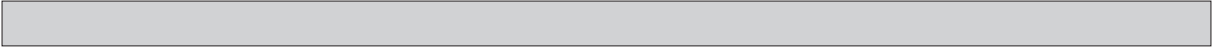


SECTION 5 STEERING SYSTEM

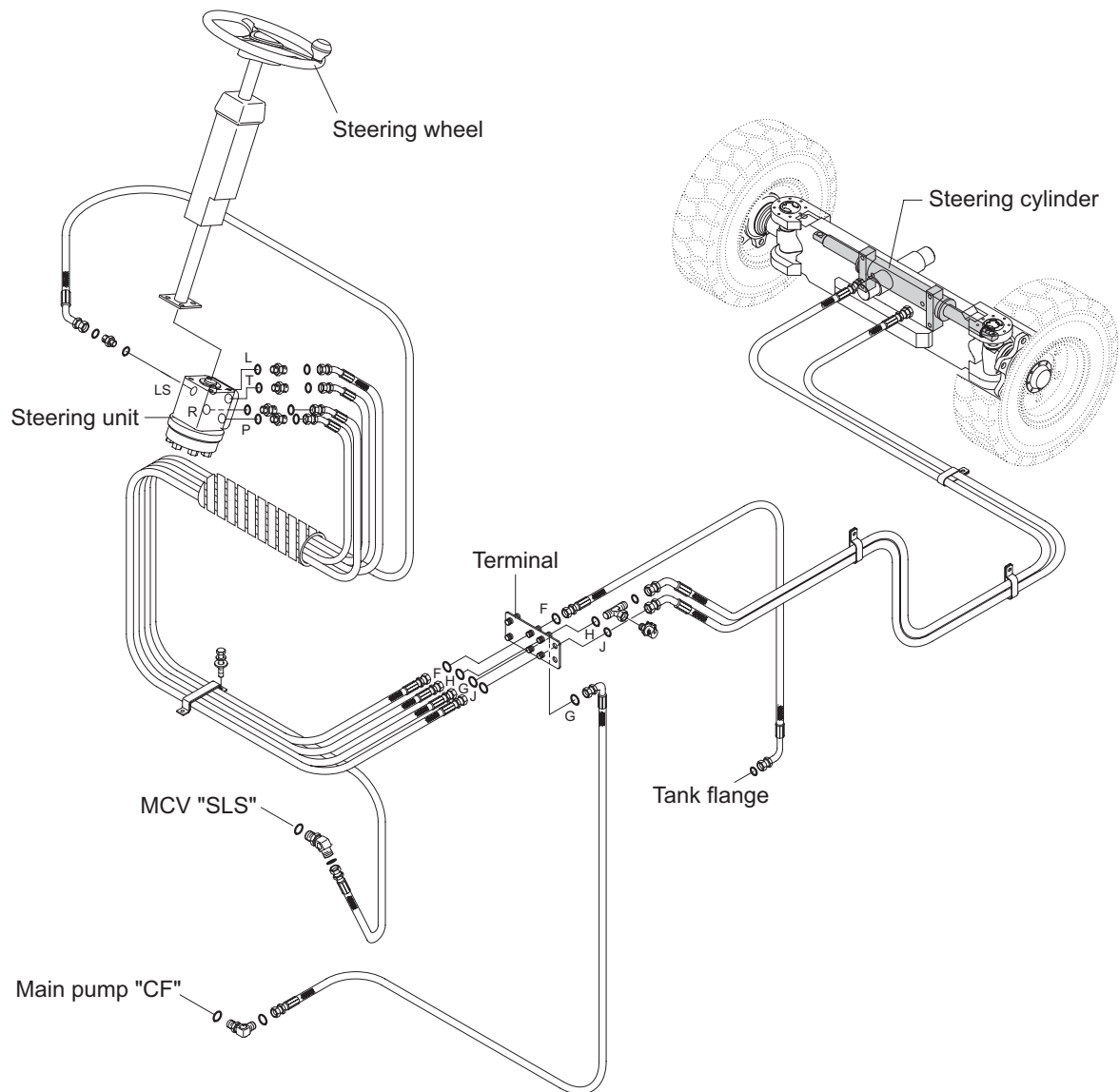


Group 1	Structure and function	5-1
Group 2	Operational checks and troubleshooting	5-10
Group 3	Tests and adjustments	5-18
Group 4	Disassembly and assembly	5-22

SECTION 5 STEERING SYSTEM

GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

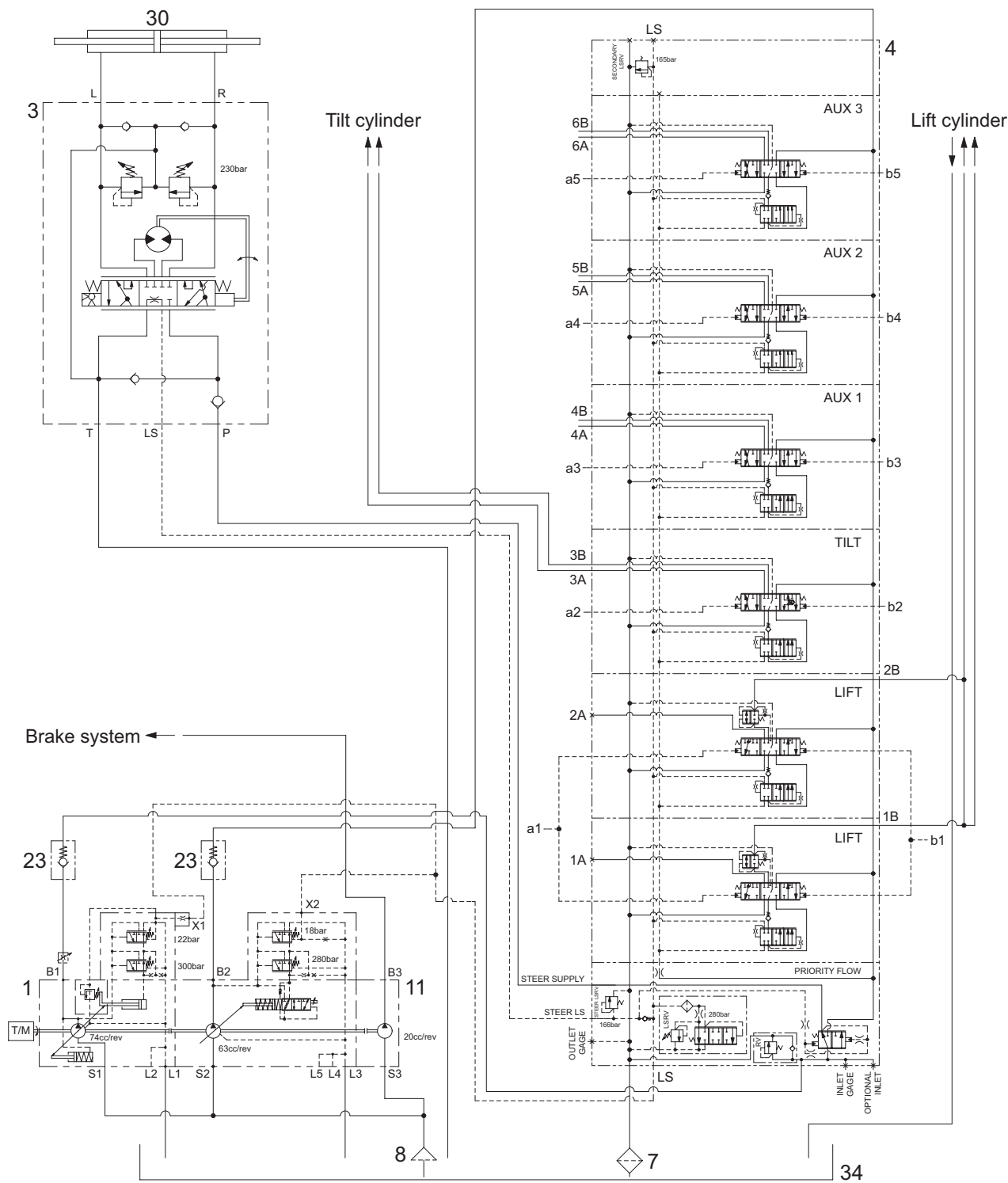


160D9LSS01

The steering system for this vehicle is composed of steering wheel assembly, steering unit, steering cylinder, steering axle and piping. The steering force given to the steering wheel enters the steering unit through the steering column. The required oil flow is sensed by the function of the control section of the unit, and pressurized oil delivered from the hydraulic pump is fed to the steering cylinder. The force produced by the steering cylinder moves the knuckle of steering tires through the intermediate link.

The 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.

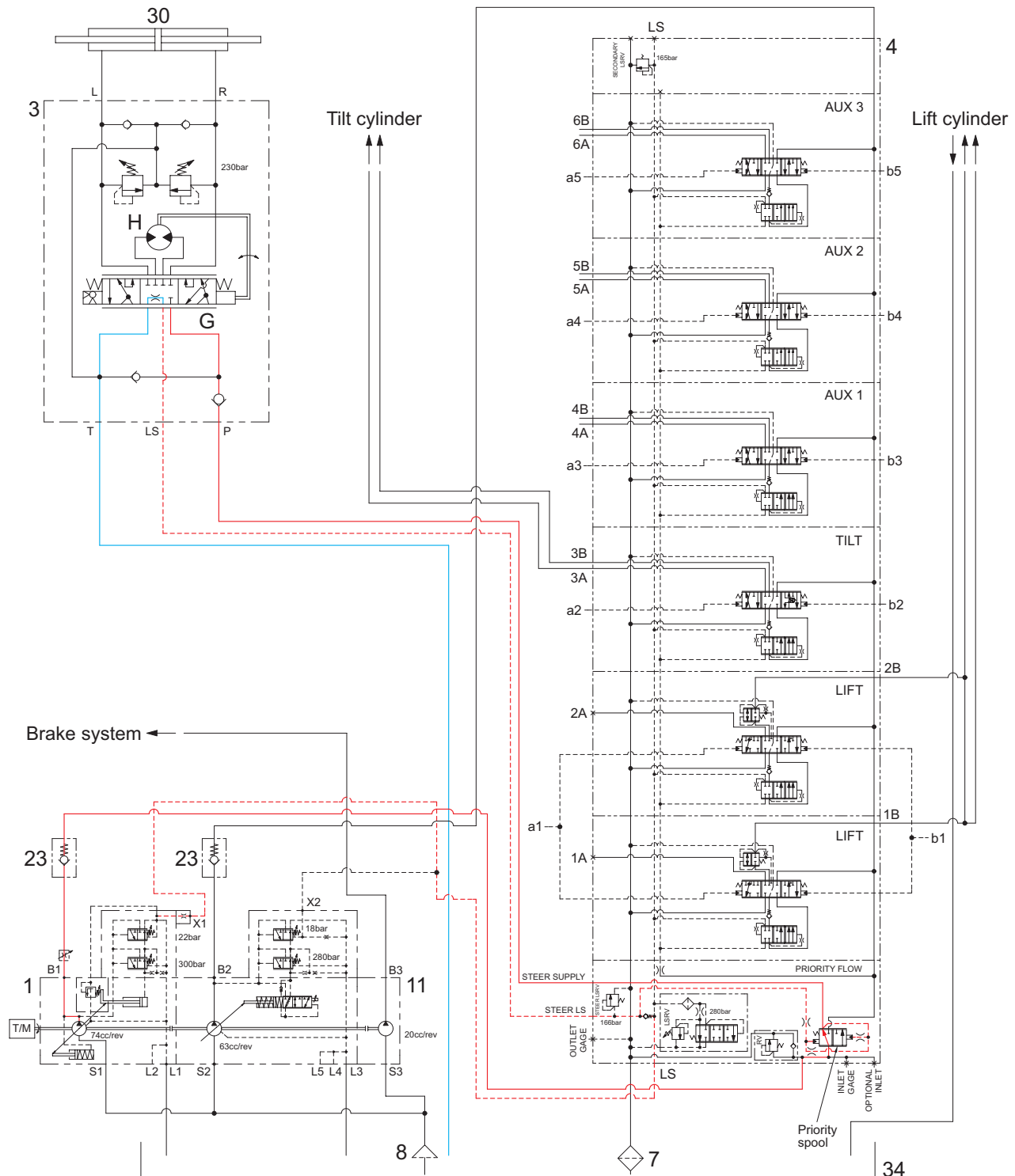
2. HYDRAULIC CIRCUIT



160D9LSS02

- | | | |
|----------------------|--------------------|----------------------|
| 1 Main pump | 7 Return filter | 23 Check valve |
| 3 Steering unit | 8 Suction strainer | 30 Steering cylinder |
| 4 Main control valve | 11 Brake pump | 34 Hydraulic tank |

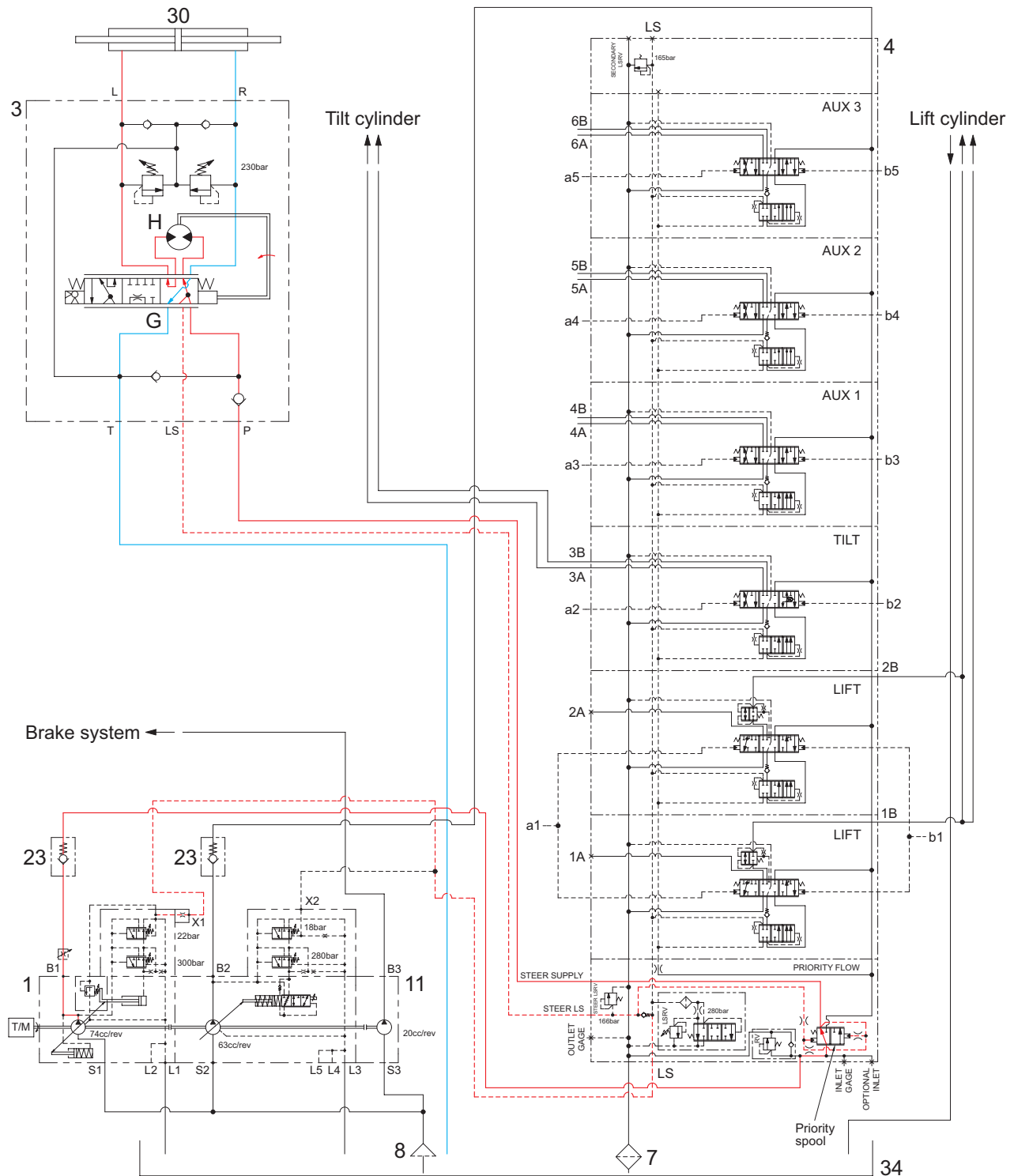
1) NEUTRAL



160D9LSS03

- The steering wheel is not being operated so control spool (G) does not move.
- The oil from the main pump (1) enters port P of steering unit (3) and the inlet pressure oil moves the priority spool built in the MCV (4) to the left.
- Almost all of pump flow goes to the main control valve through the priority spool in the MCV (4) and partly flows into the hydraulic tank (34) through the spool (G).

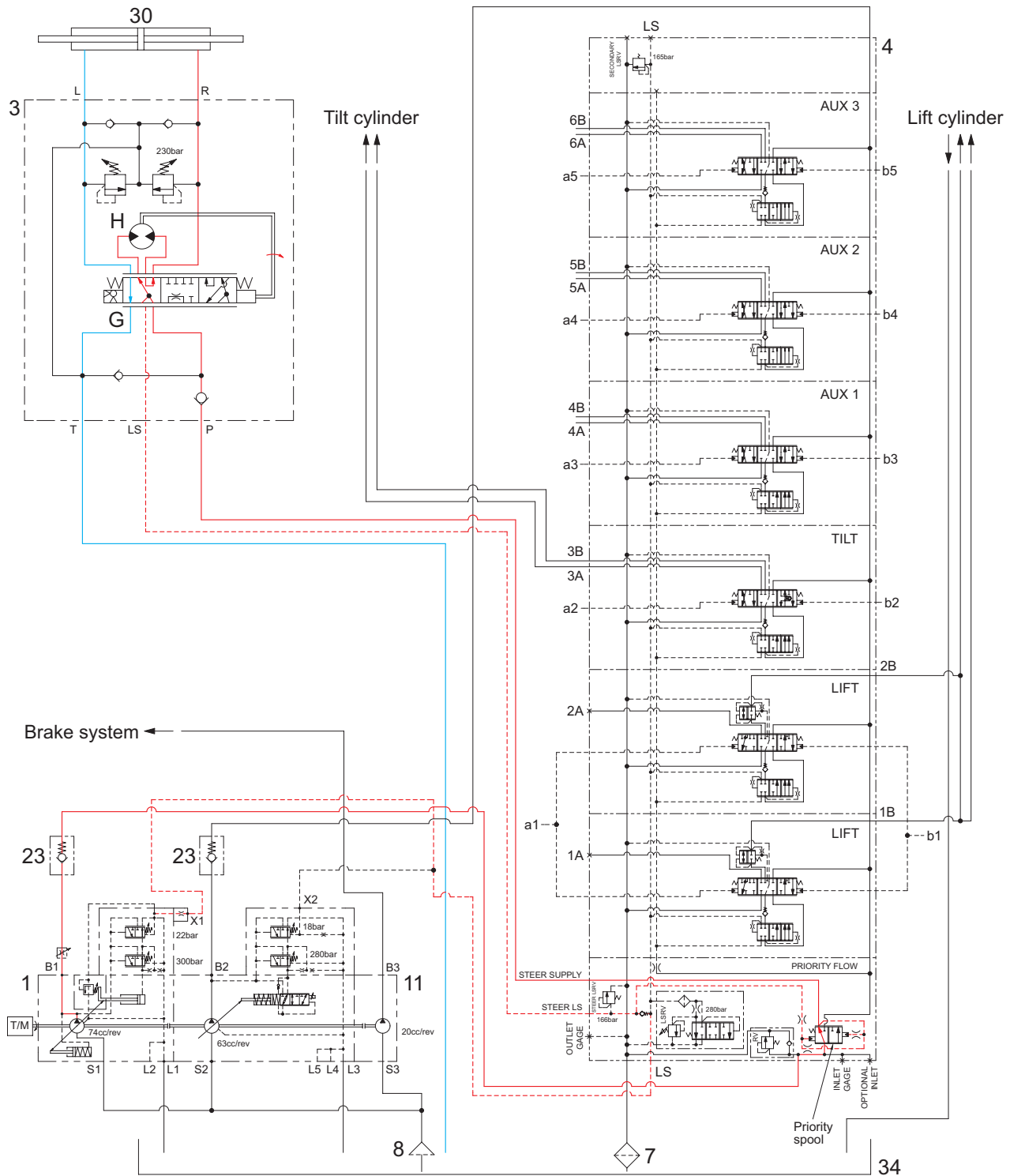
2) LEFT TURN



160D9LSS04

- When the steering wheel is turned to the left, the spool (G) within the steering unit (3) connected with steering column turns in left hand direction.
- At this time, the oil discharged from the main pump (1) flows into the spool (G) in the steering unit through the priority valve built in the MCV (4) and flows the gerotor (H).
- Oil flow from the gerotor (H) flows back into the spool (G) where it is directed out the left work port (L).
- Oil returned from cylinder returns to hydraulic tank (34).
- When the above operation is completed, the vehicle turns to the left.

3) RIGHT TURN

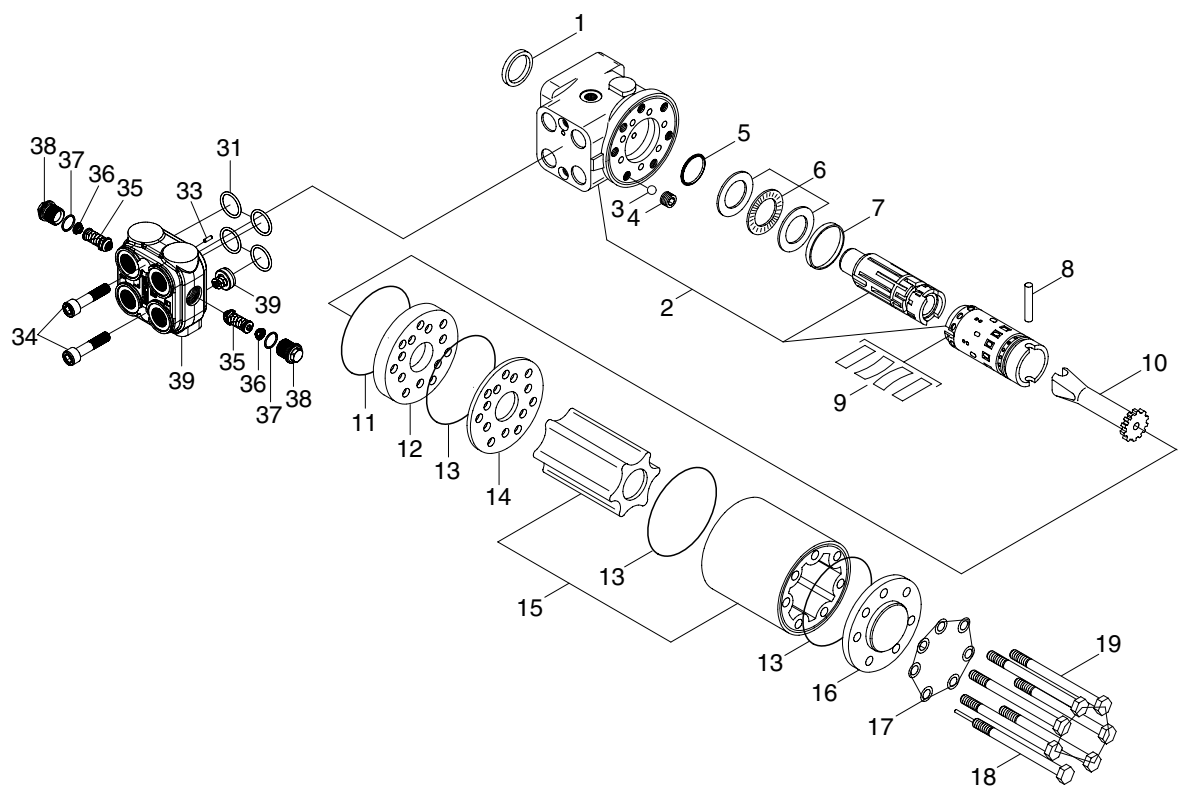


160D9LSS05

- When the steering wheel is turned to the right, the spool (G) within the steering unit (3) connected with steering column turns in right hand direction.
- At this time, the oil discharged from the main pump (1) flows into the spool (G) in the steering unit through the priority valve built in the MCV (4) and flows the gerotor (H).
- Oil flow from the gerotor (H) flows back into the spool (G) where it is directed out the right work port (R).
- Oil returned from cylinder returns to hydraulic tank (34).
- When the above operation is completed, the vehicle turns to the right.

3. STEERING UNIT

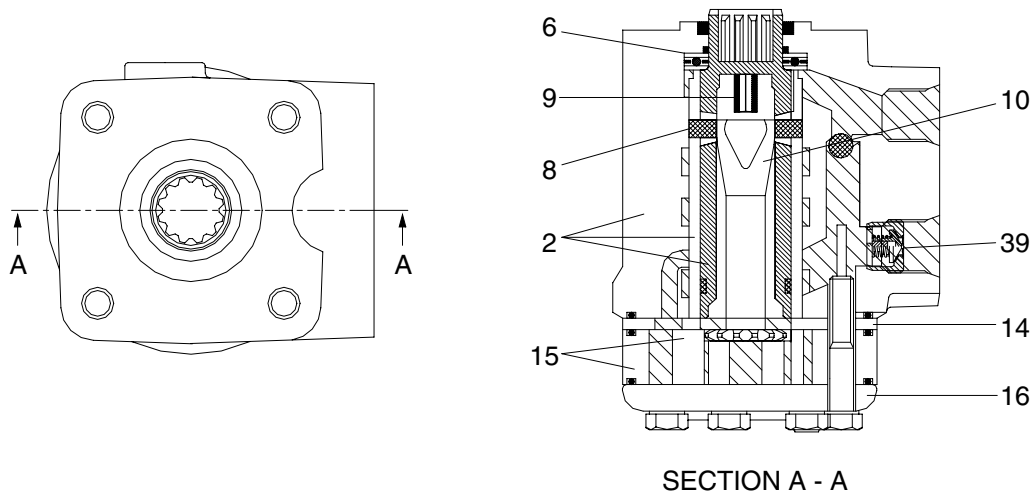
1) STRUCTURE



74095SE05

- | | | | | | |
|---|------------------------|----|--------------------|----|----------------------|
| 1 | Dust seal ring | 10 | Cardan shaft | 19 | Screw |
| 2 | Housing, spool, sleeve | 11 | O-ring | 31 | Set of O-rings |
| 3 | Ball | 12 | Intermediate plate | 33 | Roller pin |
| 4 | Thread bushing | 13 | O-ring | 34 | Screw |
| 5 | Rotor glyd ring | 14 | Distributor plate | 35 | Shock valve |
| 6 | Bearing assembly | 15 | Gearwheel set | 36 | Spring |
| 7 | Ring | 16 | End cover | 37 | O-ring |
| 8 | Cross pin | 17 | Washer | 38 | Plug |
| 9 | Set of springs | 18 | Screw with pin | 39 | Housing, check valve |

2) OPERATION



7407SE06

The steering unit consists of a rotary valve and a rotary meter.

Via a steering column the steering unit is connected to the steering wheel of the vehicle.

When the steering wheel is turned, oil is directed from the steering system pump via the rotary valve (spool and sleeve) and rotary meter (gear wheel set) to the cylinder ports L or R, depending on the direction of turn. The rotary meter meters the oil flow to the steering cylinder in proportion to the angular rotation of the steering wheel.

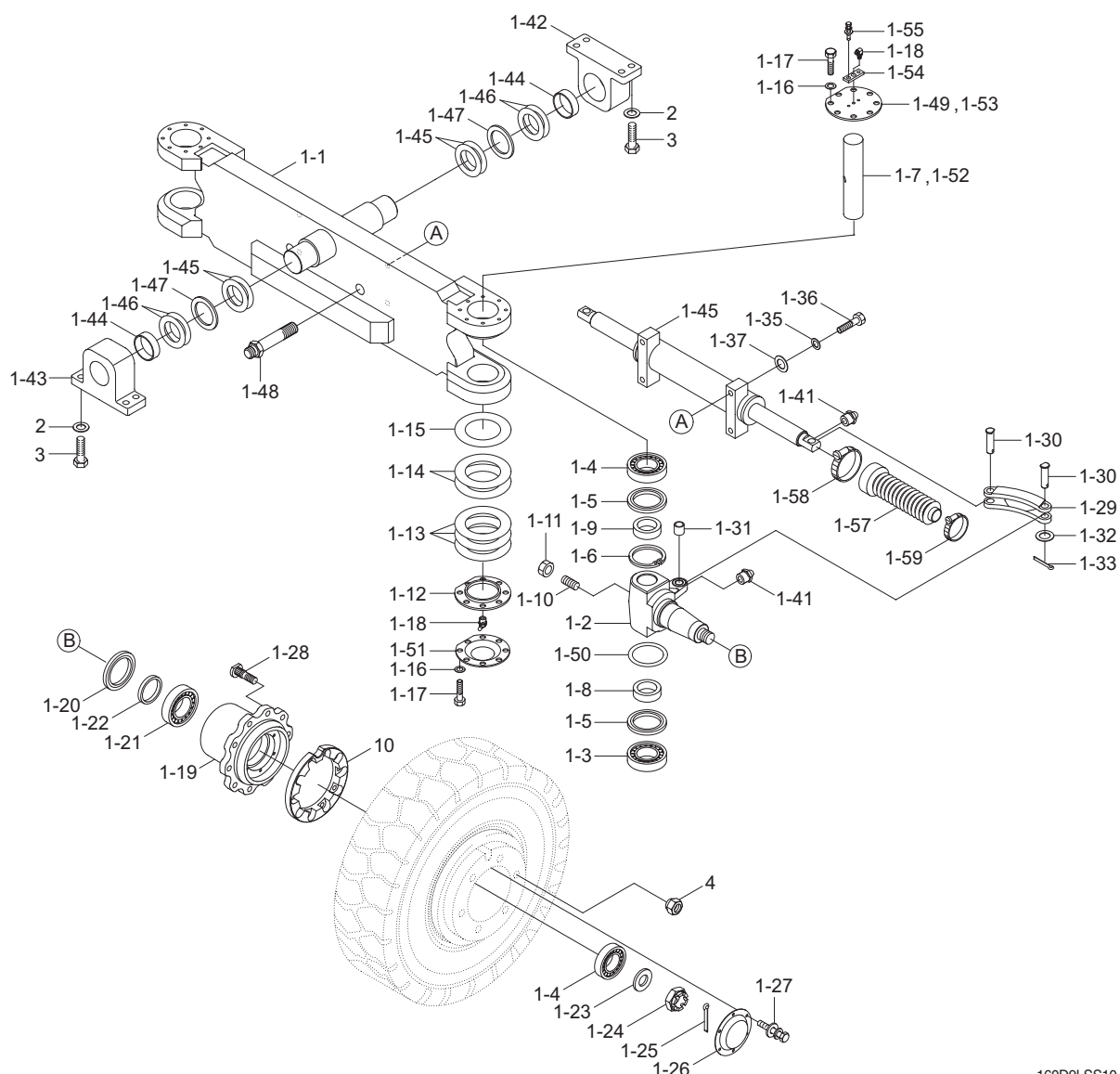
Spool is connected directly to the cardan shaft (10) of steering wheel. It is connected to sleeve by cross pin (8) (not in contact with the spool when the steering wheel is at neutral) and neutral position spring (9).

Cardan shaft (10) is meshed at the top with cross pin (8) and forms one unit with sleeve.

At the same time, it is meshed with gear rim of the gerotor set by spline.

There are four ports in valve body. They are connected to the pump circuit, tank circuit, and the head, and left and right steering cylinder. In addition, the pump port and tank port are connected inside the body by the check valve. Therefore, if there is any failure in the pump of engine, oil can be sucked in directly from the tank through the check valve.

4. STEERING AXLE

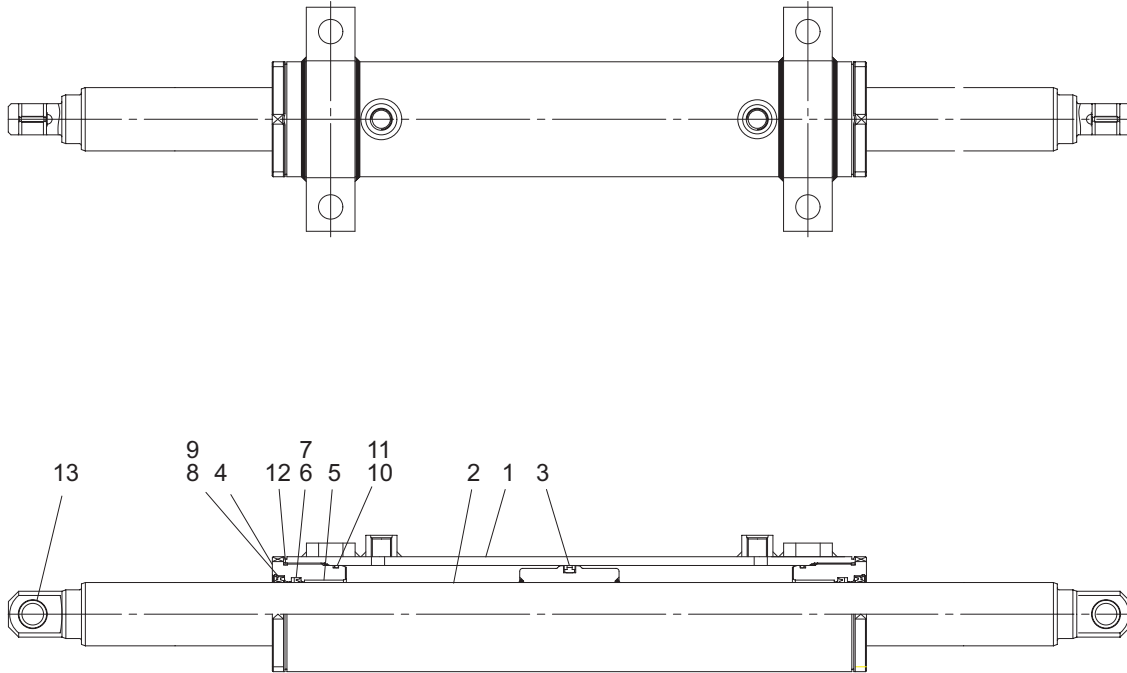


160D9LSS10

1-1	Steering axle	1-16	Hardened washer	1-31	Bushing	1-49	Cover (LH)
1-2	Knuckle	1-17	Hexagon bolt	1-32	Special washer	1-50	Spacer
1-3	Taper roller bearing	1-18	Grease nipple	1-33	Split pin	1-51	Plate
1-4	Taper roller bearing	1-19	Hub	1-34	Steering cylinder	1-52	King pin (RH)
1-5	Oil seal	1-20	Oil seal	1-35	Hardened washer	1-53	Cover (RH)
1-6	Retaining ring	1-21	Taper roller bearing	1-36	Hexagon bolt	1-54	Plate
1-7	King pin (LH)	1-22	Spacer	1-37	Shim (0.2 t)	1-55	Bolt with washer
1-8	Spacer	1-23	Special washer	1-41	Grease nipple	1-57	Steering cylinder boots
1-9	Spacer	1-24	Lock nut	1-42	Rear support	1-58	Hose clamp
1-10	Socket set screw	1-25	Split pin	1-43	Front support	1-59	Hose clamp
1-11	Hexagon nut	1-26	Cap	1-44	Bushing	2	Hardened washer
1-12	Cover	1-27	Bolt with washer	1-45	Spacer	3	Hexagon bolt
1-13	Shim (0.1t)	1-28	Wheel bolt	1-46	Shim (0.2 t)	4	Hub nut
1-14	Shim (0.2 t)	1-29	Link	1-47	Shim (0.5 t)	10	Protector (opt)
1-15	Shim (0.5 t)	1-30	Link pin	1-48	Connector		

5. STEERING CYLINDER

1) STRUCTURE



160D9LSS06

- | | | | | | |
|---|---------------|----|----------------|----|--------------|
| 1 | Tube assembly | 6 | U-packing | 11 | Back up ring |
| 2 | Rod assembly | 7 | Back up ring | 12 | O-ring |
| 3 | Piston seal | 8 | Dust wiper | 13 | Pin bushing |
| 4 | Rod cover | 9 | Retaining ring | | |
| 5 | Rod bushing | 10 | O-ring | | |

2) OPERATION

This machine use to cross connected cylinder for steering operation.

The steering cylinder use a rod cover (4) to remove piston and sealed seals. Dust wiper (8) located on the in side of the rod cover protects cylinder inner parts from dust. The piston is fastened to the rod (2) by weld.

The piston uses a single piston seal (3) to seal between the piston and tube. The rod cover seals against the tube with two O-rings. The rod is sealed against the rod cover with a U-packing (6).

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

This procedure is designed so the service man can make a quick check of the steering system using a minimum amount of diagnostic equipment. If you need additional information, refer to structure and function in group 1.

A location will be required which is level and has adequate space to complete the checks.

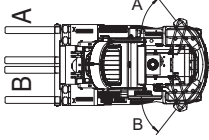
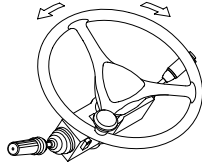
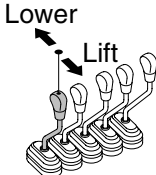
The engine and all other major components must be at operating temperature for some checks.

Locate system check in the left column and read completely, following this sequence from left to right. Read each check completely before performing.

At the end of each check, if no problem is found (OK), that check is complete or an additional check is needed. If problem is indicated (NOT OK), you will be give repair required and group location. If verification is needed, you will be give next best source of information :

- Chapter 2 : Troubleshooting
- Group 3 : Tests and adjustments

※ Hydraulic oil must be at operating temperature for these checks.

Item	Description	Service action
Steering unit check	 <p>Run engine at low idle.</p> <p>Turn steering wheel until frames are at maximum right (A) and then left (B) positions.</p> <p>LOOK : Frames must move smoothly in both directions.</p> <p>When steering wheel is stopped, tires must stop.</p> <p>FEEL : Excessive effort must not be required to turn steering wheel.</p> <p>NOTE : It is normal for steering to drift from stops when steering wheel is released.</p>	<p>OK Check completed.</p> <p>NOT OK Go to next check.</p>
Steering system leakage check Heat hydraulic oil to operating temperature. Run engine at high idle.	 <p>Turn steering wheel rapidly until frames are against stop.</p> <p>Hold approximately 2kg on steering wheel.</p> <p>Count steering wheel revolutions for 1 minute.</p> <p>Repeat test in opposite direction.</p> <p>LOOK : Steering wheel should rotate less than 3 rpm.</p> <p>NOTE : Use good judgment; Excessive steering wheel rpm does not mean steering will be affected.</p>	<p>OK Check completed.</p> <p>NOT OK Do steering system leakage test in group 3 to isolate the leakage.</p>
Priority valve (In main pump) low pressure check	<p>Park machine on a hard surface.</p> <p>Hold brake pedal down.</p> <p>Run engine at high idle.</p> <p>Steer machine to the right and left as far as possible.</p> <p>LOOK : Machine must turn at least half way to the right and left stops.</p>	<p>OK Check completed.</p> <p>NOT OK Do priority valve pressure test.</p>
Priority valve (In main pump) high pressure check Run engine at high idle.	 <p>Steer to steering stop and release steering wheel.</p> <p>Lift, tilt hold over relief and observe engine rpm.</p> <p>Turn steering wheel to steering stop and hold, observe engine rpm.</p> <p>LOOK : Steering stall engine rpm must be higher than hydraulic stall rpm.</p>	<p>OK Check completed.</p> <p>NOT OK Priority pressure is set too high. Do priority valve pressure test.</p>

2. TROUBLESHOOTING

※ Diagnose malfunction charts are arranged from most probable and simplest to verify, to least likely, more difficult to verify. Remember the following steps when troubleshooting a problem :

Step 1. Operational check out procedure (See group 3 in section 1)

Step 2. Operational checks (In this group)

Step 3. Troubleshooting

Step 4. Tests and adjustments (See group 3)

Problem	Cause	Remedy
No steering	Low oil level Failed steering pump Failed main pump drive Stuck priority valve spool Broken priority valve spring Relief valve in steering valve stuck open.	Add recommended oil. Remove and inspect return filter for metal pump particles. Do main pump flow test. Remove and inspect priority valve spool. Remove and inspect spring. Do relief cartridge leakage test.
No hydraulic functions steering normal	Stuck open system relief valve Locked safety valve Plugged pilot line filter Failed hydraulic pump Low secondary pressure of RCV	Replace relief valve. Unlock safety valve. Inspect and replace. Remove and inspect the pump. Check the pressure and replace if necessary.

Problem	Cause	Remedy
Slow or hard steering	Too much friction in the mechanical parts of the machine Cold oil Low priority valve pressure setting Worn hydraulic pump Sticking priority valve spool Broken priority valve spring	Lubricate bearings and joints of steering column or repair if necessary. Check steering column installation. Warm the hydraulic oil. Do priority valve pressure test. Clean or replace cartridge in steering valve. Do hydraulic pump performance check. Remove and inspect. Remove and inspect.
Constant steering to maintain straight travel	Air in system Leakage in steering system Worn steering unit Leaf spring without spring force or broken Spring in double shock valve broken Gear wheel set worn Cylinder seized or piston seals worn	Check for foamy oil. Do steering system leakage check. Do steering system leakage check. Do steering unit neutral leakage test in group 3. Replace leaf springs. Replace shock valve. Replace gear wheel set. Replace defects parts.
Slow steering wheel movement will not cause any frame movement	Leakage in steering unit gerotor Worn steering unit gerotor	Do steering system leakage check. Do steering leakage check.
Steering wheel can be turned with frames against steering stop	Leakage in steering system	Do steering system leakage check.
Steering wheel turns with no resistance and causes no frame movement	Broken steering column or splined coupling Lack of oil in steering unit Leakage in steering system	Remove and inspect. Start engine and check steering operation. Do steering system leakage test in group 3.

Problem	Cause	Remedy
Erratic steering	Air in oil Low oil level Sticking priority valve spool Loose cylinder piston Damaged steering unit	Check for foamy oil. Add recommended oil. Remove and inspect spool. Remove rod to inspect piston. Remove and inspect.
Spongy or soft steering	Air in oil Low oil level	Check for foamy oil. Add recommended oil.
Free play at steering wheel	Loose steering wheel nut Worn or damaged splines on steering column or unit	Tighten. Inspect.
Steering unit binding or steering wheel does not immediately return to neutral when released	Binding in steering column or misalignment of column High return pressure Contamination in steering unit Large particles of contamination in steering unit	Inspect. Check for a pinched or damaged return line. Inspect hydraulic filter for contamination. Repair cause of contamination. Flush hydraulic system. Inspect hydraulic filter for contamination. Repair cause of contamination. Flush hydraulic system.
Steering unit locks up	Worn or damaged steering unit	Repair or replace steering unit.
Abrupt steering wheel oscillation	Improperly timed gerotor gear in steering unit	Time gerotor gear.
Steering wheel turns by itself	Lines connected to wrong port	Reconnect lines.
Vibration in steering system or hoses jump	High priority valve setting	Do priority valve pressure test.
Neutral position of steering wheel cannot be obtained, i.e. there is a tendency towards "motoring"	Steering column and steering unit out of line Too little or no play between steering column and steering unit input shaft Pinching between inner and outer spools	Align the steering column with steering unit. Adjust the play and, if necessary, shorten the splines journal. Contact the nearest service shop.

Problem	Cause	Remedy
"Motoring" effect. The steering wheel can turn on its own.	Leaf springs are stuck or broken and have therefore reduced spring force	Replace leaf springs.
	Inner and outer spools pinch, possibly due to dirt	Clean steering unit or contact the nearest service shop.
	Return pressure in connection with the reaction between differential cylinder and steering unit too high	Reduce return pressure.
	Oil is needed in the tank	Fill with clean oil and bleed the system.
	Steering cylinder worn	Replace or repair cylinder.
	Gear wheel set worn	Replace gear wheel set.
	Spacer across cardan shaft forgotten	Install spacer.

Problem	Cause	Remedy
Backlash	Cardan shaft fork worn or broken Leaf springs without spring force or broken Worn splines on the steering column	Replace cardan shaft. Replace leaf springs. Replace steering column.
"Shimmy" effect. The steered wheels vibrate. (rough tread on tires gives vibrations)	Air in the steering cylinder Mechanical connections or wheel bearings worn High priority valve setting pressure	Bleed cylinder. Find and remove the reason for air collection. Replace worn parts. Set pressure as regular value.
Steering wheel can be turned slowly in one or both directions without the steered wheels turn-ing.	One or both shock valves are leaky or are missing in steering valve	Clean or replace defective or missing valves.
Steering is too slow and heavy when trying to turn quickly.	Insufficient oil supply to steering unit, pump defective or number of revolutions too low Relief valve setting too low Relief valve sticking owing to dirt Spool in priority valve sticking owing to dirt. Too weak spring in priority valve	Replace pump or increase number of revolutions. Adjust valve to correct setting. Clean the valve. Clean the valve, check that spool moves easily without spring. Replace spring by a stronger.
"Kick back" in steering wheel from system. Kicks from wheels.	Fault in the system	Contact authorized man or shop.

Problem	Cause	Remedy
Heavy kick-back in steering wheel in both directions.	Wrong setting of cardan shaft and gear-wheel set	Correct setting as shown in service manual.
Turning the steering wheel activates the steered wheels opposite.	Hydraulic hoses for the steering cylinders have been switched around	Connect lines to correct ports.
Hard point when starting to turn the steering wheel	Spring force in priority valve too weak Clogged orifices in LS side in priority valve Oil is too thick(Cold)	Replace spring by a stronger. Clean orifices in spool and in connecting plugs for LS. Let motor run until oil is warm.
Too little steering force (possibly to one side only)	Pump pressure too low Too little steering cylinder Piston rod area of the differential cylinder too large compared with piston diameter	Correct pump pressure. Fit a larger cylinder. Fit cylinder with thinner piston rod or 2 differential cylinders.
Leakage at either input shaft, end cover, gear wheel set, housing or top part.	Shaft defective Screws loose Washers or O-rings defective	Replace shaft seal. Tighten screws. Replace.

GROUP 3 TESTS AND ADJUSTMENTS

1. HYDRAULIC OIL CLEAN UP PROCEDURE USING PORTABLE FILTER CADDY

- ※ Service equipment and tool.
 - Portable filter caddy
 - Two 3658 mm (12ft) × 1" I.D. 100R1 hoses with 3/4 M NPT ends
 - Quick disconnect fittings
 - Discharge wand
 - Various size fittings and hoses
- ※ Brake system uses oil from hydraulic oil tank.
Flush all lines in the steering system.
Disassemble and clean major components for steering system.
Steering components may fail if steering system is not cleaned after hydraulic oil tank contamination.
- 1) If hydraulic system is contaminated due to a major component failure, remove and disassemble steering cylinders to clean debris from cylinders.
- 2) Install a new return filter element. Clean filter housing before installing new element.
- ※ For a failure that creates a lot of debris, remove access cover from hydraulic oil tank. Drain and clean hydraulic oil tank of fill the specified oil to hydraulic oil tank through upper cover.
- 3) To minimize oil loss, pull a vacuum in hydraulic oil tank using a vacuum pump. Connect filter caddy suction line to drain port at bottom of hydraulic oil tank using connector. Check to be sure debris has not closed drain port.
- 4) Put filter caddy discharge line into hydraulic oil tank filter hole so end is as far away from drain port as possible to obtain a through cleaning of oil.

- 5) Start the filter caddy. Check to be sure oil is flowing through the filters.
Operate filter caddy approximately 10 minutes so oil in hydraulic oil tank is circulated through filter a minimum of four times.
 - ※ Hydraulic oil tank capacity.
 - 242 ℓ (53.2 U.S. gal)
 - Leave filter caddy operating for the next steps.
- 6) Start the engine and run it at high idle.
 - ※ For the most effective results, cleaning procedure must start with the smallest capacity circuit then proceed to the next largest capacity circuit.
- 7) Operate all functions, one at a time, through a complete cycle. Also include all auxiliary hydraulic functions.

Repeat procedure until the total system capacity has circulated through filter caddy seven times, approximately 30 minutes.
Each function must go through a minimum of three complete cycles for a through cleaning for oil.
 - ※ Filtering time for machines with auxiliary hydraulic functions must be increased because system capacity is larger.
- 8) Stop the engine. Remove the filter caddy.
- 9) Install a new return filter element.
- 10) Check oil level in hydraulic oil tank ; Add oil if necessary.

2. TEST TOOLS

1) CLAMP-ON ELECTRONIC TACHOMETER INSTALLATION

- Service equipment and tools

Tachometer

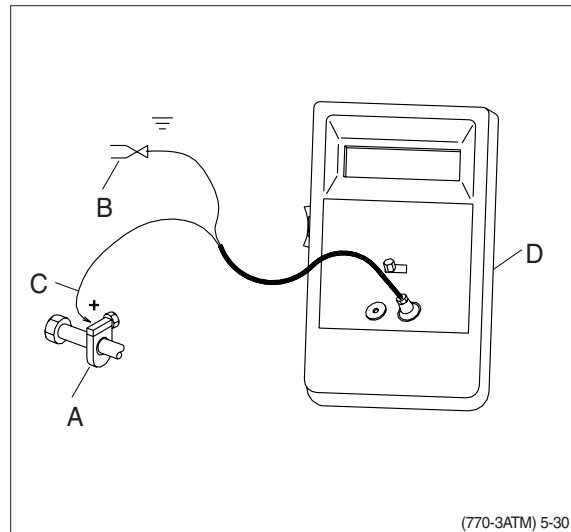
A : Clamp on tachometer.

Remove paint using emery cloth and connect to a straight section of injection line within 100 mm (4 in) of pump. Finger tighten only-do not over tighten.

B : Black clip (-). Connect to main frame.

C : Red clip (+). Connect to transducer.

D : Tachometer readout. Install cable.



2) DIGITAL THERMOMETER INSTALLATION

- Service equipment and tools

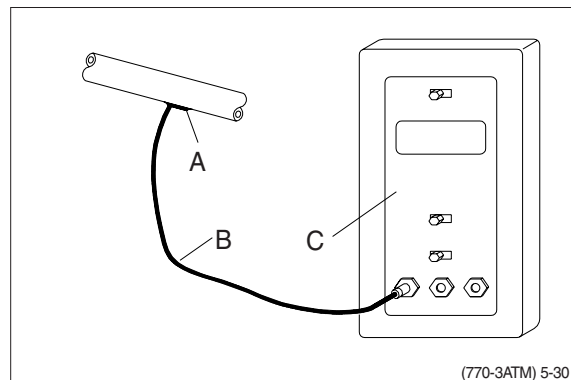
Digital thermometer

A : Temperature probe.

Fasten to a bare metal line using a tie band. Wrap with shop towel.

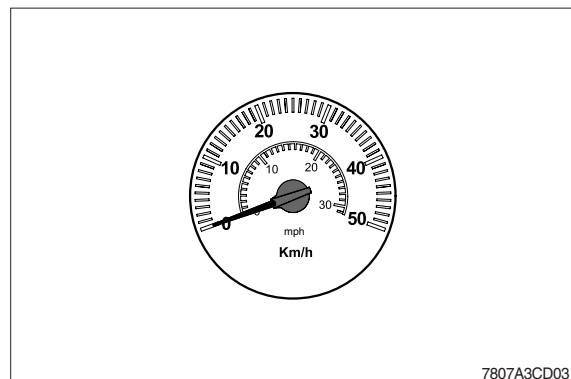
B : Cable.

C : Digital thermometer.



3) DISPLAY MONITOR TACHOMETER

The display monitor tachometer is accurate enough for test work.



3. STEERING UNIT LEAKAGE TEST

- **SPECIFICATION**

Oil temperature 45 ± 5 °C (113 ± 9 °F)

Engine speed High idle

Maximum leakage 7.5 ℓ /min (2 gpm)

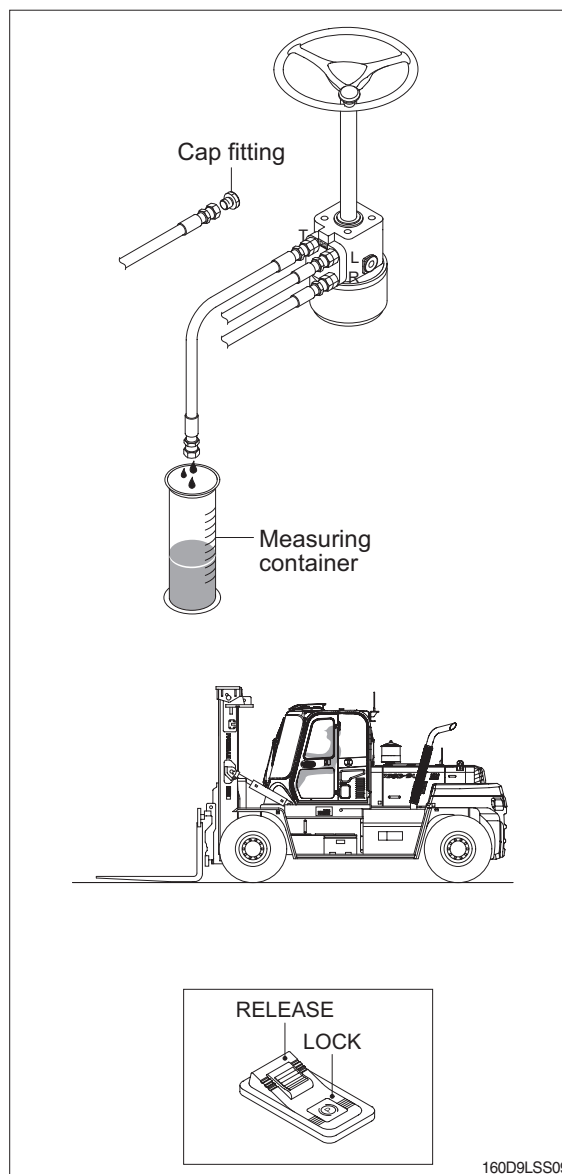
- **GAUGE AND TOOL**

Temperature reader

Measuring container (Approx. 20 ℓ)

Stop watch

- 1) Install temperature reader.
(See temperature reader installation procedure in this group).
- 2) Heat hydraulic oil to specifications.
- 3) Disconnect return hose from fitting.
Install cap fitting.
- 4) Run engine at specifications. Rotate steering wheel completely to the right (or left) approximately 1.2 kgf · m of force.
Measure oil flow from return hose for 1 minute.
- 5) If leakage is greater than specifications, repair or replace steering unit.

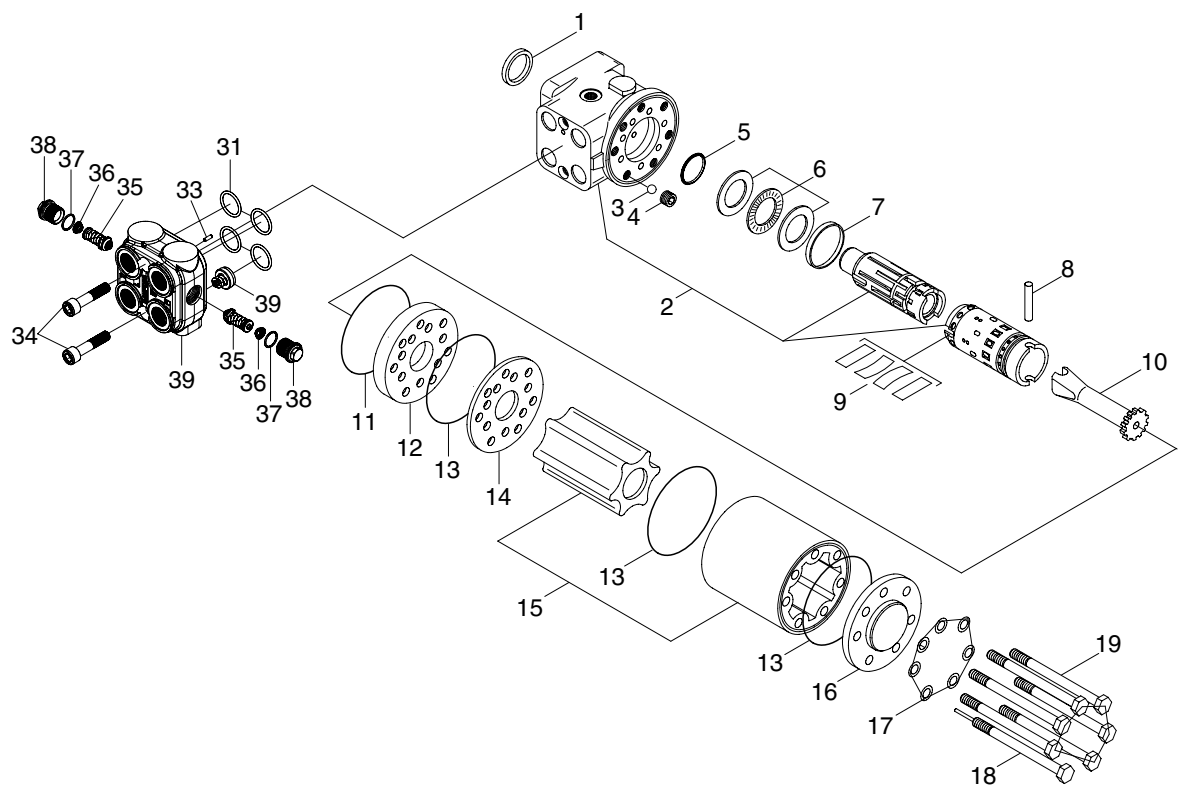


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GROUP 4 DISASSEMBLY AND ASSEMBLY

1. STEERING UNIT

1) STRUCTURE

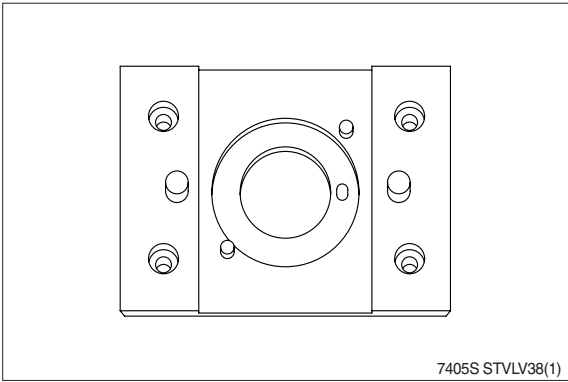


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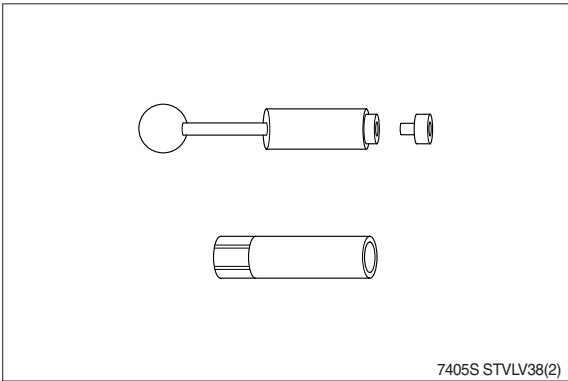
- | | | | | | |
|---|------------------------|----|--------------------|----|----------------------|
| 1 | Dust seal ring | 10 | Cardan shaft | 19 | Screw |
| 2 | Housing, spool, sleeve | 11 | O-ring | 31 | Set of O-rings |
| 3 | Ball | 12 | Intermediate plate | 33 | Rollled pin |
| 4 | Thread bushing | 13 | O-ring | 34 | Screw |
| 5 | Roto glyd ring | 14 | Distributor plate | 35 | Shock valve |
| 6 | Bearing assembly | 15 | Gearwheel set | 36 | Spring |
| 7 | Ring | 16 | End cover | 37 | O-ring |
| 8 | Cross pin | 17 | Washer | 38 | Plug |
| 9 | Set of springs | 18 | Screw with pin | 39 | Housing, check valve |

2) TOOLS

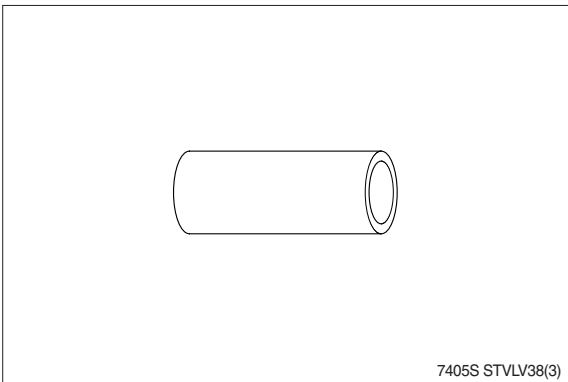
(1) Holding tool.



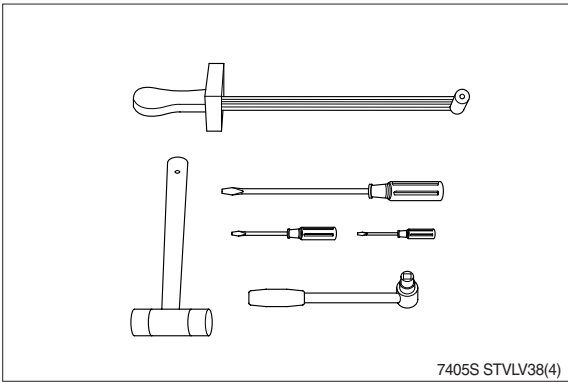
(2) Assembly tool for O-ring and kin-ring.



(3) Assembly tool for dust seal.

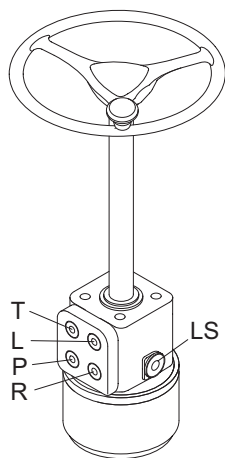


- (4) Torque wrench 0~7.1 kgf · m (0~51.6 lb · ft)
13 mm socket spanner
12 mm screwdriver
6 mm screwdriver
2 mm screwdriver
Plastic hammer
Ratchet spanner



3) TIGHTENING TORQUE AND HYDRAULIC CONNECTIONS

(1) Hydraulic connections



L : Left port
R : Right port
T : Tank port
P : Pump port
L : Load sensing port

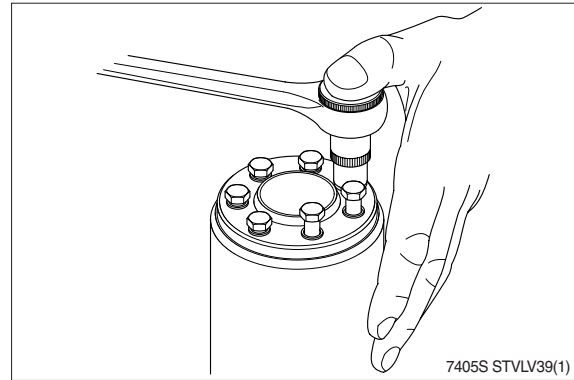
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(2) Tightening torque

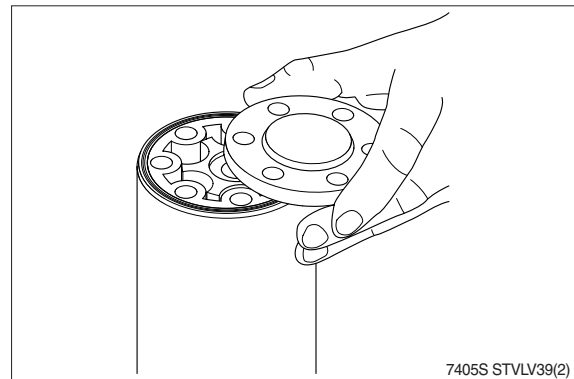
Screwed connection	Max. tightening torque [kgf·m (lbf·ft)]			
	With cutting edge	With copper washer	With aluminum washer	With O-ring
1/4 BSP.F	4.1 (29.7)	2.0 (14.5)	3.1 (22.4)	-
3/8 BSP.F	6.1 (44.1)	2.0 (14.5)	5.1 (36.9)	-
1/2 BSP.F	10.2 (73.8)	3.1 (22.4)	8.2 (59.3)	-
7/16-20 UNF	-	2.0 (14.5)	-	-
3/4-16 UNF	-	6.1 (44.1)	-	-
M 12×1.5	4.1 (29.7)	2.0 (14.5)	3.1 (22.4)	2.0 (14.5)
M 18×1.5	7.1 (51.4)	2.0 (14.5)	5.1 (36.9)	5.1 (36.9)
M 22×1.5	10.2 (73.8)	3.1 (22.4)	8.2 (59.3)	7.1 (51.4)

4) DISASSEMBLY

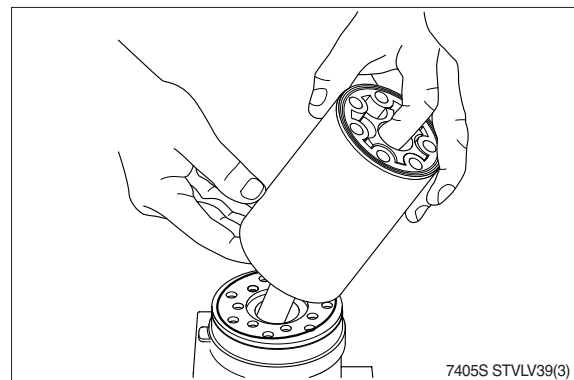
- (1) Disassemble steering column from steering unit and place the steering unit in the holding tool. Screw out the screws in the end cover (7-off-one rolled pin).



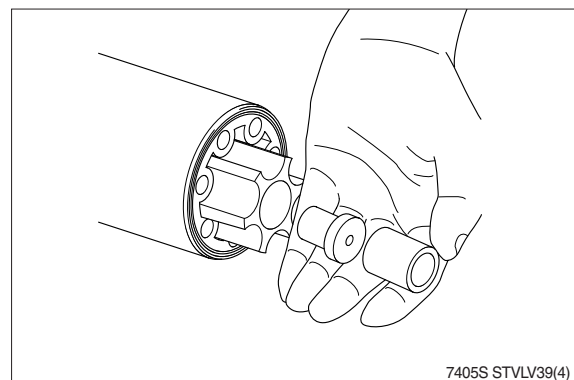
- (2) Remove the end cover, sideways.



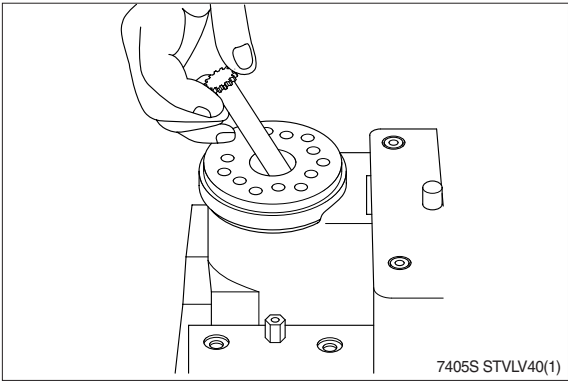
- (3) Lift the gearwheel set with spacer bushing (and spacer if fitted) off the unit. Take out the two O-rings.



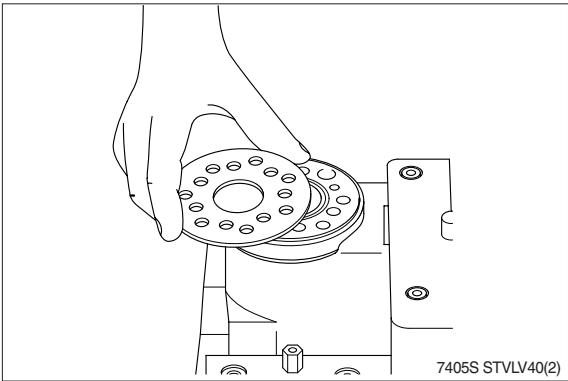
- (4) Remove spacer bushing and spacer(if fitted) from the gearwheel.



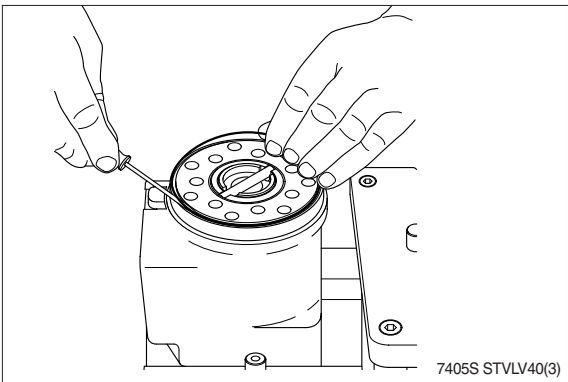
(5) Remove cardan shaft.



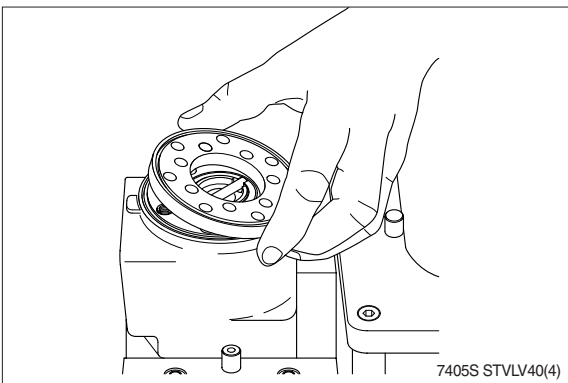
(6) Remove distributor plate.



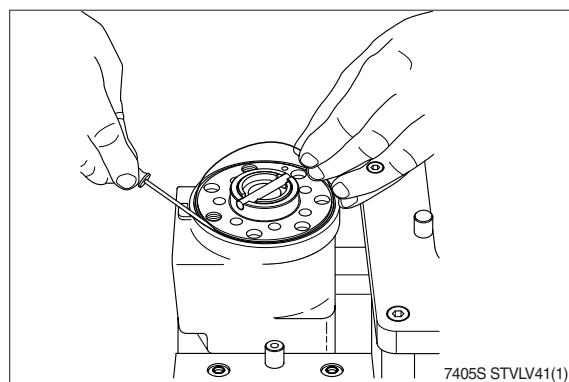
(7) Remove O-ring.



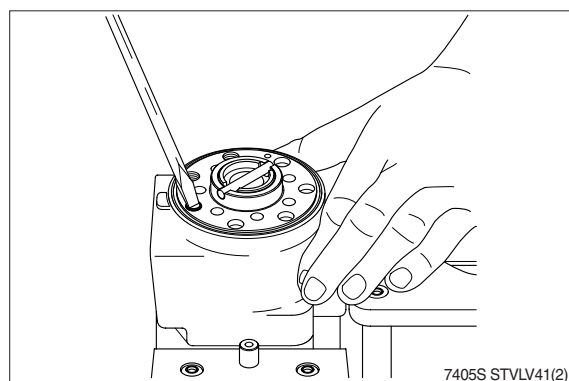
(8) Lift off intermediate plate.



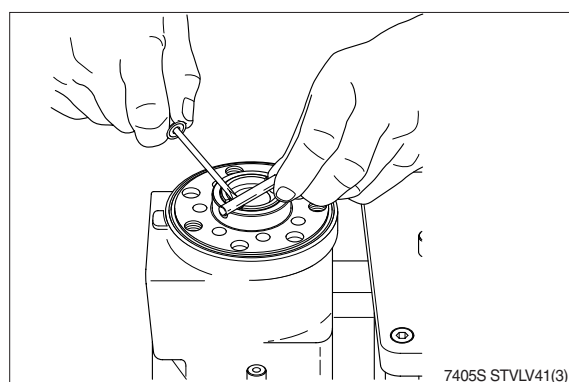
(9) Remove O-ring.



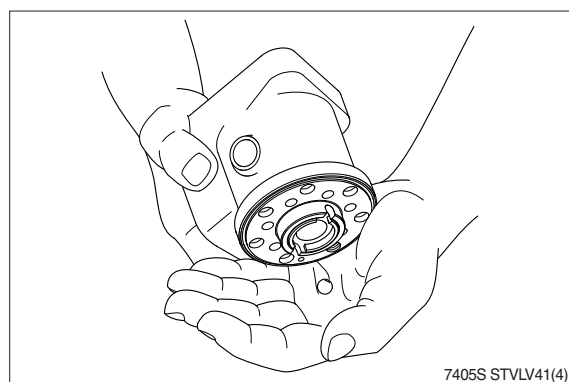
(10) Screw out the threaded bushing.



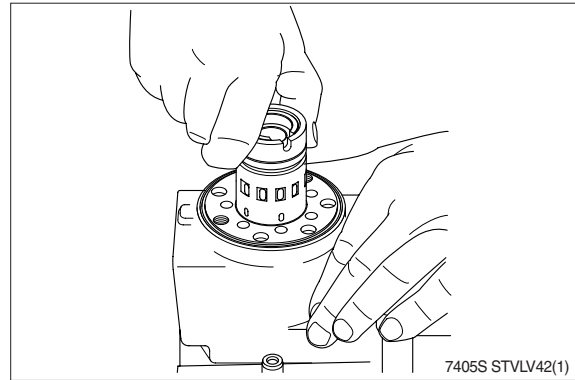
(11) Remove cross pin.



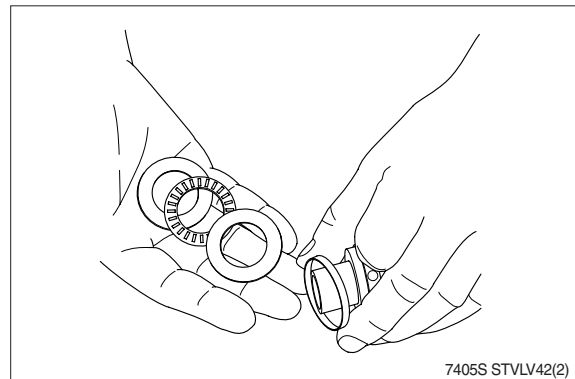
(12) Shake out the ball (Ø8.5 mm).



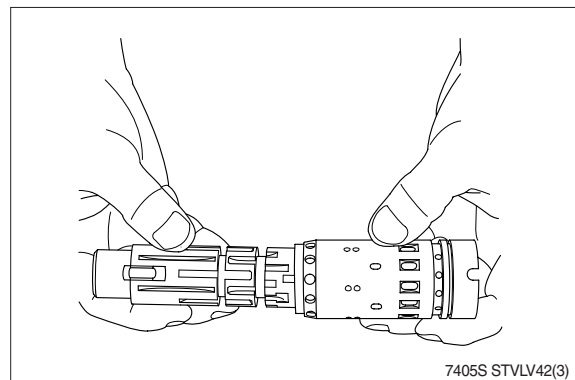
(13) Pull sleeve and spool out of the housing.



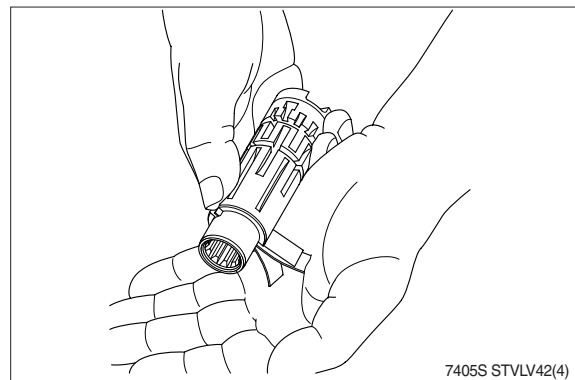
(14) Take ring, bearing races and needle bearing from sleeve and spool. The outer (thin) bearing race can sometimes "stick" in the housing, therefore check that it has come out.



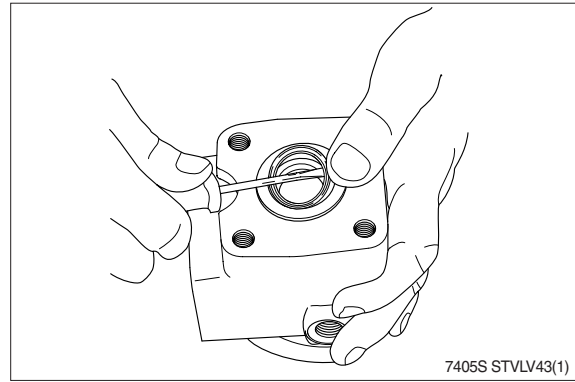
(15) Carefully pull the spool out of the sleeve.



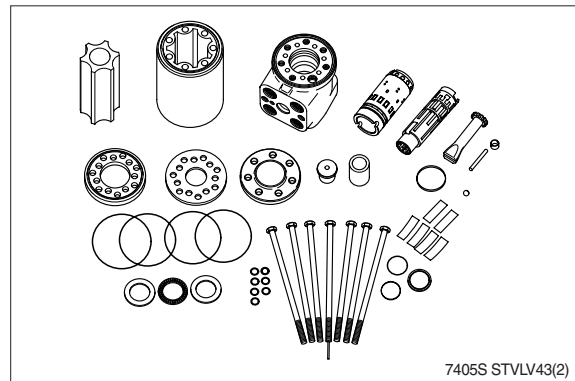
(16) Press the neutral position springs out of their slots in the spool.



(17) Remove dust seal and O-ring.



(18) The steering unit is now completely disassembled.



Cleaning

Clamp all parts carefully in Shellsol K or the like.

Inspection an replacement

Replace all seals and washer. Check all parts carefully and make any replacements necessary.

Lubrication

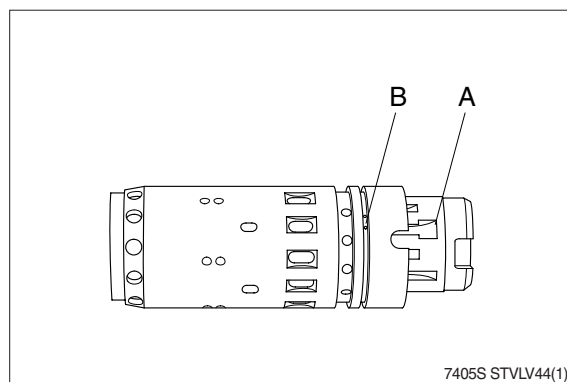
Before assembly, lubricate all parts with hydraulic oil.

5) ASSEMBLY

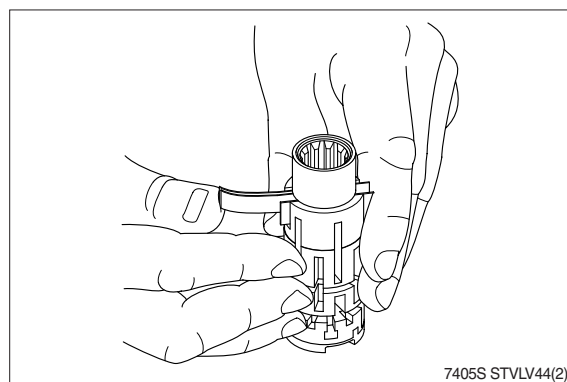
(1) Assemble spool and sleeve.

※ The sleeve and spool are correctly assembled when

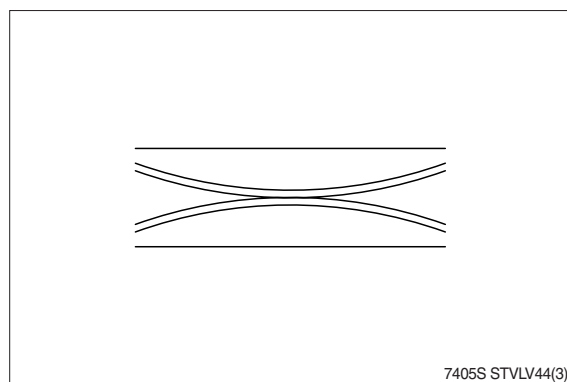
- ① The slots-in sleeve and spool-for the neutral position springs are opposite each other and
- ② One of the 3 T-shaped grooves (A) in the spool is opposite one of the sets (B) of small holes in the sleeve.



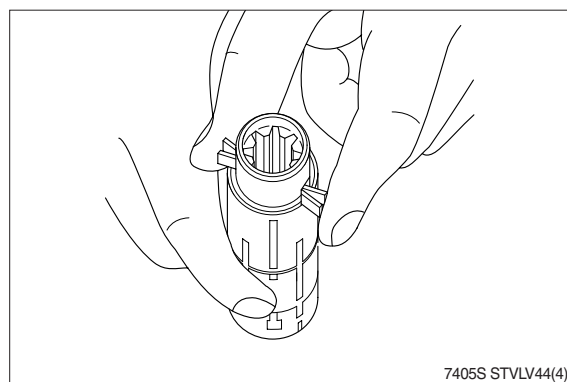
(2) Place the two flat neutral position springs in the slot.



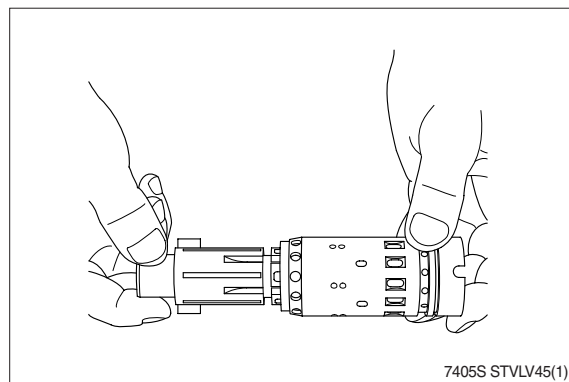
(3) Place the curved springs between the flat ones and press them into place.



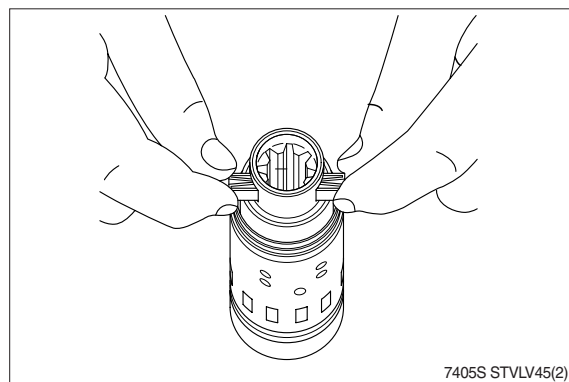
(4) Line up the spring set.



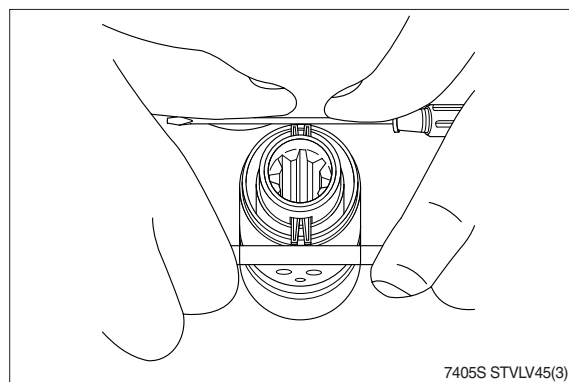
(5) Guide the spool into the sleeve.



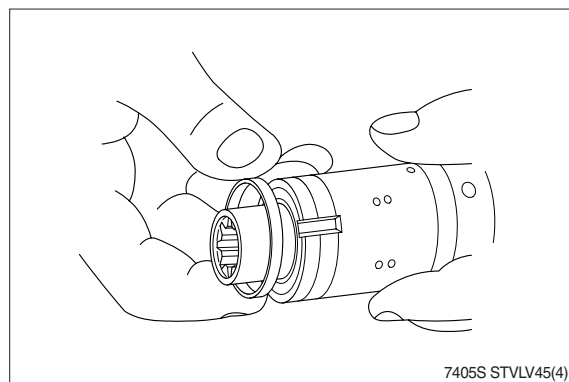
(6) Press the springs together and push the neutral position springs into place in the sleeve.



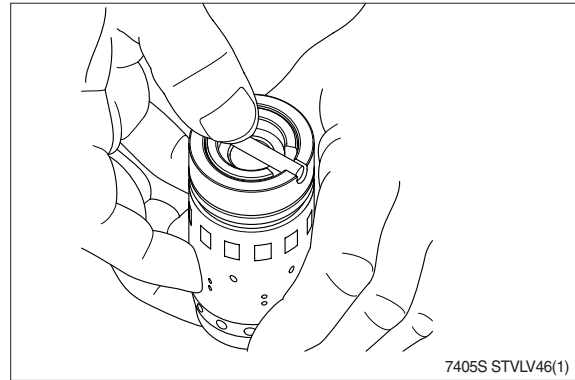
(7) Line up the springs and center them.



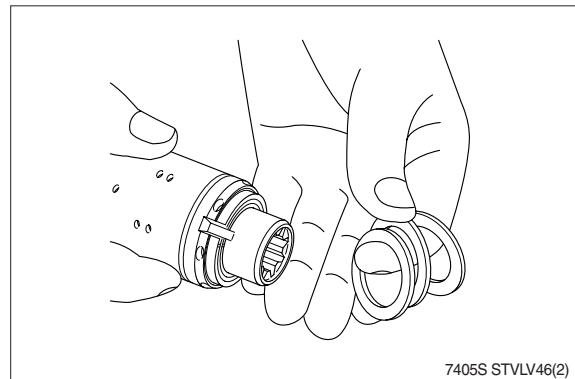
(8) Guide the ring down over the sleeve.
※ The ring should be able to rotate-free of the springs.



(9) Fit the cross pin into the spool/sleeve.

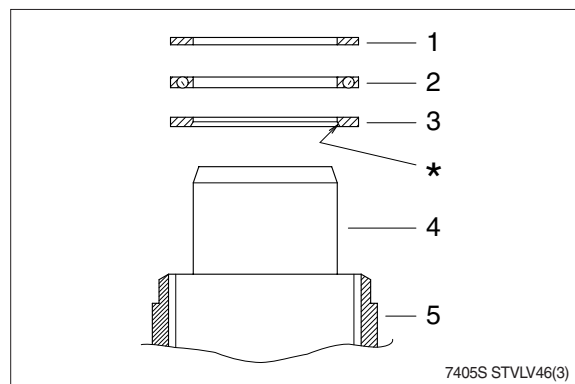


(10) Fit bearing races and needle bearing as shown on below drawing.

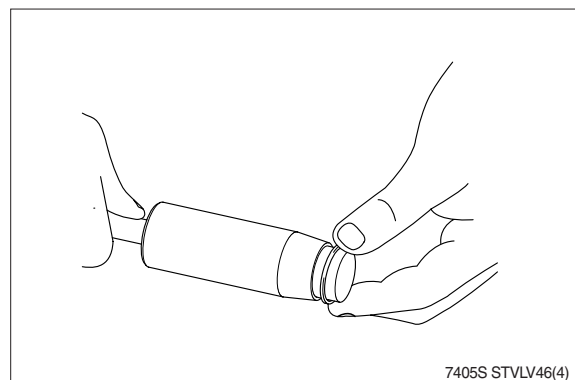


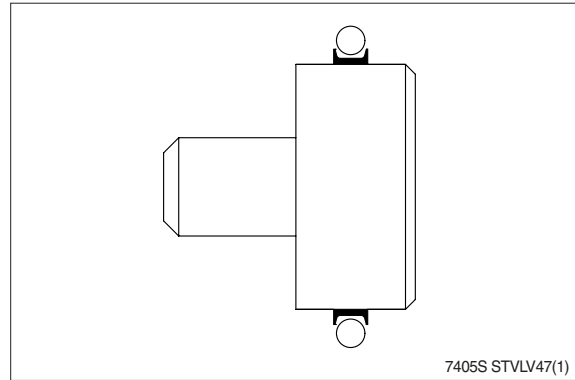
- 1 Outer bearing race
- 2 Needle bearing
- 3 Inner bearing race
- 4 Spool
- 5 Sleeve

* Inside chamfer on inner bearing race must face inner spool.

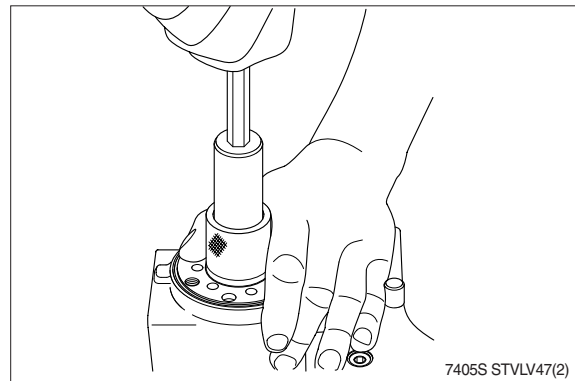


(11) Grease O-ring and kin-ring with hydraulic oil and place them on the tool. See next page.

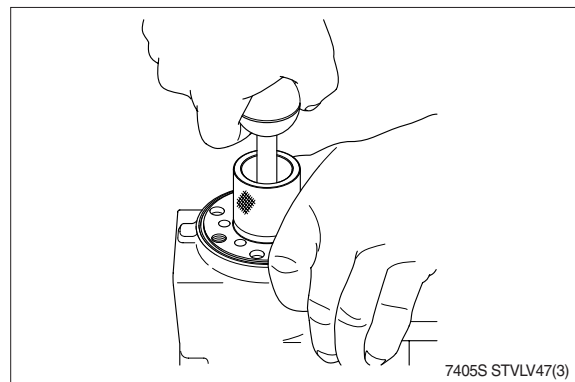




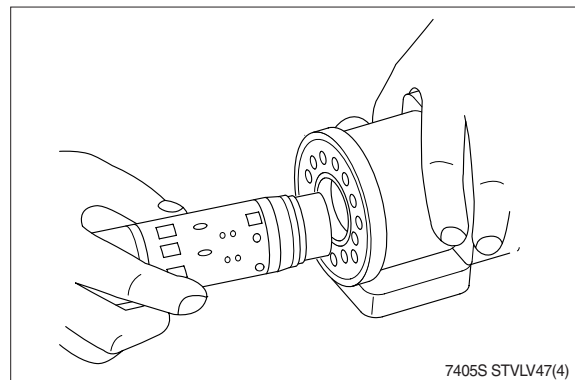
- (12) Put the steering unit in the holding tool keeping the bore vertical. Guide the outer part of the assembly tool into the bore. Guide the inner part of the tool right to the bottom.



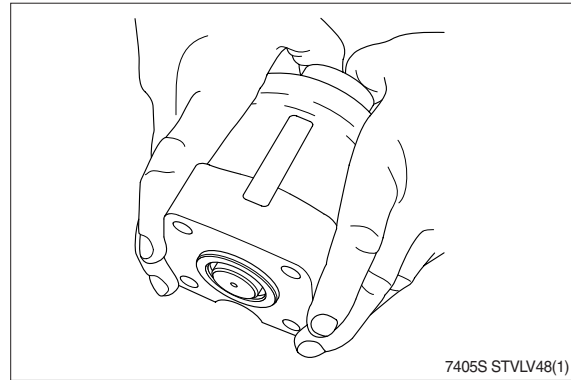
- (13) Press and turn the O-ring into position in the housing. Draw the inner and outer parts of the assembly tool out of the steering unit bore, leaving the guide in the bore.



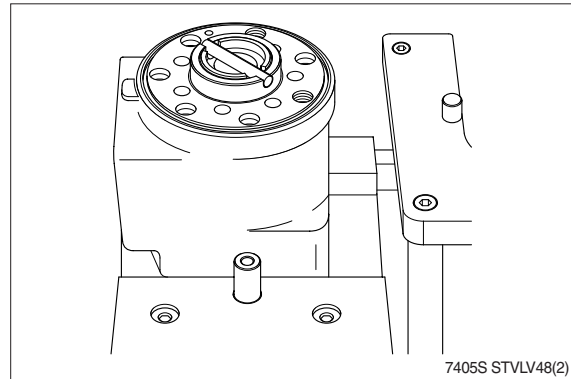
- (14) Take the steering unit out of the holding tool and place it horizontally. With a light turning movement, guide the spool and sleeve into the bore.



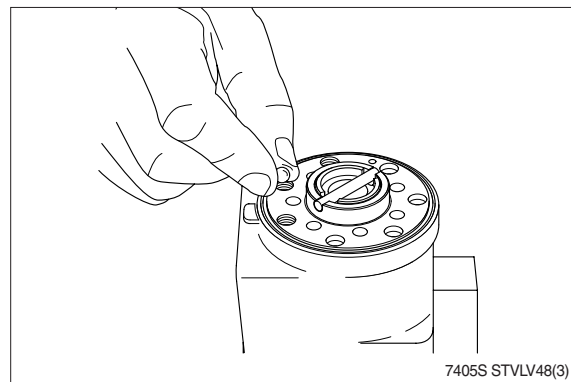
- (15) The spool set will push out the assembly tool guide. The O-ring is now in position.



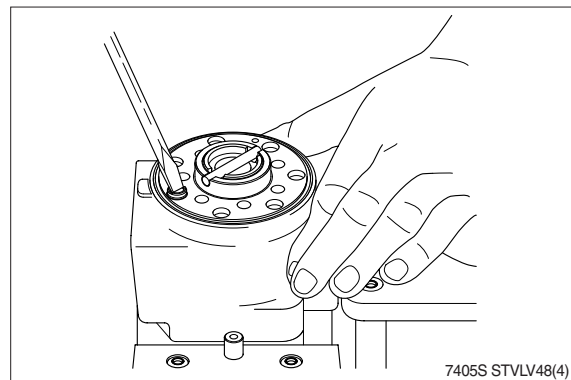
- (16) Put the steering unit back into the holding tool keeping the bore vertical. Place the cross pin in the spool/sleeve so that it is parallel to the port flange.



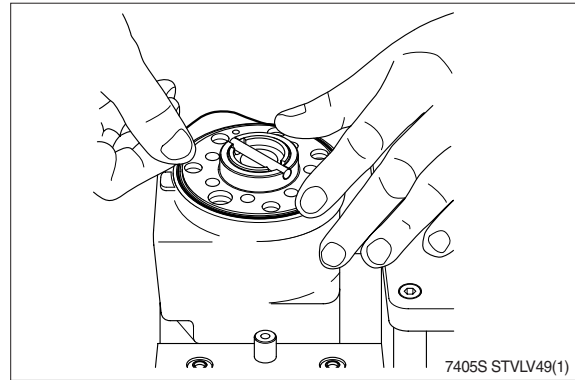
- (17) Put the ball into the hole indicated by the arrow.



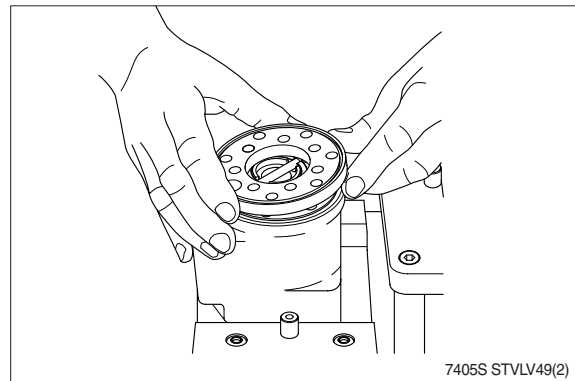
- (18) Screw the threaded bushing lightly into the bore. The top of the bushing must lie just below the surface of the housing.



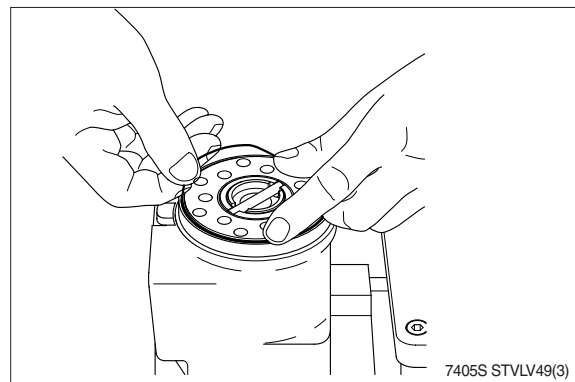
- (19) The spool set will push out the assembly tool guide. The O-ring is now in position.



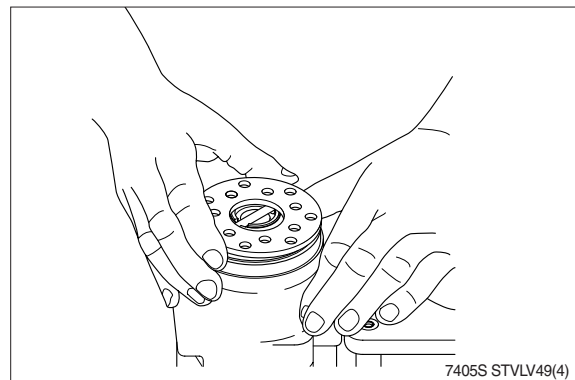
- (20) Put the steering unit back into the holding tool keeping the bore vertical. place the cross pin in the spool/sleeve so that it is parallel to the port flange.



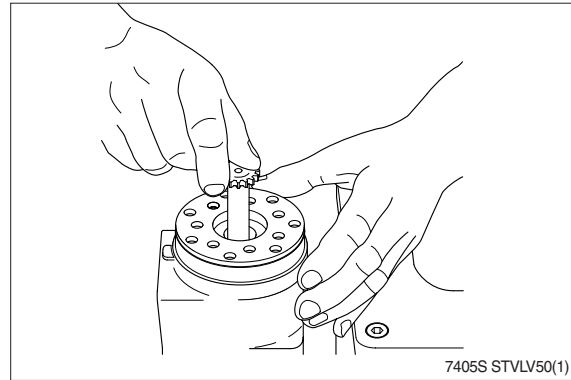
- (21) Put the ball into the hole indicated by the arrow.



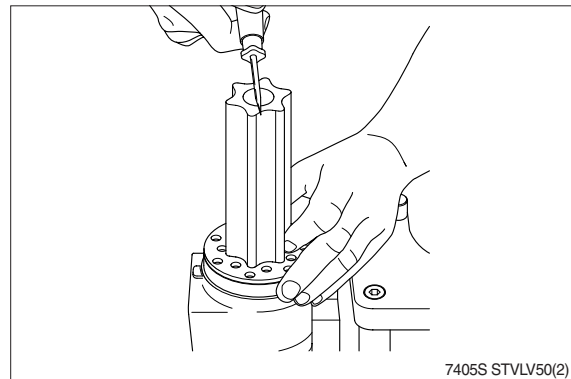
- (22) Screw the threaded bushing lightly into the bore. The top of the bushing must lie just below the surface of the housing.



- (23) Guide the cardan shaft down into the bore so that the slot is parallel with the connection flange.

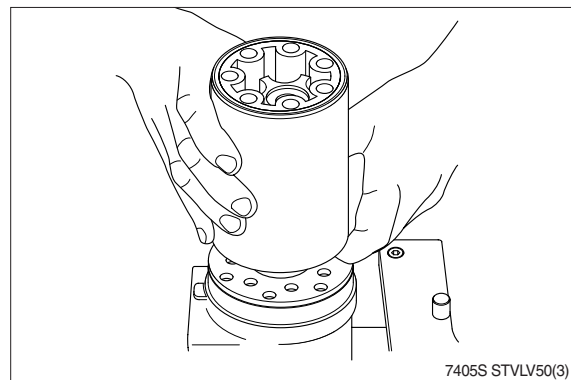


- (24) Place the gear wheel (rotor) so that the cross pin from item 33 is positioned in relation to two tooth bases - as the screw driver indicates.

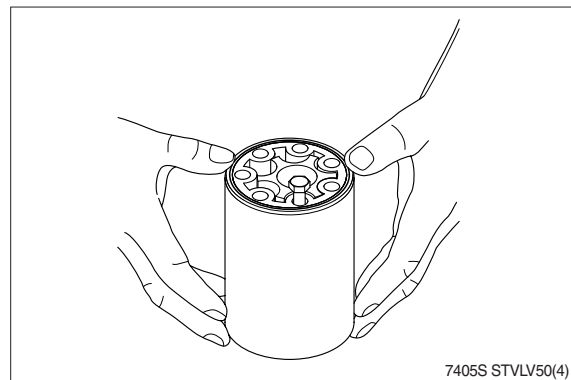


- (25) Grease the two O-rings with mineral oil approximate viscosity 500 cSt at 20°C and place them in the two grooves in the gear rim. Fit the gear rim so that the seven through holes match the holes in the distributor plate.

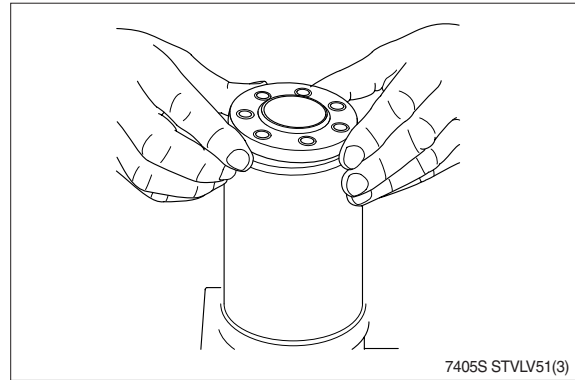
- ※ Turn the gear rim so that the smaller diameter of the holes face the distributor plate.



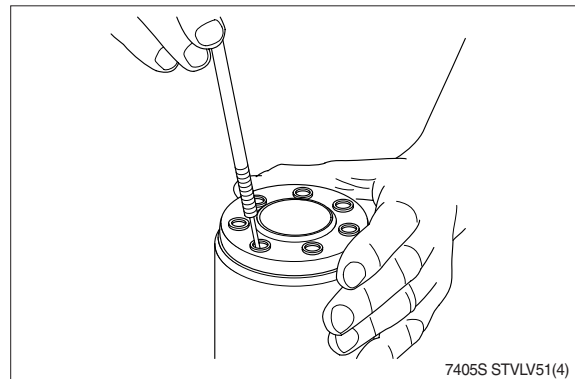
- (26) Orientate the holes with a single screw.



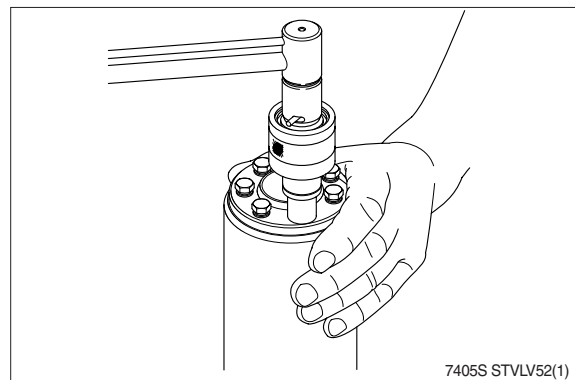
(27) Place the end cover in position.



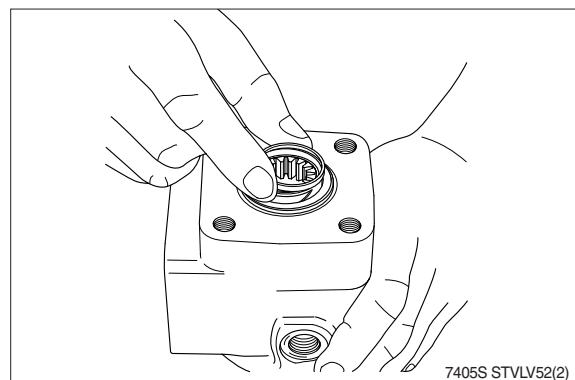
(28) Place the washers over the holes and the rolled pin in the hole shown.



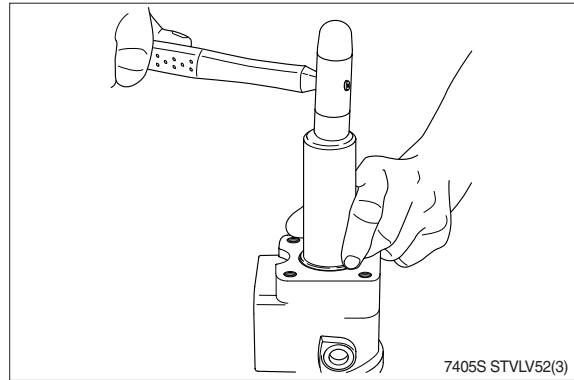
(29) Fit the other six screws. Cross - tighten all the screws and the rolled pin with a torque of $3 \pm 0.6 \text{ kgf} \cdot \text{m}$ ($22 \pm 4.4 \text{ lb} \cdot \text{ft}$). Steering unit can now be function tested.



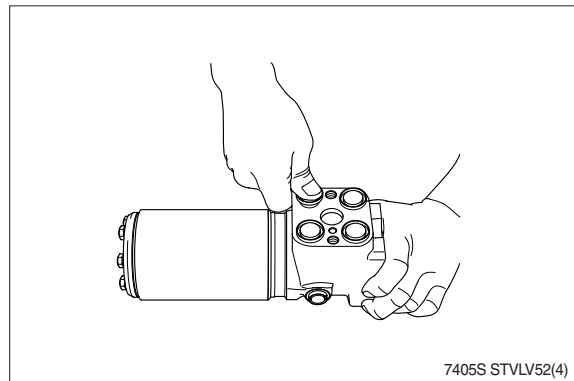
(30) Turn the steering unit 180° and place the dust seal ring in the housing.



- (31) Fit the dust seal ring in the housing using special tool and a plastic hammer.

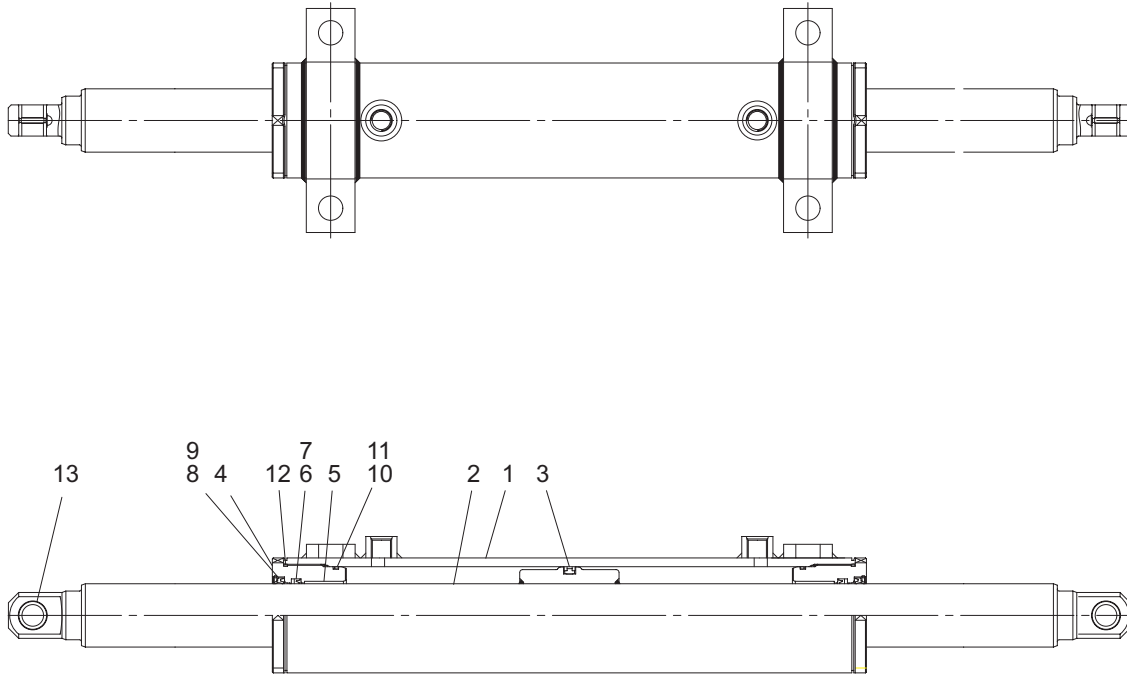


- (32) Press the plastic plugs into the connection ports. Do not use a hammer.



2. STEERING CYLINDER

1) STRUCTURE



160D9LSS06

- | | | | | | |
|---|---------------|----|----------------|----|--------------|
| 1 | Tube assembly | 6 | Rod seal | 11 | Back up ring |
| 2 | Rod assembly | 7 | Back up ring | 12 | O-ring |
| 3 | Piston seal | 8 | Dust wiper | 13 | Pin bushing |
| 4 | Gland | 9 | Retaining ring | | |
| 5 | DU bushing | 10 | O-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.

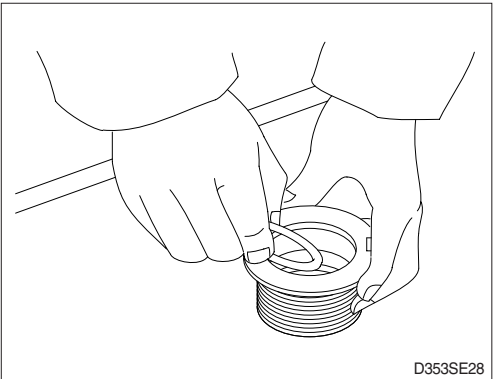
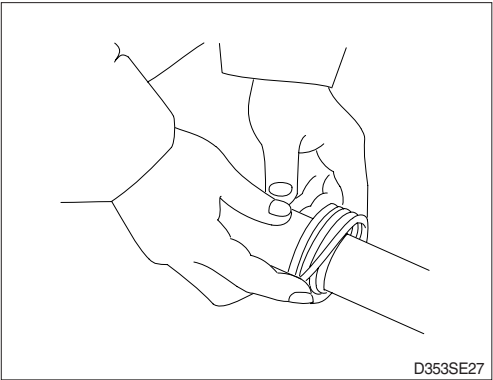
3) CHECK AND INSPECTION

mm (in)

Check item	Criteria		
	Standard size	Repair limit	Remarks
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

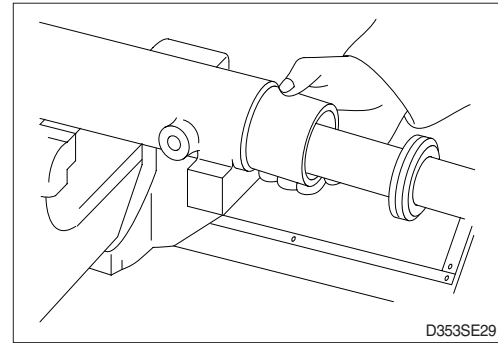
4) ASSEMBLY

- (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 U-packing (6) to the position in the cover applying a slight coat with grease prior to install.

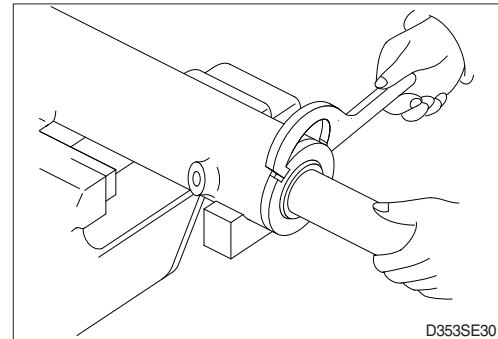


(3) Install the dust wiper to the rod cover using a special installing tool. Coat the dust wiper with grease slightly before installing.

(4) Using a special tool, install rod cover assembly into the cylinder tube.

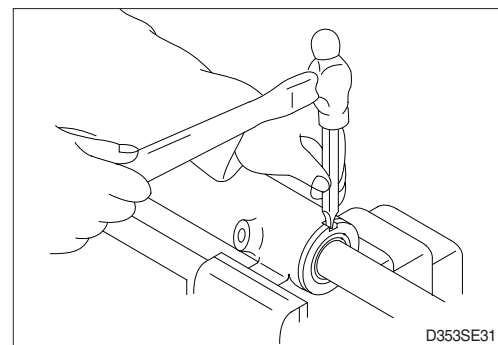


(5) Using a hook spanner, install the rod cover assembly, and tighten it with torque $60 \pm 6 \text{ kgf} \cdot \text{m}$ ($434 \pm 43 \text{ lbf} \cdot \text{ft}$).



(6) After the rod cover assembly was installed to the cylinder tube, calk at the tube end into the groove on the rod cover 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.

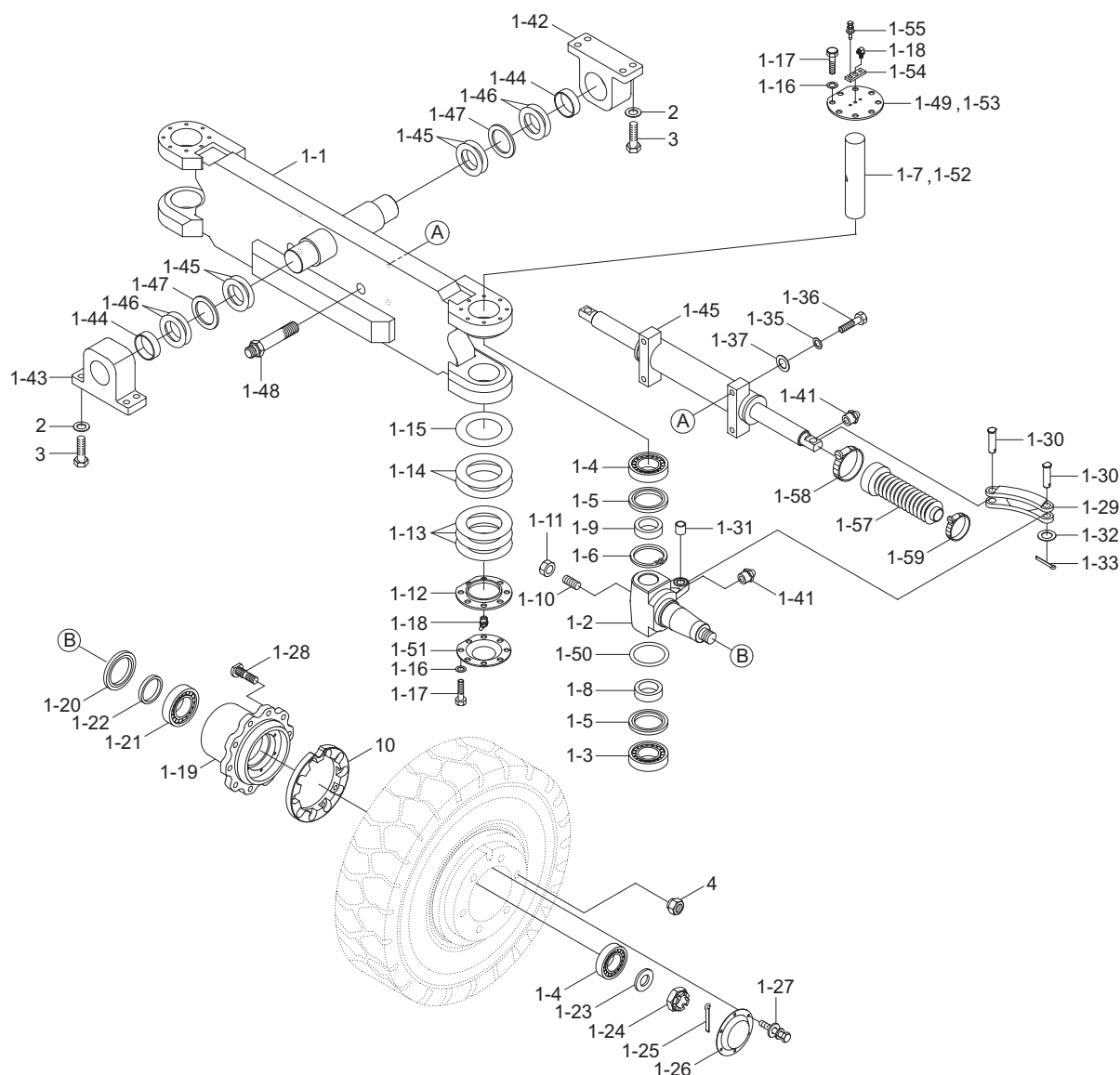
※ Then, repeat the above operation at gradually increasing engine rpm. This releases air from the system and completes preparation for operation.

(10) Stop the engine, lower the floating rear wheels, and check pump joints for oil leaks and looseness and retighten, them as required.

3. STEERING AXLE

1) STRUCTURE

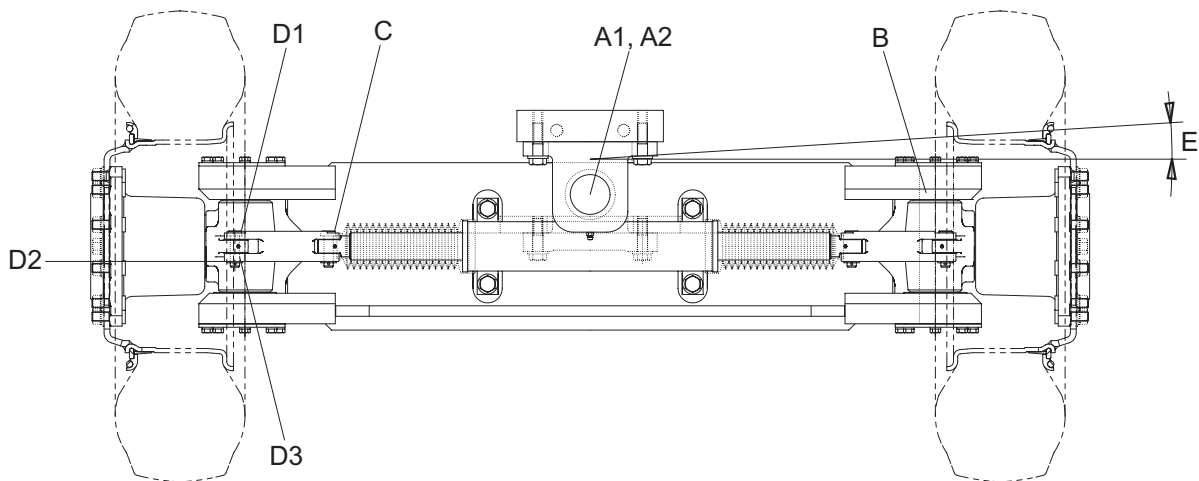
※ Do not remove the stopper bolt unless necessary.



160D9LSS10

1-1	Steering axle	1-16	Hardened washer	1-31	Bushing	1-49	Cover (LH)
1-2	Knuckle	1-17	Hexagon bolt	1-32	Special washer	1-50	Spacer
1-3	Taper roller bearing	1-18	Grease nipple	1-33	Split pin	1-51	Plate
1-4	Taper roller bearing	1-19	Hub	1-34	Steering cylinder	1-52	King pin (RH)
1-5	Oil seal	1-20	Oil seal	1-35	Hardened washer	1-53	Cover (RH)
1-6	Retaining ring	1-21	Taper roller bearing	1-36	Hexagon bolt	1-54	Plate
1-7	King pin (LH)	1-22	Spacer	1-37	Shim (0.2 t)	1-55	Bolt with washer
1-8	Spacer	1-23	Special washer	1-41	Grease nipple	1-57	Steering cylinder boots
1-9	Spacer	1-24	Lock nut	1-42	Rear support	1-58	Hose clamp
1-10	Socket setscrew	1-25	Split pin	1-43	Front support	1-59	Hose clamp
1-11	Hexagon nut	1-26	Cap	1-44	Bushing	2	Hardened washer
1-12	Cover	1-27	Bolt with washer	1-45	Spacer	3	Hexagon bolt
1-13	Shim (0.1t)	1-28	Wheel bolt	1-46	Shim (0.2 t)	4	Hub nut
1-14	Shim (0.2 t)	1-29	Link	1-47	Shim (0.5 t)	10	Protector (opt)
1-15	Shim (0.5 t)	1-30	Link pin	1-48	Connector		

2) CHECK AND INSPECTION



160D9LSS22

unit : mm (in)

No.	Check item			Criteria		Remarks
				Standard size	Repair limit	
A	Shaft	A1	OD of shaft	100 (3.94)	99 (3.90)	Replace
		A2	ID of bushing	100 (3.94)	99 (3.90)	
B	OD of king pin			80 (3.2)	79.5 (3.1)	
C	OD of steering cylinder pin			22 (0.9)	21.9 (0.9)	
D	Knuckle	D1	OD of pin	22 (0.9)	21.9 (0.9)	Adjust shim
		D2	Vertical play	-	0.2 (0.008)	
		D3	ID of bushing	22 (0.9)	22.5 (0.9)	Replace
E	Articulating angle			5 degree	-	

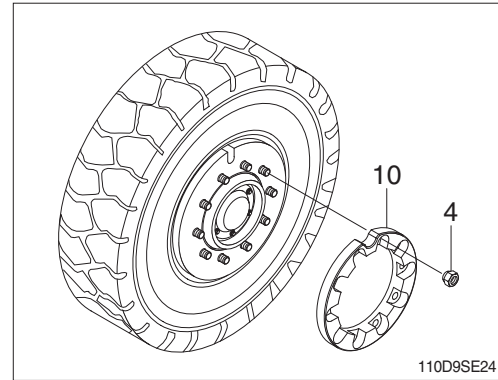
- OD : Outer diameter
- ID : Inner diameter

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 balance weight part of the truck.

(1) Loosen the hub nut (4) and take off the steering wheel tire.

※ Remove the protector (10) if equipped.



(2) Loosen the bolt (1-27) and remove hub cap (1-26).

(3) Pull out split pin (1-25) and remove lock nut (1-24), washer (1-23).

(4) Using the puller, take off the hub (1-19) together with the roller bearing (1-4, 1-21).

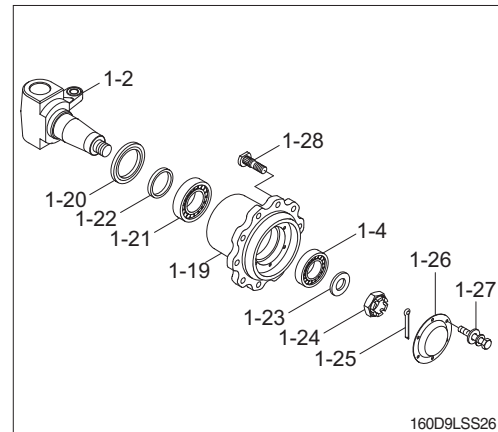
※ Be very careful because just before the hub comes off, tapered roller bearing will fall out.

(5) After hub is removed take off the inner race of roller bearing (1-4, 1-21).

(6) Pull out oil seal (1-20).

※ Don't use same oil seal twice.

(7) Repeat the same procedure for the other side. Moreover, when disassembling is completed, put the lock nut in the knuckle to protect the threaded portion.



(8) Loosen set screw (1-10) and nut (1-11).

(9) Loosen bolt and washer (1-16, 1-17) and remove cover (1-49, 1-53, 1-12), shim (1-13, 1-14, 1-15). Remove grease nipple (1-18).

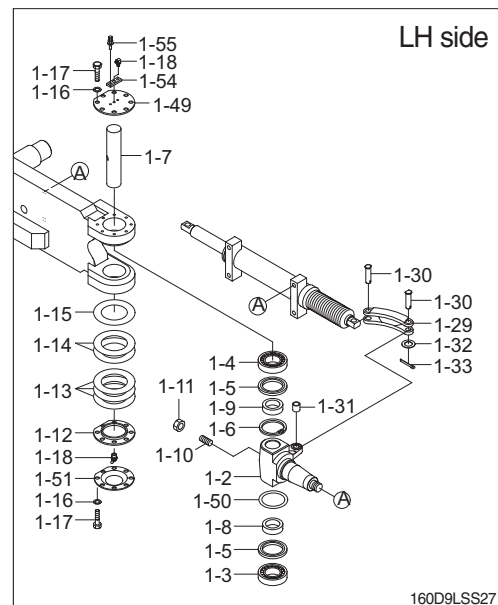
(10) Push out the king pin (1-7) without damaging the knuckle arm (1-2).

(11) At the same time the king pin is removed, pull out the oil seal (1-5).

(12) If defect is observed in taper roller bearing (1-3), pull it out by using extractor.

(13) Remove split pin (1-33), special washer (1-32) and link pin (1-30).

※ Repeat the same procedure for the RH side.



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 set screw (1-10) of king pin (1-7).
- (2) There is a notch in the middle of the king pin (1-7), make sure that this notch is on the set screw side.
- (3) Do not hammer to drive in taper roller bearing (1-3) because it will break.
Always use drive-in tool.
- (4) Hub
 - ① Mount spacer (1-22), oil seal (1-20) and inner race of tapered roller bearing (1-21) on the knuckle.
The bearing should be well greased before assembling.
 - ② Install hub (1-19), outer race of the bearing (1-4) in the wheel center and assemble to the knuckle.
 - ③ Put washer (1-23) in place, tighten with nut (1-24) and locked with split pin (1-25). 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 (1-26).

Bearing should be well greased before assembling.

