SECTION 5 STEERING SYSTEM

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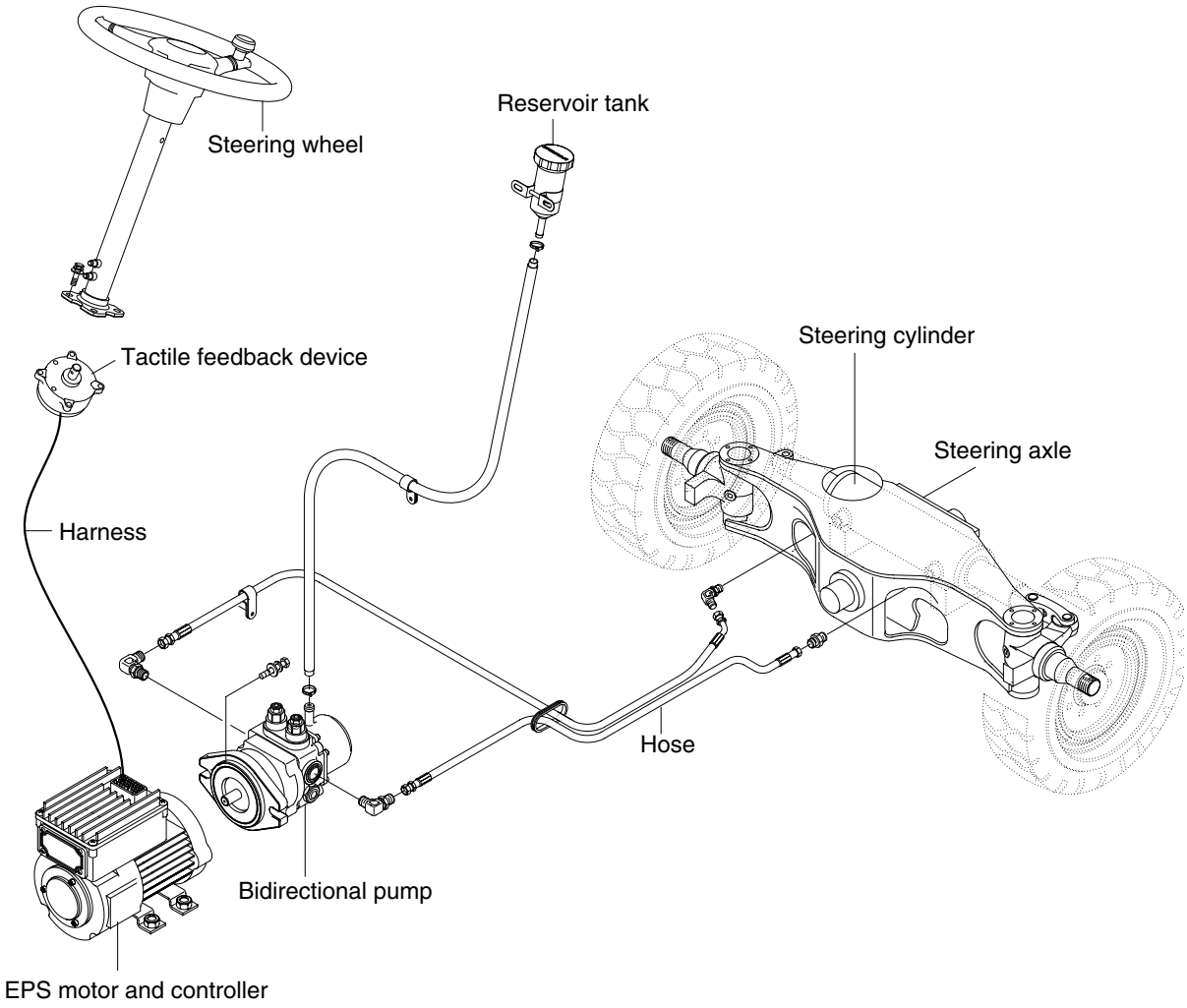
GROUP 1 STRUCTURE AND FUNCTION

1. OUTLINE

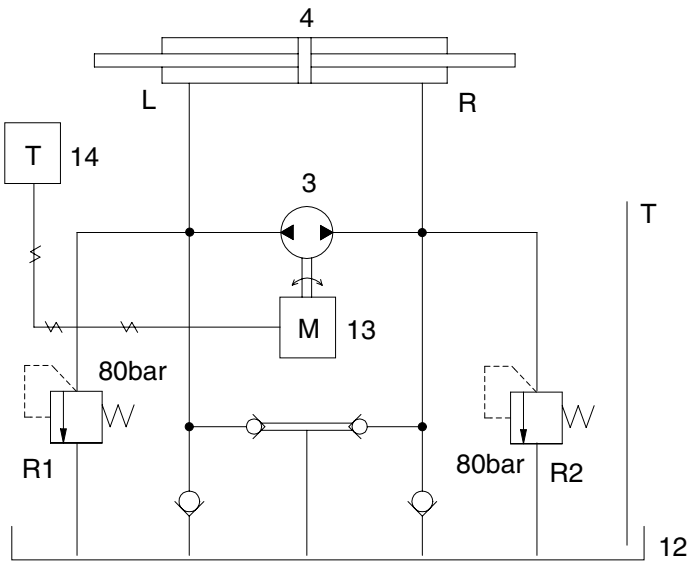


25B9USS01

The steering system for this machine is composed of steering wheel assembly, Tactile feedback device, EPS motor and controller, bidirectional pump, steering sensor, steering cylinder, steering axle and pipings. As the operator turns the steering wheel, the tactile feedback device detects and transmits the steering position to the EPS controller and the motor rotates. The bidirectional pump is rotated with the EPS motor and delivered pressurized oil 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.

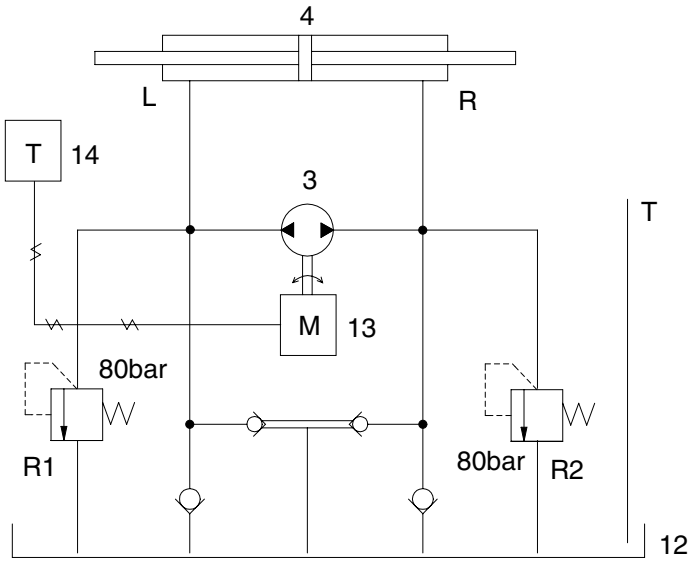
2. HYDRAULIC CIRCUIT



22B9SS02

3	Bidirectional pump	12	Reservoir tank	14	Tactile feedback device
4	Steering cylinder	13	EPS motor and controller		

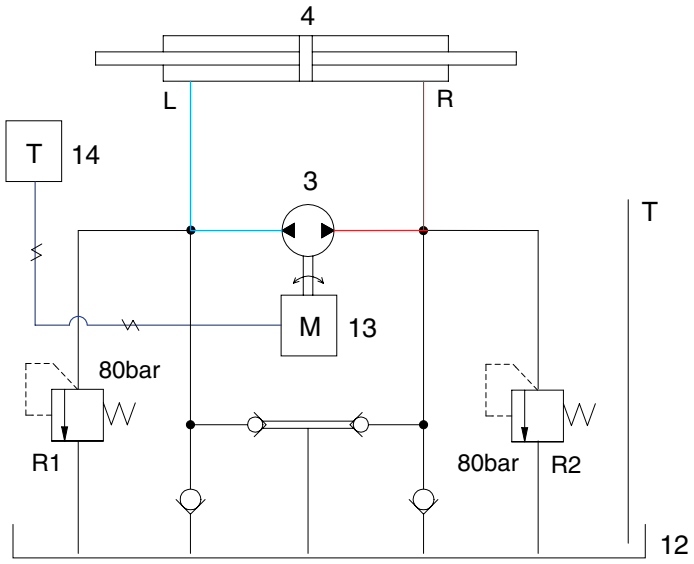
1) NEUTRAL



25B9USS02

The steering wheel is not being operated and the tactile feedback device does not sense any signal. The forklift keeps neutral position.

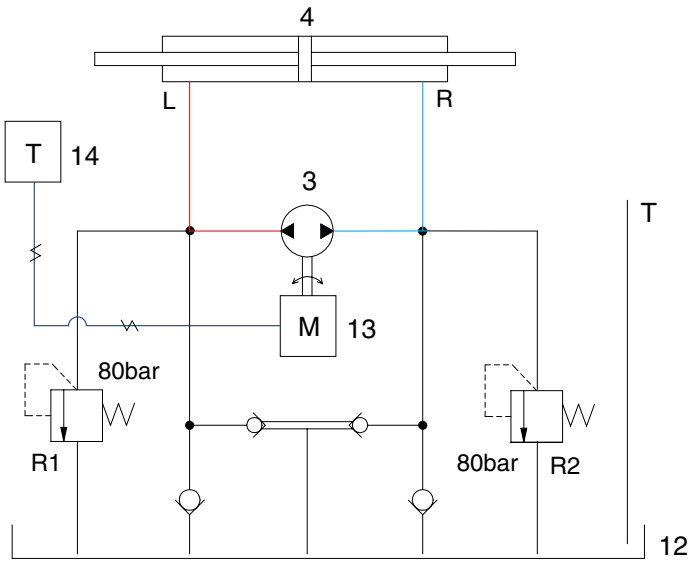
2) LEFT TURN



25B9USS03

When the steering wheel is turned to the left, the tactile feedback device senses left rotating signal and transmits to the EPS controller. The EPS motor and bidirectional pump is rotated and delivered pressurized oil to the port R of the steering cylinder and then the forklift turns to the left.

3) RIGHT TURN

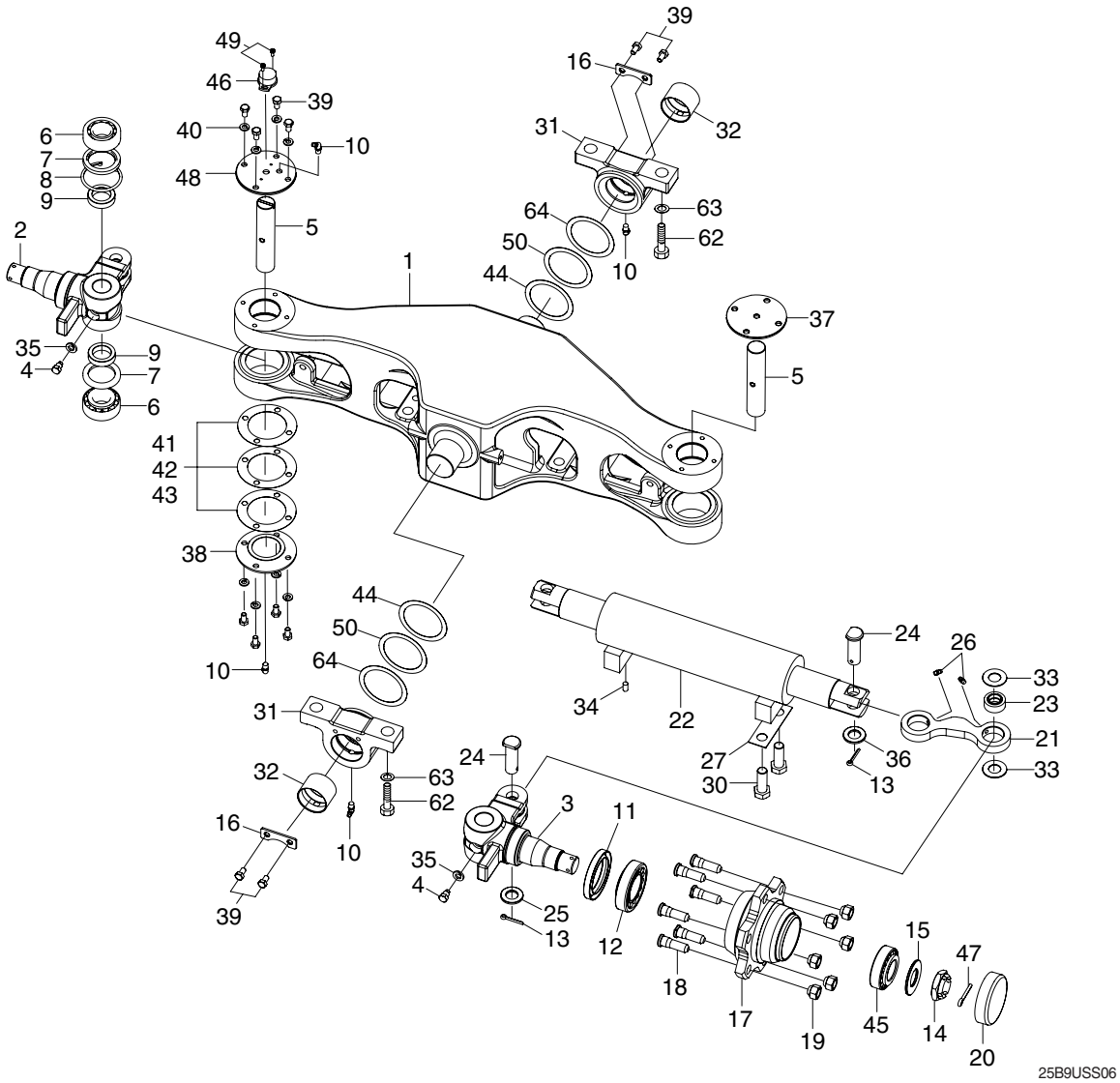


25B9USS04

When the steering wheel is turned to the right, the tactile feedback a senses right rotating signal and transmits to the EPS controller. The EPS motor and bidirectional pump is rotated and delivered pressurized oil to the port L of the steering cylinder and then the forklift turns to the right.

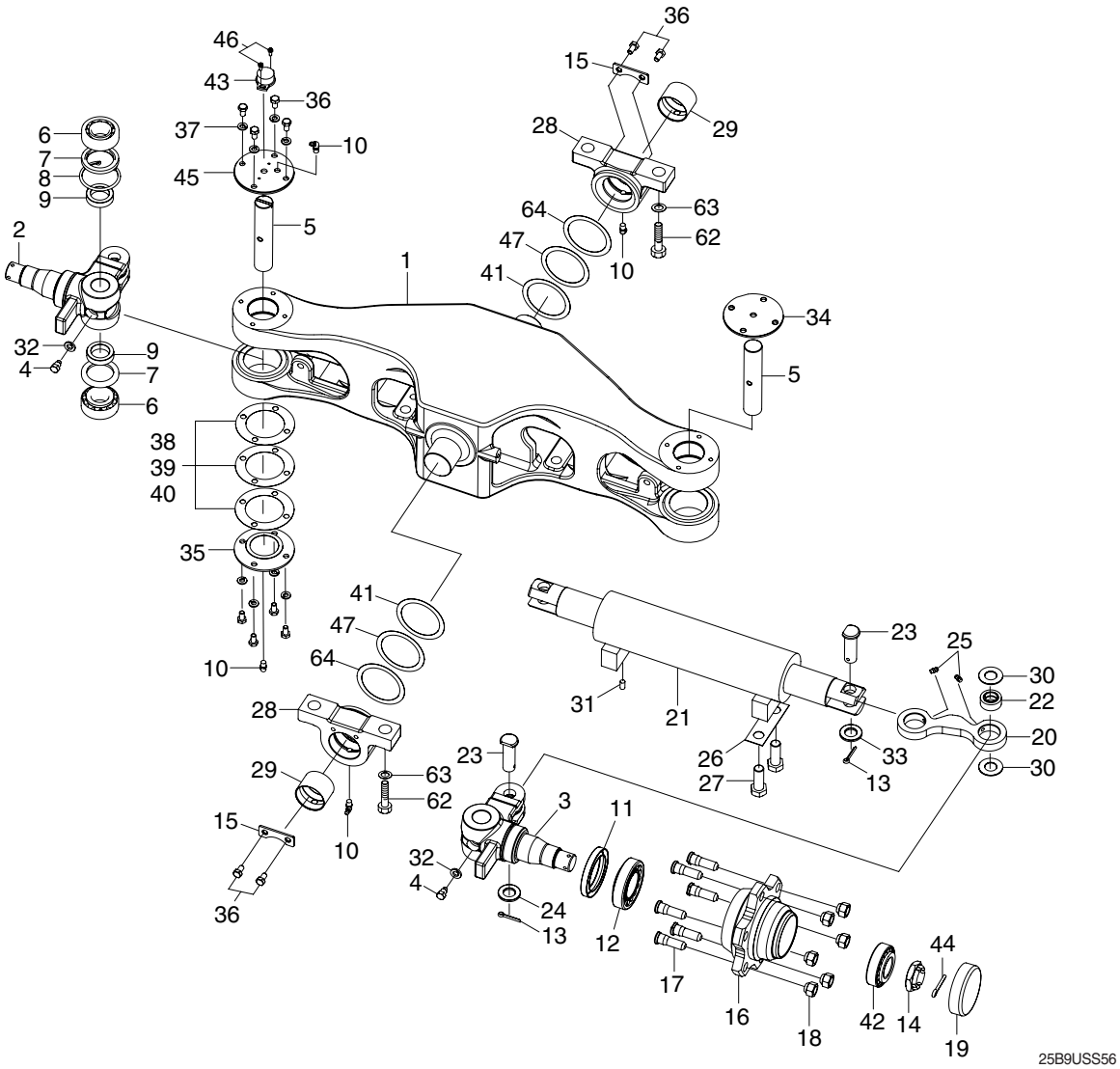
3. STEERING AXLE

1) STRUCTURE



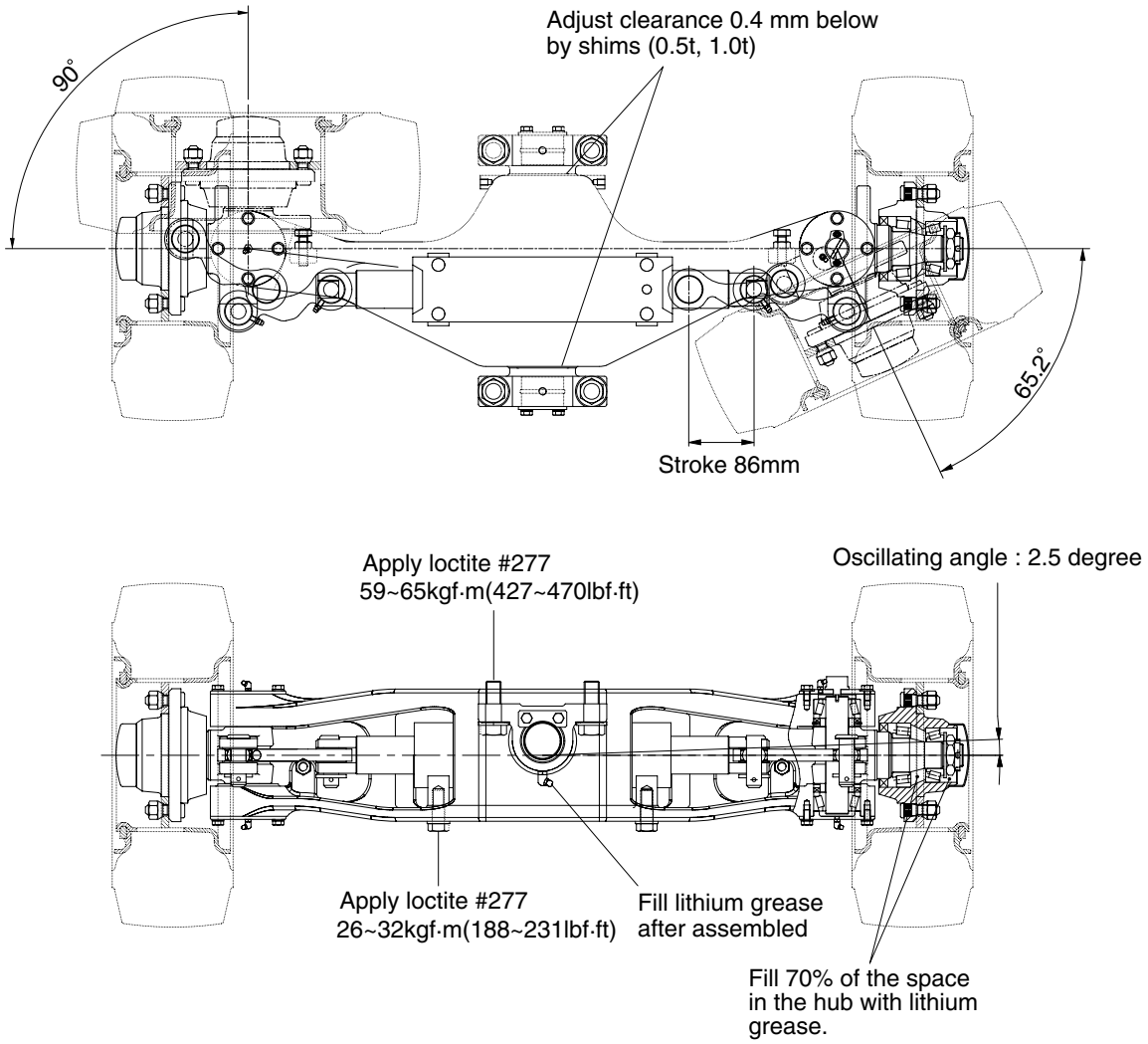
1	Steering axle body	19	Hub nut	39	Hex bolt
2	Knuckle-RH	20	Hub cap	40	Spring washer
3	Knuckle-LH	21	Steering link	41	Shim (0.1t)
4	Special bolt	22	Steering cylinder assy	42	Shim (0.15t)
5	King pin	23	Spherical plain bearing	43	Shim (0.3t)
6	Taper roller bearing	24	Steering link pin	44	Shim
7	Oil seal	25	Plain washer	45	Taper roller bearing
8	Snap ring	26	Grease nipple	46	Steering sensor
9	Collar	27	Lock plate	47	Split pin
10	Grease nipple	30	Hex bolt	48	Cover
11	Oil seal	31	Trunnion block	49	W/Washer bolt
12	Taper roller bearing	32	Bushing	50	Shim (1.0t)
13	Split pin	33	Thrust washer	51	Protector (not shown)
14	Slotted nut	34	Pin	52	Hex bolt
15	Washer	35	Spring washer	53	Spring washer
16	Plate	36	Hardened washer	62	Hex bolt
17	Hub	37	Upper cover	63	Hardened washer
18	Hub bolt	38	Lower cover		

STRUCTURE (KIA OPTION)



1	Steering axle body	18	Hub nut	35	Lower cover
2	Knuckle-RH	29	Hub cap	36	Hex bolt
3	Knuckle-LH	20	Steering link	37	Spring washer
4	Special bolt	21	Steering cylinder assy	38	Shim (0.1t)
5	King pin	22	Spherical plain bearing	39	Shim (0.15t)
6	Taper roller bearing	23	Steering link pin	40	Shim (0.3t)
7	Oil seal	24	Plain washer	41	Shim
8	Snap ring	25	Grease nipple	42	Taper roller bearing
9	Collar	26	Lock plate	43	Potentiometer assy
10	Grease nipple	27	Hex bolt	44	Split pin
11	Oil seal	28	Trunnion block	45	Cover
12	Taper roller bearing	29	Bushing	46	W/Washer bolt
13	Split pin	30	Thrust washer	47	Shim (1.0t)
14	Slotted nut	31	Pin	62	Hex bolt
15	Plate	32	Spring washer	63	Hardened washer
16	Hub	33	Hardened washer	64	Spacer
17	Hub bolt	34	Upper cover		

2) TIGHTENING TORQUE AND SPECIFICATION



25B9USS07

Item	Unit	Center pin support single shaft
Max steering angle of wheels (Inside/Outside)	degree	90/65.2
Tread (Front/Rear)	mm (in)	993 (39.1)/980 (38.6)

GROUP 2 OPERATIONAL CHECKS AND TROUBLESHOOTING

1. OPERATIONAL CHECKS

Check item	Checking procedure
Knuckle	· Check knuckle visually or use crack detection method. If the knuckle is bent, the tire wear is uneven, so check tire wear.
Steering axle	· Ask assistant to drive machine at minimum turning radius. · Fit bar and a piece of chalk at outside edge of counterweight to mark line of turning radius. · Min turning radius (Outside) : Refer to page 1-5 (Specifications)
Hydraulic pressure of power steering	· Install oil pressure gauge at the bidirectional pump. · Turn steering wheel fully and check oil pressure. ※ Oil pressure : 80 kgf/cm^2 (1138 psi)

2. TROUBLESHOOTING

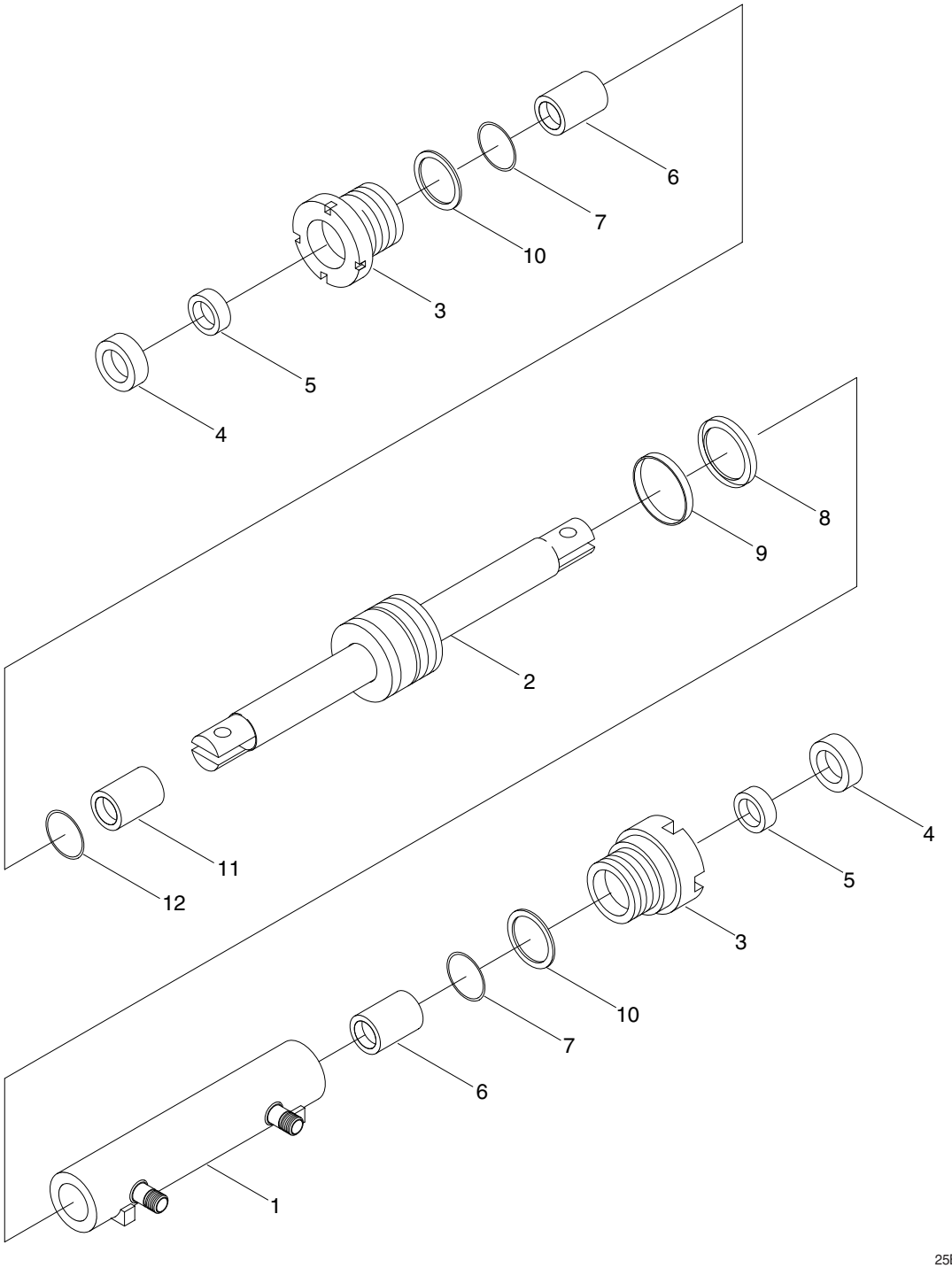
Problem	Cause	Remedy
Steering wheel drags.	· Low oil pressure. · Bearing faulty. · Gears poorly meshing.	· Check lockout. Repair. · Clean or replace. · Check and correct meshing.
Steering wheel fails to return smoothly.	· Bearing faulty. · Gears poorly meshing.	· Clean or replace. · Check and correct meshing.
Steering wheel turns unsteadily. Steering system makes abnormal sound or vibration.	· Lockout loosening. · Lockout loosening. · Air in oil circuit.	· Retighten. · Retighten. · Bleed air.
Abnormal sound heard when steering wheel is turned fully	Bidirectional pump · Faulty. (Valve fails to open.) Piping · Pipe(from pump to power steering cylinder) dented or clogged.	· Adjust valve set pressure and check for specified oil pressure. · Repair or replace.
Piping makes abnormal sounds.	Bidirectional pump · Lack of oil. · Oil inlet pipe sucks air. · Insufficient air bleeding.	· Add oil. · Repair. · Bleed air completely.
Valve or valve unit makes abnormal sounds.	Bidirectional pump · Oil inlet pipe sucks air. · Faulty. (Unbalance oil pressure) Piping · Pipe(from pump to power steering) dented or clogged. · Insufficient air bleeding.	· Repair or replace. · Adjust valve set pressure and check specified oil pressure. · Repair or replace. · Bleed air completely.

Problem	Cause	Remedy
Steering cylinder head leakage (Piston rod)	· Packing foreign material. · Piston rod damage. · Rod seal damage and distortion. · Chrome gilding damage.	· Replace · Grind surface with oil stone. · Replace · Grind
Steering cylinder head thread (A little bit leak is no problem)	· O-ring damage.	· O-ring damage.
Welding leakage	· Tube inside damage. · Piston seal damage and distortion	· Grind surface with oil store. · Replace
Rod	· Tube inside damage. · Piston seal damage and distortion	· Grind surface with oil store. · Replace
Piston rod bushing inner diameter excessive gap	· Bushing wear.	· Replace

GROUP 3 DISASSEMBLY AND ASSEMBLY

1. STEERING CYLINDER

1) STRUCTURE



25B9USS14

1	Tube assembly	5	Rod seal	9	Wear ring
2	Rod assembly	6	DD bushing	10	Lock washer
3	Rod cover	7	O-ring	11	Spacer
4	Dust wiper	8	Piston seal	12	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 a vice.

(2) Remove the gland 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. If there are some damage, replace with new parts.

3) CHECK AND INSPECTION

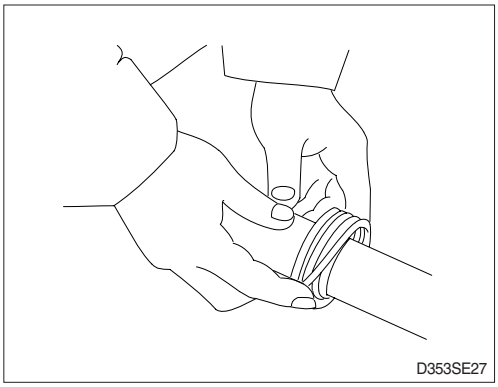
mm(in)

Check item	Criteria		Remedy
	Standard size	Repair limit	
Clearance between piston & cylinder tube	0.064~0.137 (0.0025~0.0054)	0.180 (0.0070)	Replace piston seal
Clearance between cylinder rod & bushing	0.024~0.112 (0.0009~0.0044)	0.120 (0.0049)	Replace bushing
Seals, O-ring	Damage		Replace
Cylinder rod	Dents		Replace
Cylinder tube	Biting		Replace

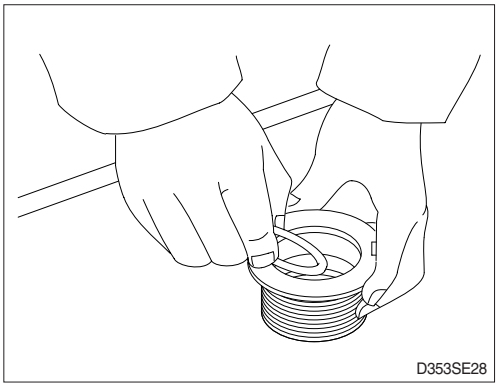
4) ASSEMBLY

(1) Install a new piston seal the groove on the piston.

※ Be careful not to scratch the seal too much during installation or it will not seat properly.

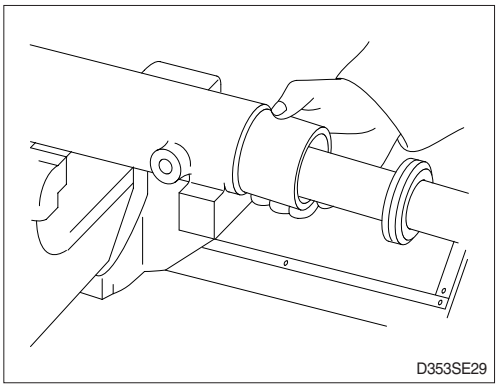


(2) Install the rod seal to the position in the gland applying a slight coat with grease prior to install.

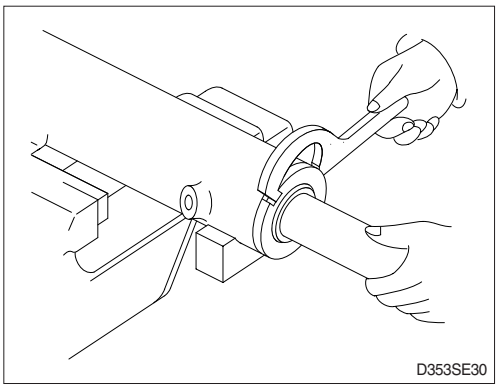


(3) Install the dust wiper to the gland using a special installing tool. Coat the dust wiper with grease slightly before installing.

(4) Set a special tool the cylinder, gland assembly into the cylinder tube.

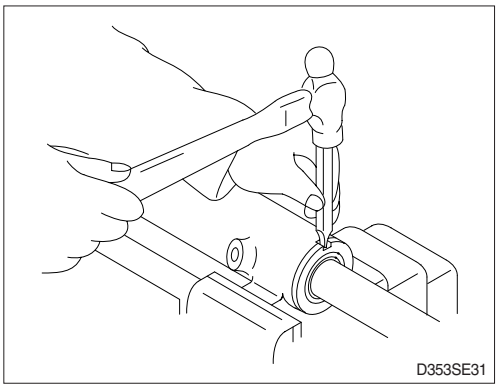

D353SE29

(5) Using a hook spanner, install the gland assembly, and tighten it with torque 40±4kgf · m (289±29lbf · ft).


D353SE30

(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 need calking again, never using previous calking position.


D353SE31

(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.

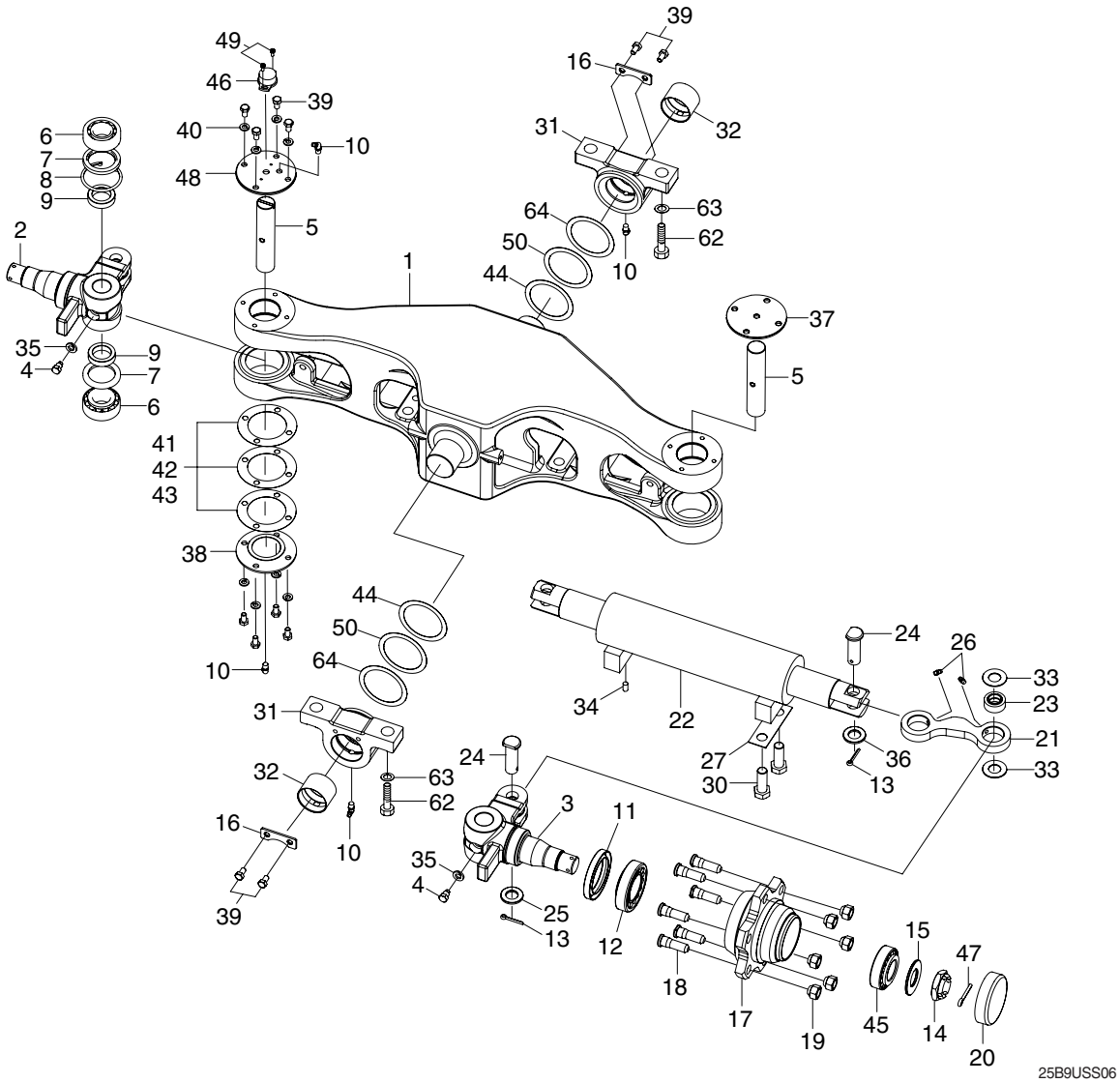
(9) While idling the engine with the rear wheels off the ground, operate the steering wheel left and right alternately.

※ 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.

2. STEERING AXLE

1) STRUCTURE



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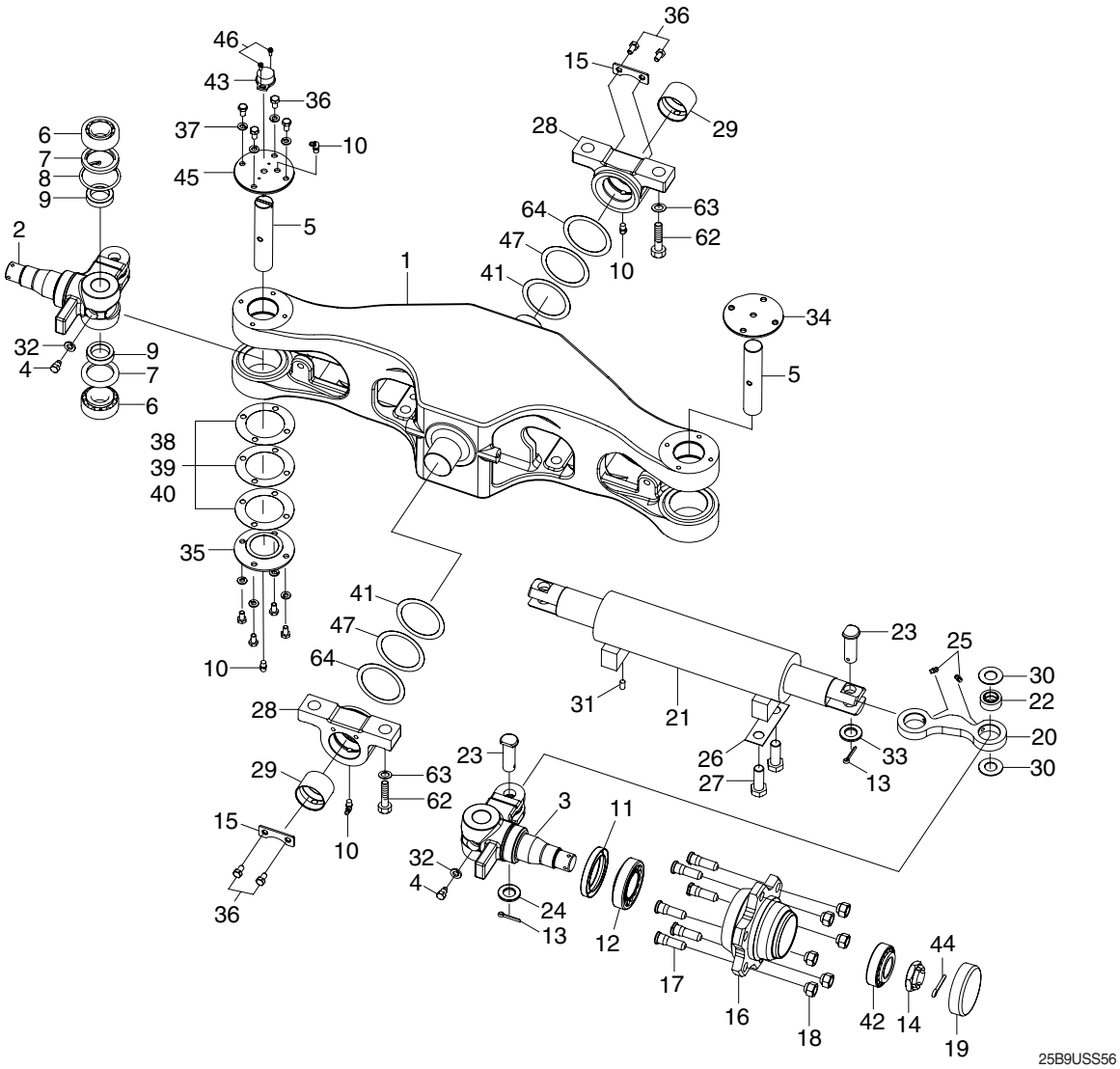
5	King pin	23	Spherical plain bearing	43	Shim (0.3t)
6	Taper roller bearing	24	Steering link pin	44	Shim
7	Oil seal	25	Plain washer	45	Taper roller bearing
8	Snap ring	26	Grease nipple	46	Steering sensor
9	Collar	27	Lock plate	47	Split pin
10	Grease nipple	30	Hex bolt	48	Cover
11	Oil seal	31	Trunnion block	49	W/Washer bolt
12	Taper roller bearing	32	Bushing	50	Shim (1.0t)
13	Split pin	33	Thrust washer	51	Protector (not shown)
14	Slotted nut	34	Pin	52	Hex bolt
15	Washer	35	Spring washer	53	Spring washer
16	Plate	36	Hardened washer	62	Hex bolt
17	Hub	37	Upper cover	63	Hardened washer
18	Hub bolt	38	Lower cover		

STRUCTURE (KIA OPTION)



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3	Knuckle-LH	20	Steering link	37	Spring washer
4	Special bolt	21	Steering cylinder assy	48	Shim (0.1t)
5	King pin	22	Spherical plain bearing	39	Shim (0.15t)
6	Taper roller bearing	23	Steering link pin	40	Shim (0.3t)
7	Oil seal	24	Plain washer	41	Shim
8	Snap ring	25	Grease nipple	42	Taper roller bearing
9	Collar	26	Lock plate	43	Potentiometer assy
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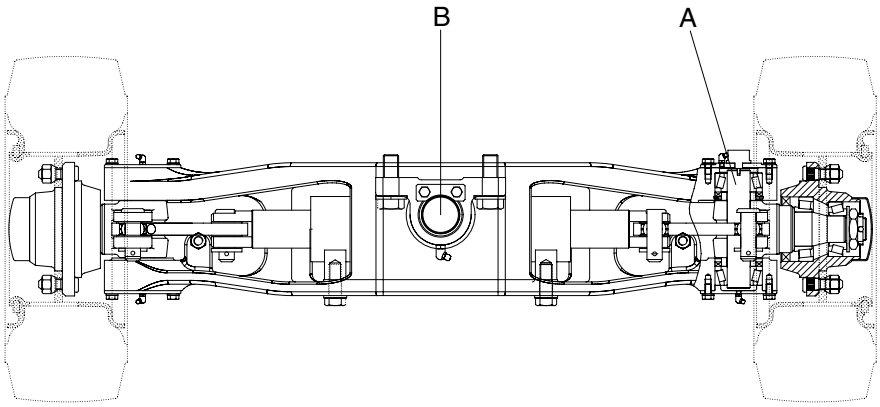
14	Slotted nut	31	Pin	62	Hex bolt
15	Plate	32	Spring washer	63	Hardened washer
16	Hub	33	Hardened washer	64	Spacer
17	Hub bolt	34	Upper cover		

2) CHECK AND INSPECTION



22B7SS12

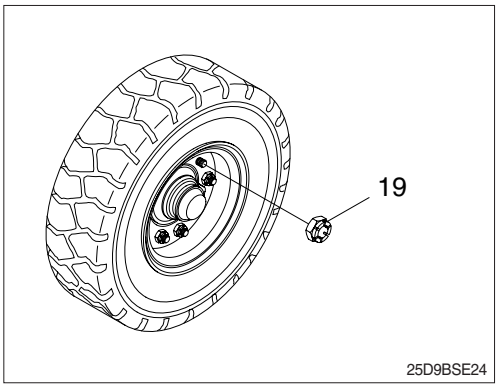
mm (in)

No.	Check item	Criteria		Remedy
		Standard size	Repair limit	
A	Diameter of king pin	30 (1.18)	29.8 (1.17)	Replace
B	Diameter of center pin	50 (2.0)	49.5 (1.9)	Replace
-	Rear axle, hub, knuckle, bearing	· Damage, wear · Seizure, abnormal noise, defective rotation		Replace

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 (19) and take off the steering wheel tire.



(2) Remove hub cap (20).

(3) Pull out split pin (47) before removing slotted nut (14) and washer (15).

(4) Using the puller, take off the wheel hub (17) together with the taper roller bearing (12, 45).

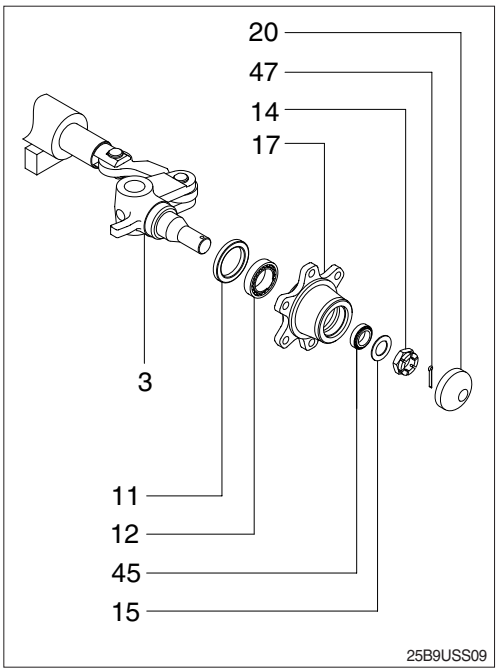
※ Be very careful because just before the hub (17) comes off, taper roller bearing (12, 45) will fall out.

(5) After wheel hub (17) is removed take off the inner race of bearing (12, 45).

(6) Pull out oil seal (11).

※ 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 (14) in the knuckle (3) to protect the threaded portion.



(8) Loosen special bolt (4) and spring washer (35).

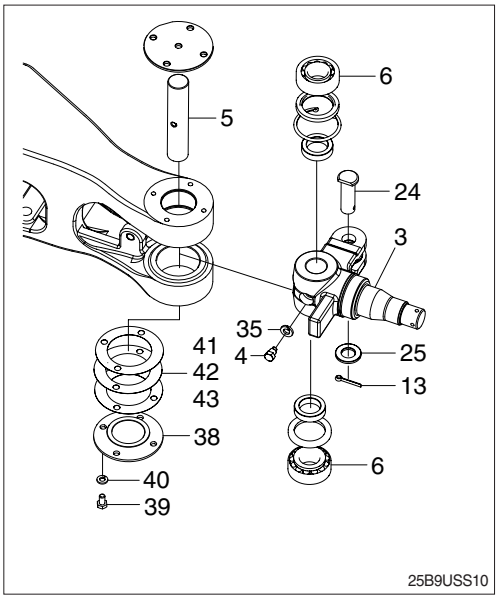
(9) Remove bolt (39), washer (40), lower cover (38) and shims (41, 42, 43).

(10) Push out the king pin (5) without damaging the knuckle (3).

(11) Pull out the taper roller bearing (6).

(12) Remove spilt pin (13), plain washer (25) and then pull out link pin (24).

(13) Remove knuckle (3).



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 (4) and spring washer (35) of king pin (5).

※ There is a notch in the middle of the king pin (5), make sure that this notch is on the special bolt (4) side.

(2) Always use drive-in tool. In assembling the taper roller bearing (6), be sure that the fixed ring of the bearing is placed in position facing the knuckle (3).

(3) Wheel hub

- Mount oil seal (11) and inner race of taper roller bearing (12) on the knuckle (3). The bearing should be well greased before assembling.
- Install the outer race of the taper roller bearing (45) in the wheel center and assemble to the knuckle (3).
- Tighten slotted nut (14) with washer (15) and lock with split pin (47). 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.
- Mount the hub cap (20).
  Bearing should be well greased before assembling.