

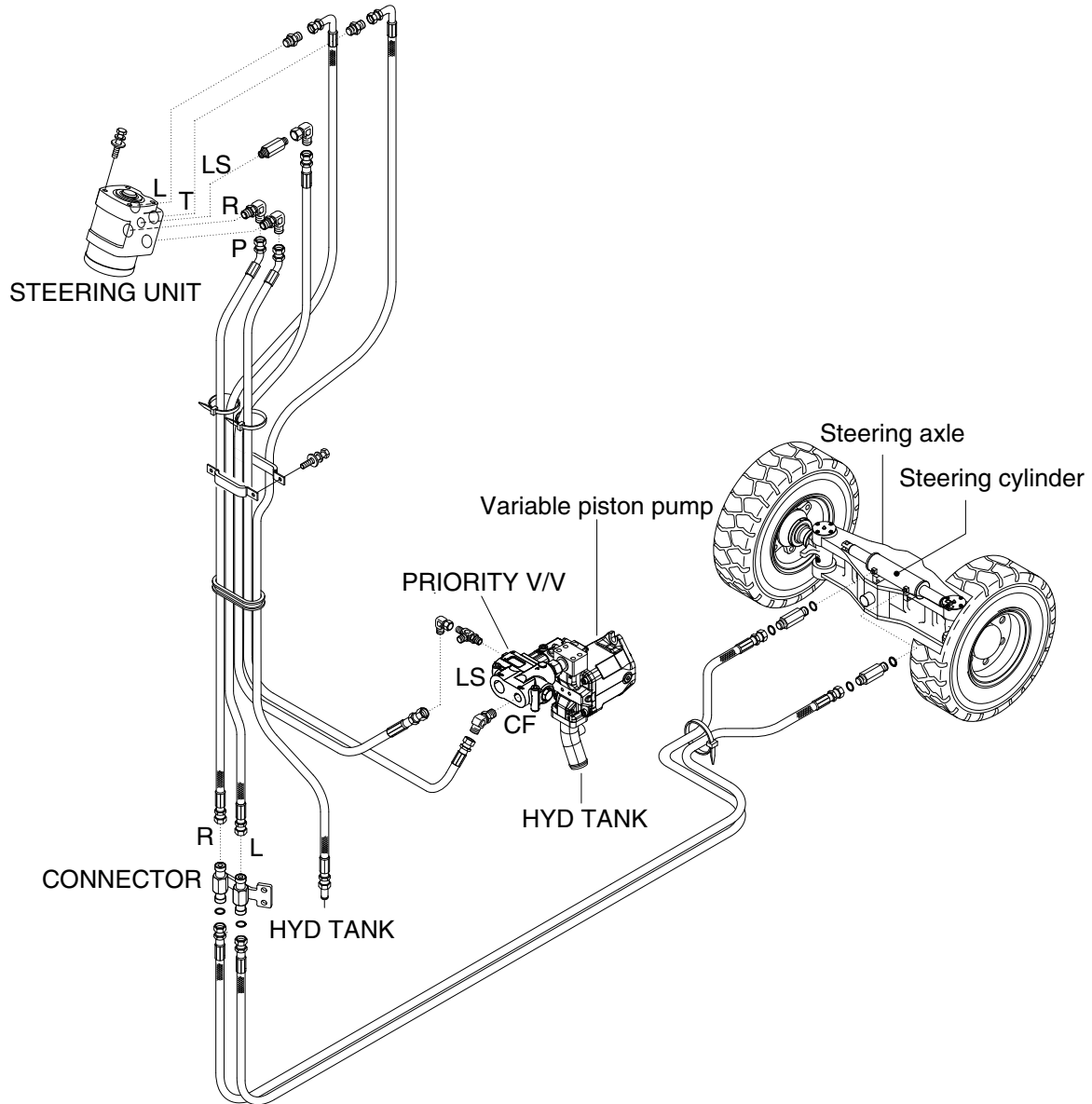
## SECTION 5 STEERING SYSTEM

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# SECTION 5 STEERING SYSTEM

## GROUP 1 STRUCTURE AND FUNCTION

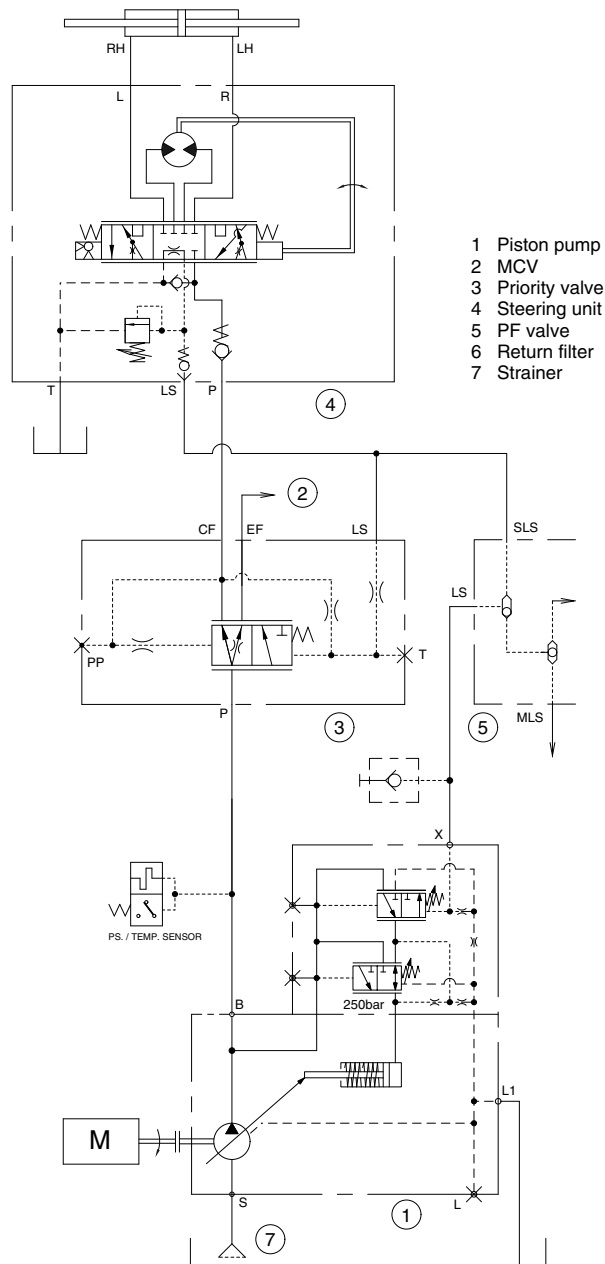
### 1. OUTLINE



35D9VB5SS72

The steering system for this truck is composed of main pump, steering wheel assembly, steering unit, priority valve, steering cylinders, steering axle and piping. The steering axle supports the forklift weight with the rear axle, contains a cylinder and controls the position of the rear tires. The steering axle body is unit structure having steering knuckles installed to its both ends by means of king pins. Hub and wheel are mounted through bearing to spindle of knuckle. When the steering wheel is turned, the rotation torque is transmitted to the steering unit, and the hydraulic oil in the steering unit is transmitted to the steering axle hydraulic cylinder through the hose, so that the forklift moves left and right. The force produced by the steering cylinders moves the knuckle of rear tires through the intermediate link. Refer to the illustration for the location of the steering system components.

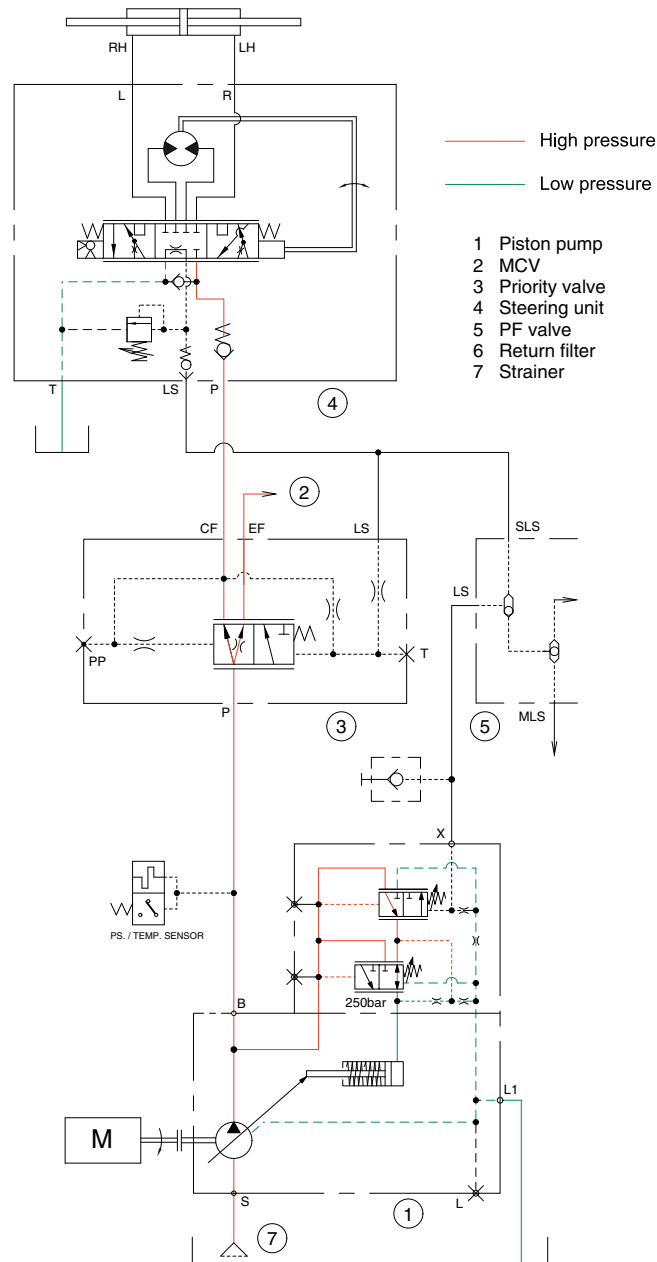
## 2. HYDRAULIC CIRCUIT



35D9VB5SS67

The hydraulic oil discharged from the variable displacement pump (1) flows to the priority valve (2). When the driver operates the steering wheel, the steering unit (3) is supplied with pressure oil preferentially by the priority valve operation circuit. The oil passages in the steering unit are changed over to direct the hydraulic pressure from the priority valve to the steering cylinder, which extends or contracts depending on the hydraulic pressure, thereby steering the truck. The excess flow of the pump generated at this time flows to the MCV and the tank through the priority valve EF flow path.

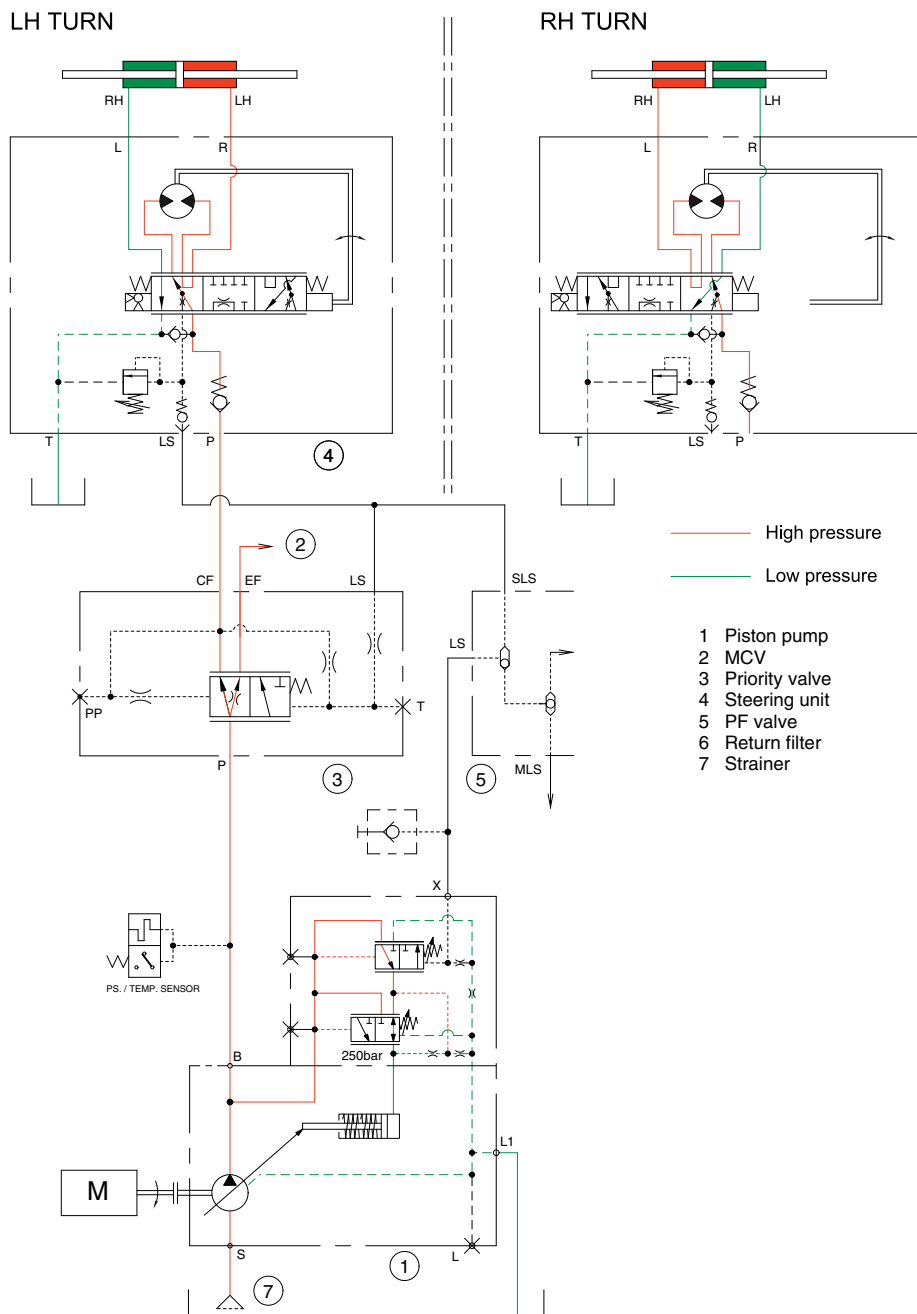
# 1) NEUTRAL



35D9VB5SS73

When the engine is running and the steering wheel is not being turned, the steering unit spool and sleeve set are aligned (neutral position). Oil flow through the valve is blocked from entering the left or right steering ports. The pressure on the pilot side (PP) of the priority valve spool controls the spool to move in the opposite direction (spring direction). This movement causes the pump discharge flow to flow to the MCV through the EF passage. In this neutral position, a small amount of oil is constantly bled through the dynamic orifice. The oil then flows into the LS hose piping and returns to the tank through the steering unit spool and sleeve set. This dynamic flow prevents initial hard spot when steering is turned rapidly or abruptly.

## 2) LEFT OR RIGHT TURN

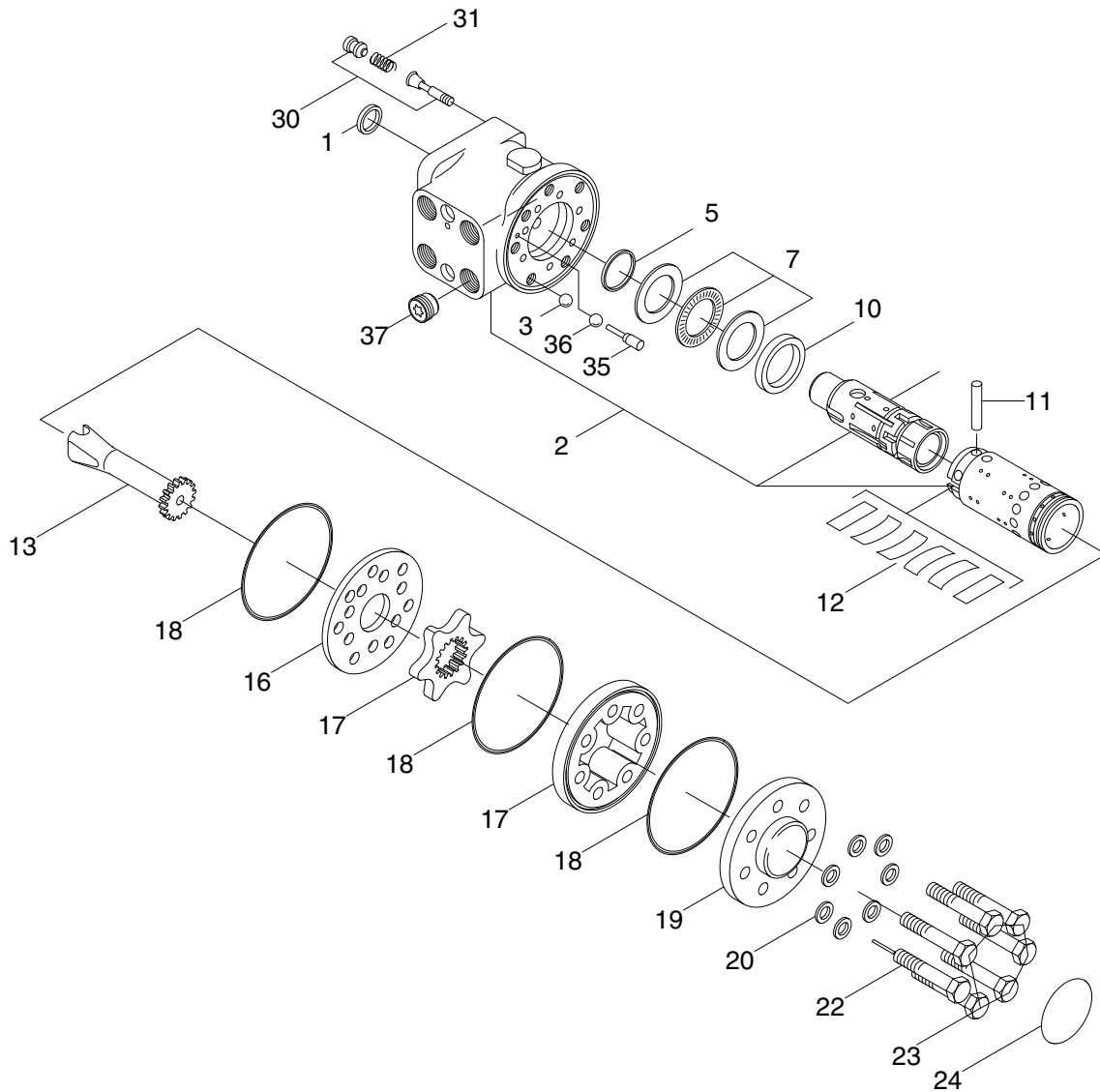


35D9VBSS75

When the engine is running and the steering wheel is being turned, the steering unit spool and sleeve set rotates. The passage opens to allow oil to flow into the internal gerotor gear of the steering unit. The oil flow causes the gerotor pump to rotate. Oil flows back into the steering valve spool and sleeve set and out to the left or right steering ports depending on the direction of steering wheel rotation. At the same time, the LS circuit blocks the return to the hydraulic tank and is connected to the CF port to sense the pressure required to turn the steering wheel. As the required pressure increases or decreases in the LS circuit, the priority valve spool moves to meet the flow and pressure required to rotate the tire. When the steering cylinder reaches the end of the stroke, a relief valve in the steering circuit releases LS pressure into the hydraulic tank. The priority valve spool moves and directs the pump flow through the EF passage to the MCV.

### 3. STEERING UNIT

#### 1) STRUCTURE

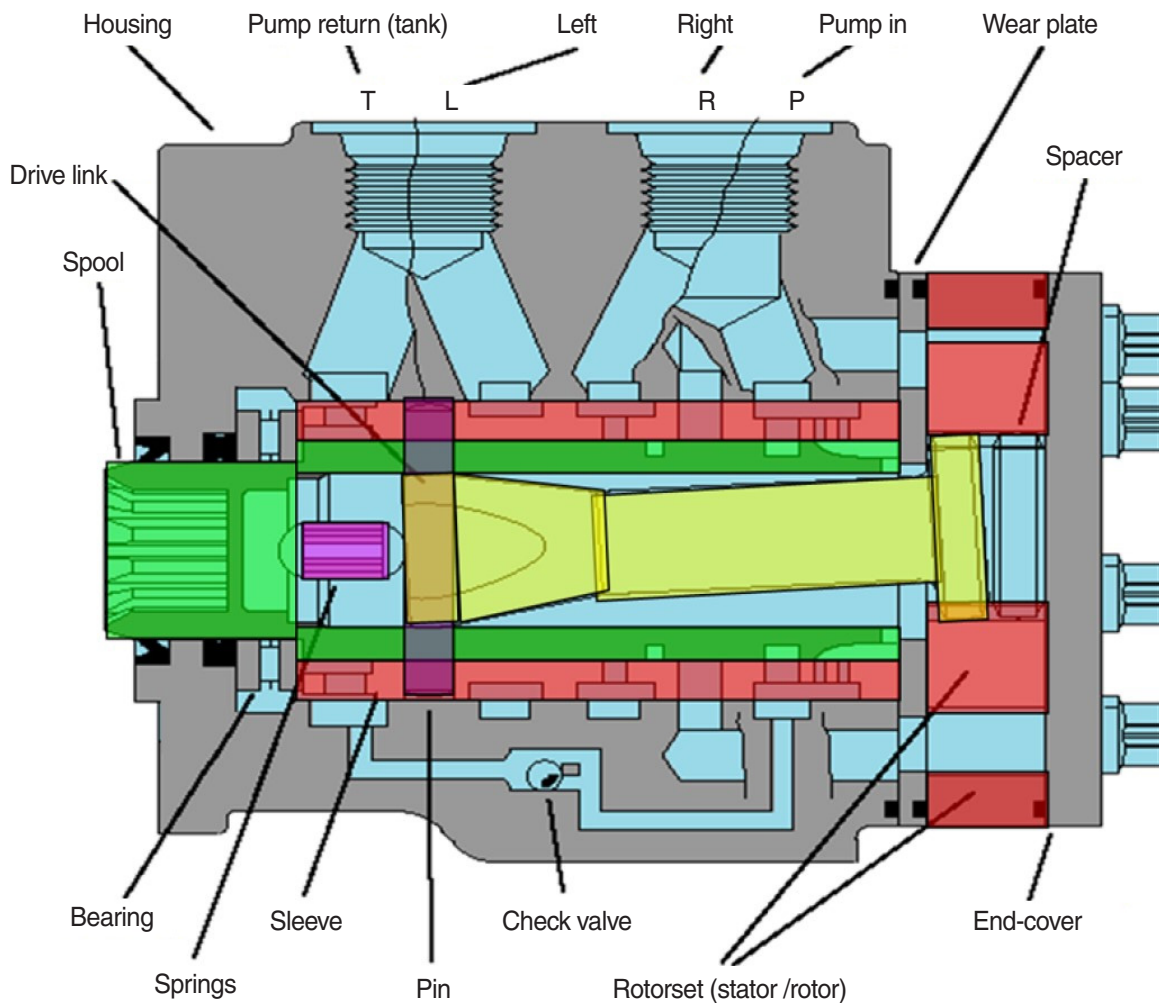


35D9VB5SS74

- |    |                          |    |                   |    |                                 |
|----|--------------------------|----|-------------------|----|---------------------------------|
| 1  | Dust seal ring           | 13 | Cardan shaft      | 24 | Model / Code label              |
| 2  | Housing and spool/sleeve | 16 | Distributor plate | 30 | Relief valve                    |
| 3  | Ball                     | 17 | Gearwheel set     | 31 | Spring for relief valve         |
| 5  | Shaft seal               | 18 | O-ring            | 35 | Ball stop threaded for LS Check |
| 7  | Bearing assy             | 19 | End cover         | 36 | Ball Ø3 for is check            |
| 10 | Ring                     | 20 | Washer            | 37 | Check valve                     |
| 11 | Cross pin                | 22 | Pin bolt screw    |    |                                 |
| 12 | Set of springs           | 23 | Screw             |    |                                 |

※ Seal kit : 1, 5, 18, 20

## 2) OPERATION

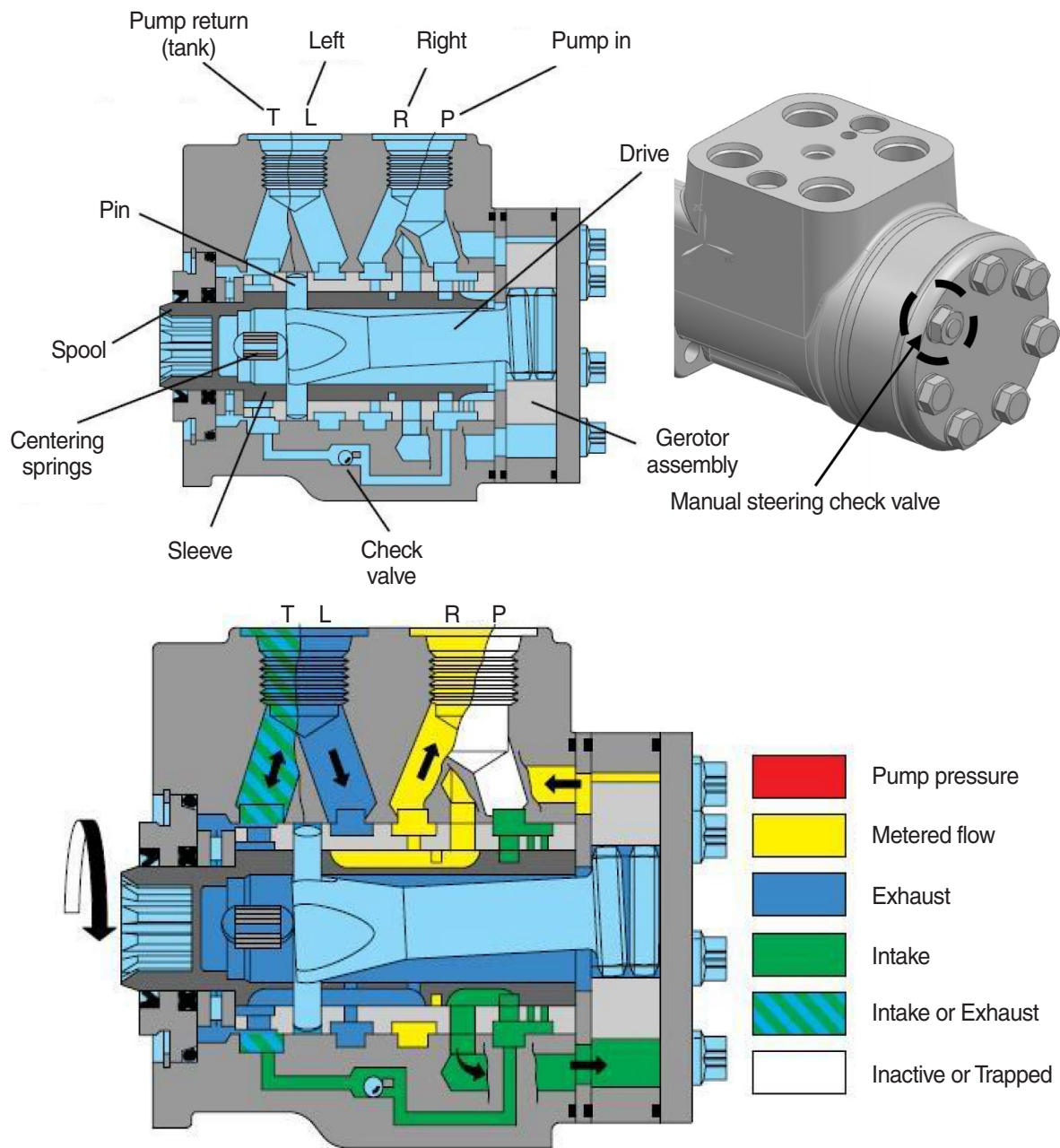


35D9VB5SS76

The steering unit is a closed center circuit and consists of a rotary valve (spool + sleeve set) and a metering gear set. With a LS (load sensing) dynamic circuit, even when the viscosity of the oil is low in winter, it operates smoothly without jamming the steering wheel and reduces the impact of the steering wheel due to rapid rotation or kickback of the tire. The LS circuit in the valve is used to control the operation of the priority valve spool. Steering relief valve oil flows through an internal flow path to the tank return line. The relief valve is set lower than the AUX relief valve set pressure in the MCV.

- Manual steering check valve : converts unit to hand operated pump for limited manual steering.
- Inlet check valve (P port) : Prevents oil from returning through the steering unit when pressure on the cylinder side is greater than pressure on the inlet side to prevent steering wheel kick.
- LS relief valve : Limits maximum pressure in the steering circuit.

### 3) MANUAL STEERING (EMERGENCY)



35D9VBSS77

When the engine is not running and the steering wheel is being turned, the priority divider valve spool is pushed against the end stop by spring force. In this position, oil flow opens to the spool and sleeve set and the EF port closes. As the steering wheel turns, a vacuum is created in the supply line between the priority valve and the steering unit spool and sleeve set. As the spool and sleeve set rotates, a passage opens to allow oil to flow to the inner gerotor gear set of the steering unit. Oil trapped in the steering port passes through the manual steering check valve and feeds through the gerotor gear to the opposite side of the steering cylinder, enabling manual steering.



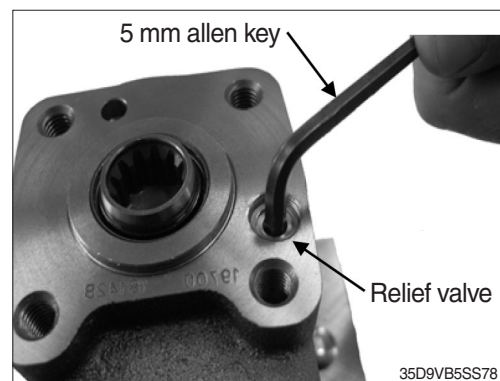
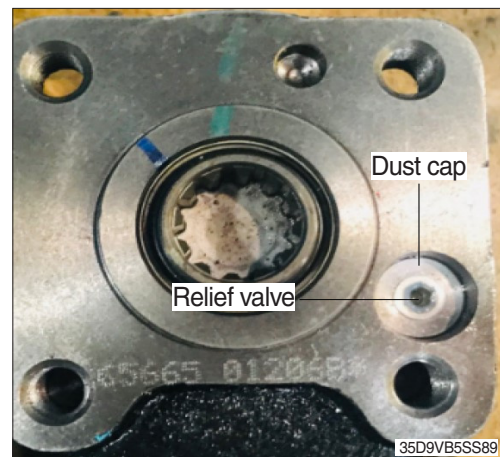
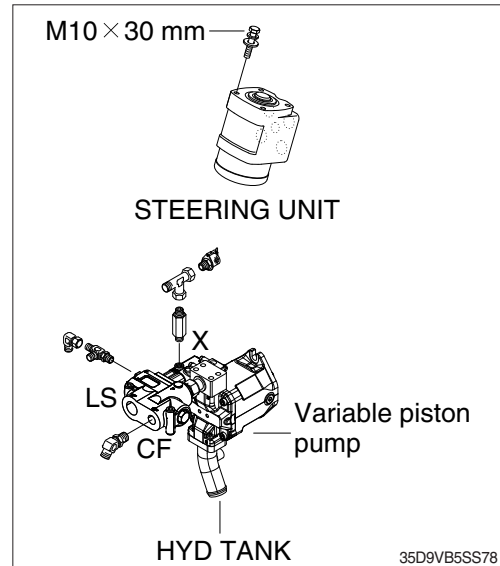
## 4) RELIEF VALVE PRESSURE TEST AND ADJUSTMENT

### (1) Test specification

- Engine speed : low idle rpm
- Oil temperature :  $50 \pm 5 \text{ }^\circ\text{C}$  ( $122 \pm 9 \text{ }^\circ\text{F}$ )
- Steering relief set pressure : 135 ~ 140 bar (1958 ~ 2031 psi)

### (2) Pressure test and adjustment

- ① Operate hydraulic system until the oil temperature is within test specification. See Hydraulic warmup procedure.
  - ② Lower the fork to the ground, stop the engine, and apply the parking brake switch.
  - ③ Loose the steering unit mounting bolts for removal front column covers and the floor panel.
    - Tightening torque :  $4 \pm 0.5 \text{ kgf}\cdot\text{m}$   
( $28.9 \pm 3.6 \text{ lbf}\cdot\text{ft}$ )
  - ④ Connect pressure gauge to "X" pressure check port of variable pump as shown the illustration.
  - ⑤ Operate engine at test specifications.
  - ⑥ Turn the steering wheel all the way to a stop and hold it there.
  - ⑦ Check pressure gauge reading. Compare the readings and specifications.
  - ⑧ Remove the steering unit. Remove the dust cap and loosen the relief valve plug and turn the adjusting screw to adjust the pressure.
    - Tightening torque :  $0.6 \pm 0.1 \text{ kgf}\cdot\text{m}$   
( $4.4 \pm 0.7 \text{ lbf}\cdot\text{ft}$ )
    - If pressure is lower than specification, turn relief valve adjusting screw clockwise.
    - If the pressure is higher than the specification, turn the adjusting screw counterclockwise.
  - ⑨ Repeat Step ⑦, ⑧. If pressure is to specifications, remove test equipment.
- △ Do not permit dirt or other contaminants to enter the hydraulic system. Disconnected hoses, tubes, open valves, cylinder fittings, and ports should be protected with clean caps or plugs.



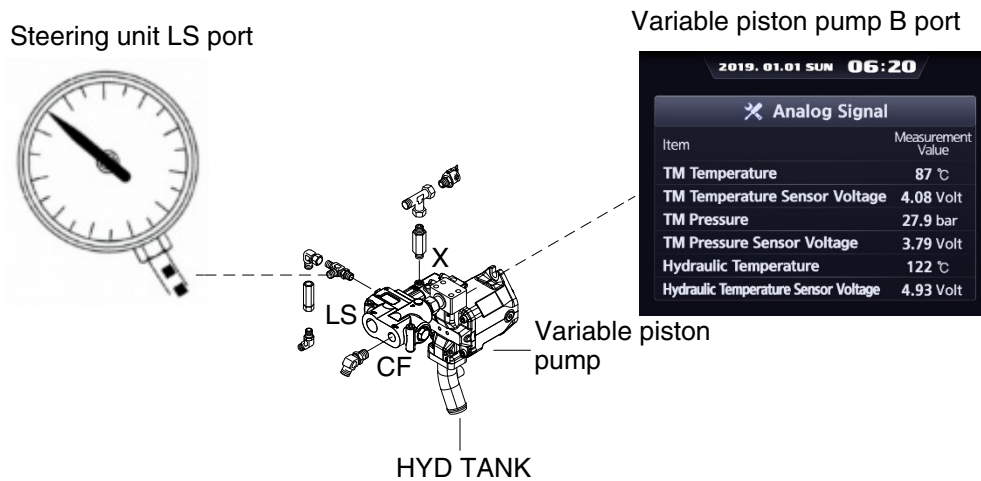
## 5) LS PRESSURE TEST OR STEERING SYSTEM

This test checks if LS (Load-Sense) pressure is correct to operate the priority valve spool functions of the steering system. The margin pressure is required to control priority valve spool movement, which controls priority oil to steering and excess flow (EF) to the MCV. The margin pressure is the pump pressure (B) minus the LS pressure (X).

### (1) Test specification

- Engine speed : low idle rpm
- Oil temperature :  $50 \pm 5 \text{ }^\circ\text{C}$  ( $122 \pm 9 \text{ }^\circ\text{F}$ )
- Margin pressure :  $22 \pm 1 \text{ bar}$  ( $320 \pm 14.5 \text{ psi}$ )

### (2) Pressure test

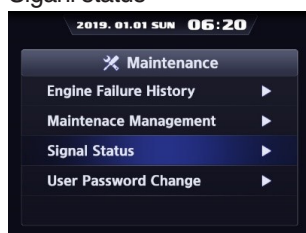


35D9VB5SS88

- ① Operate hydraulic system until the oil temperature is within test specification. See hydraulic warmup procedure.
- ② Lower the fork to the ground, stop the engine, and apply the parking brake switch.
- ③ Remove floor panel.
- ④ Connect pressure gauge to LS port of steering unit as shown the illustration. For pump B pressure check port you can check it in the analog signal value item in the cluster menu.
- ⑤ Operate engine at test specifications.
- ⑥ Measure the pump B port pressure and then check the margin pressure by measuring the steering unit LS port pressure.
  - Margin pressure (Pump B - Steering unit LS) :  $22 \pm 1 \text{ bar}$  ( $320 \pm 14.5 \text{ psi}$ )
- ⑦ If the LS pressure is out of specifications, remove the priority valve LS plug. Inspect and clean LS orifices.
- ⑧ If pressure is to specifications, remove test equipment.

※ **Cluster menu : Maintenance → Password enter → Signal status → Analog signal**

Signal status



35D9VB3KY138

Analog signal



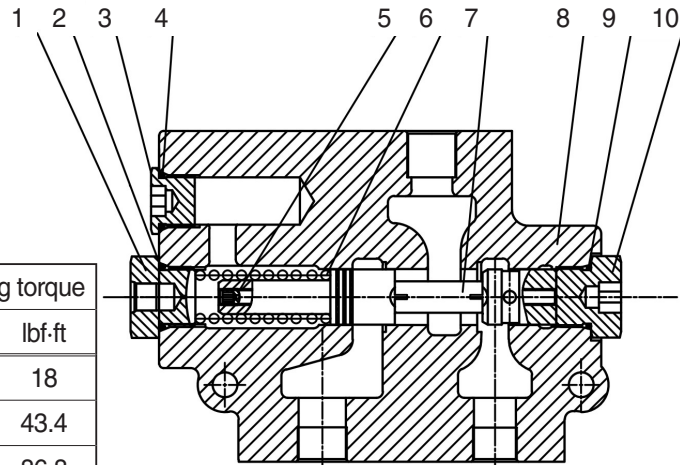
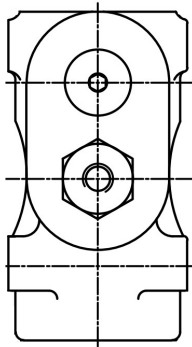
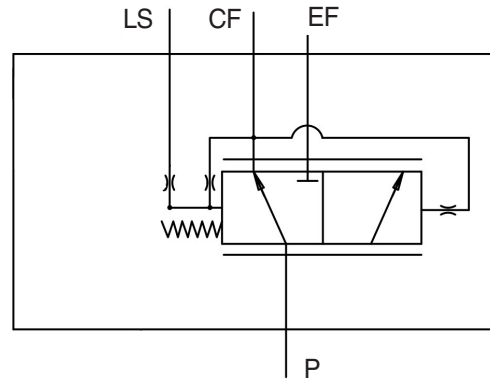
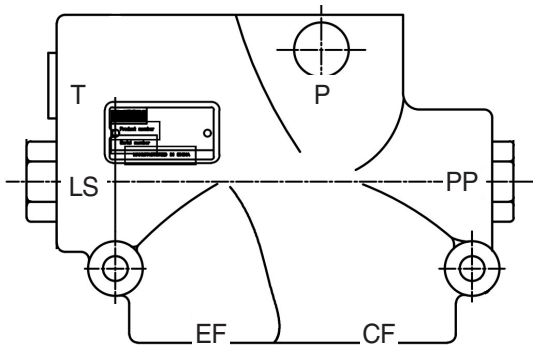
35D9VB3KY139

Analog signal list



35D9VB3KY140

#### 4. PRIORITY VALVE



Port	Port size	Tightening torque	
		kgf-m	lbf-ft
LS	7/16-20UNF	2.5	18
CF	3/4-16 UNF	6	43.4
P, EF	1-1/16-12 UN	12	86.8

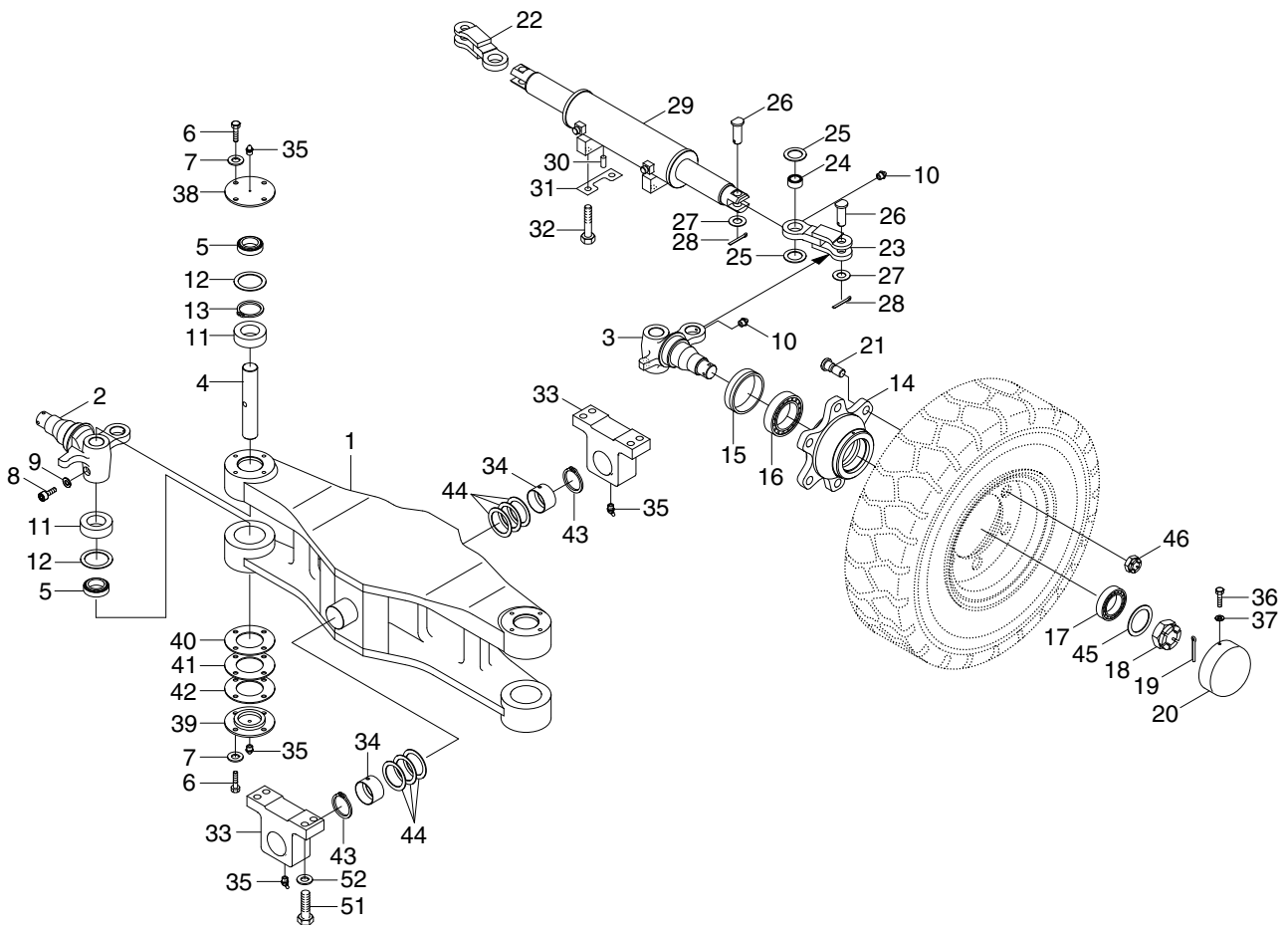
35D9VB5SS79

- |          |                      |          |
|----------|----------------------|----------|
| 1 Plug   | 5 Throttle           | 9 O-ring |
| 2 O-ring | 6 Spring compression | 10 Plug  |
| 3 Plug   | 7 Spool              |          |
| 4 O-ring | 8 Housing            |          |

The priority valve is located on the top of the pump and is influenced by the LS signal from the steering unit to ensure that the steering circuit receives sufficient feed. This valve always keeps the steering force and speed constant against changes in the pump discharge flow rate, and gives priority to hydraulic oil to the steering circuit.

## 5. STEERING AXLE

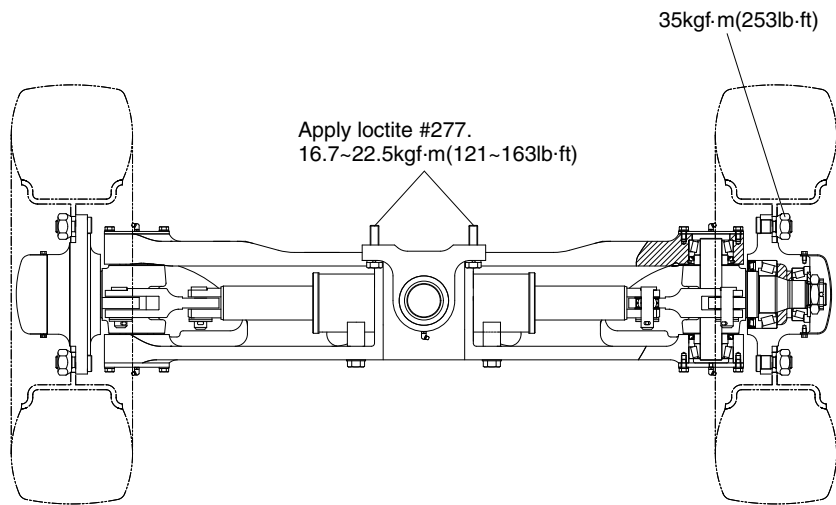
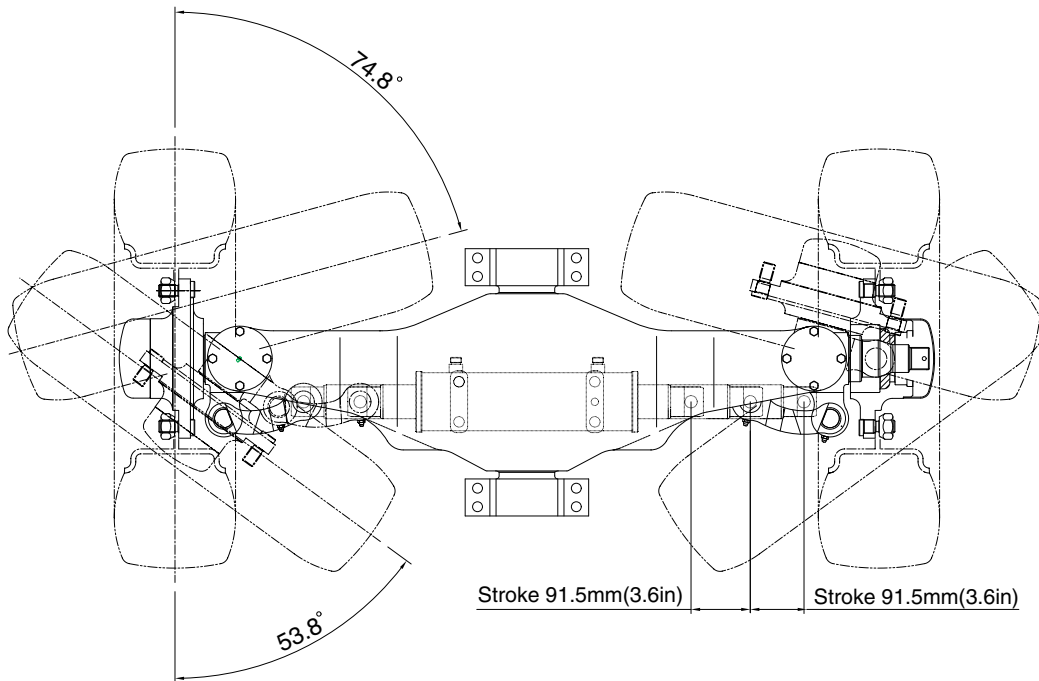
### 1) STRUCTURE



35D9SSE06

1	Axle center	13	Retaining ring	25	Thrust washer	37	Spring washer
2	Knuckle-RH	14	Hub	26	Clevis pin	38	Upper cover
3	Knuckle-LH	15	Oil seal	27	Plain washer	39	Lower cover
4	King pin	16	Taper roller bearing	28	Split pin	40	Shim (0.1t)
5	Taper roller bearing	17	Taper roller bearing	29	Steering cylinder	41	Shim (0.15t)
6	Hexagon bolt	18	Slotted nut	30	Pin	42	Shim (0.3t)
7	Spring washer	19	Split pin	31	Lock plate	43	Retaining ring
8	Special bolt	20	Hub cap	32	Hexagon bolt	44	Shim (0.5t)
9	Spring washer	21	Serration bolt	33	Support	45	Plain washer
10	Grease nipple	22	Link-RH	34	Bushing	46	Hub nut
11	Collar	23	Link-LH	35	Grease nipple	51	Hexagon bolt
12	Oil seal	24	SPH plain bearing	36	Hexagon bolt	52	Spring washer

## 2) GREASING AND SPECIFICATION

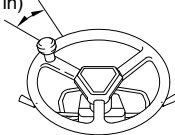


36DS7SE07

Type	Unit	Center pin support single shaft
Structure of knuckle	-	Elliott type
Toe-in	degree	0
Camber	degree	0
Caster	degree	0
King pin angle	degree	0
Max steering angle of wheels(Inside/Outside)	degree	74.8/53.8
Tread	mm (ft-in)	1140 (3' 9")

## GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

### 1. OPERATIONAL CHECKS

Check item	Checking procedure								
Steering wheel 30-60mm (1.2-2.4 in) 	<ul style="list-style-type: none"> <li>· Set rear wheels facing straight forward, then turn steering wheel to left and right. Measure range of steering wheel movement before rear wheel starts to move. Range should be 30~60 mm at rim of steering wheel. If play is too large, adjust at gear box.</li> <li>· Test steering wheel play with engine at idling.</li> </ul>								
Knuckle	<ul style="list-style-type: none"> <li>· Check knuckle visually or use crack detection method. If the knuckle is bent, the tire wear is uneven, so check tire wear.</li> </ul>								
Steering axle	<ul style="list-style-type: none"> <li>· Put camber gauge in contact with hub and measure camber. If camber is not within <math>0 \pm 0.5^\circ</math>; rear axle is bent.</li> <li>· Ask assistant to drive truck at minimum turning radius.</li> <li>· Fit bar and a piece of chalk at outside edge of counterweight to mark line of turning radius.</li> <li>· If minimum turning radius is not within <math>\pm 100</math> mm (<math>\pm 4</math> in) of specified value, adjust turning angle stopper bolt. Min turning radius (Outside)</li> </ul> <table border="1" style="width: 100%; border-collapse: collapse; margin-top: 10px;"> <tbody> <tr> <td style="padding: 2px;">35D-9VB, 40D-VC</td> <td style="padding: 2px;">2895 mm (114 in)</td> <td style="padding: 2px;">45D-9VB, 50DN-9VC</td> <td style="padding: 2px;">3038 mm (120 in)</td> </tr> <tr> <td style="padding: 2px;">40D-9VB, 45D-VC</td> <td style="padding: 2px;">2944 mm (116 in)</td> <td style="padding: 2px;">50DN-9VB</td> <td style="padding: 2px;">3081 mm (121 in)</td> </tr> </tbody> </table>	35D-9VB, 40D-VC	2895 mm (114 in)	45D-9VB, 50DN-9VC	3038 mm (120 in)	40D-9VB, 45D-VC	2944 mm (116 in)	50DN-9VB	3081 mm (121 in)
35D-9VB, 40D-VC	2895 mm (114 in)	45D-9VB, 50DN-9VC	3038 mm (120 in)						
40D-9VB, 45D-VC	2944 mm (116 in)	50DN-9VB	3081 mm (121 in)						
Hydraulic pressure of power steering	Remove screw coupling from X port of pump and install oil pressure gauge. Turn steering wheel fully and check oil pressure. ※ Oil pressure : 135 bar (1960 psi)								

### 2. TROUBLESHOOTING

#### 1) STEERING UNIT

Problem	cause	Remedy
Steering wheel drags.	<ul style="list-style-type: none"> <li>· Low oil pressure.</li> <li>· Bearing faulty.</li> <li>· Spring spool faulty.</li> <li>· Reaction plunger faulty.</li> <li>· Ball-and-screw assembly faulty.</li> <li>· Sector shaft adjusting screw excessively tight.</li> <li>· Gears poorly meshing.</li> <li>· Flow divider coil spring fatigued.</li> </ul>	<ul style="list-style-type: none"> <li>· Check lockout. Repair.</li> <li>· Clean or replace.</li> <li>· Clean or replace.</li> <li>· Replace.</li> <li>· Clean or replace.</li> <li>· Adjust.</li> <li>· Check and correct meshing.</li> <li>· Replace.</li> </ul>
Steering wheel fails to return smoothly.	<ul style="list-style-type: none"> <li>· Bearing faulty.</li> <li>· Reaction plunger faulty.</li> <li>· Ball-and-screw assy faulty</li> <li>· Gears poorly meshing.</li> </ul>	<ul style="list-style-type: none"> <li>· Clean or replace.</li> <li>· Replace.</li> <li>· Clean or replace.</li> <li>· Check and correct meshing.</li> </ul>

Problem	cause	Remedy
Steering wheel turns unsteadily. Steering system makes abnormal sound or vibration.	<ul style="list-style-type: none"> <li>· Lockout loosening.</li> <li>· Metal spring deteriorated.</li> <li>· Gear backlash out of adjustment.</li> <li>· Lockout loosening.</li> <li>· Air in oil circuit.</li> </ul>	<ul style="list-style-type: none"> <li>· Retighten.</li> <li>· Replace.</li> <li>· Adjust.</li> <li>· Retighten.</li> <li>· Bleed air.</li> </ul>
Abnormal sound heard when steering wheel is turned fully	<p>Valve</p> <ul style="list-style-type: none"> <li>· Faulty. (Valve fails to open.)</li> </ul> <p>Piping</p> <ul style="list-style-type: none"> <li>· Pipe (from pump to power steering cylinder) dented or clogged.</li> </ul>	<ul style="list-style-type: none"> <li>· Adjust valve set pressure and check for specified oil pressure.</li> <li>· Repair or replace.</li> </ul>
Piping makes abnormal sounds.	<p>Oil pump</p> <ul style="list-style-type: none"> <li>· Lack of oil.</li> <li>· Oil inlet pipe sucks air.</li> <li>· Insufficient air bleeding.</li> </ul>	<ul style="list-style-type: none"> <li>· Add oil.</li> <li>· Repair.</li> <li>· Bleed air completely.</li> </ul>
Valve or valve unit makes abnormal sounds.	<p>Oil pump</p> <ul style="list-style-type: none"> <li>· Oil inlet pipe sucks air.</li> </ul> <p>Valve</p> <ul style="list-style-type: none"> <li>· Faulty. (Unbalance oil pressure)</li> </ul> <p>Piping</p> <ul style="list-style-type: none"> <li>· Pipe (from pump to power steering) dented or clogged.</li> <li>· Insufficient air bleeding.</li> </ul>	<ul style="list-style-type: none"> <li>· Repair or replace.</li> <li>· Adjust valve set pressure and check specified oil pressure.</li> <li>· Repair or replace.</li> <li>· Bleed air completely.</li> </ul>
Insufficient or variable oil flow.	<ul style="list-style-type: none"> <li>· Flow control valve orifice clogged.</li> </ul>	<ul style="list-style-type: none"> <li>· Clean</li> </ul>
Insufficient or variable discharge pressure.	<p>Piping</p> <ul style="list-style-type: none"> <li>· Pipe (from tank to pipe) dented or clogged.</li> </ul>	<ul style="list-style-type: none"> <li>· Repair or replace.</li> </ul>
Steering cylinder head leakage (Piston rod)	<ul style="list-style-type: none"> <li>· Packing foreign material.</li> <li>· Piston rod damage.</li> <li>· Rod seal damage and distortion.</li> <li>· Chrome gilding damage.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace</li> <li>· Grind surface with oil stone.</li> <li>· Replace</li> <li>· Grind</li> </ul>
Steering cylinder head thread (A little bit leak is no problem)	<ul style="list-style-type: none"> <li>· O-ring damage.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace</li> </ul>
Welding leakage	<ul style="list-style-type: none"> <li>· Cylinder tube damage.</li> </ul>	<ul style="list-style-type: none"> <li>· Tube replace.</li> </ul>
Rod	<ul style="list-style-type: none"> <li>· Tube inside damage.</li> <li>· Piston seal damage and distortion</li> </ul>	<ul style="list-style-type: none"> <li>· Grind surface with oil store.</li> <li>· Replace</li> </ul>
Piston rod bushing inner diameter excessive gap	<ul style="list-style-type: none"> <li>· Bushing wear.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace</li> </ul>

Problem	Cause	Remedy
The steering wheel cannot be rotated.	<ul style="list-style-type: none"> <li>· The steering unit column shaft is installed incorrectly or damaged.</li> <li>· The oil pressure does not rise.</li> <li>· The relief valve is faulty or not closed.</li> <li>· LS line (Hose) incorrectly connected.</li> <li>· The piping is damaged.</li> </ul>	<ul style="list-style-type: none"> <li>· Inspect and correct or replace.</li> <li>· Inspect and adjust the relief set pressure.</li> <li>· Inspect and correct.</li> <li>· Inspect and correct.</li> <li>· Replace.</li> </ul>
The steering wheel is heavy.	<ul style="list-style-type: none"> <li>· The tire inflating pressure is low.</li> <li>· The oil pressure does not rise.</li> <li>· The high and low pressure hoses are connected reversely.</li> <li>· The power steering cylinder rod is bent or the piston is sticking.</li> </ul>	<ul style="list-style-type: none"> <li>· Adjust the inflating pressure.</li> <li>· Inspect and adjust the relief set pressure.</li> <li>· Inspect and correct.</li> <li>· Inspect and correct or replace.</li> </ul>
The oil pressure does not rise.	<ul style="list-style-type: none"> <li>· The high and low pressure hoses are connected reversely.</li> <li>· The relief valve is faulty or not closed.</li> <li>· The oil pump function is degraded or the oil volume is insufficient.</li> <li>· The power steering cylinder piston packing is damaged.</li> </ul>	<ul style="list-style-type: none"> <li>· Inspect and correct.</li> <li>· Inspect and correct.</li> <li>· Inspect and correct or replace.</li> <li>· Replace.</li> </ul>
The steering wheel does not return properly.	<ul style="list-style-type: none"> <li>· The tire inflating pressure is low.</li> <li>· The steering unit spool does not move smoothly.</li> <li>· The steering knuckle sliding motion is improper.</li> </ul>	<ul style="list-style-type: none"> <li>· Adjust the inflating pressure.</li> <li>· Correct or replace the steering unit</li> <li>· Add the lubricant or correct.</li> </ul>
The steering wheel does not return (lateness) to the neutral position when released.	<ul style="list-style-type: none"> <li>· The steering unit spool does not move smoothly.</li> <li>· The steering unit column shaft is damaged.</li> <li>· The centering spring is damaged.</li> <li>· The piping is blocked (crushed or clogged).</li> </ul>	<ul style="list-style-type: none"> <li>· Correct or replace the steering unit.</li> <li>· Replace the steering unit</li> <li>· Replace.</li> <li>· Inspect and correct or replace.</li> </ul>
The play is excessive and the vehicle wobbles.	<ul style="list-style-type: none"> <li>· Oil moves in the steering unit.</li> <li>· The steering unit spool is not moving correctly.</li> <li>· Air is sucked from the piping.</li> <li>· The steering unit column shaft is defective.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace the steering unit.</li> <li>· Correct or replace the steering unit.</li> <li>· Inspect and correct or replace.</li> <li>· Inspect and correct or replace.</li> </ul>
The tires are steered opposite to the steering wheel operated direction.	<ul style="list-style-type: none"> <li>· The cylinder piping is connected reversely.</li> </ul>	<ul style="list-style-type: none"> <li>· Inspect and correct.</li> </ul>



<b>Problem</b>	<b>Cause</b>	<b>Remedy</b>
The steering wheel in the idling state is heavy.	<ul style="list-style-type: none"> <li>· Oil moves in the steering unit.</li> <li>· The relief valve is not functioning correctly.</li> <li>· Air is sucked from the piping.</li> <li>· The piping is blocked (crushed or clogged).</li> <li>· The end cap set screw is tightened to an excessive torque.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace the steering unit.</li> <li>· Inspect and correct.</li> <li>· Inspect and correct or replace.</li> <li>· Inspect and correct or replace.</li> <li>· Tighten uniformly to the specified torque.</li> </ul>
Abnormal noise is generated.	<ul style="list-style-type: none"> <li>· The relief valve is defective.</li> <li>· Air is sucked from the piping.</li> <li>· The piping is blocked (crushed or clogged).</li> </ul>	<ul style="list-style-type: none"> <li>· Correct, inspect the pressure, and adjust.</li> <li>· Inspect and correct or replace.</li> <li>· Inspect and correct or replace.</li> </ul>

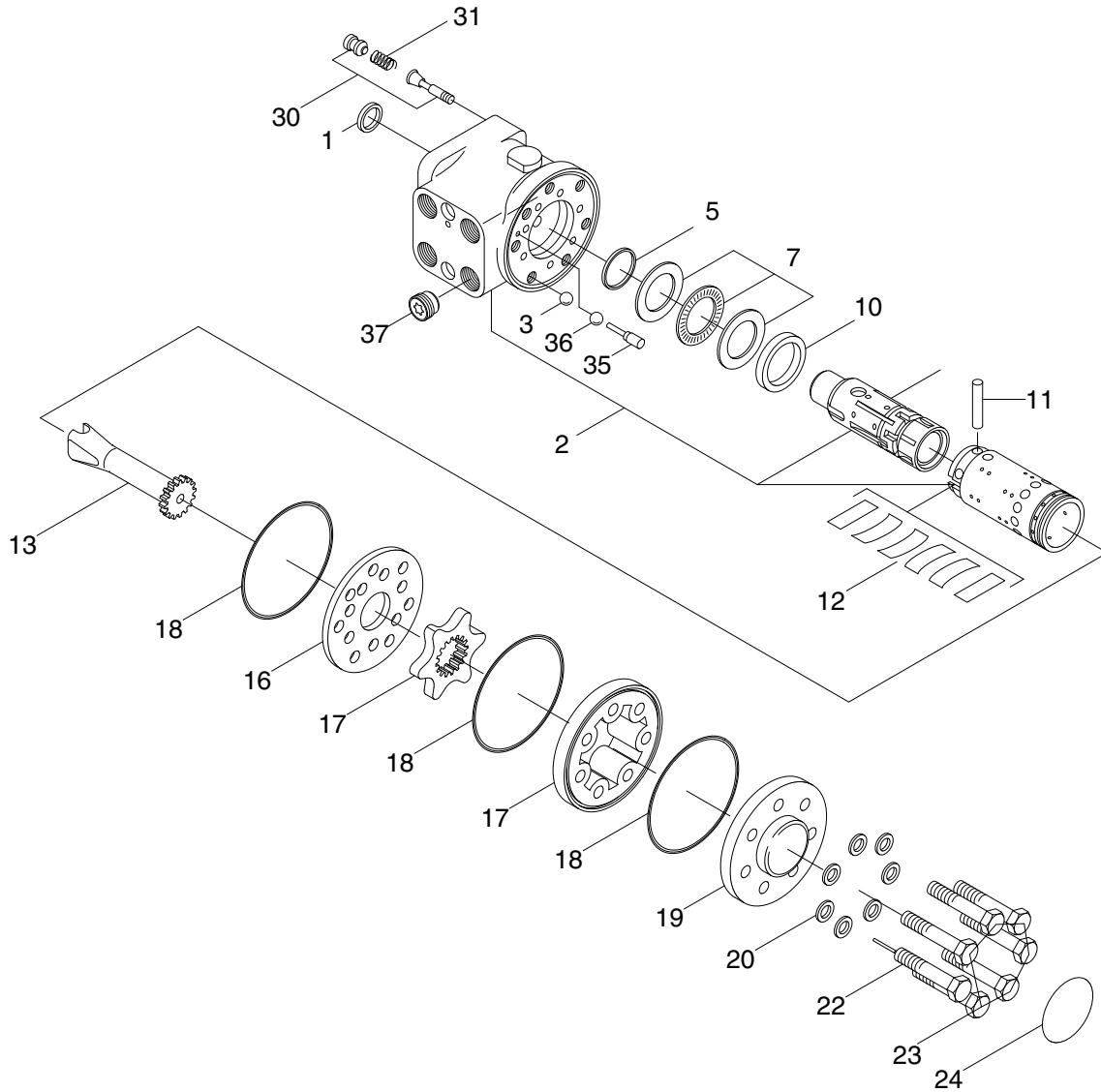
## 2) PRIORITY VALVE

<b>Problem</b>	<b>Check point</b>	<b>Remedy</b>
Springs scratche, wear or fall.	<ul style="list-style-type: none"> <li>· Those of having critical scratches or wear and those of below the repair limit must be replaced with a new one.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace.</li> </ul>
Spools scratche or wear on sliding surface.	<ul style="list-style-type: none"> <li>· Extremely small scratches must be removed with sandpaper.</li> <li>· Those of having critical scratches or wear must be replaced with a new one.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace.</li> </ul>
O-ring	<ul style="list-style-type: none"> <li>· Those of having scratches on the seal or having critical wear must be replaced with a new one.</li> </ul>	<ul style="list-style-type: none"> <li>· Replace.</li> </ul>

## GROUP 3 DISASSEMBLY AND ASSEMBLY

### 1. STEERING UNIT

#### 1) STRUCTURE



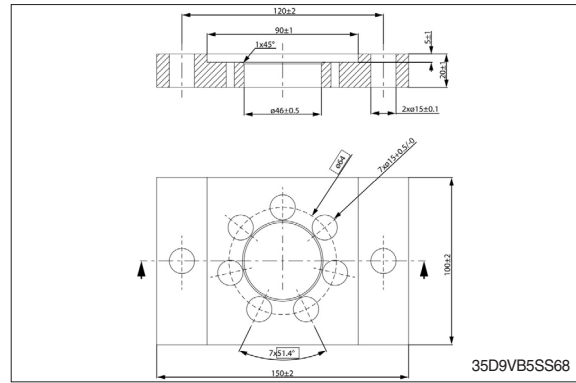
35D9VB5SS74

1	Dust seal ring	13	Cardan shaft	24	Model / Code label
2	Housing and spool/sleeve	16	Distributor plate	30	Relief valve
3	Ball	17	Gearwheel set	31	Spring for relief valve
5	Shaft seal	18	O-ring	35	Ball stop threaded for LS Check
7	Bearing assy	19	End over	36	Ball Ø3 for is check
10	Ring	20	Washer	37	Check valve
11	Cross pin	22	Pin bolt screw		
12	Set of springs	23	Screw		

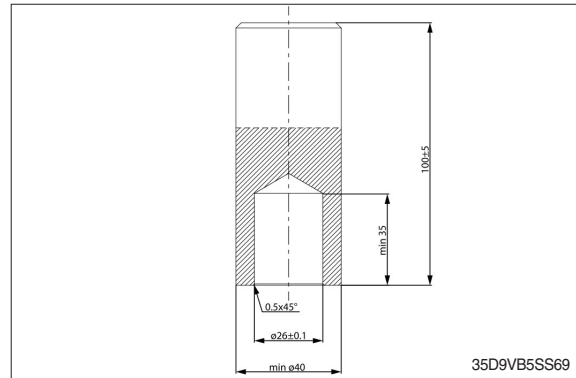
※ Seal kit : 1, 5, 18, 20

## 2) TOOLS

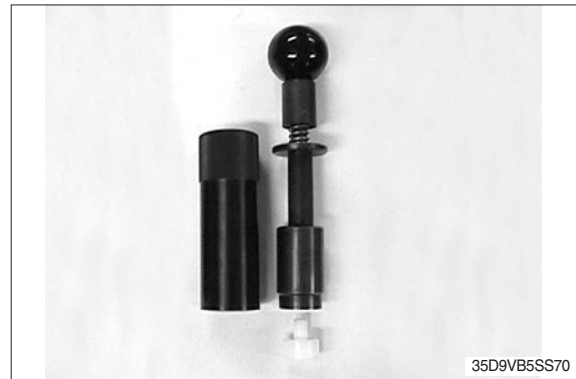
- (1) Holding tool for the entire steering unit.  
Material: Appropriate metal or hard plastic.



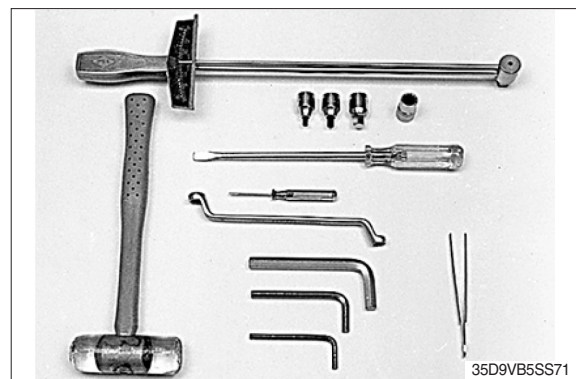
- (2) Assembly tool for dust seal.  
Material: Free cutting steel.



- (3) Assembly tool for shaft seal, O-ring/Roto Glyd type:  
Code number: 11092408.



- (4) Torque wrench 0 ~ 70 N-m.
- 13 mm socket spanner
  - 2 ~ 2.75 – 5 ~ 6 and 8 mm Allen key
  - Torx Bit size T50
  - 12 mm screwdriver
  - 2 mm screwdriver
  - 13 mm ring spanner
  - Plastic hammer
  - Tweezers



### 3) TIGHTENING TORQUE

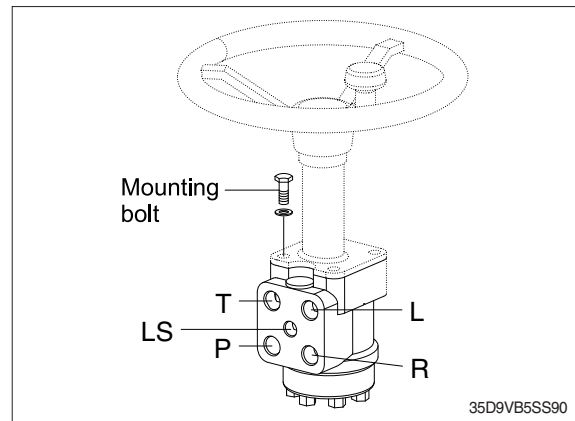
L : Left port

R : Right port

T : Tank port

P : Pump port

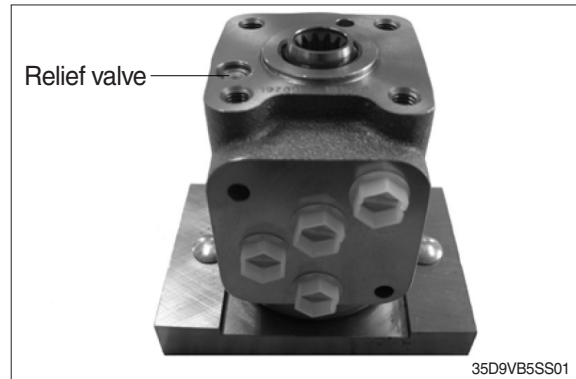
LS : Load sensing port



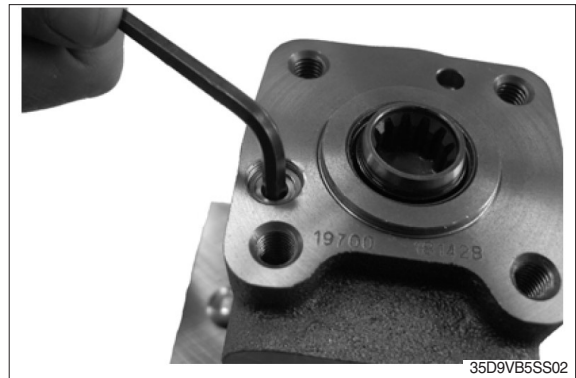
Port	Port size	Tightening torque	
		kgf·m	lbf·ft
L, R, T, P	7/16-20UNF	6	43.4
LS	3/4-16 UNF	2.5	18.4
Mounting bolt	M10	4	28.9

#### 4) DISASSEMBLY

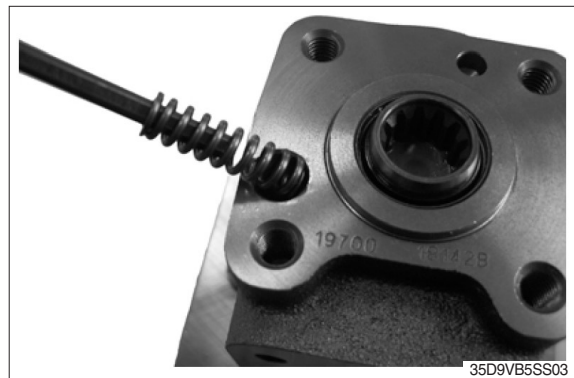
- (1) Place the unit in the holding tool on gear set end. Remove the dust cap on the relief valve.



- (2) Screw out the adjusting screw for relief valve (30) using a 5 mm Allen key.



- (3) Remove the spring for relief valve (31).



- (4) Remove the piston for relief valve.



- (5) Replace the unit in the holding tool on steering column end.  
Remove the screws (22 and 23) with washers (20) using a 13 mm ring spanner or top wrench.



- (6) Remove the end cover (19), sideways.



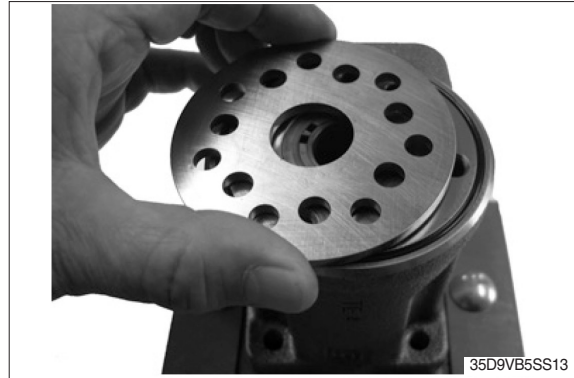
- (7) Lift the gearwheel set (17) off the unit.  
Remove the two O-rings (18).



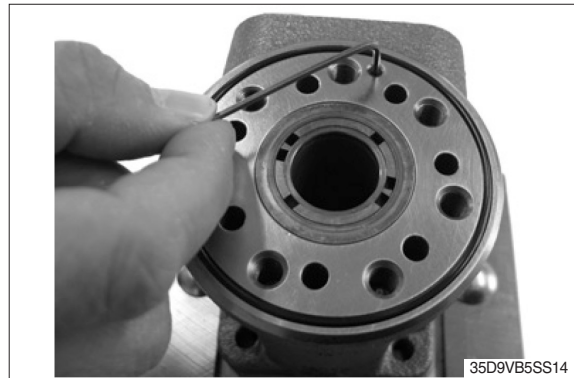
- (8) Remove the cardan shaft (13).



(9) Remove the distributor plate (16).



(10) Screw out the ball stop (35) using a 2 mm Allen key.



(11) Remove the O-ring (18) from housing.



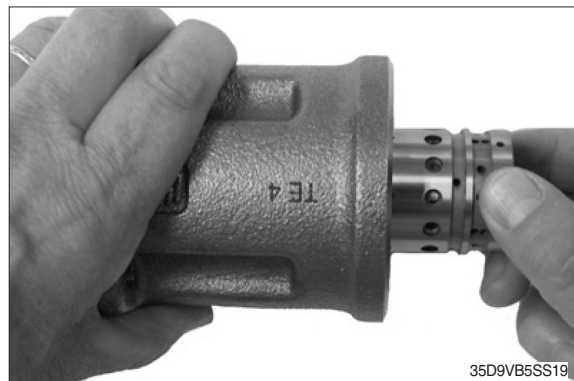
(12) Remove the check valve (37) using a torx bit size T50.



(13) Shake out the check valve ball (3), suction valve pins (34), balls (33 and 36).



(14) Place the housing with the ports facing down on the work bench. Ensure that the cross pin (11) in the spool and sleeve set (2) is in the horizontal position. The pin (11) can be observed through the open end of the spool. Press the spool (2) inwards (from the housing mounting face end) and the sleeve (2), ring (7) and bearing assembly (6) will be pushed out of the housing together.



(15) Take the bearing races and needle bearing (7) from the spool and sleeve set (2). The outer bearing (7) race can sometimes “stick” in the housing, therefore check that it has come out.





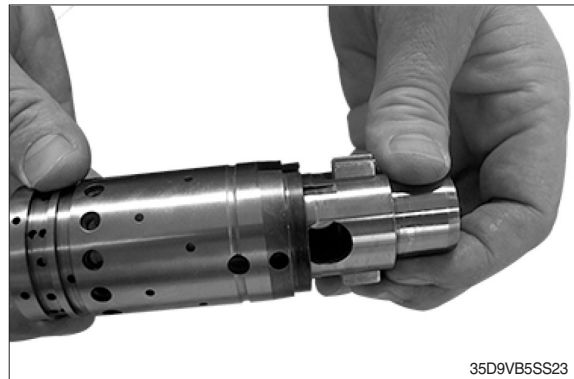
(16) Press out the cross pin (11).



(17) Remove the ring (10).



(18) Carefully press the spool out of the sleeve.



(19) Press the neutral position springs (12) out of the slot of the spool.



(20) Remove dust seal (1) and shaft seal (Roto Glyd) (5) carefully with a screw driver or similar tool.



(21) The steering unit is now completely dismantled.

- ※ Clean all parts carefully in shellsol K or similar cleaner fluid.
- ※ Inspection and replacement Replace all seals and washers. Check all parts carefully and make any replacements as is necessary.

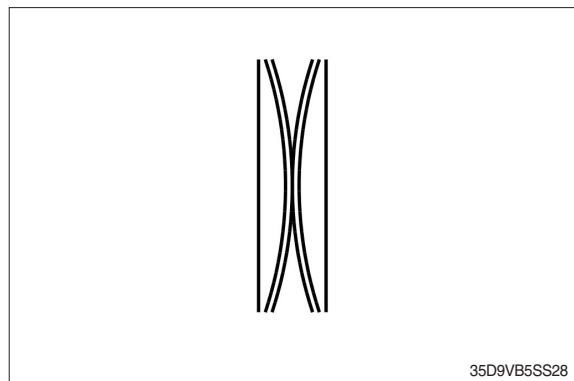


## 5) ASSEMBLY

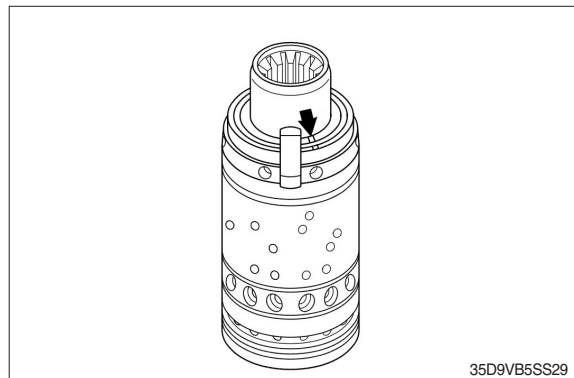
- (1) Place the two flat neutral position springs in the slot. Place the curved springs between the flat ones and press them into place.



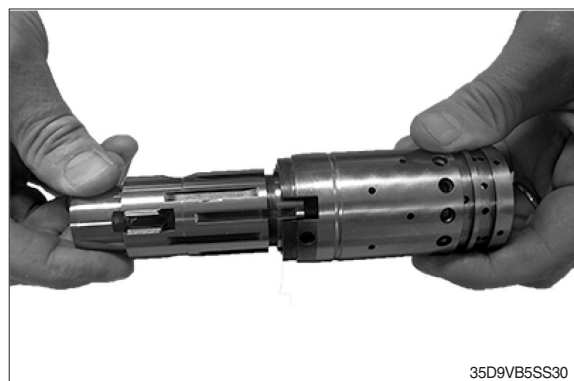
- (2) Configuration of spring set (12). There can be different numbers of curved springs depending on configuration of spring set. There can be 2, 4 or 6 curved springs.



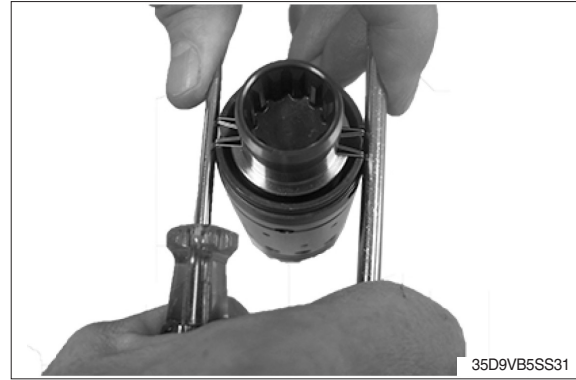
- (3) Some spool and sleeve sets for steering unit must be positioned correctly relative to each other. Small marks are present on both spool and sleeve close to one of the slots for the spring set. Most spool and sleeve sets for steering unit have no marks, so those can be positioned relatively to each other in any of the 2 positions possible.



- (4) Guide the spool into the sleeve (2). Make sure the centering springs (12) are placed into the slot.



(5) Line up the spring set (12).



(6) Guide the ring (10) down over the sleeve. The ring should be able to move free of the springs.



(7) Fit the cross pin (11) into the spool/sleeve.

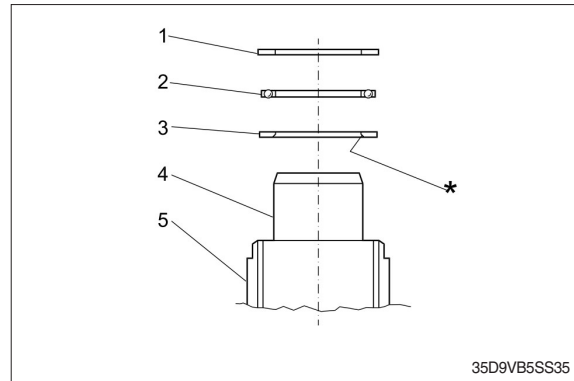


(8) Fit bearing races and needle bearing (7) as shown on the drawing below.

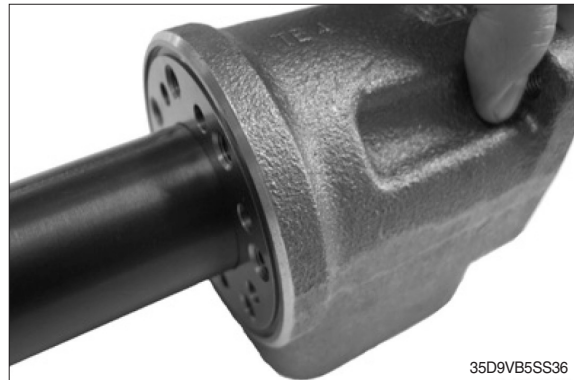


- (9) Assembly pattern for standard bearing 1  
Outer bearing race → 2 Needlebearing →  
3 Inner bearing race → 4 Spool → 5  
Sleeve.

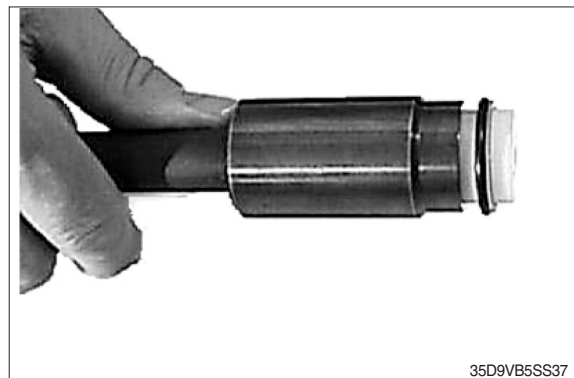
The inside chamfer on the inner bearing race must face the chest of the inner spool.



- (11) Place the steering unit housing with the port face down on the work bench. Guide the outer part of the assembly tool for shaft seal into the bore for the spool/sleeve set (2).



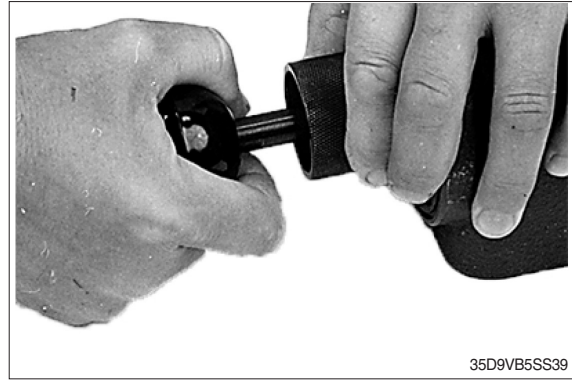
- (10) Grease the shaft seal (Roto Glyd, 5) with hydraulic oil and place them on the tool. Ensure that the Roto Glyd seal is placed on the insertion tool as per the photograph.



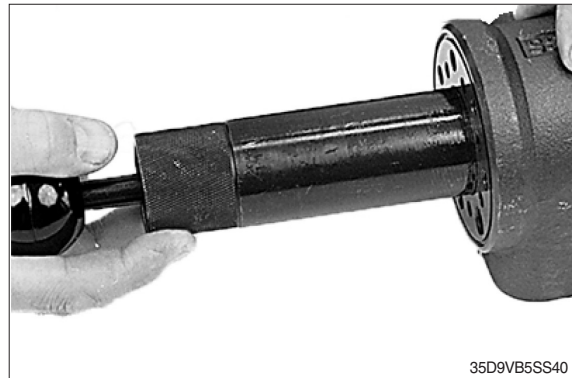
- (13) Hold the outer part of the assembly tool in the bottom of the steering unit housing and guide the inner part of the tool right to the bottom.



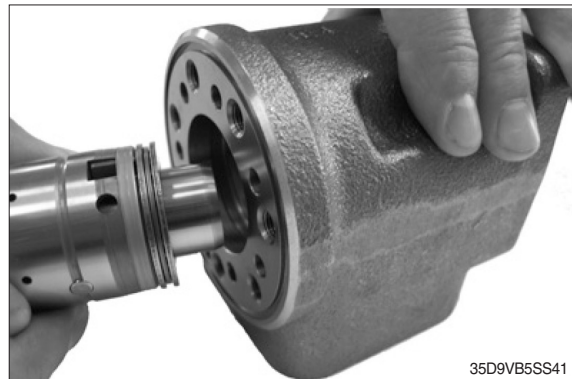
(14) Press and turn the shaft seal (5) into position in the housing.



(15) Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide from the inner part in the bore.



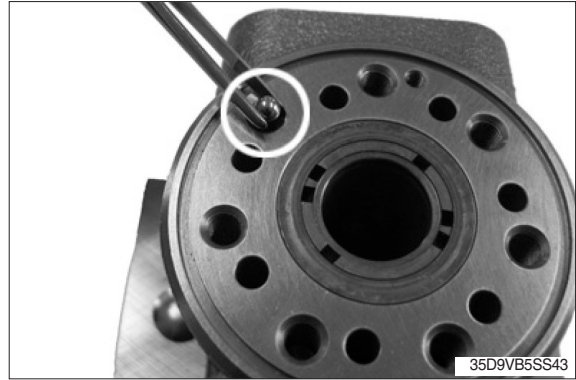
(16) With a light turning movement, guide the spool and sleeve into the bore. Fit the spool set holding the cross pin (11) horizontal.



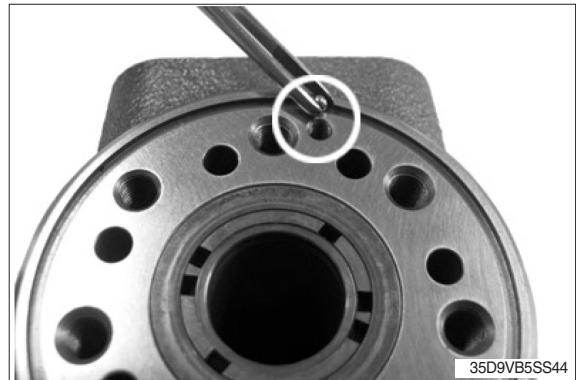
(17) The spool set will push out the assembly tool guide. The shaft seal (5) are now installed.



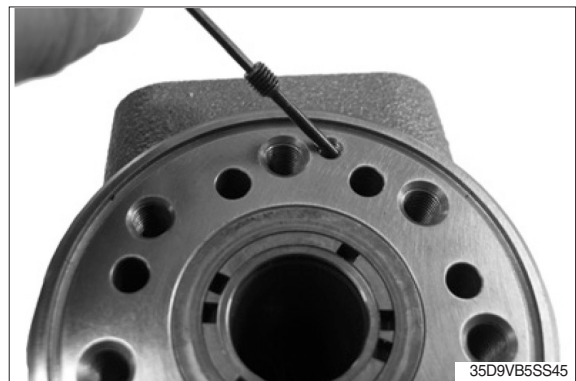
- (18) Place the steering unit housing on the holding tool on the steering column end. Put the check valve ball (3) into the hole indicated by the circle.



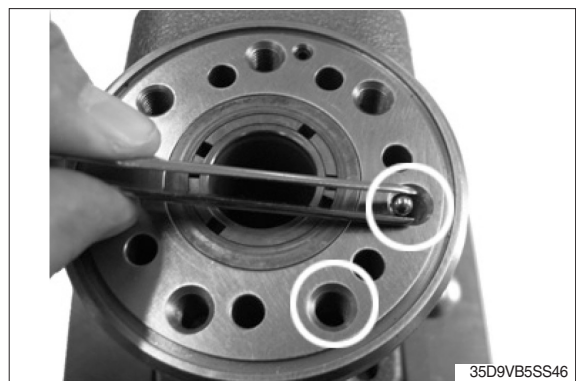
- (19) Place the ball for LS check valve (36) into the hole indicated by the circle.



- (20) Screw the ball stop (35) into the LS check valve bore using a 2 mm Allen key.  
· Tightening torque :  $0.1 \pm 0.01$  kgf·m  
( $0.72 \pm 0.072$  lbf·ft)



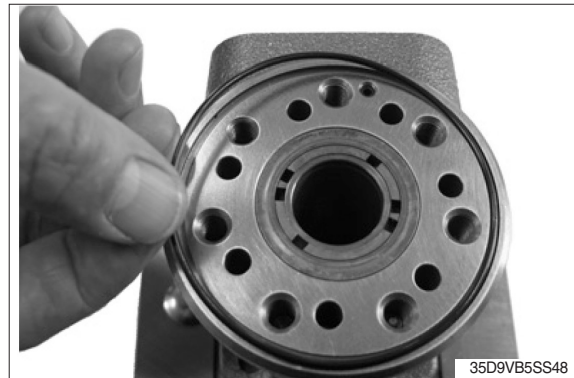
- (21) Place a ball (33) in the two bolt holes indicated by the circles.



(22) Place the pins (34) in the same two bolt holes.



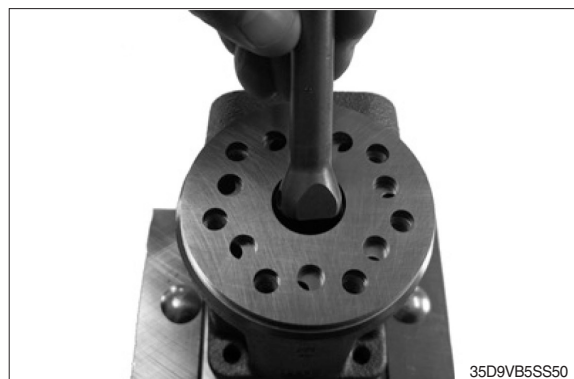
(23) Insert the O-ring (18) in the groove on the housing.



(24) Place the distributor plate (16) so that the channel holes match the thread holes in the housing.



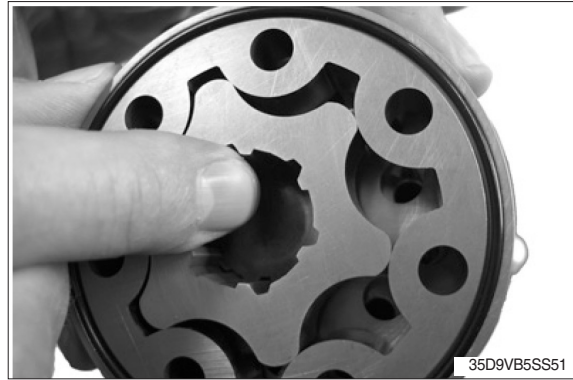
(25) Guide the cardan shaft (13) down into the bore so that the slot is parallel with the connection flange ports and lines up with the cross pin (11).





- (26) Place the 2 O-rings (18) in the two grooves in the gear rim. Fit the gearwheel and rim (17) on the cardan shaft (13).

Place the gear wheel side with all the deeper splines facing downwards. Only this side will fit on the cardan shaft due to all gear sets used in steering unit have timing securing: splines of gear wheel and cardan shaft can only be assembled with correct timing. Line up the gear rim holes to match the thread holes of the housing.



- (27) Place the end cover (19) in position. Ensure that the bar codes and writing are parallel with port face.

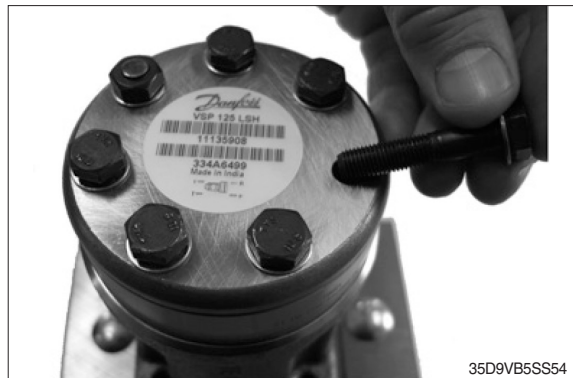


- (28) Fit the pin bolt screw (22) with washer (20) and place it in the hole shown.



- (29) Fit the six screws (23) with new washers (20) and insert them. Use a 13 mm top wrench. Cross-tighten all the screws (22 and 23) with a torque.

- Tightening torque :  $3.1 \pm 0.6$  kgf·m  
( $22.4 \pm 4.3$  lbf·ft)



- (30) Screw in the check valve (37) into the P-port using a Torx Bit size T50.  
· Tightening torque :  $2.6 \pm 0.5$  kgf-m  
( $18.8 \pm 3.6$  lbf-ft)



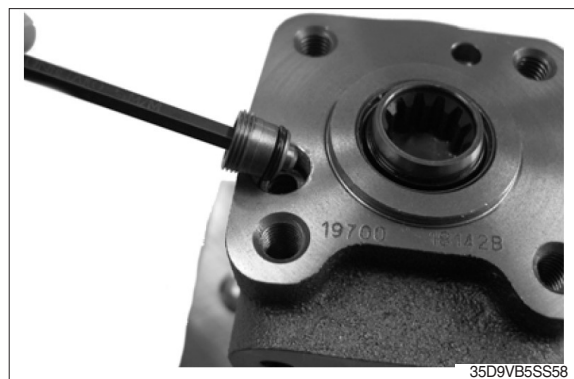
- (31) Replace the unit in the holding tool on gear set end.  
Install the piston (30) to housing.



- (32) Install the spring (31) on top of the piston.



- (33) Place o-ring on adjusting screw (30).  
Screw in the adjustment screw (30) using a 5 mm Allen key. Make the pressure setting on a test panel according to valve setting specification.



(34) Place the dust seal ring (1) in the housing.



(35) Fit the dust seal ring in the housing using special tool for dust seal assembly and a plastic hammer.



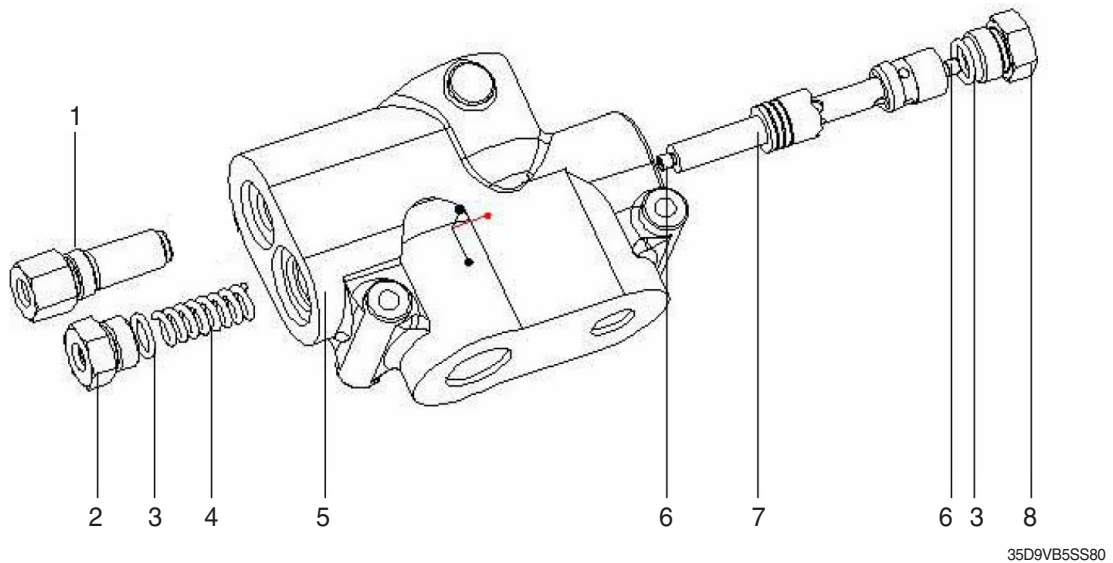
(36) After finalizing the entire assembly, screw in the plastic plugs into the connection ports to keep the ports clean during storage and transportation.

※ Refer to the relief valve and LS port pressure test and adjustment.



## 2. PRIORITY VALVE

### 1) STRUCTURE



- |          |                      |         |
|----------|----------------------|---------|
| 1 Plug   | 4 Spring compression | 7 Spool |
| 2 Plug   | 5 Housing            | 8 Plug  |
| 3 O-ring | 6 Throttle           |         |

### 2) DISASSEMBLY

- ※ Check that the priority valve has not been damaged during transportation.
- ※ Clean the working area before operation.
- ※ If needed, components must be replaced exclusively by serviceman.

- (1) Clamp the unit in vice. Loosen the plug (using 27 mm wrench) and screw out. Be careful of the spring.



(2) Take out the spring vertically.



(3) Unscrew the plug in the opposite side using the 27mm wrench.



(4) Press out the spool by hand.

※ It is strongly recommended that relief valve cartridge not be adjusted by customer. If necessary, it must be done by Eaton representative. Approximately 800psi per revolution of the adjusting screw.



(5) Clean all metal parts in clean solvent. Blow dry with air. Do not wipe dry with cloth or paper towel because lint or other matter can get into the hydraulic system and cause damage.

### 3) ASSEMBLY

※ Before assembly, lubricate all parts with normal hydraulic oil.

- (1) Position the valve horizontally and insert the spool into its bore. Pay attention to spool direction and ensure spool moves smoothly.



- (2) Insert the spring into the bore.

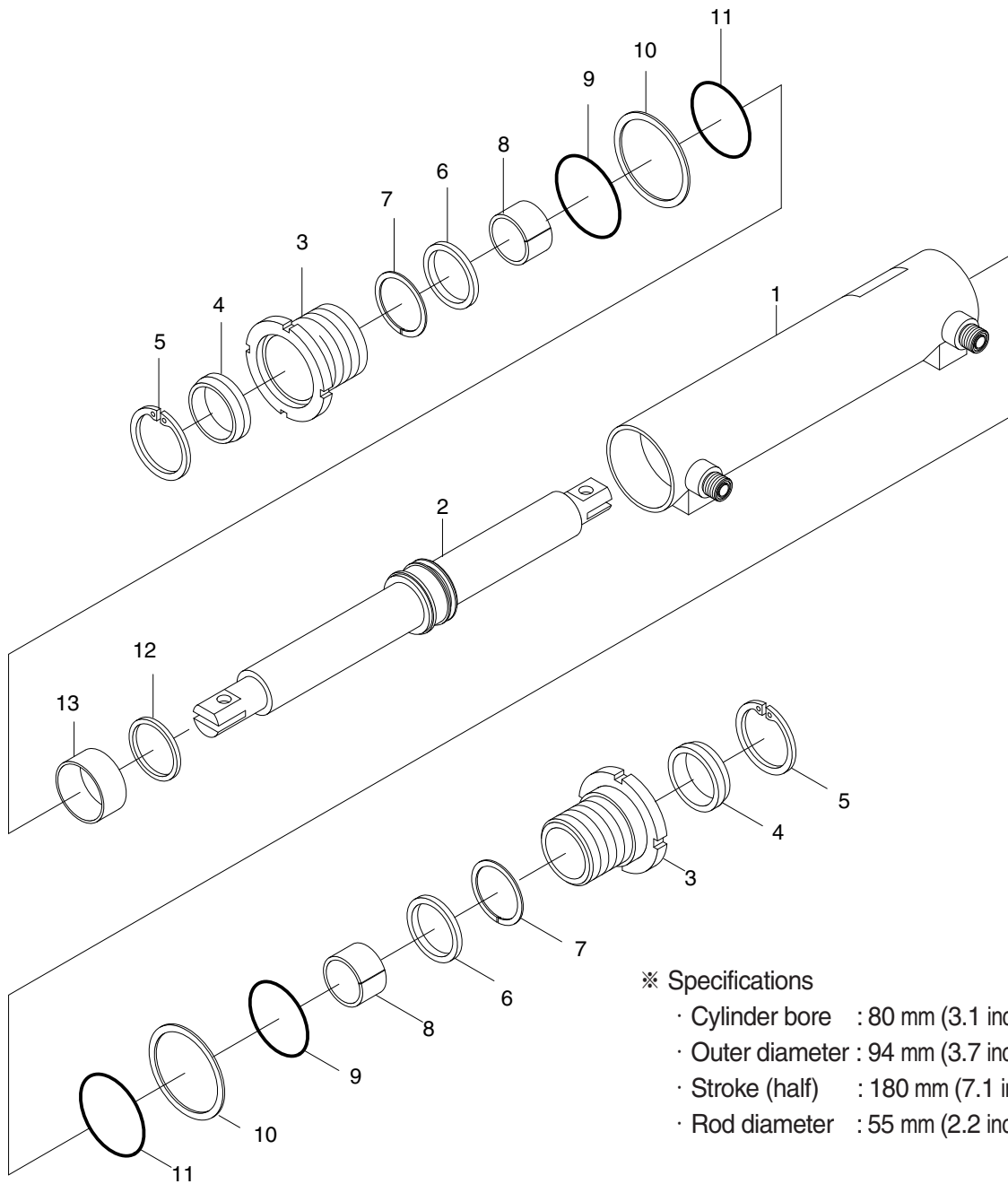


- (3) Screw in the two plugs and tighten.
  - Tightening torque : 4.1 ~ 6.1 kgf·m  
(29.7 ~ 44.1 lbf·ft)



### 3. STEERING CYLINDER

#### 1) STRUCTURE



※ Specifications

- Cylinder bore : 80 mm (3.1 inch)
- Outer diameter : 94 mm (3.7 inch)
- Stroke (half) : 180 mm (7.1 inch)
- Rod diameter : 55 mm (2.2 inch)

35D9VB5SS91

- |              |                |                |
|--------------|----------------|----------------|
| 1 Tube       | 6 Rod seal     | 11 O-ring      |
| 2 Rod piston | 7 Backup ring  | 12 Piston seal |
| 3 Gland      | 8 Dry bearing  | 13 Wear ring   |
| 4 Dust wiper | 9 O-ring       |                |
| 5 Retainer   | 10 Backup ring |                |

## 2) DISASSEMBLY

※ Before disassembling steering cylinder, release oil in the cylinder first.

- (1) Put wooden blocks against the cylinder tube, then hold in & vice.
- (2) Remove the cover by hook a wrench in the notch of cylinder head and turn counter-clockwise.
- (3) Remove the cylinder rod and piston from the tube.
- (4) Check wear condition of the sealing parts (O-ring, oil seal, dust seal, U-packing, bush). If there are some damage, replace with new parts.

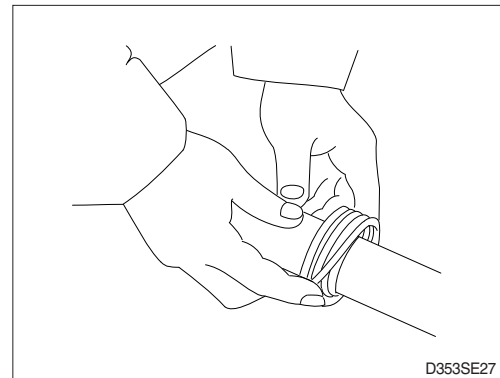
## 3) CHECK AND INSPECTION

mm (in)

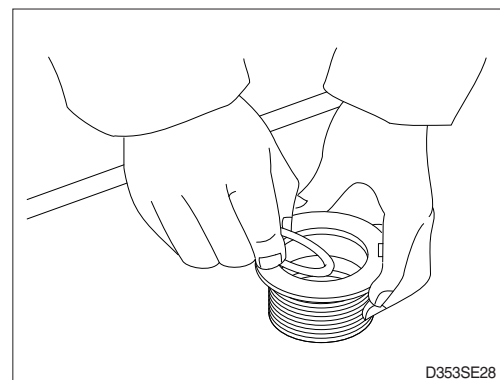
Check item	Criteria		Remedy
	Standard size	Repair limit	
Clearance between piston & cylinder tube	0.05~0.25 (0.002~0.01)	0.4 (0.02)	Replace piston seal
Clearance between cylinder rod & bushing	0.05~0.18 (0.002~0.007)	0.3 (0.01)	Replace bushing
Seals, O-ring	Damage		Replace
Cylinder rod	Dents		Replace
Cylinder tube	Biting		Replace

## 4) ASSEMBLY

- (1) Install a new piston seal around the groove on the piston.
- ※ Be careful not to scratch the seal too much during installation or it could not be seated properly.

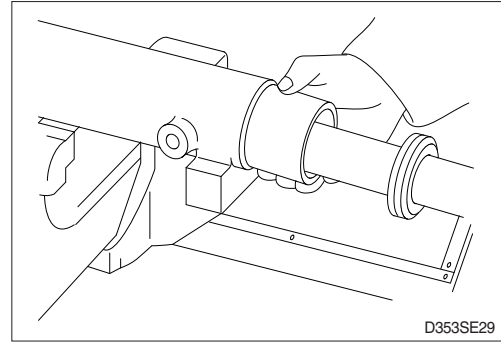


- (2) Install the rod seal to the position in the gland applying a slight coat with grease prior to install.

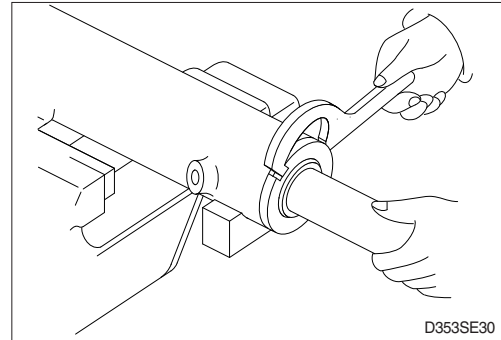




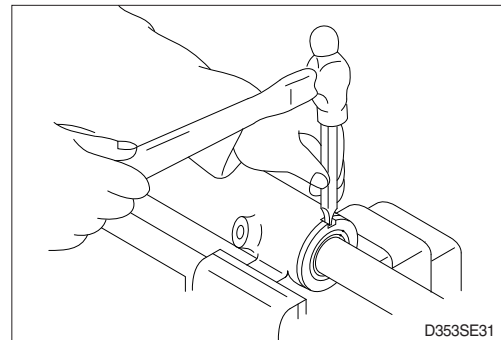
- (3) Install the dust wiper to the gland using a special installing tool. Coat the dust wiper with grease slightly before installing.
- (4) Using a special tool, install gland assembly into the cylinder tube.



- (5) Using a hook spanner, install the gland assembly, and tighten it with torque  $60 \pm 6$  kgf·m ( $434 \pm 43$  lbf·ft).



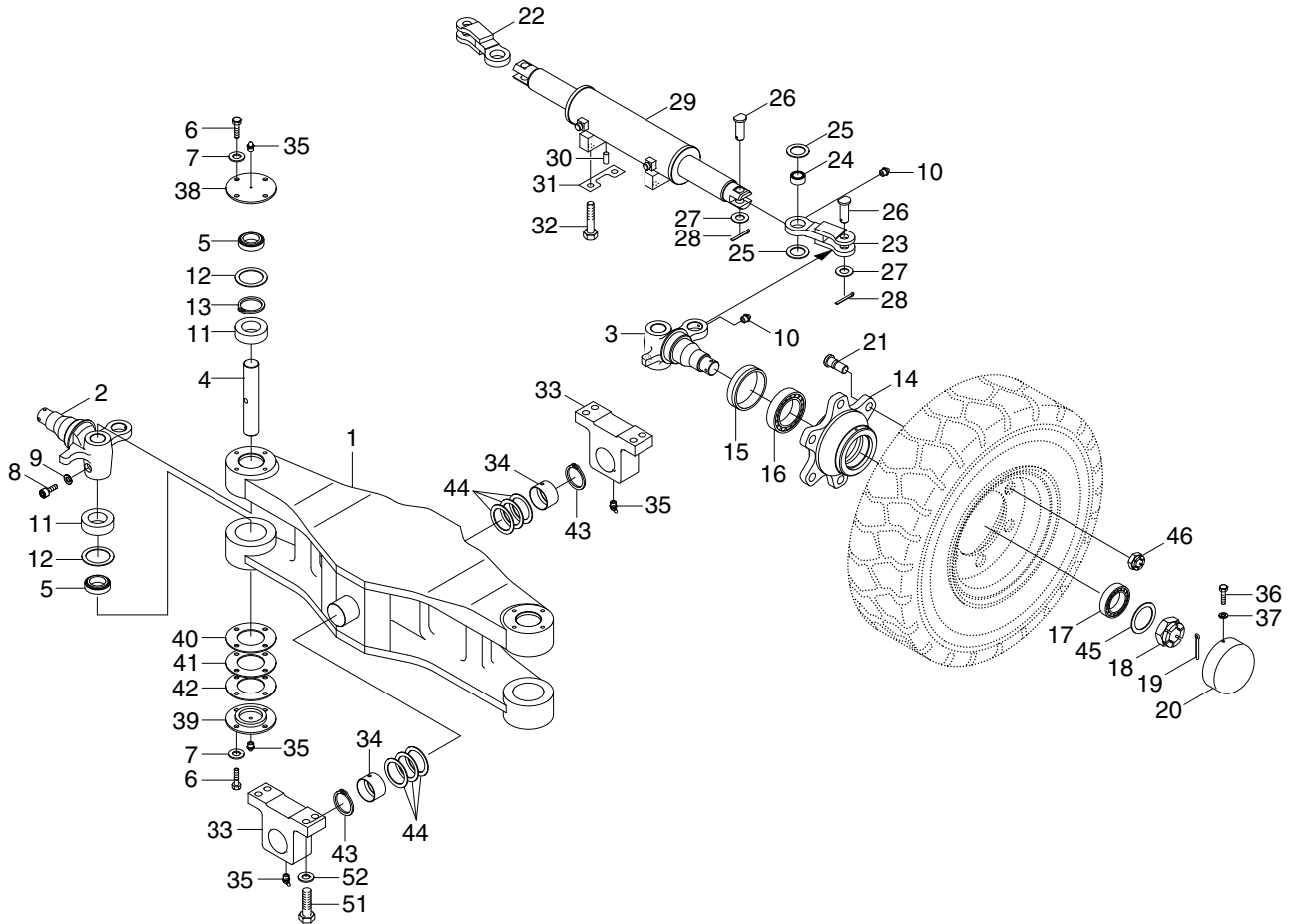
- (6) After the gland assembly was installed to the cylinder tube, calk at the tube end into the groove on the gland to prevent screw loosening.
- ※ If it is needed to calk again, never calk on the same place.



- (7) Move the piston rod back and forth several times for the full distance of its stroke. This helps to seat the ring and seals before applying full hydraulic pressure to the cylinder.
- (8) Install cylinder into trail axle.
- (9) While idling the engine with the rear wheels off the ground, operate the steering wheel left and right alternately.
- ※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.
- (10) Stop the engine, lower the floating rear wheels, and check pump joints for oil leaks and looseness and retighten, them as required.

## 4. STEERING AXLE

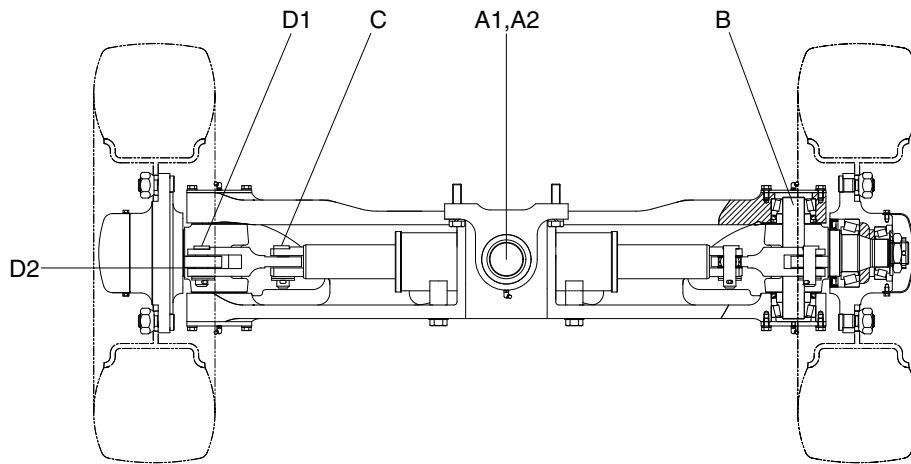
### 1) STRUCTURE



35D9SE06

1	Axle center	13	Retaining ring	25	Thrust washer	37	Spring washer
2	Knuckle-RH	14	Hub	26	Clevis pin	38	Upper cover
3	Knuckle-LH	15	Oil seal	27	Plain washer	39	Lower cover
4	King pin	16	Taper roller bearing	28	Split pin	40	Shim (0.1t)
5	Taper roller bearing	17	Taper roller bearing	29	Steering cylinder	41	Shim (0.15t)
6	Hexagon bolt	18	Slotted nut	30	Pin	42	Shim (0.3t)
7	Spring washer	19	Split pin	31	Lock plate	43	Retaining ring
8	Special bolt	20	Hub cap	32	Hexagon bolt	44	Shim (0.5t)
9	Spring washer	21	Serration bolt	33	Support	45	Plain washer
10	Grease nipple	22	Link-RH	34	Bushing	46	Hub nut
11	Collar	23	Link-LH	35	Grease nipple	51	Hexagon bolt
12	Oil seal	24	SPH plain bearing	36	Hexagon bolt	52	Spring washer

## 2) CHECK AND INSPECTION



35DS7SE08

unit : mm (in)

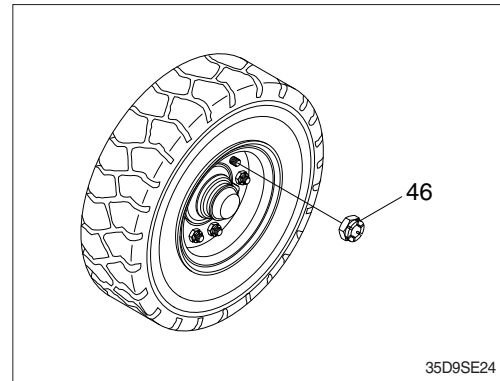
No.	Check item		Criteria		Remedy	
			Standard size	Repair limit		
A	Shaft	A1	OD of shaft	55 (2.2)	54.5 (2.1)	Replace
		A2	ID of bushing	55 (2.2)	55.5 (2.2)	
B	OD of king pin			35 (1.4)	34.5 (1.4)	
C	OD of steering cylinder pin			20 (0.8)	19.5 (0.8)	
D	Knuckle	D1	OD of pin	20 (0.8)	19.5 (0.8)	Adjust with shims
		D2	Vertical play	-	-	

- OD : Outer diameter
- ID : Inner diameter

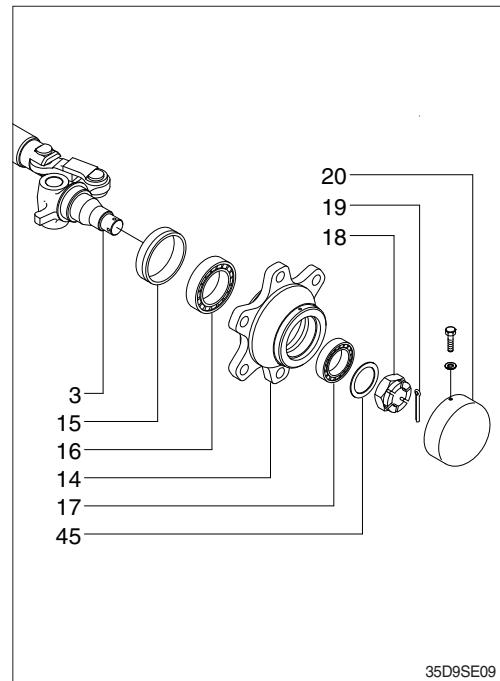
### 3) DISASSEMBLY

※ Servicing work on the knuckle part can be carried out without removing the axle assy from chassis.  
The work can be done by jacking up the counter weight part of the truck.

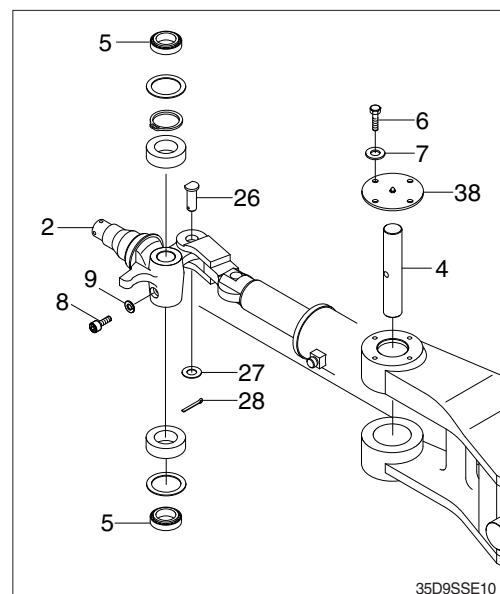
- (1) Loosen the hub nut (46) and take off the steering wheel tire.



- (2) Remove hub cap (20).
- (3) Pull out split pin (19) and remove slotted nut (18) and washer (45).
- (4) Using the puller, take off the hub (14) together with the taper roller bearing (16, 17).  
※ Be very careful because just before the hub comes off, taper roller bearing will fall out.
- (5) After hub (14) is removed take off the inner race of the taper roller bearing (16, 17).
- (6) Pull out oil seal (15).  
※ Don't use same oil seal twice.
- (7) Repeat the same procedure for the other side.  
Moreover, when disassembling is completed, part the slotted nut in the knuckle to protect the threaded portion.



- (8) Loosen special bolt (8) and spring washer (9).
- (9) Remove hexagon bolt (6) and upper cover (38).
- (10) Push out the king pin (4) without damaging the knuckle arm (2).
- (11) If defect is observed in taper roller bearing (5), pull it out by using extractor.
- (12) Remove spilt pin (28), plain washer (27) and clevis pin (26).



#### 4) ASSEMBLY

※ In reassembling, have all parts washed, grease applied to lubricating parts, and all expendable items such as oil seal and spring washers replaced by new ones.

Perform the disassembly in reverse order.

- (1) Tighten the special bolt (8) and washer (9) of king pin (4).
- (2) There is a notch in the middle of the king pin (4), make sure that this notch is on the special bolt side.
- (3) Do not hammer to drive in taper roller bearing (5) because it will break. Always use drive-in tool. Be sure that the fixed ring of the bearing is placed in position facing the knuckle (3).

#### (4) Hub

- ① Mount oil seal (15) and inner race of taper roller bearing (16) on the knuckle. The bearing should be well greased before assembling.
  - ② Install the outer race of the taper roller bearing (17) in the wheel center and assemble to the knuckle.
  - ③ Put the plain washer (45) in place, tighten the slotted nut (18) and lock with split pin (19). In locking with split pin, locate the hole for the split pin by turning the nut back 1/6 of a turn. Adjust the preload of bearing.
  - ④ Mount the hub cap (20) and tighten with bolt (36).
- ※ Apply loctite #609 on the contact surface of the hub cap (20).
- ※ Apply loctite #277 on the thread of the bolt (36).
- ※ Bearing should be well greased before assembling.

