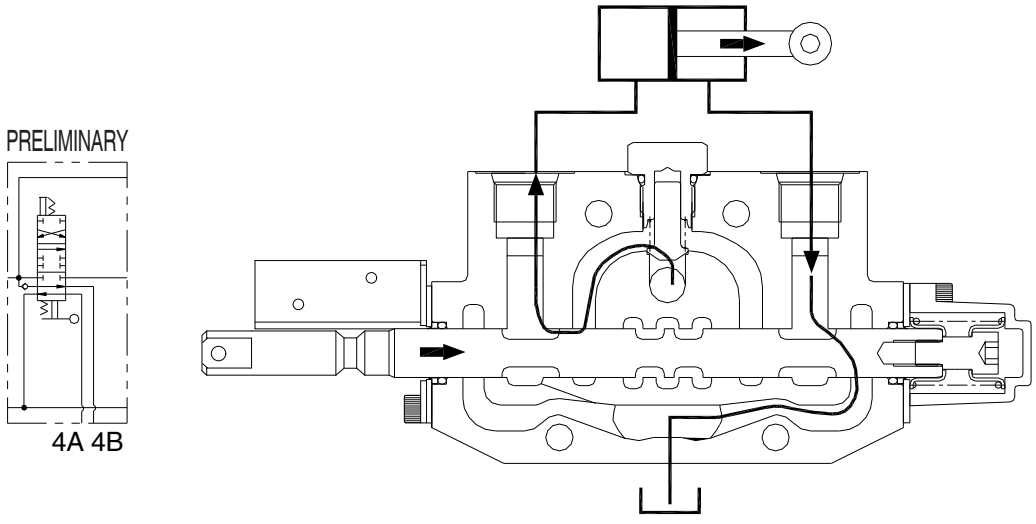
The preliminary spool section can control many other functions. Generally, the high-pressure oil is reacted with the pressure on one work port, and this oil passes through the load check valve and spool metering notch to flow to the cylinder. At the same time, the oil on another work port passes through the spool metering notch to flow to the tank.

The preliminary section is used for controlling the attachment function.

The flowing direction of the oil is equal to the tilt and reach according to the lever operation.



15BRXHS18



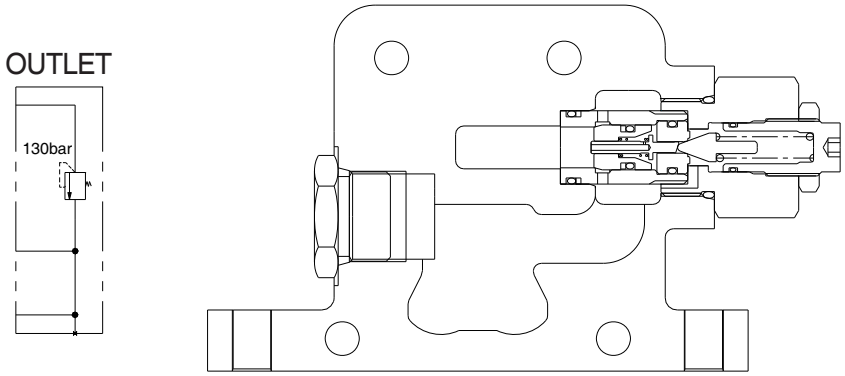
15BRXHS19

Pressure is limited by the secondary relief valve.

8) OUTLET SECTION

(1) Operation

The outlet section includes the tank port (T) and secondary relief valve.
The secondary relief valve controls the pressure on the preliminary (AUX) section.
(The 3-spool specification has no secondary relief valve.)

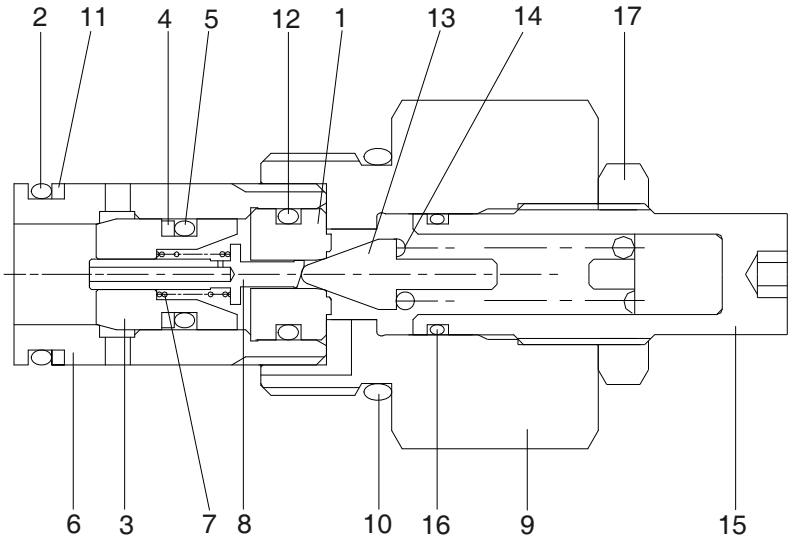


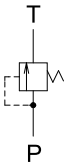
15BRXHS20

9) MAIN RELIEF VALVE

This valve is a type of pilot piston valve to prevent the damage of the hydraulic parts and pipe due to the high pressure, and the hydraulic pressure is maintained in the set value or less.

When the adjusting valve is rotated once, the relief valve pressure is changed by 130 kgf/cm^2.





· Main relief valve : 15/18BR-X-180 kgf/cm^2, 20/25BR-X-190 kgf/cm^2

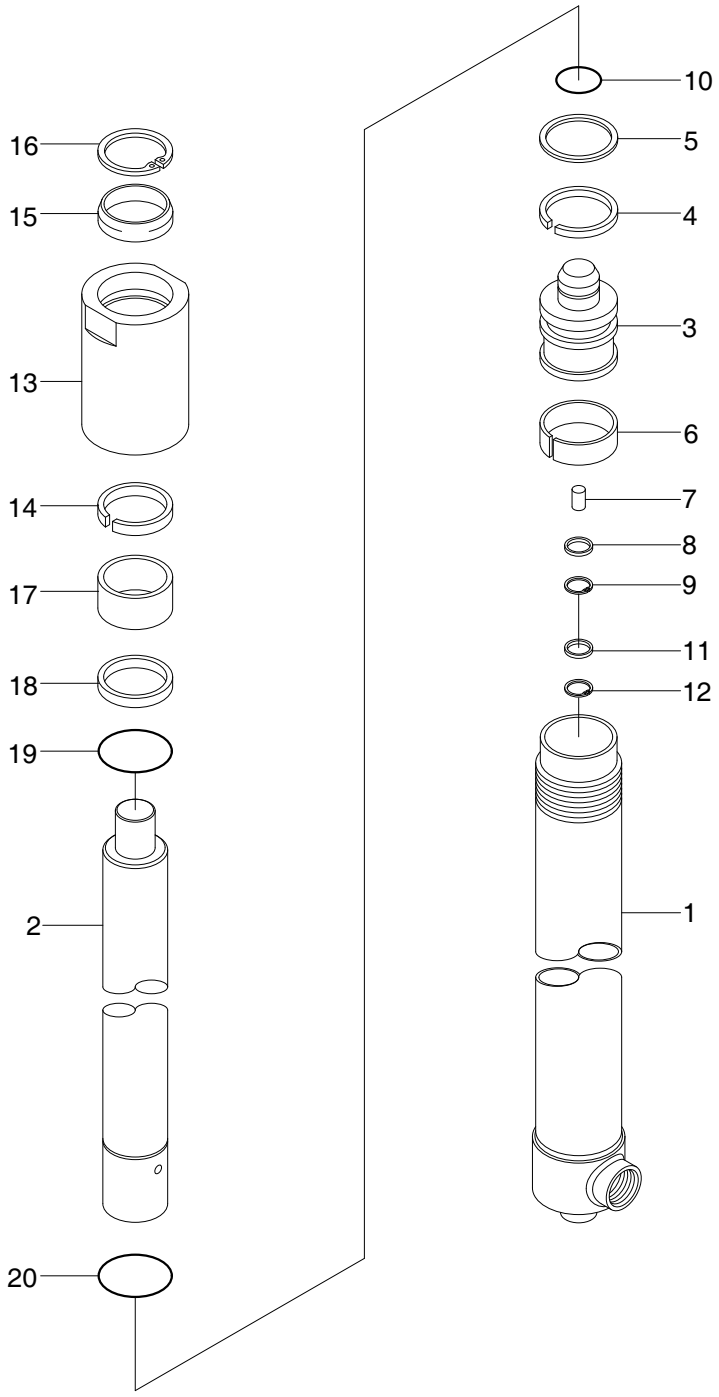
· 2nd relief valve : 130 kgf/cm^2 (Only relevant to the 4-spool)

15BRXHS21

1	Pilot sheet	7	Main Spring	13	Pilot poppet
2	O-ring	8	Piston	14	Pilot spring
3	Main poppet	9	Body	15	Adjusting screw
4	Backup ring	10	O-ring	16	O-ring
5	O-ring	11	Backup ring	17	Locking nut
6	Socket	12	O-ring		

4. LIFT CYLINDER

1) 15/18BR-X (V-MAST)

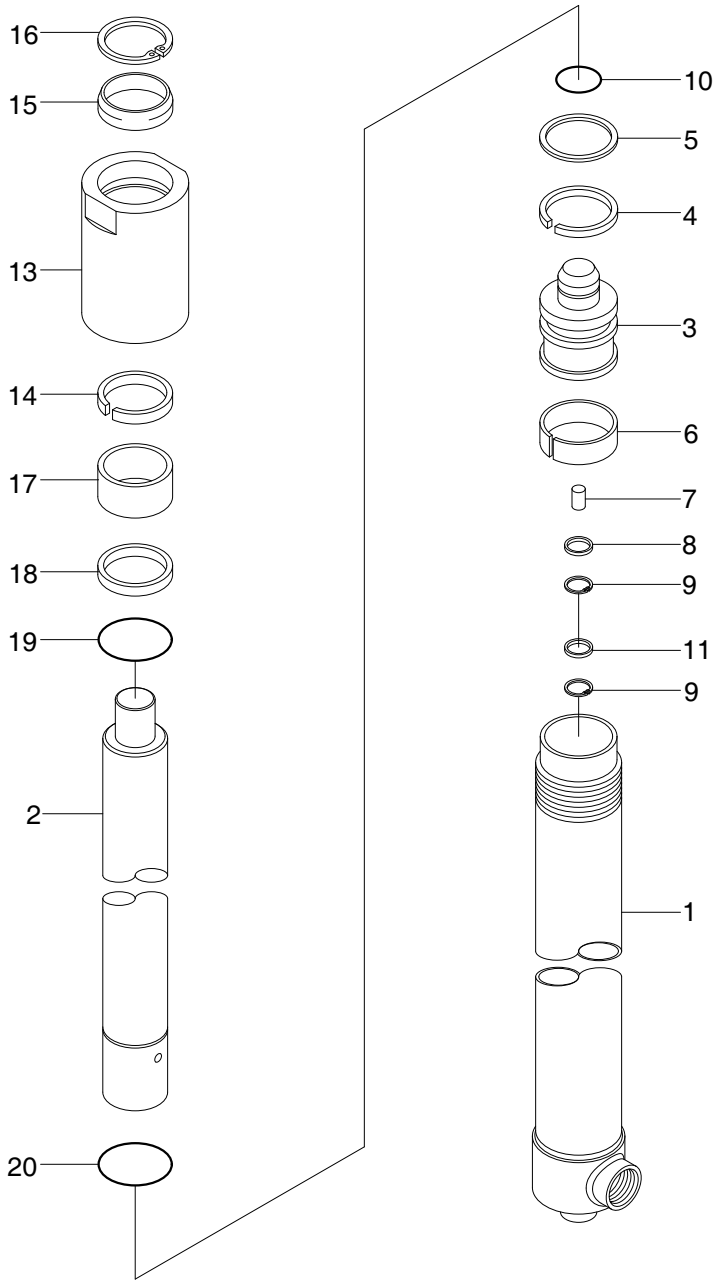


18BR9HS33

1	Tube	8	Spacer	15	Dust wiper
2	Rod	9	Retainer ring	16	Retainer ring
3	Piston	10	Stop ring	17	Rod bushing
4	U-Packing	11	Cushion seal	18	Spacer
5	Backup ring	12	Retainer ring	19	O-ring
6	Abrasion ring	13	Rod cover	20	Stop ring
7	Check valve	14	U-Packing		

※ **Seal kit : 4, 5, 6, 14, 15, 19**

2) 15/18BR-X (TF-MAST)

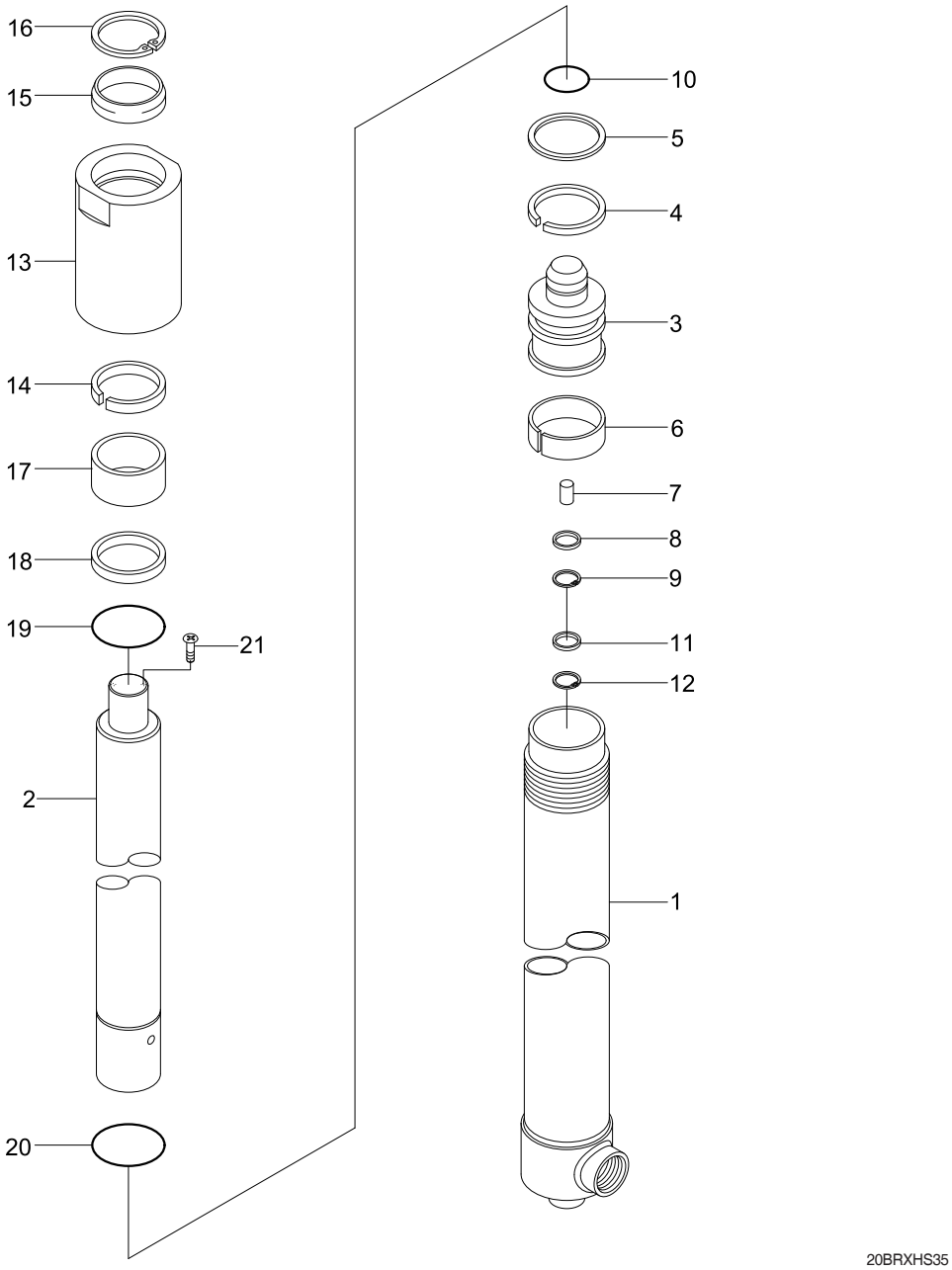


18BRXHS34

1	Tube	8	Spacer	16	Retainer ring
2	Rod	9	Retainer ring	17	Rod bushing
3	Piston	10	Stop ring	18	Spacer
4	U-Packing	11	Cushion seal	19	O-ring
5	Backup ring	13	Rod cover	20	Stop ring
6	Abrasion ring	14	U-Packing		
7	Check valve	15	Dust wiper		

※ **Seal kit : 4, 5, 6, 11, 14, 15, 19**

3) 20/25BR-X (V-MAST)

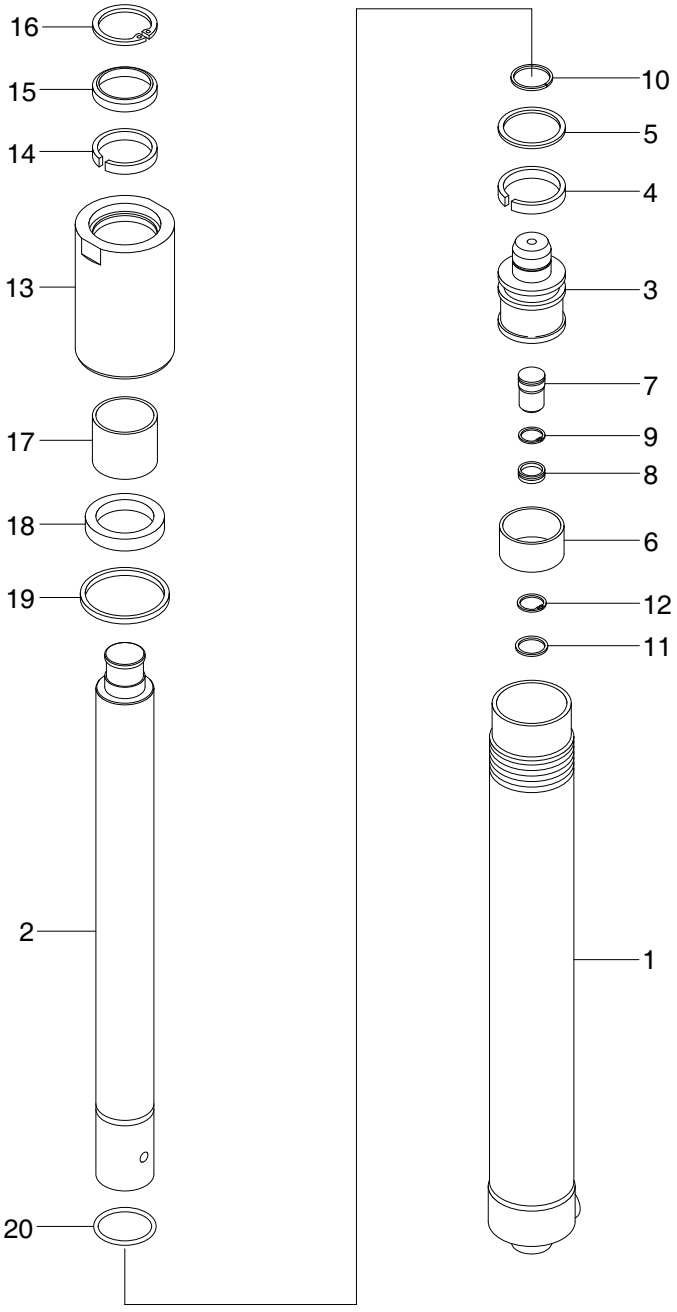


20BRXHS35

1	Tube	8	Spacer	15	Dust wiper
2	Rod	9	Retainer ring	16	Retainer ring
3	Piston	10	Stop ring	17	Rod bushing
4	U packing	11	Cushion seal	18	Spacer
5	Backup ring	12	Retainer ring	19	O-ring
6	Abrasion ring	13	Rod cover	20	Stop ring
7	Check valve	14	U packing	21	Set screw

※ **Seal kit : 4, 5, 6, 11, 14, 15, 19**

4) 20/25BR-X (TF-MAST)



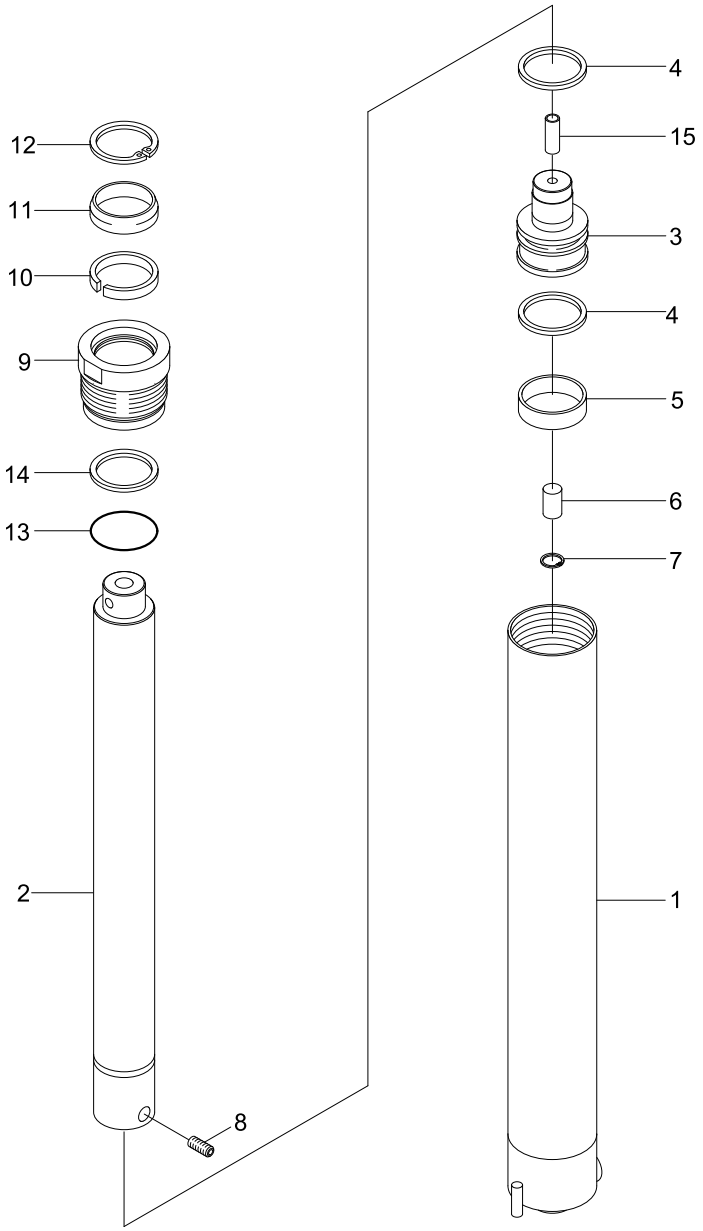
18BR9HS42

1	Tube	8	Spacer	15	Dust wiper
2	Rod	9	Retainer ring	16	Retainer ring
3	Piston	10	Stop ring	17	Abrasion ring
4	U-Packing	11	Cushion seal	18	Dust ring
5	Backup ring	12	Retainer ring	19	O-ring
6	Abrasion ring	13	Rod cover	20	Stop ring
7	Check valve	14	U-Packing		

※ **Seal kit : 4, 5, 6, 14, 15, 19**

5. PRE-LIFT CYLINDER

1) 15/18BR-X (TF-MAST)

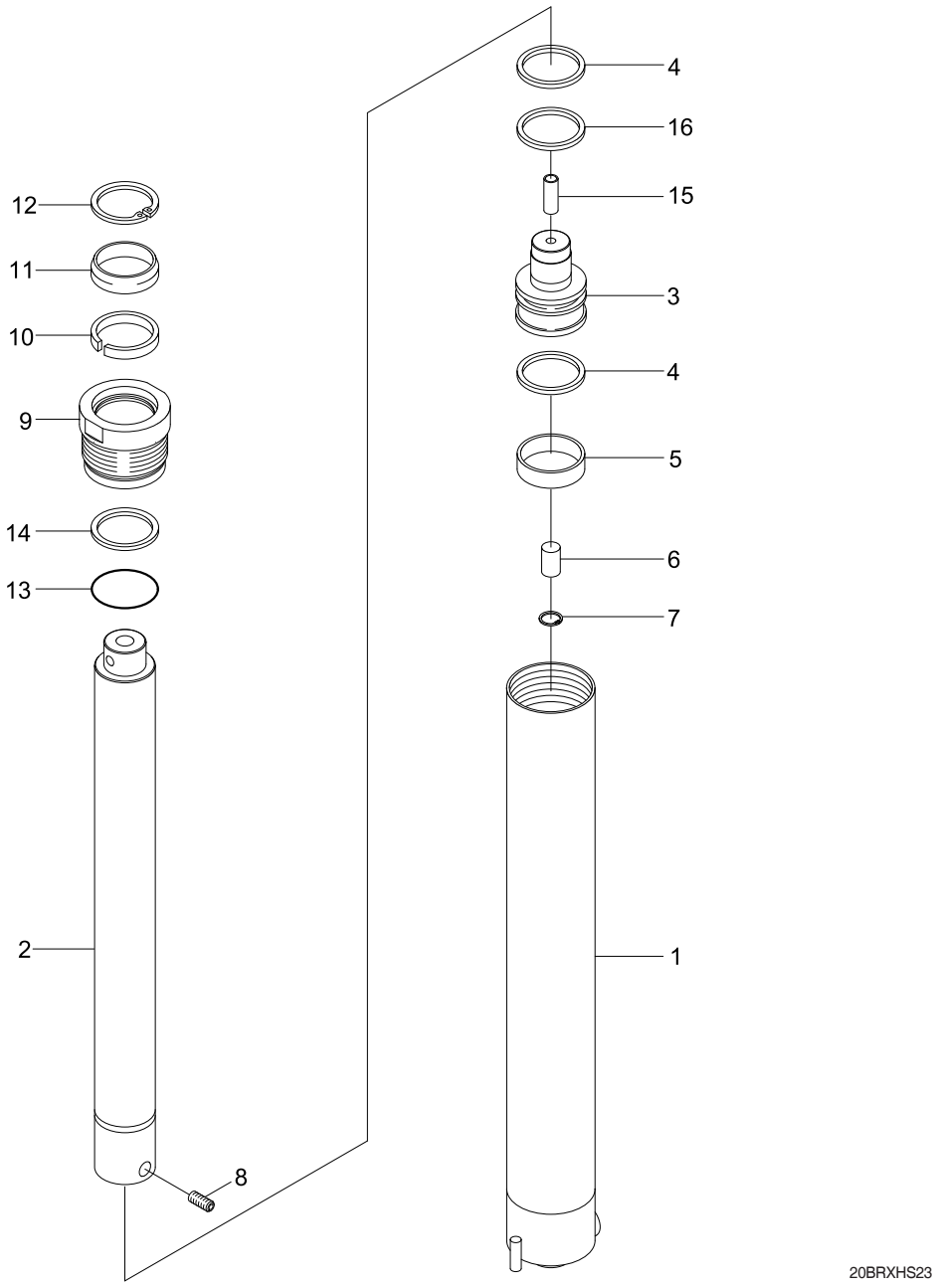


15BRXHS22

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

※ **Seal kit : 4, 5, 10, 11, 13, 14**

2) 20/25BR-X (TF-MAST)

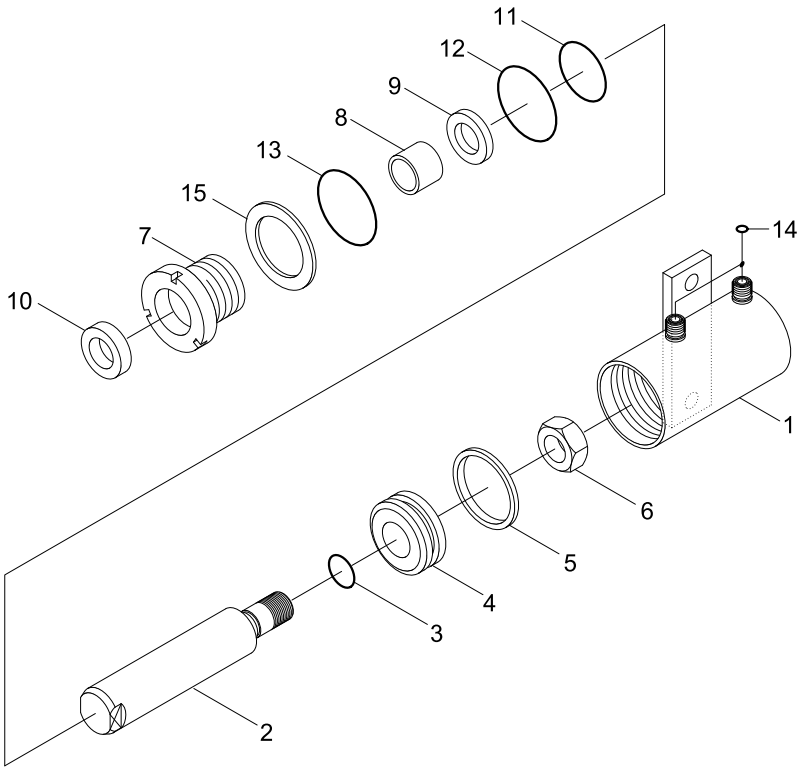


1	Tube	7	Retainer ring	13	O-ring
2	Rod	8	Set screw	14	Backup ring
3	Piston	9	Rod cover	15	Pipe
4	Piston seal	10	U-Packing	16	Backup ring
5	Abrasion ring	11	Dust wiper		
6	Check valve	12	Retainer ring		

※ **Seal kit : 4, 5, 10, 11, 13, 14, 16**

6. TILT CYLINDER

1) 15/18BR-X

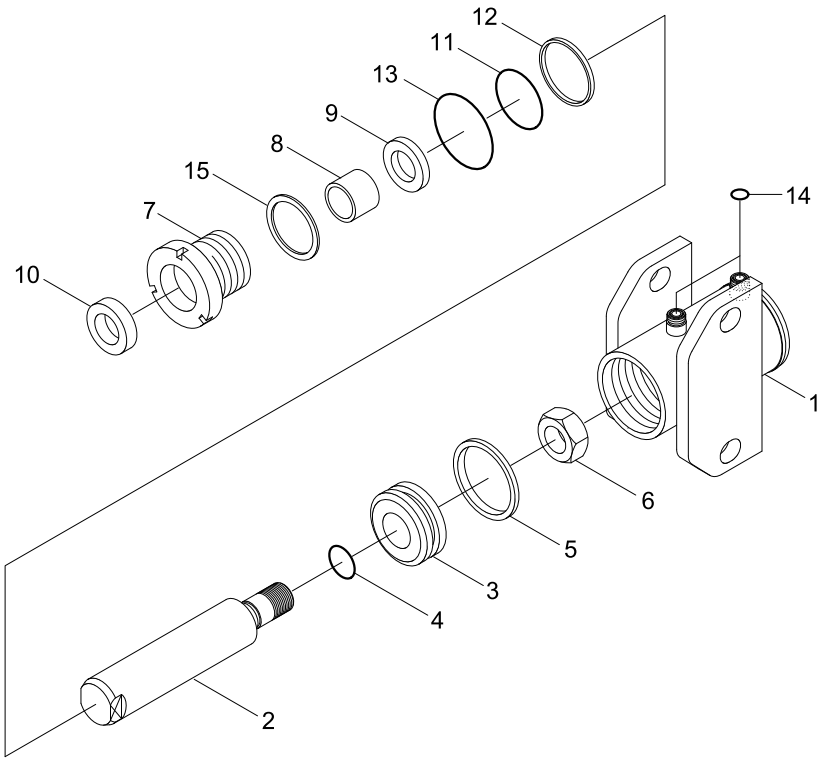


15BRXHS24

1	Tube	6	Nylon nut	11	O-ring
2	Rod	7	Gland	12	O-ring
3	O-ring	8	DU Bushing	13	O-ring
4	Piston	9	Dust wiper	14	O-ring
5	Piston seal	10	Dust wiper	15	Washer

※ **Seal kit : 3, 5, 9, 10, 11, 12**

2) 20/25BR-X



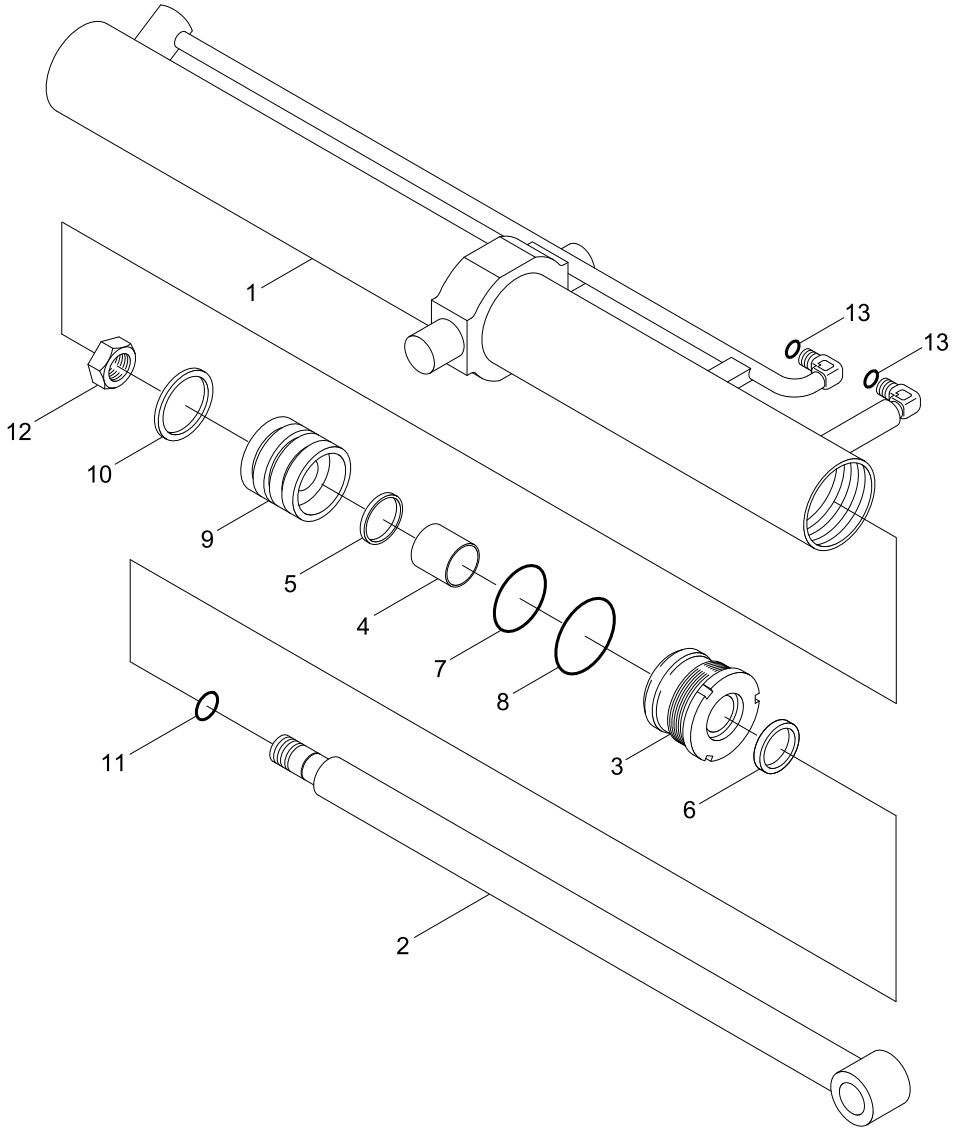
15BRXHS25

1	Tube	6	Nylon nut	11	O-ring
2	Rod	7	Rod cover	12	Retaining ring
3	Piston	8	Pun bushing	13	O-ring
4	O-ring	9	Dust wiper	14	O-ring
5	Piston seal	10	U-Packing	15	Lock washer

※ Seal kit : 4, 5, 9, 10, 11, 12, 13

7. REACH CYLINDER

1) 15/18/20/25BR-X



15BRXHS26

1	Tube	6	Dust wiper	11	O-ring
2	Rod	7	O-ring	12	Nylon nut
3	Rod cover	8	O-ring	13	O-ring
4	Pun bushing	9	Piston		
5	Packing	10	Piston seal		

※ **Seal kit : 5, 6, 7, 8, 10, 11**

1. OPERATION INSPECTION

1) INSPECTION ITEMS

(1) Visually check rod for deformation, crack or destruction.

(2) In maximum load, place the mast vertically to lift 1 m from the ground. Measure hydraulic drift (distance for fork lowering, and mast tilting forward) 10 minutes later.

· Hydraulic descending

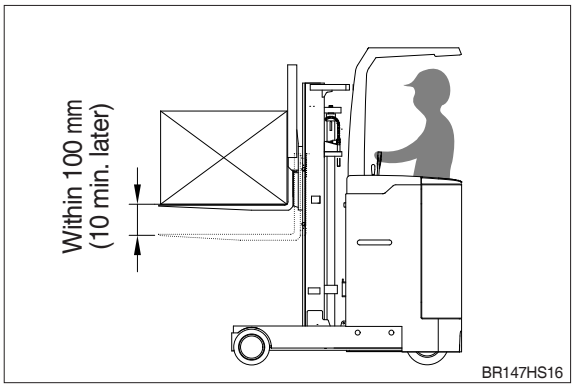
- Down (Fork moving downwards)

: Within 100 mm

- Front (Expansion of the tilt cylinder)

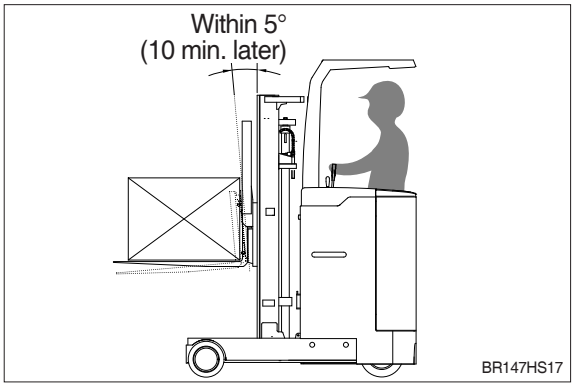
: Within 5°

If the hydraulic descending is larger than the specified value, replace the control valve or cylinder packing.



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

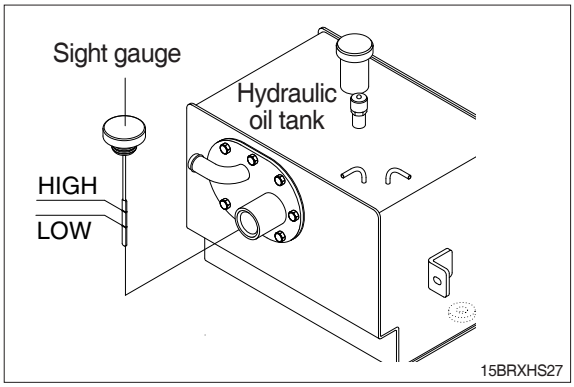
Standard	Within 0.6 mm



2) HYDRAULIC OIL INSPECTION AND SUPPLY

Check the amount of hydraulic oil in the hydraulic oil tank. Appropriate amount of hydraulic oil is important for proper system operation. Pump may be damaged when the amount of hydraulic oil is low.

The hydraulic oil is expanded according to the increase in temperature. Therefore, it is appropriate to check the amount of hydraulic oil in the working temperature (Approximately 30 minutes after operating the lift truck).



To check the amount of hydraulic oil, park the lift truck first on a flat surface, and apply the parking brake.

Raise the mast to the vertical position, and lower the fork carriage completely. Check the amount of hydraulic oil. If required, add only the recommended to hydraulic oil to maintain the level between LOW and HIGH on the amount of hydraulic oil. Do not fill excessively.

Check the condition of the hydraulic oil (use time, color, transparency and contamination). Replace the hydraulic oil if necessary.

3) CONTROL VALVE

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

· 15/18BR-X : 180 kgf/cm^2

· 20/25BR-X : 190 kgf/cm^2

2. FAILURE DIAGNOSIS AND TROUBLESHOOTING

1) HYDRAULIC SYSTEM

Nature of Trouble	Cause	Remedy
Sudden drop of forks	· Defective seal inside control valve · Oil leakage on the joint or hose · Seal defect inside the cylinder	· Replace spool or valve body · Replace · Replace packing
Large tilting angle by tare weight of mast	· Leaning backward : Defective check valve · Leaning forward : Defective tilt lock valve · Oil leakage on the joint or hose · Seal defect inside the cylinder	· Clean or replace · Clean or replace · Replace · Replace seal
Slow speed of fork lifting or mast tilting	· Insufficient hydraulic oil · Hydraulic oil mixed with air · Oil leakage on the joint or hose · Excessive limit of oil flow on the pump intake · Relief valve failed in keeping at specified pressure · Defective seal inside cylinder · High hydraulic oil viscosity · Mast not moving smoothly · Oil leakage on the lift control valve spool · Oil leakage on the tilt control valve spool	· Replenish oil additionally · Air bleeding (air removal) · Replace · Clean filter · Adjust relief valve · Replace packing · Replace to the engine oil with proper viscosity · Adjust the roll in rail distance · Replace spool or valve body · Replace spool or valve body
Noise on the hydraulic system	· Excessive limit of oil flow on the pump intake · Hydraulic pump gear or bearing defect	· Clean filter · Replace gear or bearing
Control valve lever locked	· Foreign substance between spool and valve body. · Defective valve body	· Clean · Fastening body mounting bolt uniformly.
Rise of oil temperature	· Insufficient hydraulic oil · Oil filter clogged	· Replenish oil additionally · Clean filter

2) HYDRAULIC GEAR PUMP

Trouble	Cause	Remedy
Oil leak from oil seal	· Backlashing · Abnormally high pressure on suction port · Seal damaged by foreign substance · Damage or abrasion of seal of shaft · Defective centering of shaft	· Rotating pump in correct direction. · Keeping pressure proper · Replace oil seal with new part · Replace shaft and seal. · Adjust center or replace pump.
Oil leakage on the cover and body joint	· Bolt is loosened or body or cover damage · Deterioration or damage of oil seal by thermosetting of gasket	· Bolt fastening or keeping pressure proper. · Replace gasket with new part. · Replace pump.
Oil leak on port	· Port fitting loosened · Port seal damaged · Port damaged	· Re-fasten with the designated torque · Replace port seal · Replace pump
Insufficient discharge flow or pressure not formed	· Insufficient oil in tank · Internal oil leak by abnormally high temperature, or improper oil viscosity · Capability degraded by oil contamination · Cavitation by negative pressure · Internal part destructed · Backlashing	· Replenish oil. · Supply oil of proper type and capacity into tank, and replace cooling system. · Exchanging contaminated oil. · Using suction pipe of proper length and width, and replace filter to prevent negative pressure. · Suction valve opening · Pump replacing · Rotating pump in correct direction, and preventing abnormally high temperature on suction side.
Rise of oil temperature	· Abnormal heat generated by frequent operation of pressure control valve · Internal part destructed	· Setting to proper pressure. · Replace pump.
Noise and vibration	· Poor mounting · Cavitation · Air induced · Vibration of piping or mounted flange · Chattering of relief valve · Internal part destructed	· Centered adjustment · Using suction pipe of proper length and width, and replace filter to prevent negative pressure. · Filling tank with oil, and preventing air inducing with suction pipe. · Reinforcing pipe and mounting flange, and preventing resonance. · Replace relieve valve to new part. · Replace pump.

※ Capability of disassembled pump may not be restored after reassembling.

※ If pump is damaged, replace the assembly.

※ If it is inevitable to disassemble pump, consult with the authorized shop or dealer of Hyundai.

3) MAIN RELIEF VALVE

Out of Service	Cause	Remedy
Pressure is not generated	· Poppet is open continuously, or there is contamination below the sheet	· Check for foreign substances between the parts each interlocked with the poppet. Components shall be moving freely.
Irregular pressure	· Pilot poppet sheet is damaged · Poppet is fixed	· Replace the relief valve. · Clean for free movement, and erase any flaws on the surface.
Incorrect setting pressure	· General abrasion. Locking nut and adjustment Screw loosened	· Refer to the main relief valve pressure setting method.
Oil leak	· Sheet is damaged. · O-ring is worn out. · Parts are fixed due to contamination.	· Replace the relief valve. · Install the seal and spring kit. · Disassemble and clean.

★ Pressure gauge must be installed on the line connected with the main relief valve.
Load must be applied to reach the set pressure of the main relief valve.
Afterwards, the following must be performed.

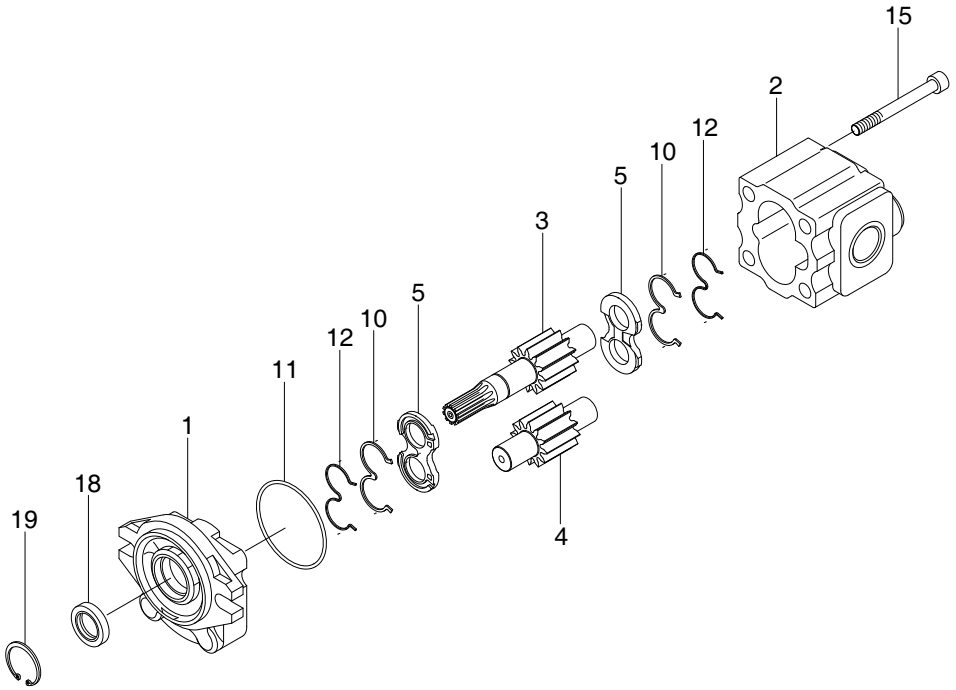
· Locking nut is released.
· Fix the adjusting nut in the preferred pressure setting.
· When the preferred pressure is not set, required shim must be added or removed.
· Fasten the locking nut.
· Perform the test again in the above method.

4) LIFT CYLINDER

Out of Service	Cause	Remedy
Oil leakage on the grand through the load	· Foreign substances on the packing · Stain that must not be on the load · Abnormal distortion of the dust seal · Chromium plating peeled off	· Replace packing · Use oil stone to enable smooth load surface. · Replace dust seal · Replace the rod
Oil leakage on the cylinder grand screw thread	· O-ring damaged	· Replace O-ring
Rod is contracted naturally	· Stain on the inner surface of the tube · Stain that must not exist on the surface inside the tube · Foreign substance on the piston seal	· Use oil stone to enable smooth load surface. · Replace the cylinder tube · Replace the piston seal
Abrasion (Clearance between the cylinder tube and abrasion ring)	· Excessive clearance between the cylinder tube and the abrasion ring	· Replace the abrasion ring
Abnormal noise on tilting	· Insufficient lubrication of the anchor pin or bushing or pin abrasion · Bent tilt cylinder rod	· Fill or replace lubricant · Replace

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 □ 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.

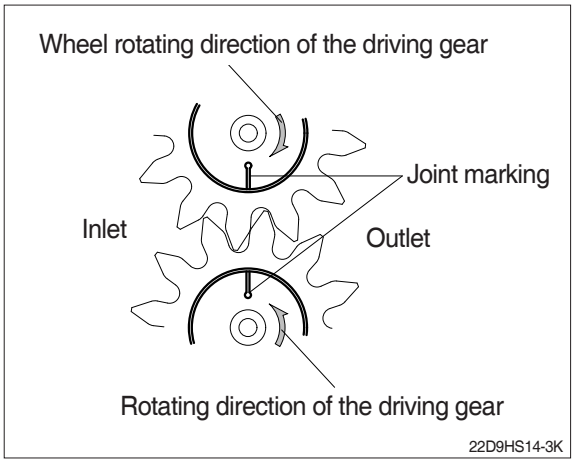
① Fix the front cover mounting part with a vice to enable the body side to be facing upwards.

② Mark the contact section of the front cover (1) and body (2) before the disassembly.

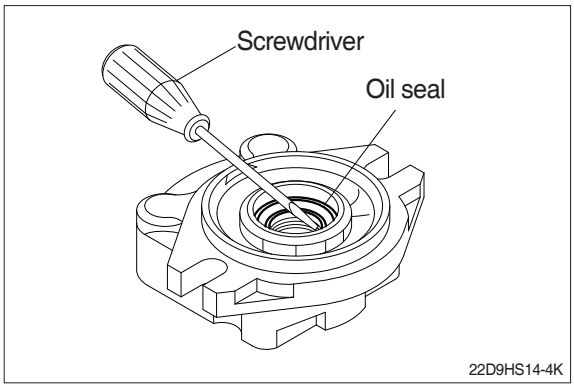
③ Loosen 4 bolts (15) and start the disassembly of the parts in order starting from the body. The following instructions shall be followed.

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

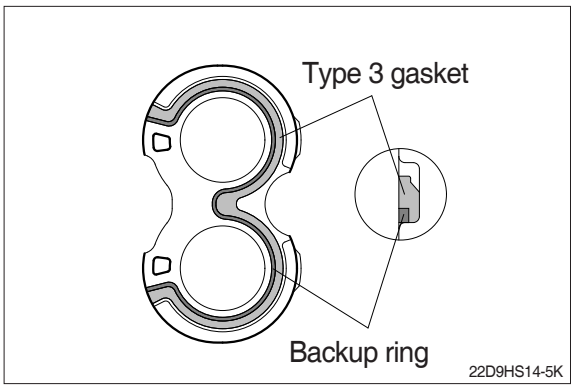
① These parts (10, 11, 12, 18, 19) are replaced with new parts.

② Each part must be removed with dust before the reassembly.

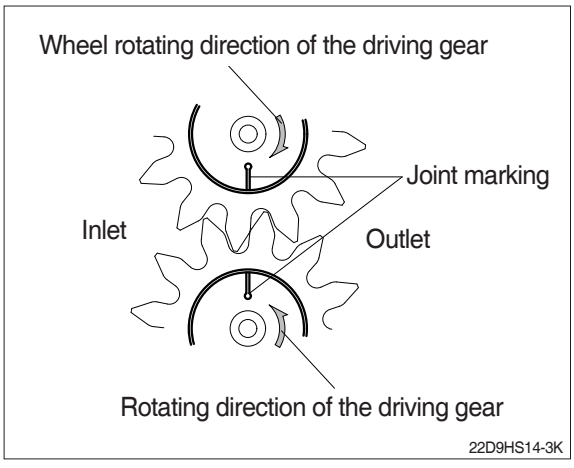
③ The body is placed on the work bench while the holes for the gear are facing upwards.

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.

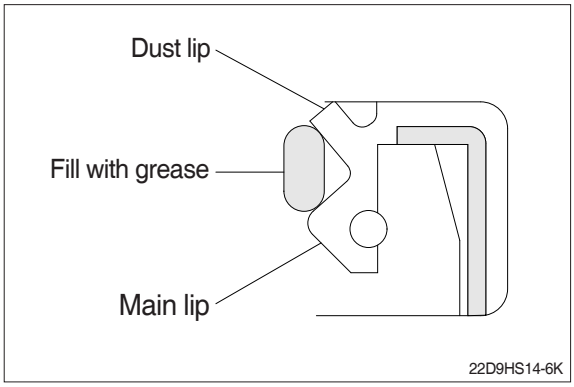


⑤ Turn the assembled pup to have the front cover facing down, and the mounting parts are fixed to the vice.

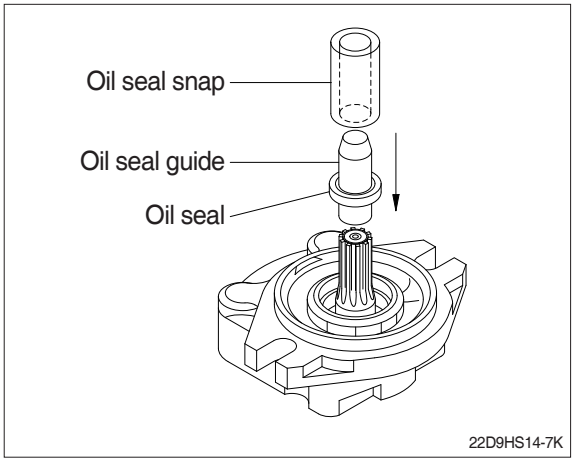
⑥ Fasten 4 bolts in 9.0~9.5 kgf·m torque.

⑦ Turn the assembled pump again to have the front cover facing up, and fix the body on the vice.

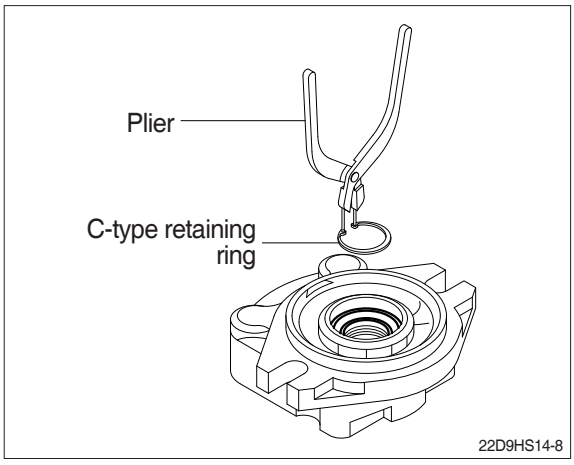
⑧ Fill with grease on the grooved part between the main lip and dust lip on the oil seal.



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. MAIN CONTROL VALVE

※ 4-spool, ISO type and non-application of the OPSS are used as the standard for description.

1) ASSEMBLY

(1) General

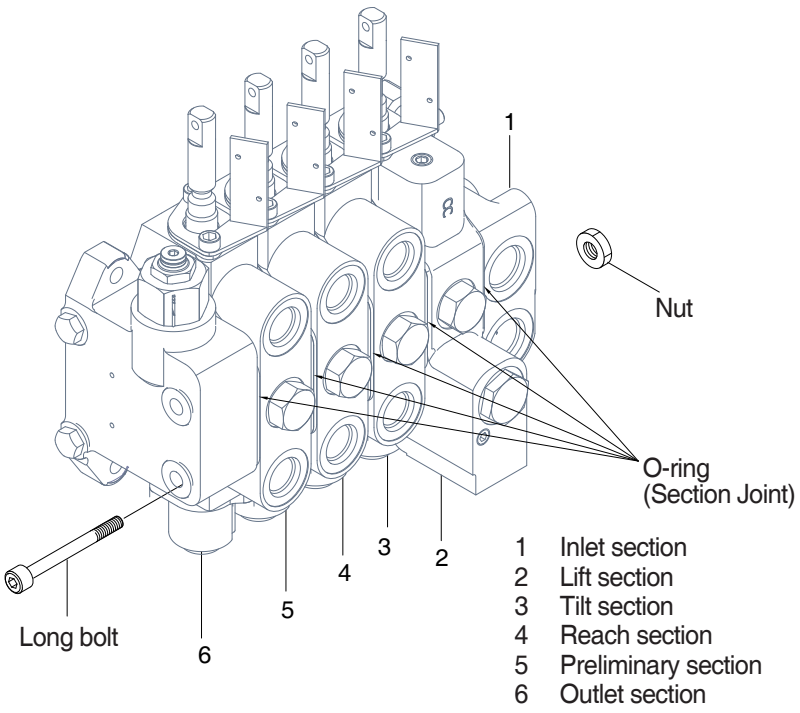
① The work space for assembly must be clean without any contamination.

② Flat working surface (Within 0.2 ㎜) is used for bolting with the valve section.

③ Calibrated torque wrench and instrument are used.

④ Refer to the component manual for the details of the components.

(2) Sub-block



15BRXHS30

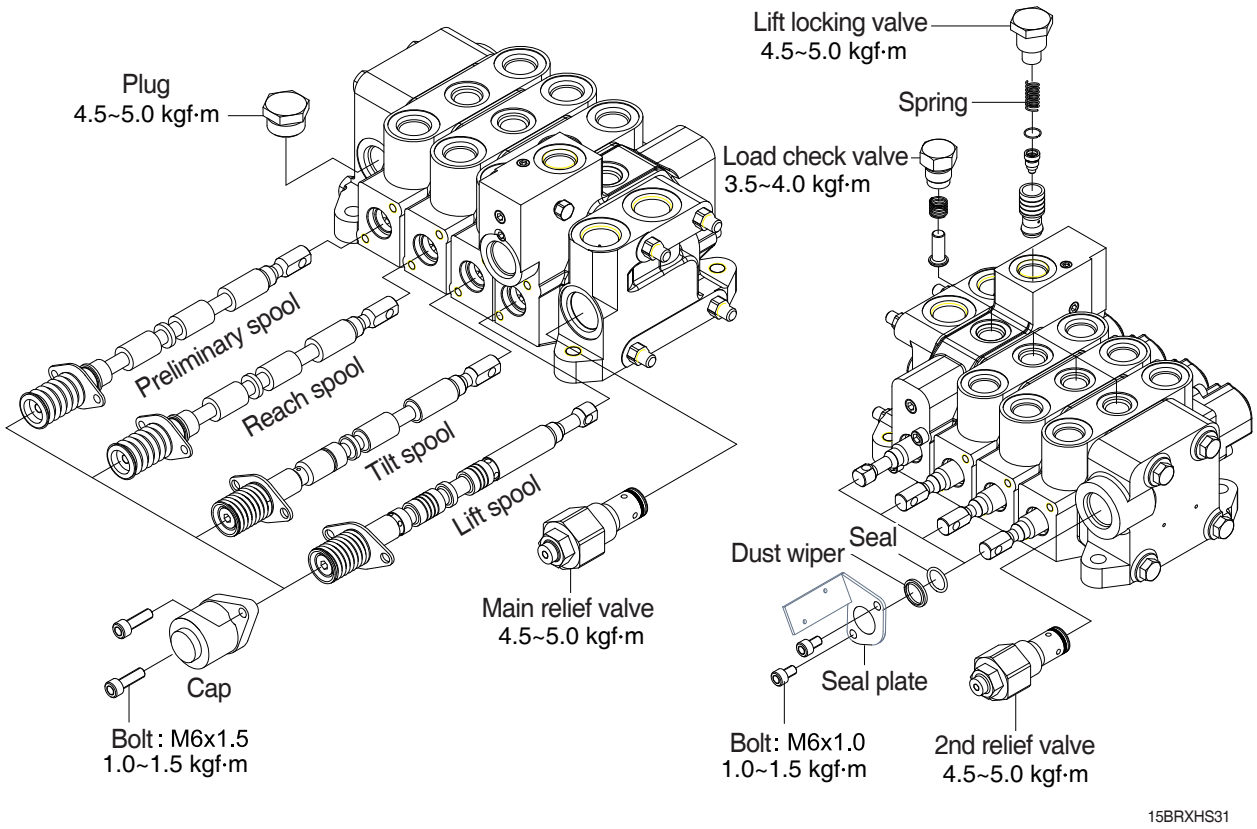
① All O-rings are assembled to the appropriate groove between the spool sections.

② All work ports must be facing up and spool ends must be in the same direction to place the valve section, and all sections are placed on the flat (Within 0.2 ㎜) surface.

③ Tie rod is inserted through the drill hole on each housing.

④ Caution is required on preventing the damage of the sealing surface or seal to press with the section.

⑤ Nut is inserted on all tie rod ends for fastening in the diagonal direction in 2.4~2.9 ㎏f·m torque. It is checked periodically whether the valve is maintained horizontally while the torque is applied.



(3) Inlet Section

① As shown in the figure, main relief valve is installed to the inlet section. Torque shall be 4.5~5.0 kgf·m.

② Install the plug on the tank port of the inlet section.
Torque shall be 4.5~5.0 kgf·m.

(4) Lift section

① The spool assembly is already configured with the lift spool, return spring, spring sheet on each end of the spring, seal plate, spool seal and dust wiper, and these are assembled on the end of the spool on the opposite side of the clevis. These are all assembled to the end of the spool on the opposite side of the clevis.

② Insert the clevis end of the spool on the right side of the spool bore (the longest side of the housing length). Arrange the spool cap on top of the spool and spring assembly, and connect the cap to the housing by using 2 bolts. Fasten in order on the both bolts in 1.0~1.5 kgf·m torque.

③ Install the dust wiper and secondary spool seal on the clevis end of the spool, and fix with the seal plate and two bolts. Fasten in order on the both bolts in 1.0~1.5 kgf·m torque.

④ Insert the rod check valve on the top center hole. Here, the torque is 3.5~4.0 kgf·m.

⑤ Lift lock check valve is installed on the remaining hole on the top of the housing. Torque shall be 4.5~5.0 kgf·m.

(5) Tilt section

① The spool assembly is already configured with the tilt spool (along with the tilt plunger and spring inserted on the hole on the end of the spring), return spring, spring sheet on each end of the spring, seal plate, spool seal and dust wiper, and these are assembled on the end of the spool on the opposite side of the clevis. These are all assembled to the end of the spool on the opposite side of the clevis.

② Insert the clevis end of the spool on the right side of the spool bore (the longest side of the housing length). Arrange the spool cap on top of the spool and spring assembly, and connect the cap to the housing by using 2 bolts. Fasten in order on the both bolts in 1.0~1.5 kgf·m torque.

③ Install the dust wiper and secondary spool seal on the clevis end of the spool, and fix with the seal plate and two bolts. Fasten in order on the both bolts in 1.0~1.5 kgf·m torque.

④ Insert the rod check valve on the top center hole.
Here, the torque is 3.5~4.0 kgf·m.

⑤ Anti-cavitation check valve is installed to the housing hole on the clevis end on top of the spool assembly. Torque shall be 4.5~5.0 kgf·m.

⑥ Plug is installed to the housing hole on the top of the spool assembly.
Here, the torque is 3.5~4.0 kgf·m.

(6) Reach section

※ Same procedure is applied to all auxiliary sections except for those with different configuration on the spool assembly.

① The spool assembly is already configured with the appropriate reach spool, return spring, spring sheet on each end of the spring, seal plate, spool seal and dust wiper, and these are assembled on the end of the spool on the opposite side of the clevis. These are all assembled to the end of the spool on the opposite side of the clevis.

② Insert the clevis end of the spool on the right side of the spool bore (the longest side of the housing length). Arrange the spool cap on top of the spool and spring assembly, and connect the cap to the housing by using 2 bolts. Fasten in order on the both bolts in 1.0~1.5 kgf·m torque.

③ Install the dust wiper and secondary spool seal on the clevis end of the spool, and fix with the seal plate and two bolts. Fasten in order on the both bolts in 1.0~1.5 kgf·m torque.

④ Insert the rod check valve on the top center hole.
Here, the torque is 3.5~4.0 kgf·m.

(7) Preliminary section

※ Same procedure is applied to all preliminary sections except for those with different configuration on the spool assembly.

① The spool assembly is already configured with the appropriate preliminary spool, return spring, spring sheet on each end of the spring, seal plate, spool seal and dust wiper, and these are assembled on the end of the spool on the opposite side of the clevis. These are all assembled to the end of the spool on the opposite side of the clevis.

② Insert the clevis end of the spool on the right side of the spool bore (the longest side of the housing length). Arrange the spool cap on top of the spool and spring assembly, and connect the cap to the housing by using 2 bolts. Fasten in order on the both bolts in 1.0~1.5 kgf·m torque.

③ Install the dust wiper and secondary spool seal on the clevis end of the spool, and fix with the seal plate and two bolts. Fasten in order on the both bolts in 1.0~1.5 kgf·m torque.

④ Insert the rod check valve on the top center hole.
Here, the torque is 3.5~4.0 kgf·m.

(8) Outlet section

① Secondary main relief valve is installed to the hole on the clevis end of the housing.
Torque shall be 4.5~5.0 kgf·m.

2) DISASSEMBLING

(1) General

① Sub (relief valve, check valve and spool) can be removed without loosening the tie rod and disassembling the overall valve.

② The valve section is disassembled on the flat work surface.

③ The work space for disassembly must be clean without any contamination.

④ The work space for disassembly must be maintained with the arranged state to prevent the loss or damage of the parts.

(2) Disassembly

① Loosen the tie rod nut to remove the tie rod from the valve section.

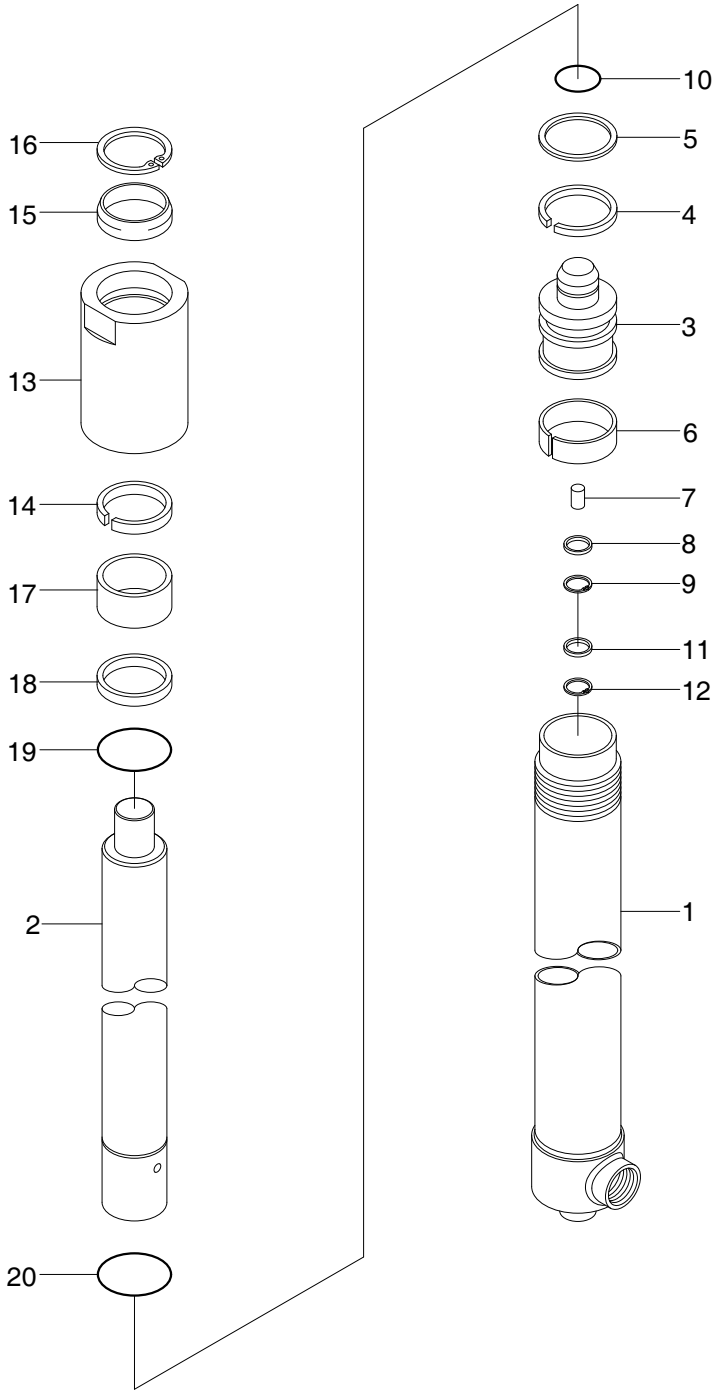
② Remove the O-ring between the valve sections to store separately to prevent damage.

③ Spool, relief valve, rod check valve, lift locking poppet, solenoid valve and plug can all be removed from the valve section. Refer to the relevant assembly procedure shown above for the specified torque and detailed handling method. As the overall unit, the assembly may require inspection, repair or replacement.

④ To prevent the damage on the precision parts, the valve components must be taken caution while handling or to prevent the contamination that can have adverse effect to the performance.

3. LIFT CYLINDER

1) STRUCTURE



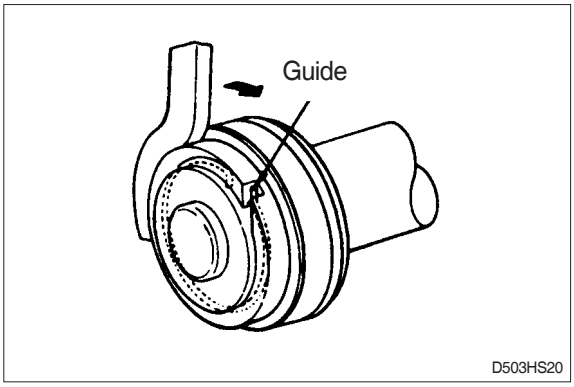
18BR9HS33

1	Tube	8	Spacer	15	Dust wiper
2	Rod	9	Retainer ring	16	Retainer ring
3	Piston	10	Stop ring	17	Rod bushing
4	U-Packing	11	Cushion seal	18	Spacer
5	Backup ring	12	Retainer ring	19	O-ring
6	Abrasion ring	13	Rod cover	20	Stop ring
7	Check valve	14	U-Packing		

※ Seal kit : 4, 5, 6, 14, 15, 19

2) DISASSEMBLING

(1) Hold cylinder tube in vice, and loosen and remove cylinder head.
Remove space from cylinder tube, and pull bushing out. Connect wrench to the hole of retainer at the end of piston, and turn the wrench. Lift the edge of guide and turn guide to move guide.



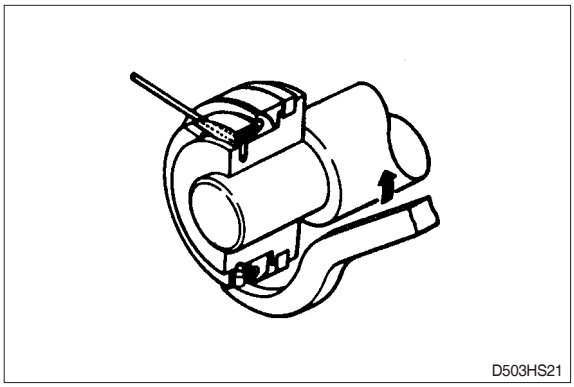
3) INSPECTION AND TEST

mm

Inspection items	Standard dimensions	Limit on repair	Remedy
Clearance between the cylinder rod and bushing	0.072 - 0.288	0.5	Replacing bushing
Clearance between the piston ring and the tube	0.05 - 0.030	0.5	Replace the piston ring

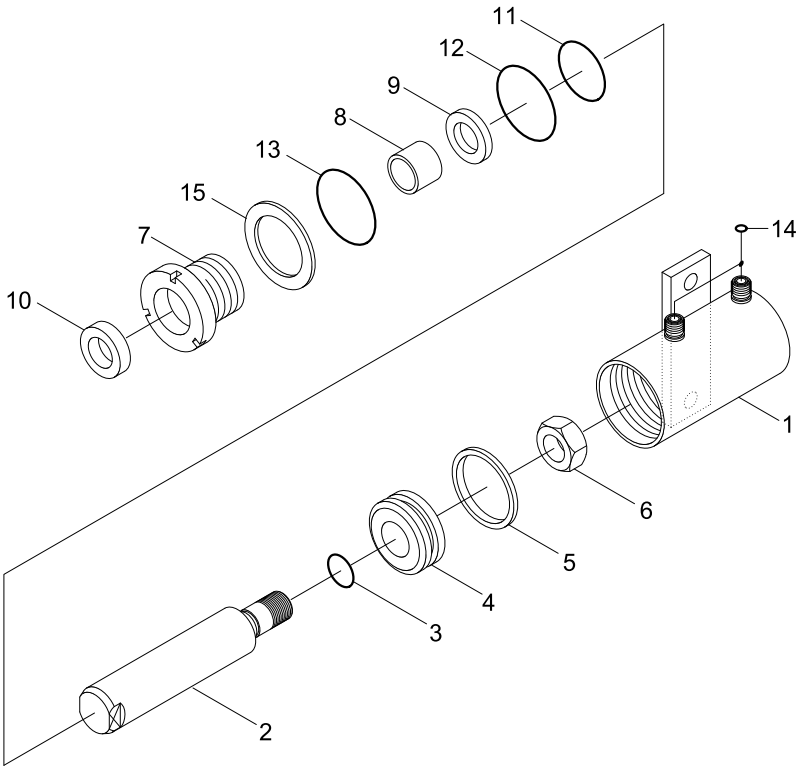
4) ASSEMBLING

(1) Put piston ring in hydraulic oil of 40-50˚C, and expand inner diameter of the ring, and assemble it on piston.
Assemble the piston seal.
Bend and turn the edge of guide to install completely.



4. TILT CYLINDER

1) STRUCTURE



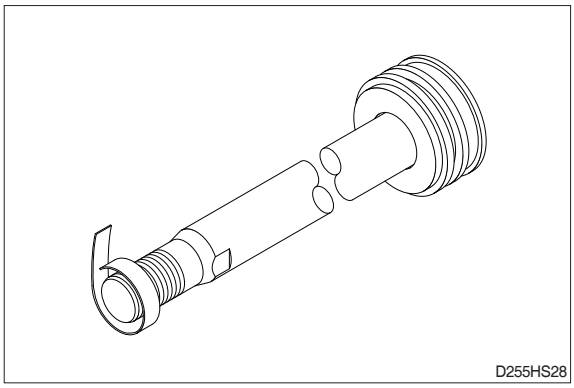
15BRXHS24

1	Tube	6	Nut	11	O-ring
2	Rod	7	Gland	12	O-ring
3	O-ring	8	DU Bushing	13	O-ring
4	Piston	9	Dust wiper	14	O-ring
5	Piston seal	10	Dust wiper	15	Washer

※ **Seal kit : 3, 5, 9, 10, 11, 12**

2) DISASSEMBLING

(1) Hold flat area on the bottom of cylinder tube in vice, mark fastening torque on the end of rod head, and then separate rod head. Hook wrench on the notch of cylinder head, and then separate cylinder head from cylinder tube.
Wind valleys of thread of rod with adhesive tape to protect dust seal and rod seal inside cylinder head from damage.



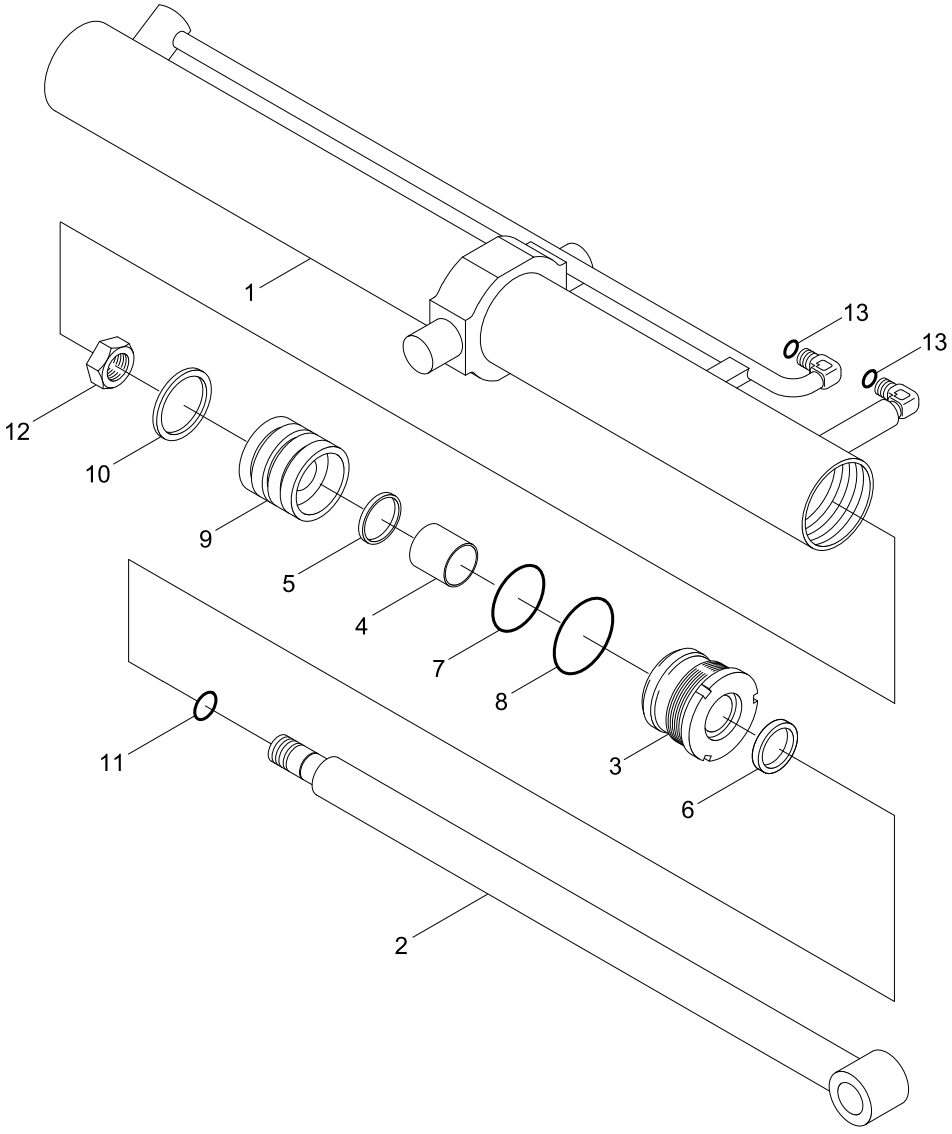
3) INSPECTION AND TEST

mm

Inspection items	Standard dimensions	Limit on repair	Remedy
Clearance between the cylinder rod and the bushing	0.072 - 0.288	0.5	Replacing bushing
Gap between rod head bushing and pin	0.10 - 0.35	0.6	Replacing bushing

5. REACH CYLINDER

1) STRUCTURE



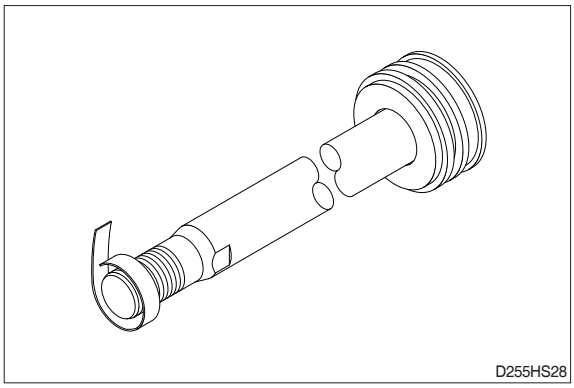
15BRXHS26

1	Tube	6	Dust wiper	11	O-ring
2	Rod	7	O-ring	12	Nylon nut
3	Rod cover	8	O-ring	13	O-ring
4	Pin bushing	9	Piston		
5	Packing	10	Piston seal		

※ **Seal kit : 5, 6, 7, 8, 10, 11**

2) DISASSEMBLING

(1) Hold flat area on the bottom of cylinder tube in vice, mark fastening torque on the end of rod head, and then separate rod head. Hook wrench on the notch of cylinder head, and then separate cylinder head from cylinder tube.
Wind valleys of thread of rod with adhesive tape to protect dust seal and rod seal inside cylinder head from damage.



3) INSPECTION AND TEST

mm

Inspection items	Standard dimensions	Limit on repair	Remedy
Clearance between the cylinder rod and the bushing	0.072 - 0.288	0.5	Replacing bushing
Gap between rod head bushing and pin	0.10 - 0.35	0.6	Replacing bushing