CEBM002002

Shop Manual

WA120-3
WA120L-3

WHEEL LOADER

SERIAL NUMBERS WA120-3L -A30001 and up
WA120L-3 -54001 - 54103

KOMATSU

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STANDARD TORQUE REQUIREMENTS

STANDARD TORQUE REQUIREMENTS OF BOLTS AND NUTS

The following charts give the standard torques values of bolts and nuts. Exceptions are given in sections of **DISASSEMBLY AND ASSEMBLY**.

1 kgm = 9.806 Nm

Thread diameter of bolt	Width across flat		
mm	mm	kgm	Nm
6	10	1.35 ±0.15	13.2 ±1.4
8	13	3.20 ±0.3	31.4 ±2.9
10	17	6.70 ±0.7	65.7 ±6.8
12	19	11.5 ±1.0	112 ±9.8
14	22	18 ±2.0	177 ±19
16	24	28.5 ±3	279 ±29
18	27	39 ±4	383 ±39
20	30	56 ±6	549 ±58
22	32	76 ±8	745 ±78
24	36	94.5 ±10	927 ±98
27	41	135 ±15	1320 ±140
30	46	175 ±20	1720 ±190
33	50	225 ±25	2210 ±240
36	55	280 ±30	2750 ±290
39	60	335 ±35	3280 ±340

★ This torque table does not apply to the bolts with which nylon packing or other non-ferrous metal washers are to be used, or which require torquing to otherwise specified values.

01 GENERAL

Approximate Freezing Point	Percentage of Antifreeze Concentration by Volume	Specific Gravity at 16°C (60°F)
0°C (+32°F)	0	1.000
-7°C (+20°F)	15	1.025
-12°C (+10°F)	25	1.040
-18°C (0°F)	33	1.053
-23°C (-10°F)	40	1.062
-29°C (-20°F)	45	1.070
-34°C (-30°F)	48	1.074
-40°C (-40°F)	53	1.080
-46°C (-50°F)	56	1.083
-51°C (-60°F)	59	1.088
-57°C (-70°F)	62	1.092
-62°C (-80°F)	65	1.095
-68°C (-90°F)	67	1.097
-69°C (-92°F)	68	1.098

In tropical climates where antifreeze availability may be limited, use a corrosion inhibitor DCA4, to protect the engine cooling system.

INHIBITORS/CONDITIONERS

1. All cooling system inhibitors, including those in antifreeze solutions, become depleted through normal operation. If the inhibitors in antifreeze are allowed to become depleted, the antifreeze becomes corrosive and attacks and coats the metallic surfaces of the cooling system which reduces heat transfer. Cooling system conditioners which contain these inhibitors must be added to maintain corrosion protection.

2. Soluble oil is not recommended for use in this engine as its use will reduce heat transfer.

3. There are no miracle additives that will increase heat transfer or prevent overheating. Conditioned water is still the best coolant.

4. DCA4 is recommended to inhibit corrosion in the cooling system for the following reasons:

   - Improved compatibility with high silicate antifreezes to minimize hydro-gel formation if over concentration occurs.

   - Provides engine protection in the following areas:
     - Solder corrosion/bloom
     - Copper corrosion/erosion/stress cracking
     - Oil fouling
     - Cylinder liner cavitation corrosion
     - Aluminum cavitation corrosion
     - Seal and gasket degradation

Maintenance of Cooling System Inhibitors

Keeping the engine coolant properly inhibited will keep the engine and radiator free of rust, scale deposits and corrosion.

New machines are delivered with antifreeze protection. Service at regular scheduled intervals specified in the OPERATION & MAINTENANCE MANUAL with a service DCA4 filter.

Each time the coolant is drained and replaced, the coolant must be recharged with DCA4. New coolant can be correctly charged with supplemental coolant additives by using DCA4 filters or DCA4 concentrate listed in the table entitled, DCA4 Unit Guide.

If coolant is added between drain intervals, additional DCA4 will be required.

Coolant Testing for Conditioner Concentration

When the cooling system is maintained as recommended, the conditioner concentration should be satisfactory. The DCA4 concentration must not fall below 1.0 unit per 3.8 ℓ (1 US gal) or exceed 2 units per 3.8 ℓ (1 US gal) of coolant. The only accurate method for testing chemical concentrations in coolant with mixed chemical compounds is a laboratory analysis. For this reason, the coolant inhibitor should be maintained as shown in the OPERATION & MAINTENANCE MANUAL.

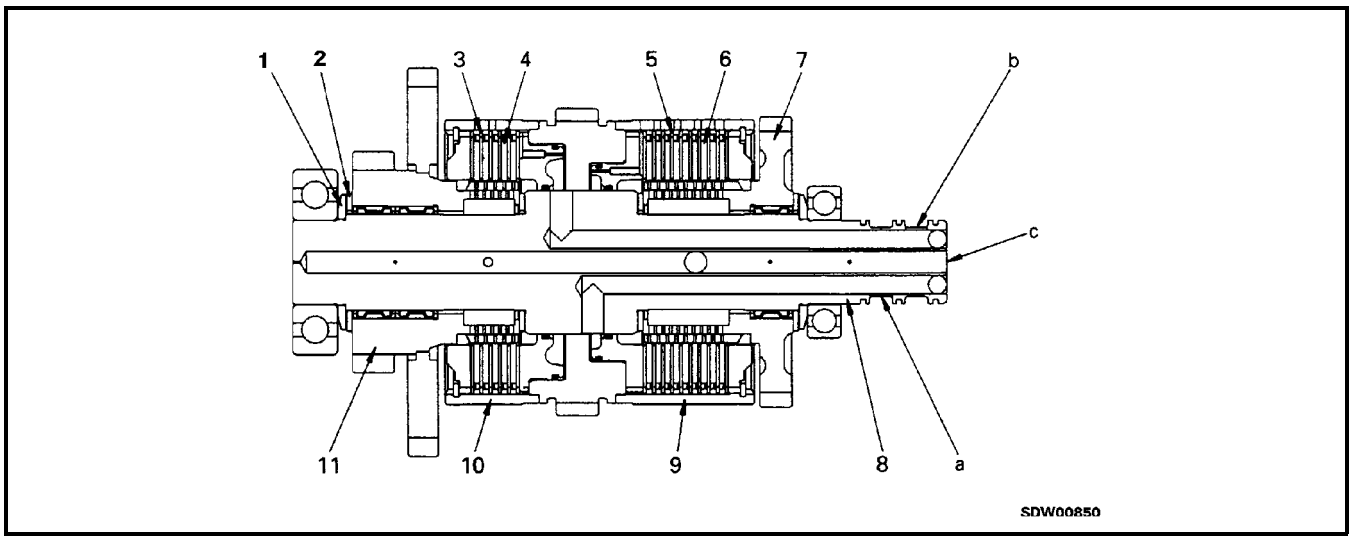
★ Inadequate concentration of the coolant additive can result in major corrosive damage to cooling system components. Over concentration can cause formation of gel that can cause restriction, plugging of passages and overheating.

1. Engine
2. Torque converter
3. Steering pump
4. Hydraulic pump
5. Torque converter charging pump
6. Transmission
7. Parking brake
8. Center drive shaft
9. Flange bearing
10. Front drive shaft
11. Front axle
12. Front differential
13. Front brake
14. Front final drive
15. Front tire
16. Rear drive shaft
17. Rear axle
18. Rear differential
19. Rear brake
20. Rear final drive
21. Rear tire

Outline

- The motive force from engine (1) passes through the flywheel and is transmitted to torque converter (2).
  The torque converter uses oil as a medium. It converts the transmitted torque in accordance with the change in the load, and transmits the motive force to the input shaft of the transmission. In addition, the motive force of the engine passes through the pump drive gear of the torque converter, and is transmitted to hydraulic, steering pump (4), (3) and torque converter charging pump (5) to drive each pump.
- Transmission (6) operates the directional spool and speed spool of the transmission valve through the solenoid valves, and actuates the six hydraulically actuated clutches to select one of the four FORWARD or REVERSE speeds. The transmission speed range is selected manually.
- The output shaft of transmission (6) transmits the power to the front and rear axles. At the front, the power is transmitted to front axle (11) through center drive shaft (8), flange bearing (9), and front drive shaft (10). At the rear, the power is transmitted to rear axle (17) through rear drive shaft (16).
- The motive force transmitted to front axle (11) and rear axle (17) has its speed reduced by the bevel gear and pinion gear of differentials (12) and (18), and is then transmitted to the sun gear shaft through the differential mechanism.
- The motive force of the sun gear is reduced further by the planetary mechanism and is transmitted to the wheels through the axle shaft.

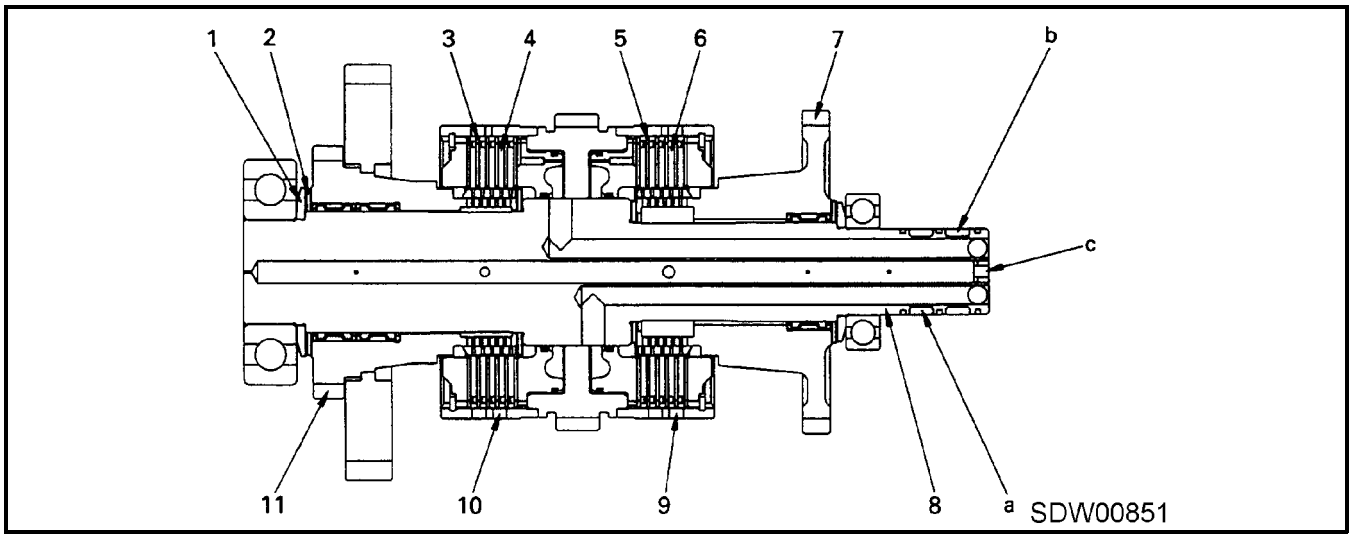
FORWARD, 2ND CLUTCH



1. Spacer
2. Thrust washer
3. 2nd clutch plate (x6)
4. 2nd clutch disc (x5)
5. FORWARD clutch plate (x10)
6. FORWARD clutch disc (9)
7. FORWARD gear (teeth: 47)
8. FORWARD 2nd shaft
9. FORWARD ring gear (teeth: 58)
10. 2nd ring gear (Teeth: 58)
11. 2nd gear (Teeth: 27, 49)

a. FORWARD clutch oil port
b. 2nd clutch oil port
c. Lubricating oil port

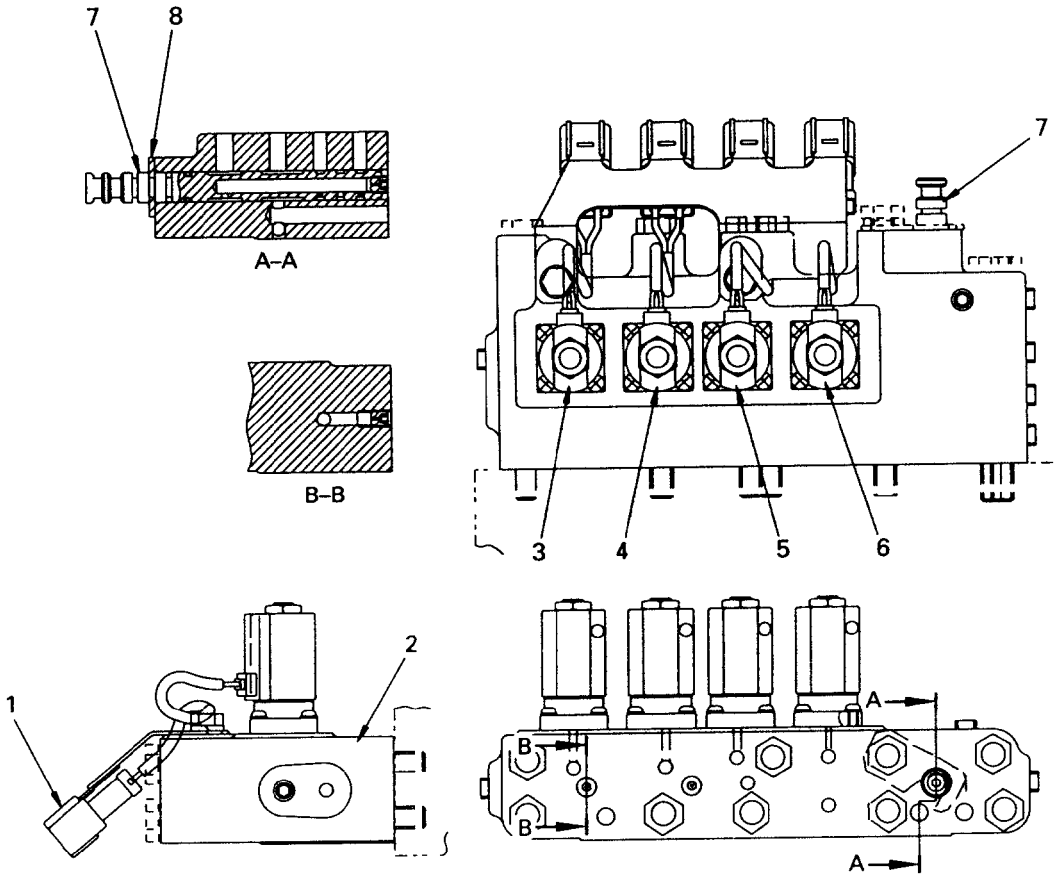
3RD, 4TH CLUTCH



1. Spacer
2. Thrust washer
3. 3rd clutch plate (x6)
4. 3rd clutch disc (x5)
5. 4th clutch plate (x6)
6. 4th clutch disc (x5)
7. 4th gear (Teeth: 51)
8. 3rd, 4th shaft
9. 4th ring gear (Teeth: 59)
10. 3rd ring gear (Teeth: 59)
11. 3rd gear (Teeth: 40, 52)

a. 4th clutch oil port
b. 3rd clutch oil port
c. Lubricating oil port

TRANSMISSION SOLENOID VALVE



1. Connector
2. Valve body
3. 1st, 4th solenoid valve
4. 3rd solenoid valve
5. REVERSE solenoid valve
6. FORWARD solenoid valve
7. Emergency manual spool
8. Lock plate

Solenoid Operating table

	①	②	③	④
F-1	○			○
F-2	○			
F-3	○		○	
F-4	○		○	○
N				
R-1		○		○
R-2		○		
R-3		○	○	
R-4		○	○	○

○ : Solenoid ON TB28

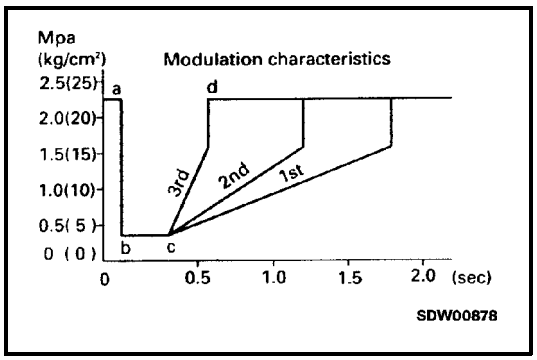
STRUCTURE

- The transmission solenoid valve is installed to the transmission together with the transmission valve. When the directional lever or speed control lever are operated, the solenoid valve is actuated and moves the spool inside the transmission valve.

MODULATION FILL VALVE

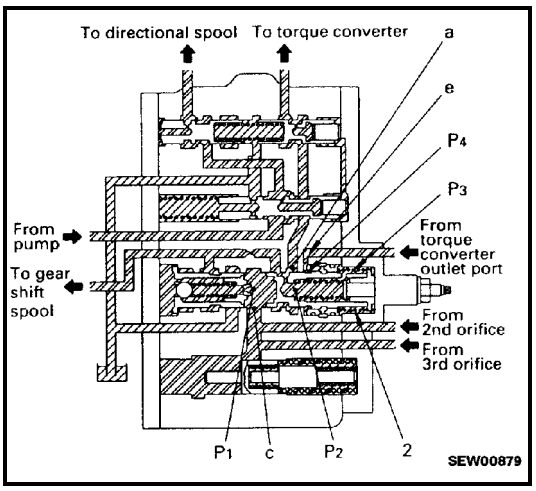
Function

- The modulation fill valve adjusts the pressure and controls the amount of oil flowing to the accumulator while allowing the clutch pressure to rise.

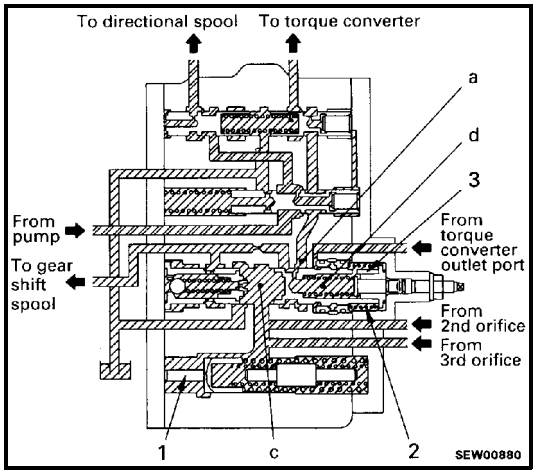


Operation

1. Clutch completely engaged (point a)

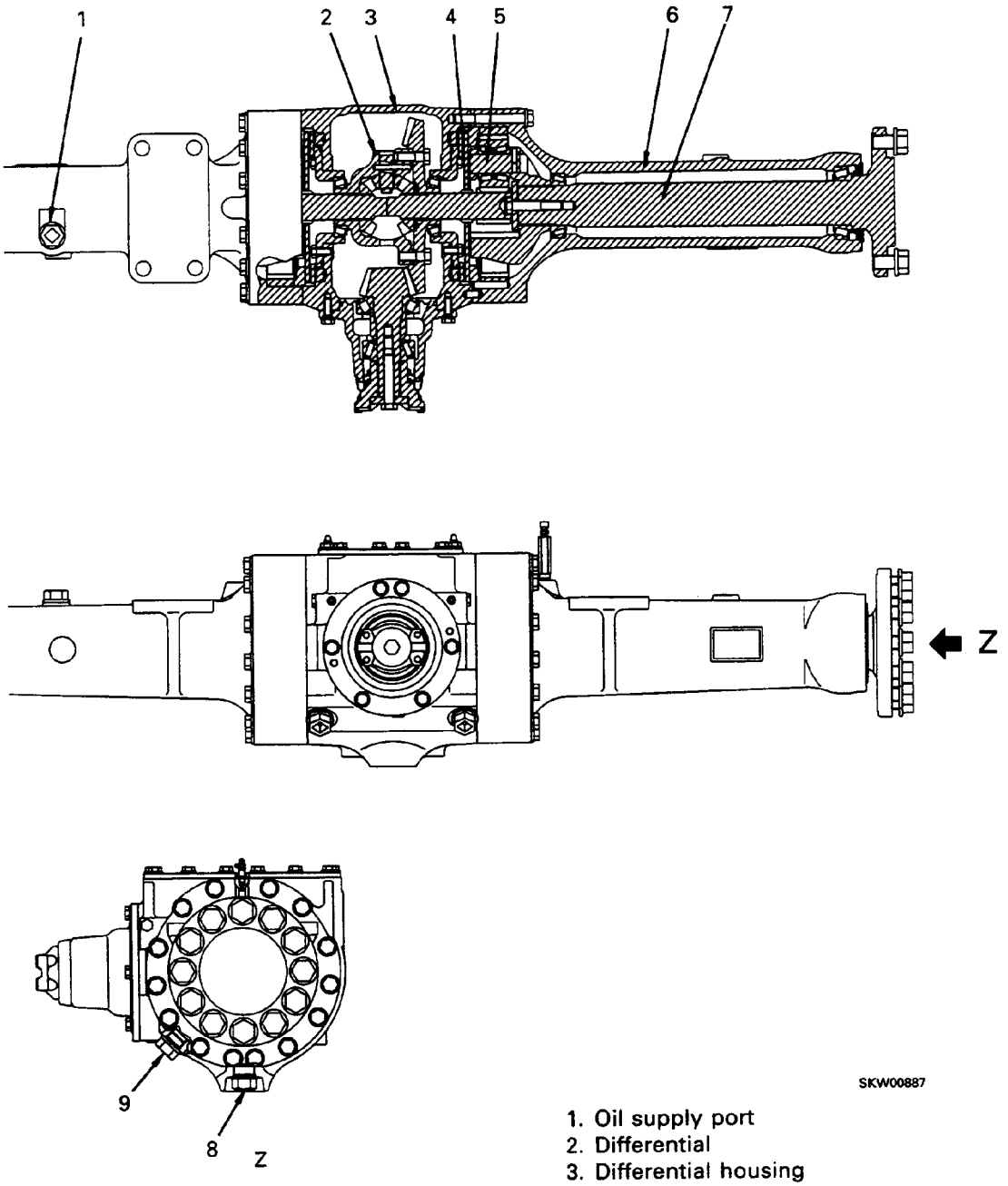


2. Shifting from FORWARD to REVERSE
   - The oil inside the accumulator is drained by the quick return valve, and accumulator piston (1) moves to the left. When this happens, the pressure in chamber c and Chamber d drops, and spring (2) moves modulation fill valve (3) to the right to open port a.



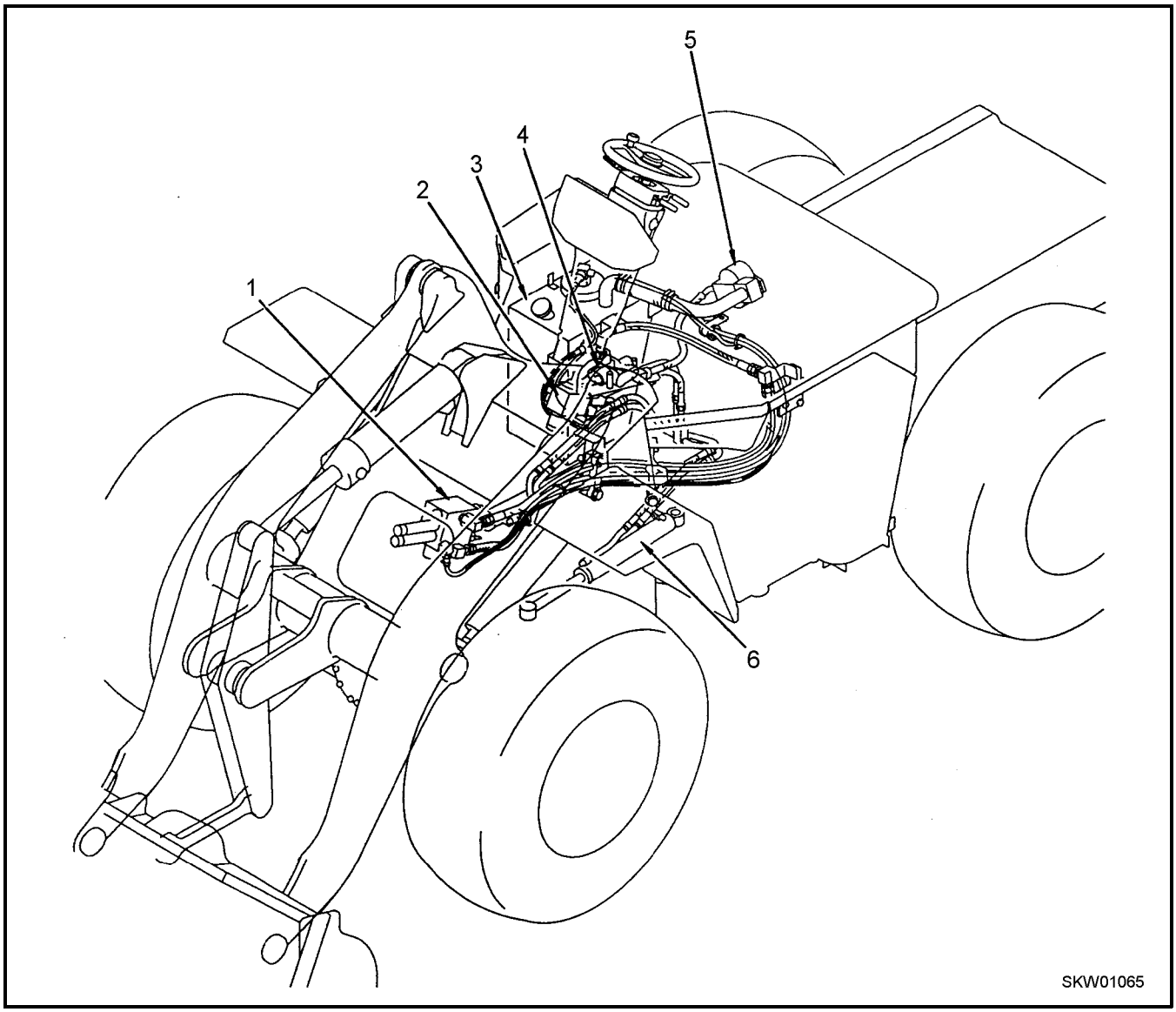
AXLE

FRONT AXLE

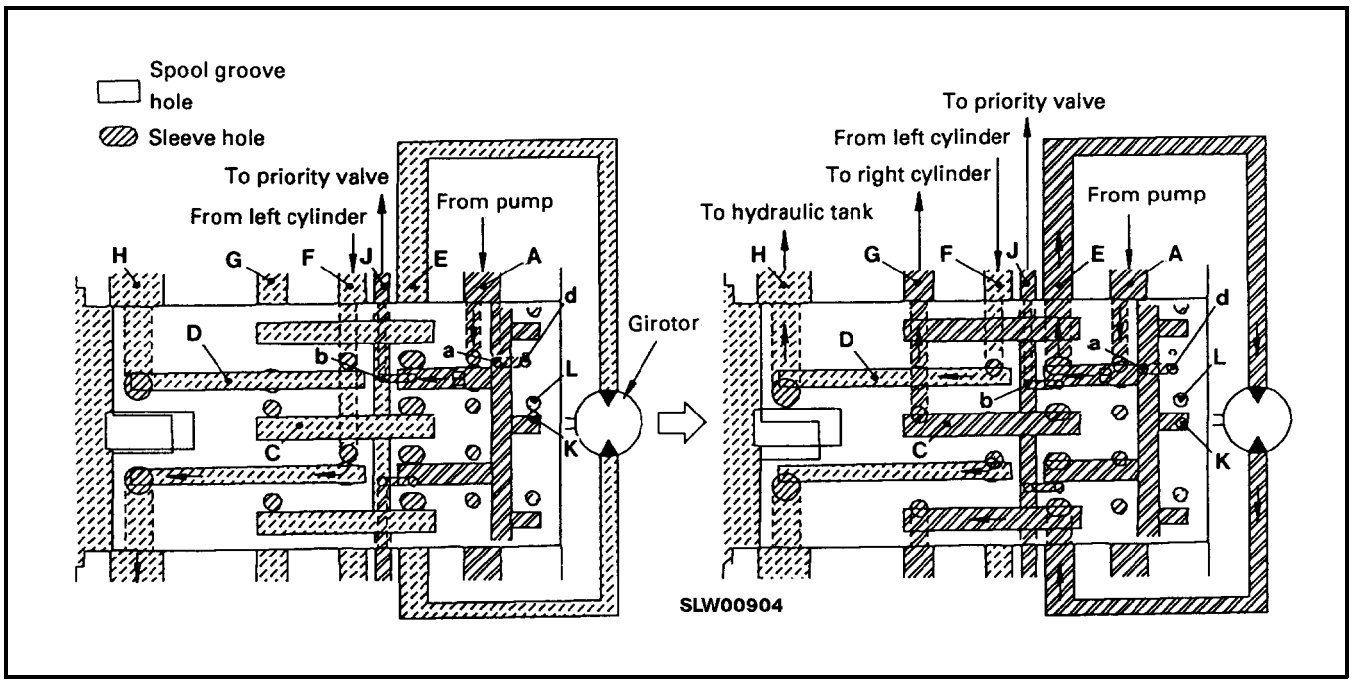


1. Oil supply port
2. Differential
3. Differential housing
4. Wet-type single-disc brake
5. Final drive
6. Axle housing
7. Axle shaft
8. Drain plug
9. Brake inspection plug

STEERING PIPING



1. Main control valve
2. Steering valve (orbit-roll)
3. Hydraulic tank
4. Priority valve
5. Hydraulic pump
6. Steering cylinder



- When the steering wheel is turned to the left, spool (3), which is connected by the spline of the steering shaft, also turns to the left. The spool and sleeve (5) are interconnected by centering spring (12), so the spool compresses the centering spring.
  Therefore, a difference in the angle of rotation (angle variation) is generated between the spool and sleeve equal to the amount that the centering spring is compressed.
  When this happens, first, port **A** and vertical groove **B** are connected. Then vertical groove **B** and port **E** to the Girotor, and port **E** from the Girotor to vertical groove **C** are connected. Finally, vertical groove **C** and port **G** to the head end of the right cylinder are connected.
  In addition, vertical groove **B** is kept connected to orifice **b** of port **J** to the priority valve, but port **K** of the sleeve gradually closes the connection of vertical groove **B** and port **L.**
  Port **F** from the head end of the left cylinder is connected to vertical groove **D** (connected to drain port **H)** at the same time as port **A** and vertical groove **B** are connected.

- By shutting off and connecting the above ports and grooves, the oil from the pump enters vertical groove **B** from port **A,** then flows to port **E** to the Girotor, and turns the Girotor. The oil discharged from the Girotor enters vertical groove **C** from port **E,** and flows from port **G** to the head end of the right cylinder.
  The oil entering vertical groove **B** passes through orifice **b** and flows to port **J.** From port **J,** it becomes the pilot pressure of the priority valve.
  The oil from the head end of the left cylinder enters vertical groove **D** from port **F** and is drained to the hydraulic tank.

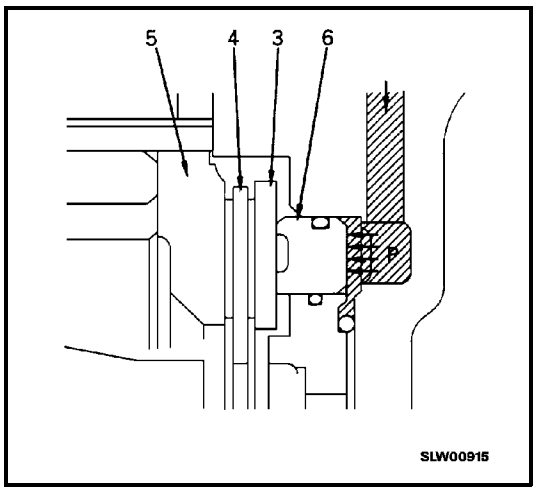
3. Steering wheel stopped

When the operation of the steering wheel is stopped, the difference in rotation between the spool and sleeve is returned to the neutral condition by the reaction of centering spring (12).

Operation

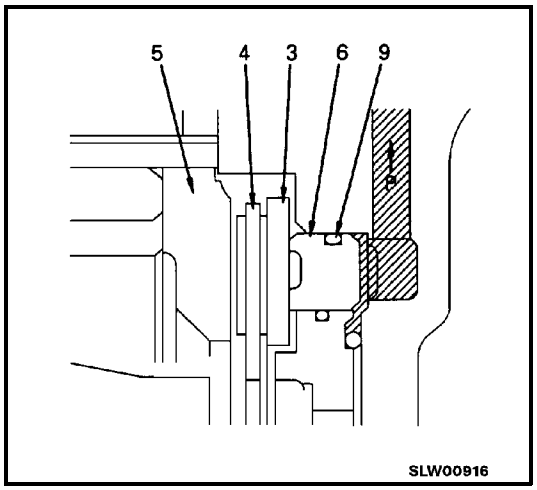
Brake applied

- When the brake pedal is depressed, the rod of the master cylinder is pushed. Oil pressure P is generated, and this acts on the piston inside the brake cylinder to slide piston (6) slightly. Therefore, the rotation of disc (4), which is between inner ring (3) and outer ring (5), is stopped, and the brakes. are applied to stop the machine.



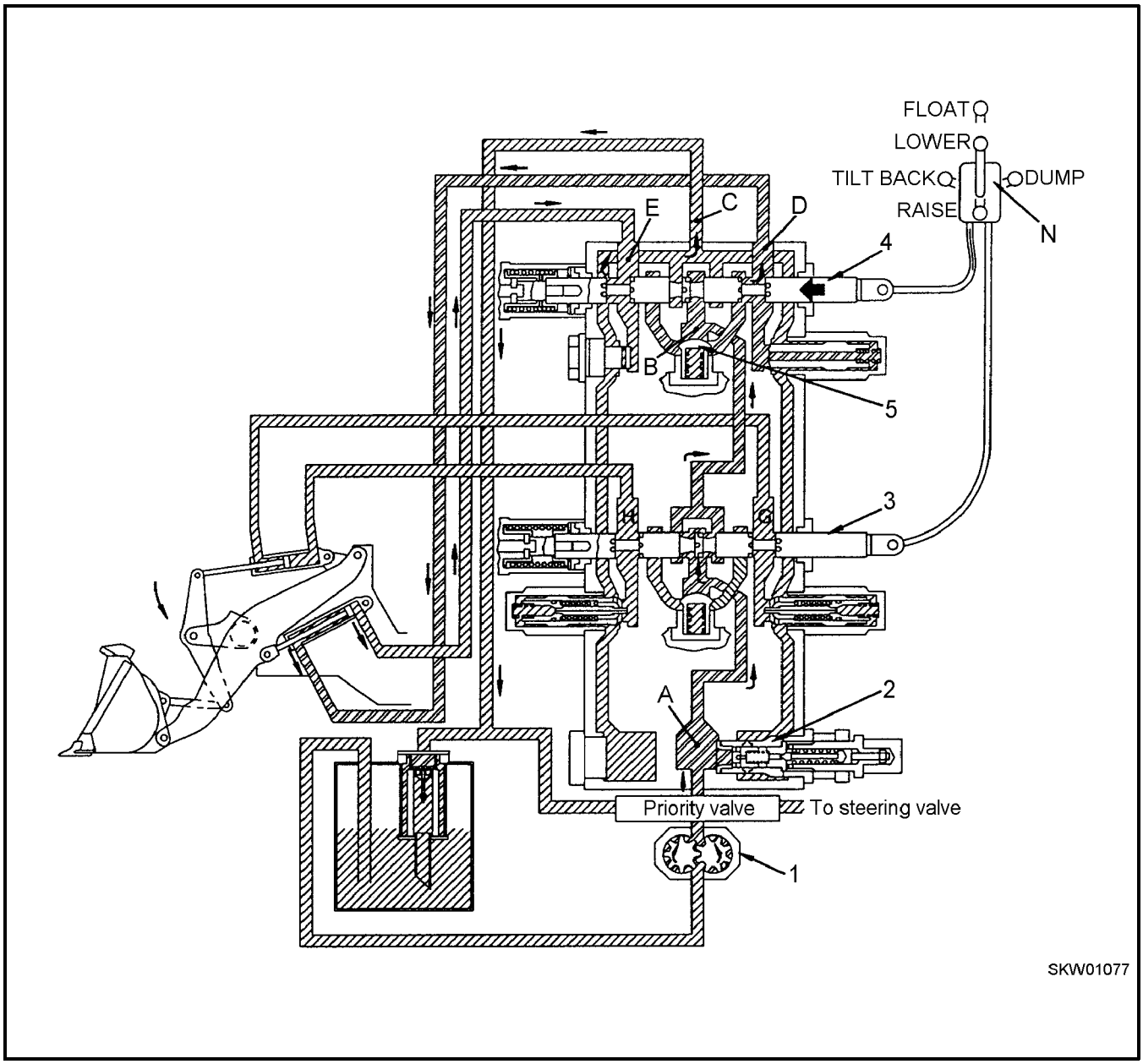
Brake released

- When the oil pressure is released, piston (6) moves back slightly because of the return force of piston O-ring (9). A gap is created between inner ring (3) and outer ring (5), so disc (4) is free.
  Grooves are cut in a lattice pattern on the lining stuck to disc (4). When the disc is rotating, oil flows in these grooves to cool the lining.



- MEMORANDA -

Boom spool at LOWER position



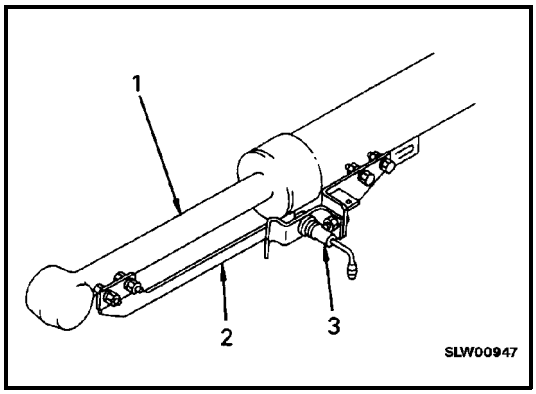
Operation

- When the work equipment control lever is pushed, boom spool (4) is pushed in to the LOWER position.

- The oil from the pump flows through the by-pass circuit of the bucket spool and flows to the by-pass circuit of boom spool (4). The by-pass circuit is closed by the spool, so the oil from port **B** pushes check valve (5) open. The oil from port **B** then flows from port **D** to the rod end of the cylinder.

- At the same time, the oil at the cylinder bottom end flows from port **E** to drain port **C** and returns to the tank. As a result, the boom is lowered.

BUCKET POSITIONER

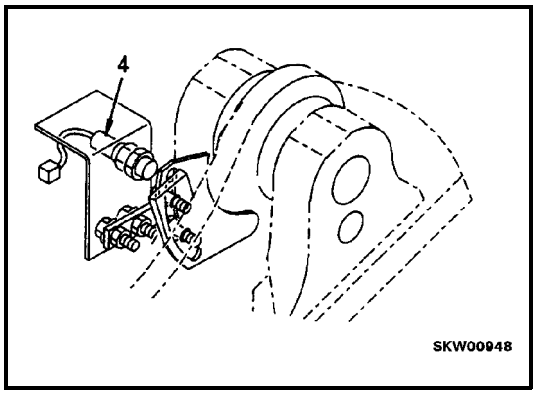


- The bucket positioner is an electrically actuated system which is used to set the bucket to the desired angle when the bucket is moved from the DUMP position to the TILT position. When the bucket reaches the desired position, the bucket control lever is returned from the TILT position to the HOLD position, and the bucket is automatically set to the suitable digging angle.

- Lever (2) is secured to the bucket cylinder rod (1) by bolts. In addition, proximity switch (3) is fixed to the cylinder by bolts.

- When the bucket is moved from the DUMP position to the TILT position, the bucket cylinder rod moves to the left, and at the same time, lever (2) also moves to the left. Proximity switch (3) separates from lever (2) at the desired position, and the bucket control lever is returned to neutral.

BOOM KICK-OUT

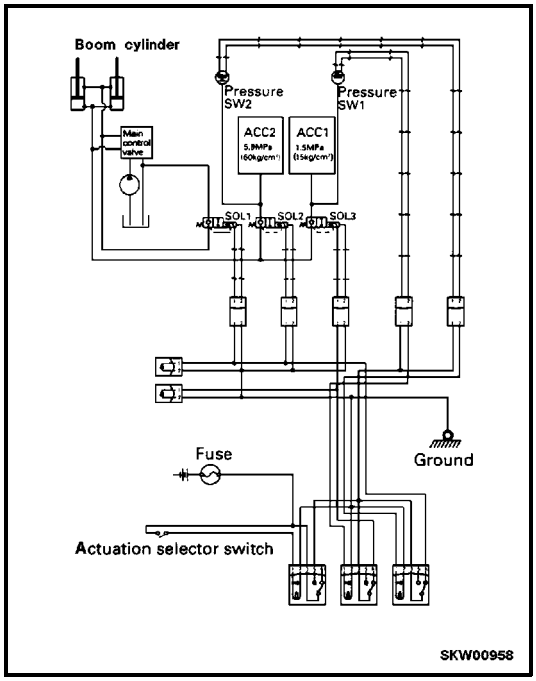


- The boom kick-out is an electrically actuated system. It acts to move the boom control lever to the HOLD position and stop the boom at the desired position before the boom reaches the maximum height.

- Plate is fixed to the boom. In addition, proximity switch (4) is fixed to the frame. When the boom is moved from the LOWER position to the RAISE position, the boom rises, and when it reaches the desired position, the proximity switch and lever come together and the system is actuated to return the boom control lever to the HOLD position.

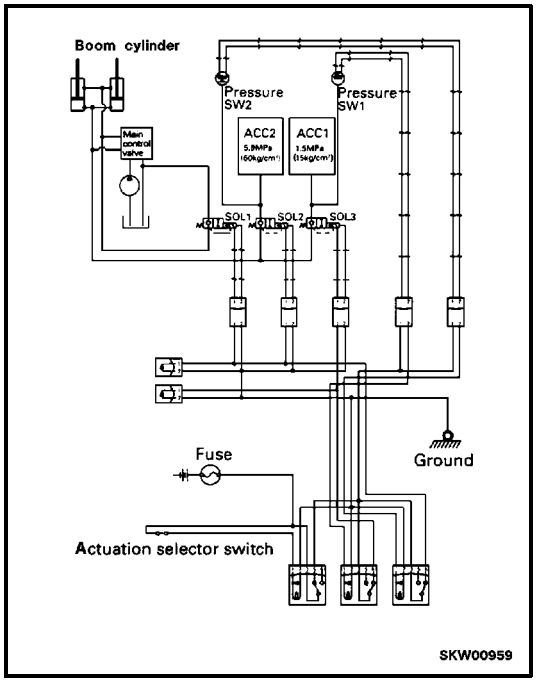
1. Actuation selector switch OFF

- Solenoid selector valves (1), (2), and (3) are at the shut-off position, so the system is not actuated.

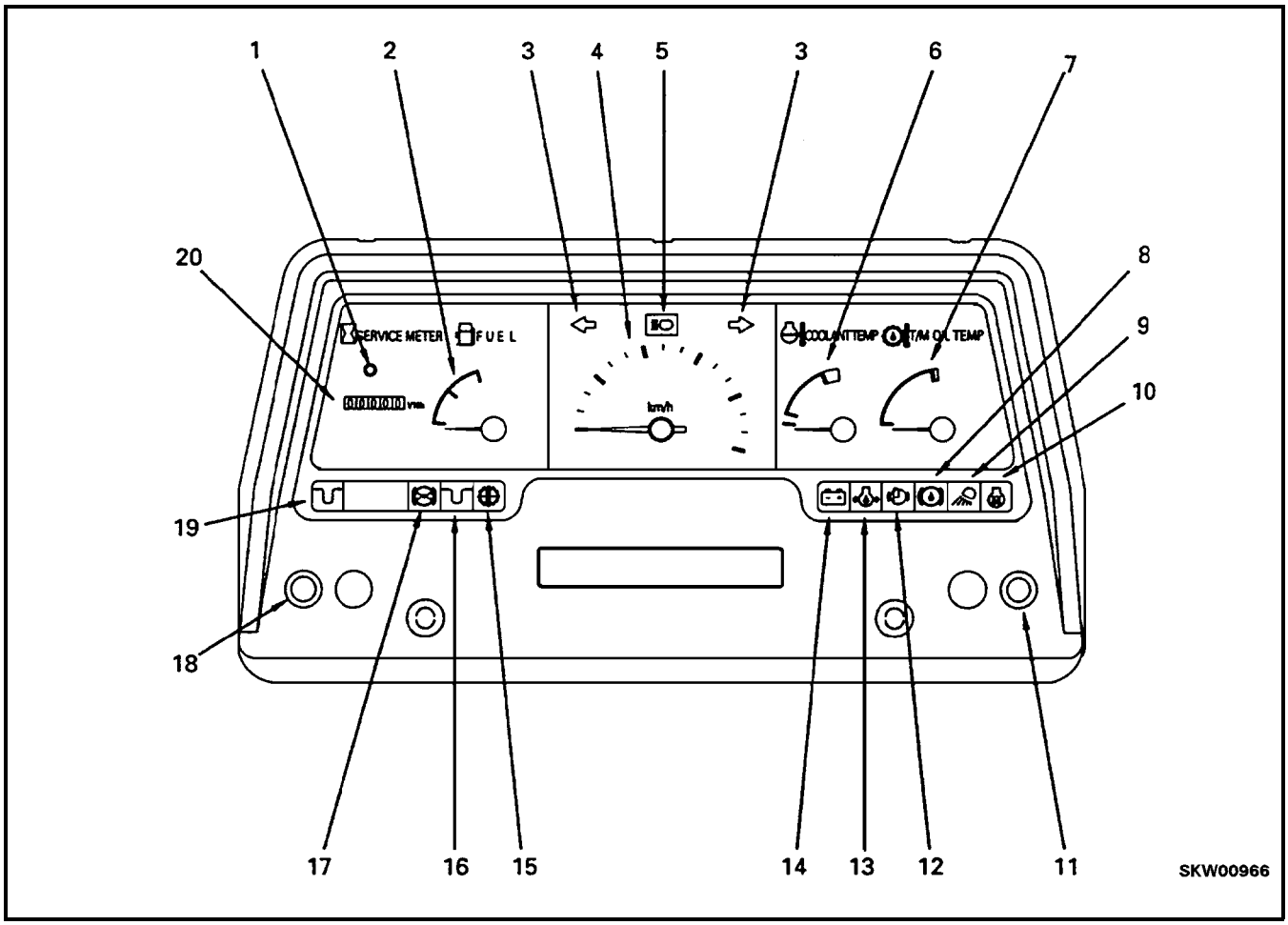


2. Actuation selector switch ON, traveling unloaded, boom cylinder bottom pressure: 0 - 5.9 Mpa (0 - 60 kg/cm^2)

- Accumulators ACC1 and ACC2 are both interconnected, but gas pressure of accumulator ACC2 > boom cylinder bottom pressure, so ACC2 is not actuated as a spring. Only accumulator ACC1 is acyuated as a spring.



CENTRAL PANEL (CLUSTER GAUGE)

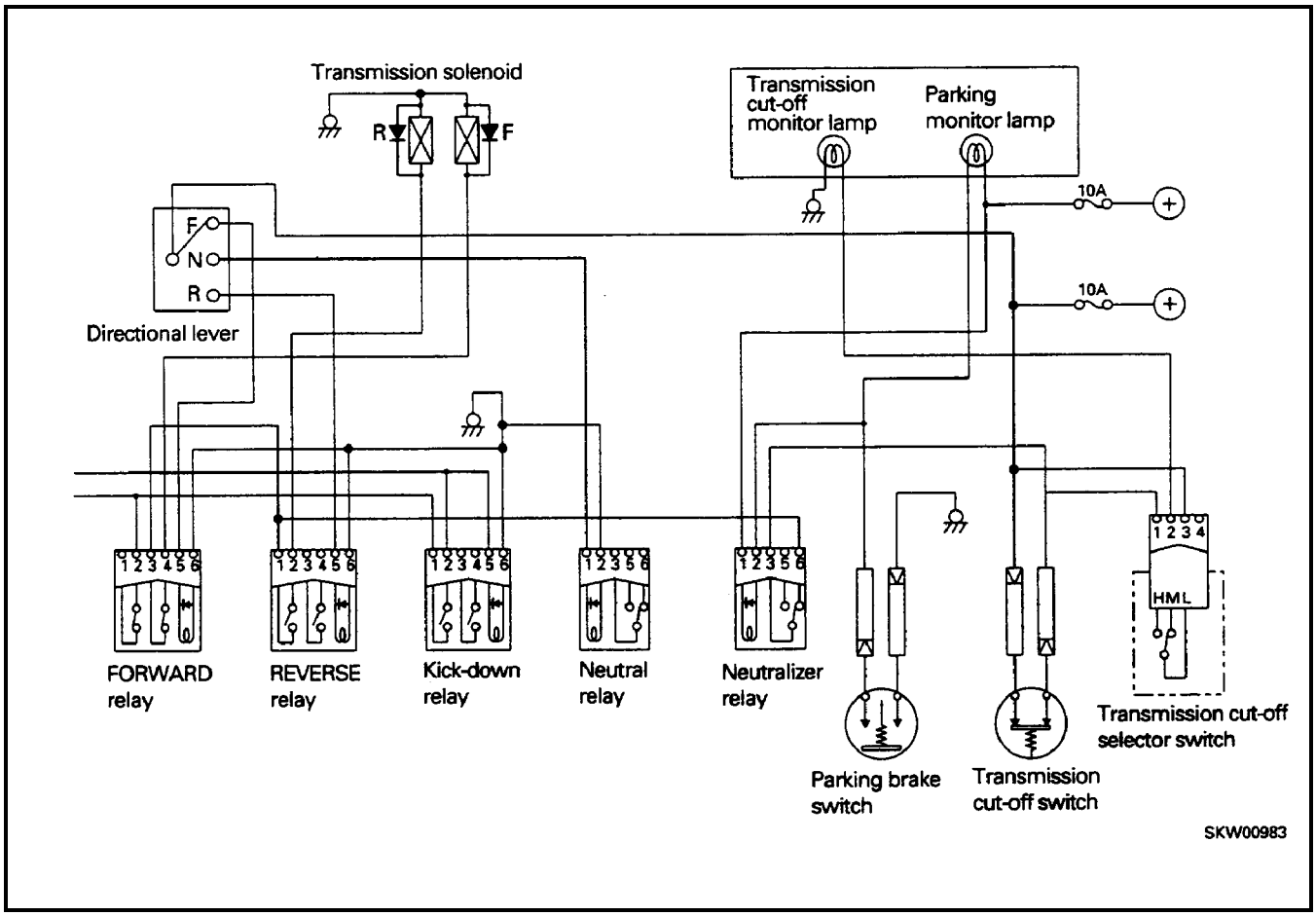


1. Service meter indicator
2. Fuel gauge
3. Turn signal pilot lamp
4. Speedometer
5. Head lamp high beam pilot lamp
6. Coolant temperature gauge
7. Torque converter oil temperature gauge
8. Brake oil level warning lamp
9. Working lamp pilot lamp
10. Preheating pilot lamp
11. Working lamp switch
12. Parking brake pilot lamp
13. Engine oil pressure warning lamp
14. Battery charge warning lamp
15. Transmission cut-off selector lamp
16. Emergency steering lamp
17. Brake boost pressure warning lamp
18. Transmission cut-off selector switch
19. Emergency steering lamp
20. Service meter

TRANSMISSION CUT-OFF FUNCTION

Outline

- If the transmission cut-off selector switch on the cluster gauge is turned ON (pilot lamp lights up), the transmission cut-off switch installed to the left brake pedal is actuated. When the left brake is operated, the brake is applied and the transmission is also shifted to neutral at the same time.
- If the transmission cut-off selector switch is turned OFF (pilot lamp goes out), the transmission is not shifted to neutral and the left brake operates in the same way as the right brake.



Operation

1. Transmission cut-off selector switch ON

- If the transmission cut-off selector switch is turned ON, a voltage of +24V is applied to the transmission F solenoid or R solenoid through the transmission cut-off switch to the neutralizer relay FORWARD relay or REVERSE relay.

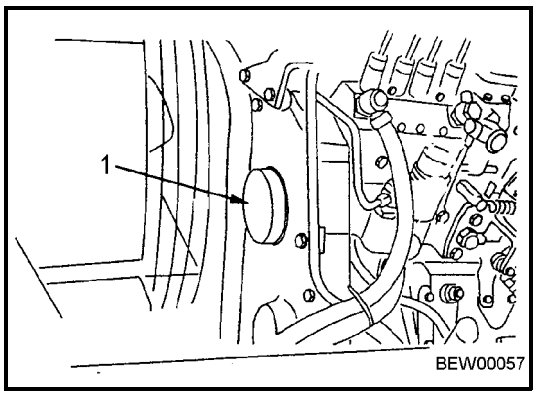
  Electric current flows from the directional lever to the FORWARD relay or REVERSE relay, so the relay coil is excited and a circuit is formed.

- When the left brake pedal is depressed, the transmission cut-off switch is turned OFF, and the electric current to the FORWARD relay or REVERSE relay is cut. As a result, the transmission is shifted to neutral in addition to the normal operation of the brake.

TOOLS FOR TESTING, ADJUSTING & TROUBLESHOOTING

Check or measurement item	Symbol		Tool Number	Tool Description	Remarks
Intake manifold pressure	--			Pressure gauge	See engine shop manual
Intake air restriction	--			Water manometer	See engine shop manual
Engine lubricating oil pressure	--			Pressure gauge	See engine shop manual
Fuel filter inlet restriction	--			Vacuum gauge	See engine shop manual
Exhaust back pressure	--			Mercury manometer	See engine shop manual
Measuring voltage and resistance values	--		Commercially available	Tester	---
Engine speeds	A	1	799-203- 8001	Digital optical tachometer	Digital display (799-203-9000) L: 60-2000 rpm R: 60-19999 rpm
		2	795-790-2500	Adapter kit	See engine shop manual
Coolant and oil temperatures	B		799-101-1502	Digital temperature gauge	See engine shop manual
Oil pressure	C	1	799-101-5002	Analog hydraulic tester	Pressure gauge 2.45, 5.88, 39.2, 58.8 Mpa (25, 60, 400, 600 kg/cm^2)
			790-261-1203	Digital hydraulic tester	Pressure gauge 0-68.6 Mpa (0-700 kg/cm^2)
		2	799-401-2320	Hydraulic gauge	1.0 Mpa (10 kg/cm^2)
		3	790-261-1311	Adapter	---
			790-261-1321		---
Compression pressure	D	1	795-502-1590	Compression gauge	0 - 6.9 Mpa (0 - 70 kg/cm^2) Kit part No. 795-502-1205
		2	795-502-1700	Adapter	Kit Part No. 799-201-1504
Blow-by pressure	E	1	799-201-1541	Gauge	
		2	799-201-1571	Tube	
		3	799-201-1450	Adapter	
		4	795-790-1950	Nozzle	---
Valve clearance	F		Commercially available	Feeler Gauge	---
Exhaust color	G	1			
		2	Commercially available	Smoke meter	---
Troubleshooting of wiring harnesses and sensors	H		799-601-7400	T-adapter	---

MEASURING STALL SPEEDS



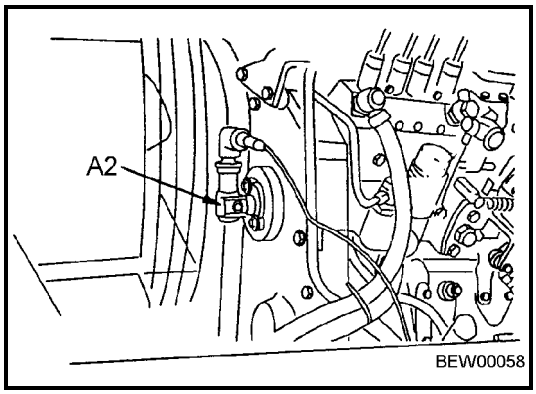
Measurement conditions

- Engine water temperature: Within the white operating range on the engine water temperature gauge.
- Hydraulic oil temperature: 45 - 55°C (113 - 131°F)
- Engine speed: High idle
- Torque converter oil temperature: 60 - 80°C (140 - 176°F)

Apply the parking brakes and block the tires

When measuring each stall speed be careful not touch any rotating part or parts that are extremely hot.

★ Check that the low idle and high idle are the standard values.
★ Before measuring each stall speed, remove cover (1) from the pickup port, install adapter **A2** of tachometer **A1**, then connect the tachometer **A1** and the adapter with a cable.
★ Check that the engine speed is the standard value. If it is not within the standard range , check for loose linkage or play.

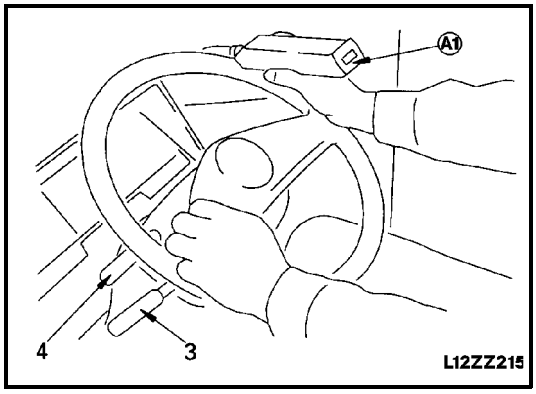


TORQUE CONVERTER STALL SPEED

★ Before starting the operation, check that the tires are chocked and release the parking brake.

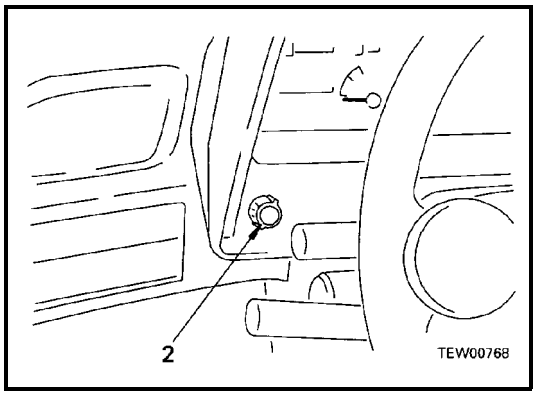
1. Start the engine and run at low idle.

2. Place direction lever (4) at FORWARD OR REVERSE, and set speed lever (3) to the highest position.

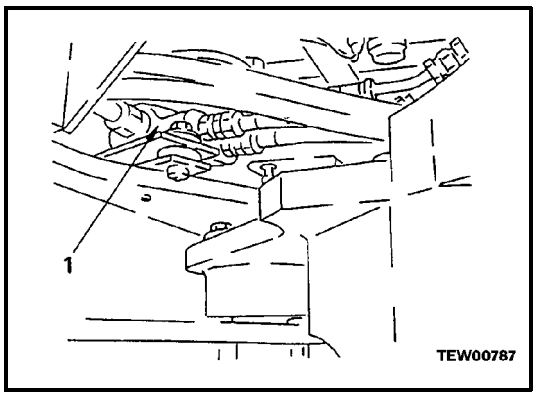


3. Use the brakes to stop the machine, then use multi-tachometer A1 to measure the speed when the engine is at high idle.

★ Turn transmission cut-off selector switch (2) OFF and use the left brake . (Check that the pilot lamp goes out.)
★ Do not keep the stall condition for more than 20 seconds. Make sure that the torque converter oil temperature does not exceed 120°C.

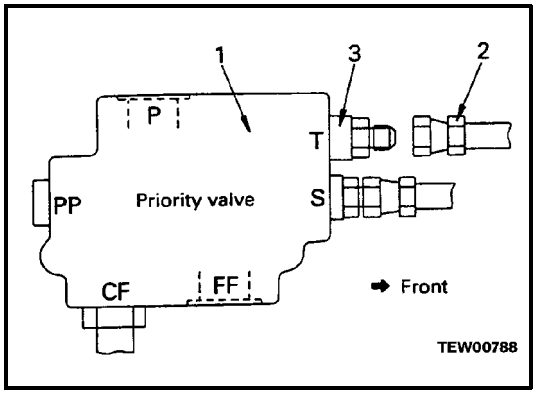


METHOD OF ADJUSTING MAIN RELIEF PRESSURE



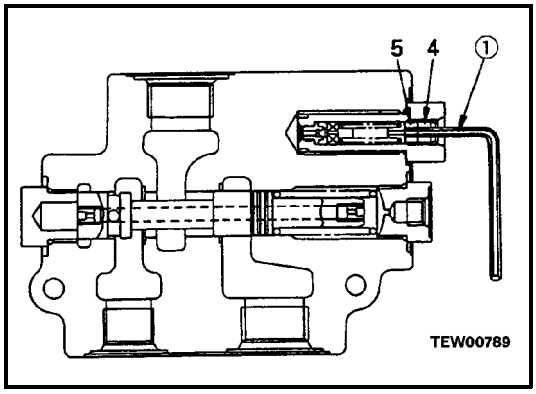
⚠ Always stop the engine before adjusting the pressure.

1. Stop the engine.
2. Remove hose (2) and fitting (3) connected to port **"T"** of the priority valve (1).
3. Remove double screw (4).
4. Turn adjustment screw (5) to adjust.
   - ★ Pressure adjustment for one turn of adjustment screw: Approx. 6.9 Mpa (70 kg/cm^2).
   - ★ Turn the adjustment screw to adjust the set pressure as follows.
     TIGHTEN to INCREASE pressure.
     LOOSEN to DECREASE pressure.
   - ★ Tool **"1"** for turning adjustment screw: Size 7/32 inch, hexagonal
   - ★ If the relief pressure cannot be measured accurately then **do not** try to adjust the pressure.

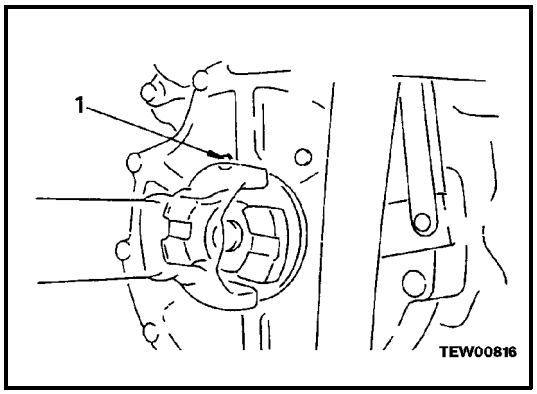


Adjustment screw (5): 4.5 ± 2.3 Nm
(0.46 ± 0.23 kgm)
(3 ± 2 lb.ft.)

Double screw (4): 14.7 ± 2 Nm
(1.5 ± 0.2 kgm)
(11 ± 1.5 lb.ft.)



TESTING PARKING BRAKE DISC WEAR



⚠ Stop the machine on level ground, install the safety bar to the frame, lower the bucket to the gruond, stop the engine, then apply the parking brake and put blocks under the wheels.

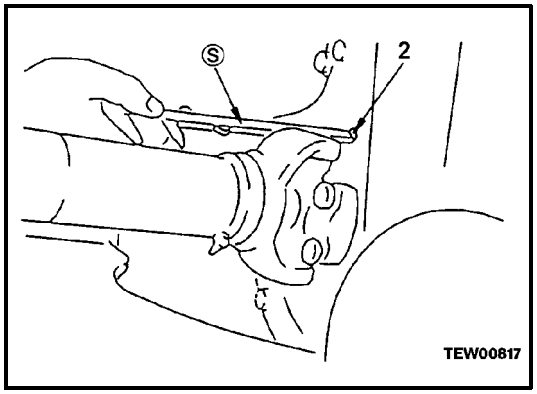
★ Check that there are blocks under the tires.

★ Carry out this operation with the drive shaft still installed.

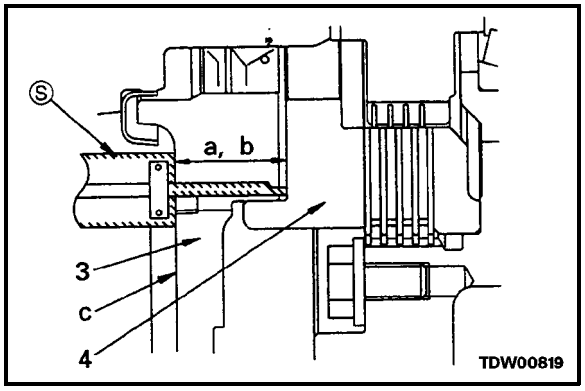
Testing

1. Check that the parking brake is applied.

2. Remove plug (1).
   - Width across flats of hexagon wrench: 6 mm

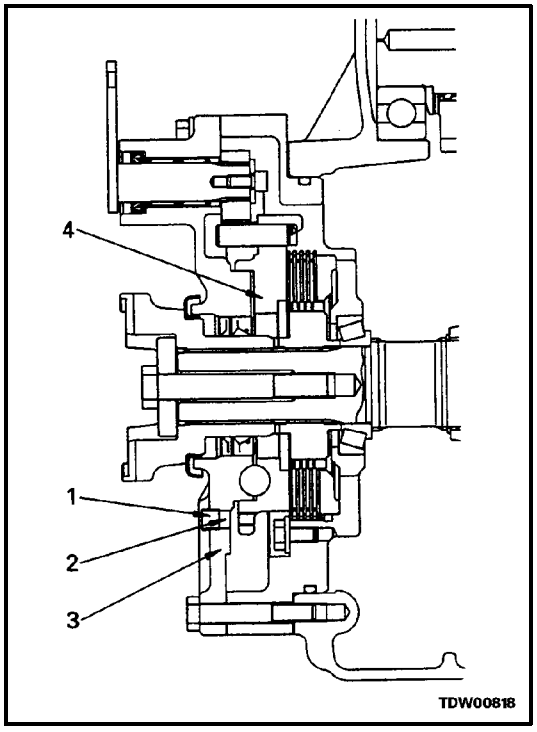


3. Insert calipers **"S"** into the measurement port (2) and measure dimension **"a"** from end face **"c"** of the cover (3) to the piston (4).



4. Release the parking brake.

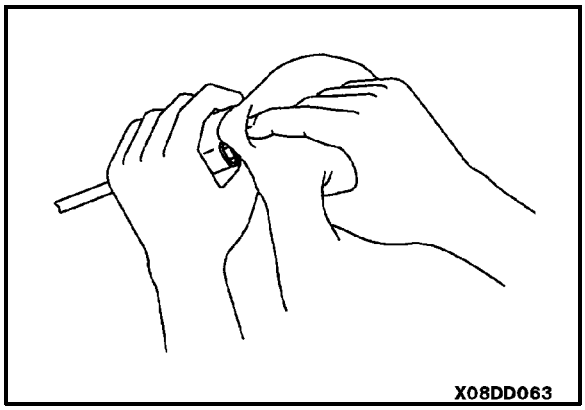
5. Insert calipers **"S"** into the measurement port (2), and measure dimension **"b"** from end **"c"** face of the cover (3) to the piston (4).
   - Piston stroke **X = "a" - "b"**
     If **X** is 3.5 mm, the brake disc is worn and must be replaced.
   - ★ For details of method of replacing the brake disc, see DISASSEMBLY AND ASSEMBLY OF TRANSMISSION.
   - ★ After measuring, check the transmission oil level.



MEMORANDA

v. Oil or dirt stuck to connector. If oil or grease is stuck to the connector and an oil film is formed on the mating surface between the male and female pins, the oil will not let the electricity pass, so there will be defective contact. If there is oil or grease stuck to the connector, wipe it off with a dry cloth or blow dry with compressed air and spray it with a contact restorer.
   - ★ When wiping the mating portion of the connector, be careful not to use excessive force or deform the pins.
   - ★ If there is oil or water in the compressed air, the contacts will become even dirtier, so remove the oil and water from the compressed air completely before cleaning with compressed air.

2. Removing, installing, and drying connectors and wiring harnesses.
   a. Disconnecting connectors
      i. Hold the connectors when disconnecting. When disconnecting the connectors, hold the connectors and not the wires. For connectors held by a screw, loosen the screw fully, then hold the male and female connectors in each hand and pull apart. For connectors which have a lock stopper, press down the stopper with your thumb and pull the connectors apart.
         - ★ Never pull with one hand.
   b. When removing from clips
      i. When removing a connector from a clip, pull the connector in a parallel direction to the clip.
         - ★ If the connector is twisted up and down or to the left or right, the housing may break.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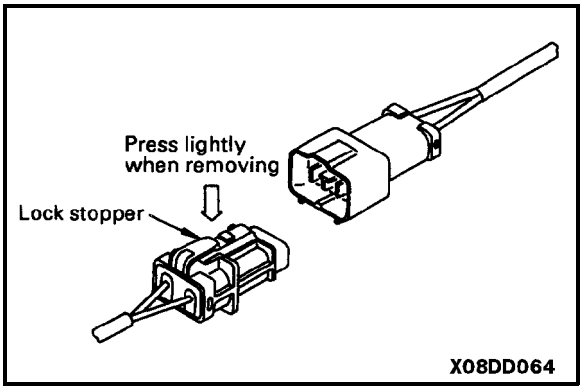

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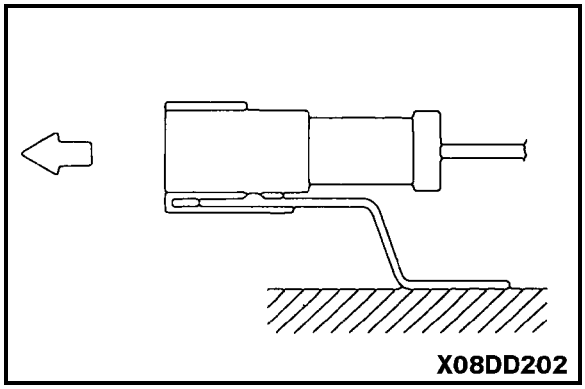
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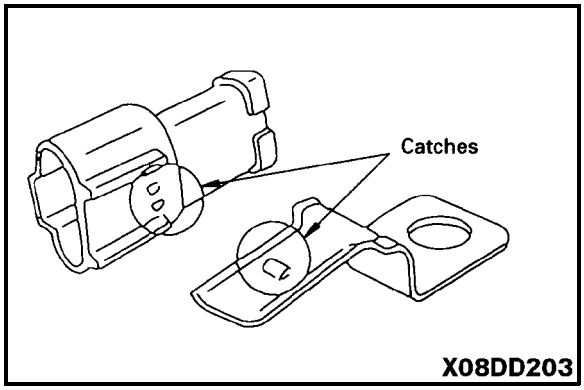


X08DD203

PREVENTING RECURRENCE OF TROUBLE

- The troubleshooting table is used to establish the direct cause of damage or breakdown of a part or piece of equipment. It is not able to establish the root cause of the damage or failure, however.
- Also, this table only describes the action to be taken with the particular part or piece of equipment. It does not mention what action should be taken to prevent a recurrence of the root cause.
- In order to remove the root cause of a fault so as to prevent a recurrence, carefully investigate the real cause while referring to the following items.
- Regarding the method of checking and adjusting each part or piece of equipment, refer to "Testing and Adjusting" in the Shop Manual.

HYDRAULIC EQUIPMENT

1. Oil checks

- The fundamental cause of almost all faults occurring in hydraulic equipment is the inclusion of water, air or other foreign matter in the oil. Accordingly, it is necessary to check the oil to see whether or not it contains any of the above substances, and then take appropriate action.

1) Oil checks
   - Check for water contamination.
     Check the oil for possible water contamination by means of a diesel engine oil checker or a hot plate.
   - Check for contamination of other foreign matter. Remove the drain plug and filter, then check the bottom of the tank and also the filter to see if any foreign matter has collected there. Check the degree of contamination by means of a contamination checker.
   - Viscosity check
     Check the viscosity of the oil using a viscometer in order to confirm whether or not the oil is satisfactory.

2) Check of contamination point
   If, as a result of the above checks, it is discovered that the oil is contaminated by water or other foreign matter, it is necessary to find out where the contamination is occurring and also to take steps to prevent it.
   Water: Oil storage tank, breather, etc.
   Sand: Oil replenishing or replacing method, etc.
   Rubber: Cylinder packing, etc.
   Metal: Wear or damage to hydraulic equipment such as pump and motor, as well as transmission and torque converter, etc.

3) Oil cleaning and replacement
   - If a large amount of metal particles or other foreign matter is discovered in the oil, either wash the oil using an oil refresher or replace it.
     If the oil is contaminated by water, it is not possible to remove the water by means of an oil refresher.
     When washing the oil, also wash or replace the strainer and replace the filter.

2. Cleaning fragments of damaged parts

- If a part becomes damaged, fragments may pass into the oil line. It is thus necessary to wash the oil.
- In addition, disassemble and wash such parts as valves and cylinders which are liable to collect metal fragments and other foreign matter, thus helping to prevent a recurrence of faults due to such fragments becoming lodged in various parts of the engine or hydraulic equipment.

- MEMORANDA -

S-7 Exhaust gas is black (incomplete combustion)

General causes why exhaust gas is black
- insufficient intake of air
- Improper condition of fuel injection
- Excessive injection of fuel

Legend
○ : Possible causes (judging from Questions and check items)
◎ : Most probable causes (judging from Questions and Check items)
△ : Possible causes due to length of use (used for a long period)
● : Items to confirm the cause.

			Causes: Seized turbocharger, interference	Clogged air cleaner element	Worn piston ring, cylinder	Clogged, seized injection nozzle	Improper injection timing	Defective injection pump (excessive injection)	Improper valve clearance	Crushed, clogged muffler	Leakage of air between turbocharger and head	Defective contact of valve, valve seat	Deffective injection pump (rack, plunger seized)
Questions	Confirm recent repair history												
	Degree of use	Operated for long period		△	△	△						△	
	Color of exhaust gas	Suddenly became black	◎			○							○
		Gradually became black		◎		○					○		
		Blue under light load			◎								
	Engine oil must be added more frequently				◎								
	Power was lost	Suddenly	◎			○			○				○
		Gradually		○	○					○	○		
	Non-specified fuel has been used					○							○
Check items	Noise of interference is heard from around turbocharger		◎										
	Dust indicator is red			◎									
	Blow-by gas is excessive				◎								
	Engine pickup is poor and combustion is irregular		○			◎			○	○	○		○
	When exhaust manifold is touched immediately after starting engine, temperature of some cylinders is low					◎							○
	Match marks on fuel injection pump are out of alignment						◎						
	Seal on injection pump has come off							◎					
	Clanging sound is heard from around cylinder head								◎				
	Exhaust noise is abnormal		○			○				◎			
	Muffler is crushed									◎			
	Leakage of air between turbocharger and head, loose clamp										◎		
Troubleshooting	When turbocharger is rotated by hand, it is found to be heavy		●										
	When air cleaner is inspected directly, it is found to be clogged			●									
	When compression pressure is measured, it is found to be low				●							●	
	Stop fuel injection to one cylinder at a time. If there is no change in engine speed, that cylinder is not working					●							
	When check is made using delivery method, injection timing is found to be incorrect						●						
	Injection pump test shows that injection amount is incorrect							●					
	When valve clearance is checked directly it is found to be outside standard value								●				
	When muffler is removed, exhaust gas color returns to normal									●			
	When control rack is pushed, it is found to be heavy, or does not return												●
	Remedy		Replace	Clean	Replace	Replace	Adjust	Adjust	Adjust	Replace	Repair	Replace	Replace

SM20209

- MEMORANDA -

S-2 Steering is heavy

Ask the operator the following questions.

- Did the problem suddenly start?
  Yes = Steering equipment damaged or broken
- Was there previously any symptom, such as heavy steering?
  Yes = Wear of internal parts of steering equipment, defective seal

Checks before troubleshooting.

- Is the hydraulic oil level correct? Is the type of oil correct?
- Is there any leakage of oil from the hydraulic hoses, valves, or cylinders?
- Is there any scuffing of the center hinge pin bearing or steering cylinder pin or bushing?
- Is the tire inflation pressure correct?

Checking for abnormalities.

- Measure the operating force of the steering wheel and the time taken to turn the steering, and check the values in the Standard Value Table to see if there is really any abnormality.

Legend
X: Replace △: Correct A: Adjust C: Clean

No.	Problems	Remedy	Causes: Detective steering pump, work equipment pump	Defect inside priority valve (relief valve, plunger)	Defect inside Orbitrol	Defect inside steering cylinder (oil leakage from piston seal)	Clogged oil cooler, defective bypass valve
			Pump	Valves			Others
			a	b	c	d	e
			△ X	△A X	△ X	△ X	△C X
1	Steering is heavy when turned in either direction (left and right)		○	○	○	○	
2	Steering is heavy when turned in one direction (left or right)				○	○	
3	Steering is particularly heavy when engine is at low speed		○	○		○	
4	Boom lifting speed is slow when engine is running at full throttle		○				
5	Steering is heavy and steering wheel jerks		○	○			
6	Hydraulic oil overheats						○
7	Oil pressure in steering circuit is low			○	○	○	
8	Oil pressure rises in return piping for steering cylinder						○

SM20410

H-9 Bucket movement is slow or tilt-back lacks power

Checks before troubleshooting

- Is the travel of the bucket control lever and main control valve spool properly adjusted?
- Is there any seizure of the work equipment linkage? (Is there any abnormal noise?)

Checking for abnormalities

- Check if there is lack of tilt-back power during actual operations.
- Measure the operating speed of the bucket and use the Standard Value Table to check if there is any abnormality

Legend
X: Replace △: Correct A: Adjust C: Clean

No.	Problems \ Remedy	C △	△ ×	△A ×	△ ×	×	×
	Causes						
		Tank – pump		Main control valve			Cylinder
		a	b	c	d	e	f
1	Boom lifting power and speed are abnormal and bucket tilt-back power or speed are abnormal	○	○	○			
2	Boom lifting power and speed are normal but bucket tilt- back power or speed are abnormal				○	○	○
3	As in Item 1, but problem is particularly bad when oil temperature rises	○	○				
4	Abnormal noise comes from hydraulic pump		○				
5	Excessive hydraulic drift of bucket cylinder				○	○	○
6	Relief pressure of relief valve in main control valve is low			○	○	○	○
7	Hydraulic pump discharge amount is small		○				

Causes:
- Clogged suction port of pump or excessive air in oil
- Defective hydraulic pump and steering pump
- Defective operation of main relief valve or defective adjustment
- Defective operation of safety valve (with suction valve) at bucket cylinder bottom end
- Breakage or wear inside valve body (bucket spool)
- Damaged bucket cylinder piston seal

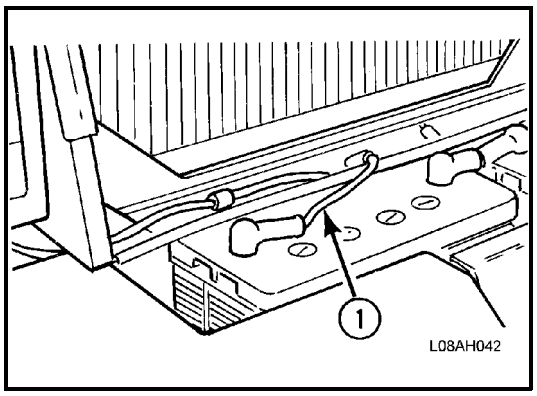
SM20420

30 DISASSEMBLY AND ASSEMBLY

STARTING MOTOR ASSEMBLY

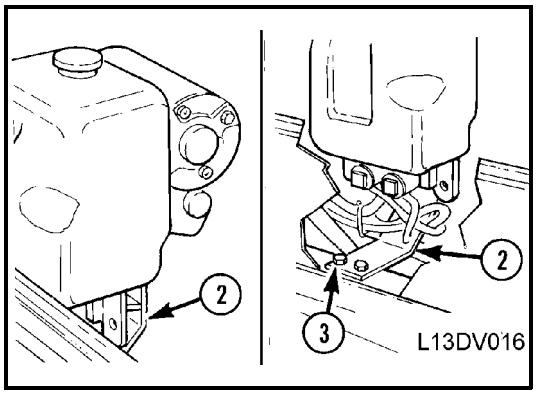
WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

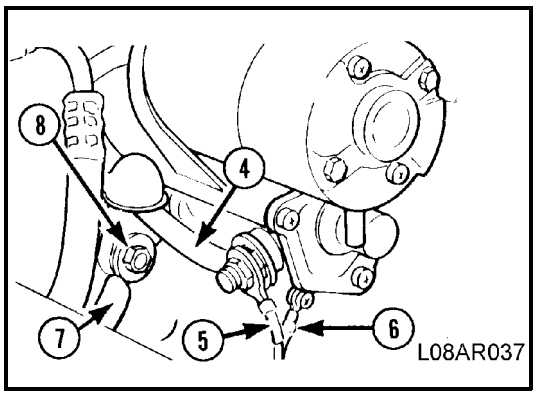
WARNING! Disconnect the cable from the negative (-) terminal of the battery.



REMOVAL

1. Disconnect negative (-) terminal (1) of the battery located behind the radiator grille.
2. Open engine hood side cover and lock in position.
3. Remove washer tank and bracket (2) and two mounting bolts with nuts (3) from frame and position out of way.
4. Disconnect cable (4) and harness wires (5) and (6).
5. Remove ground connection (7) with two mounting bolts (8), then remove starting motor assembly.





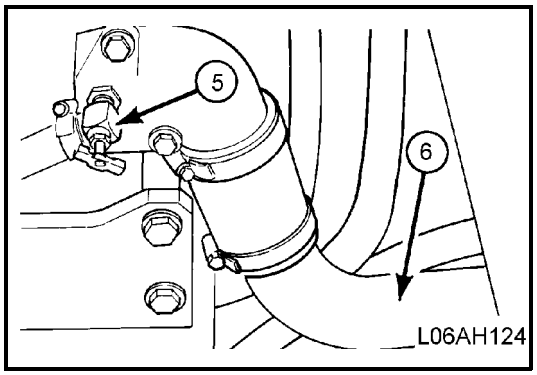
INSTALLATION

Install starting motor assembly in reverse order of removal

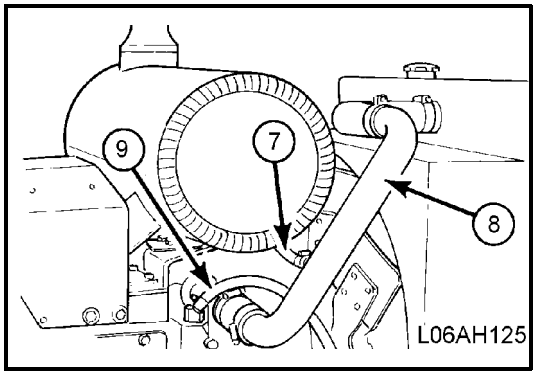
Mounting bolt: 32 ±4 lbf.ft
(43 ±6 Nm)
(4.38 ±0.61 kgm)

5. Removal of cooling lines.

A) Close petcock (5) to shut off heater hose, remove lower radiator outlet tube (6) with hoses.

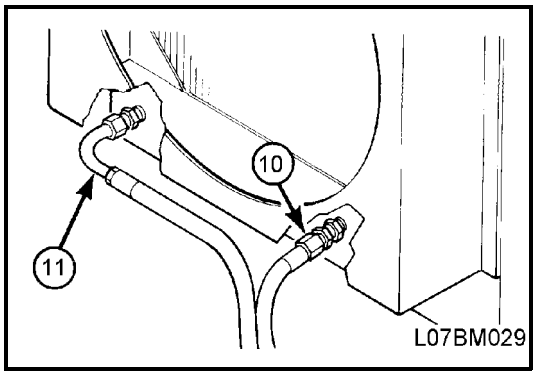


B) Disconnect engine vent line (7), remove radiator inlet tube (8), and disconnect roading trans cooler line (9) from thermostat housing.



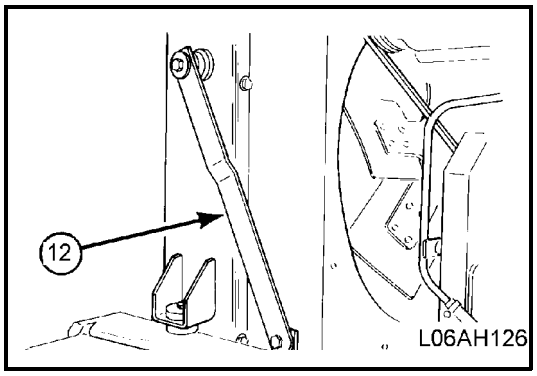
C) Disconnect torque converter cooler hoses (10) and (11) from radiator bottom tank.

Radiator fan shroud may have to be disconnected from radiator and pushed aside to disconnect hoses (10) and (11).



6. Radiator removal.

A) Disconnect radiator stay rod (12) at radiator, loosen at frame and rotate forward.



INSTALLATION

1. Install the engine assembly in reverse order of removal.
   Check that there is an o-ring installed to the mating face of the torque converter.

   Lubricate the outside circumference of O-ring: Soapy water

   When connecting the engine and torque converter, adjust the height so that the torque converter pilot goes in smoothly. **Never** use force when connecting.

   When assembling rear engine mounting bolts never use grease, oil, or soapy water on the rubber mounts.

   Mounting bolt: 550 ±61 lb/ft
   745 ±83 Nm
   76 ±8.5 kgm
   (Width across flats: 32mm)

2. Installation of radiator, refer to “REMOVAL AND INSTALLATION OF RADIATOR”.

3. Installation of engine hood, refer to “REMOVAL AND INSTALLATION OF THE ENGINE HOOD”.

4. Refilling with oils and coolant.
   Tighten radiator drain valve and open the two heater hose petcocks on the engine, and add the engine coolant through the radiator filler neck to the specified level.

   Check and if necessary add transmission oil through the oil filler neck on the transmission to the specified level.

   Check and if necessary add engine oil through the oil filler neck on the engine to the specified level.

   Run the engine (to operating temperature) and heater to circulate the oil and engine coolant through the system. Then check the engine coolant and oil, and the transmission oil levels again. Add oil or coolant if required.

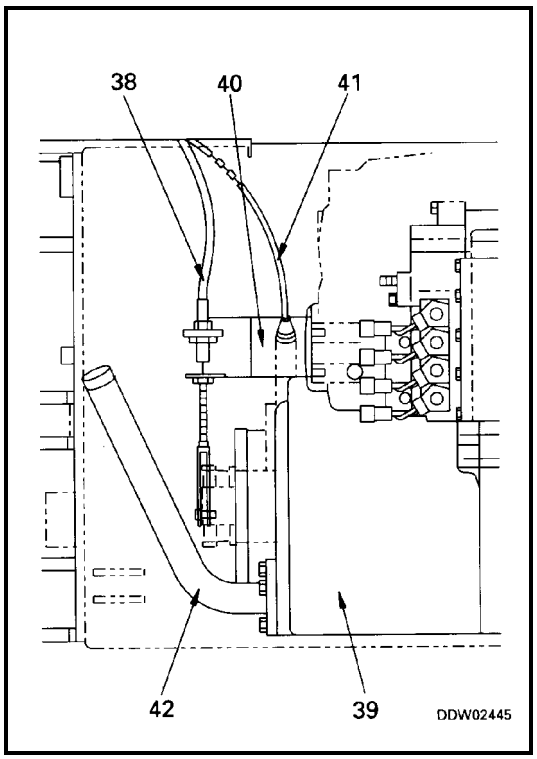
8. Parking brake cable

1) Disconnect parking brake cable (38) from lever, and remove bracket (40) from front face of transmission (39). ※2

After removing the cable, tie it temporarily to the bottom surface of the floor with wire.

2) Disconnect speedometer cable (41).

3) Remove transmission oil filler tube (42).



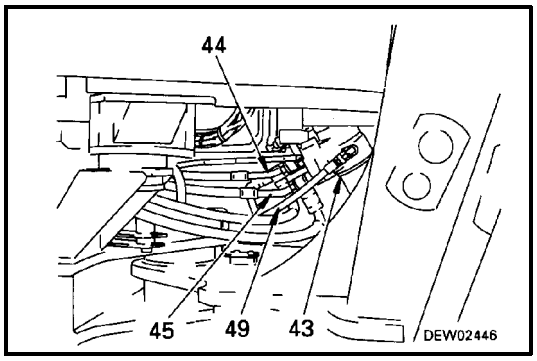
9. Steering piping

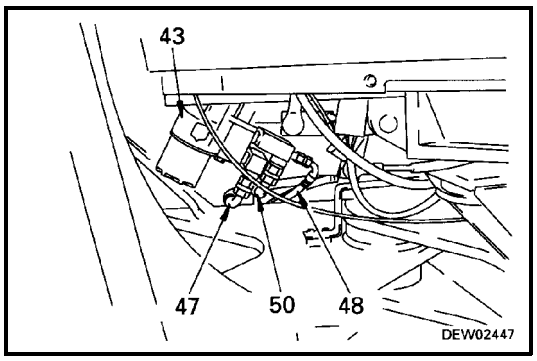
1) Remove hoses (44) and (45) from steering valve (43).

2) Disconnect hoses (47), (48), and (49) between steering valve (43) and priority valve.

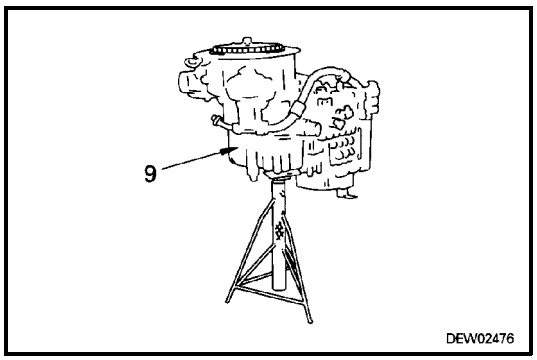
3) Remove hose (50) between steering valve and hydraulic tank.

Fit blind plugs after disconnecting the hoses.





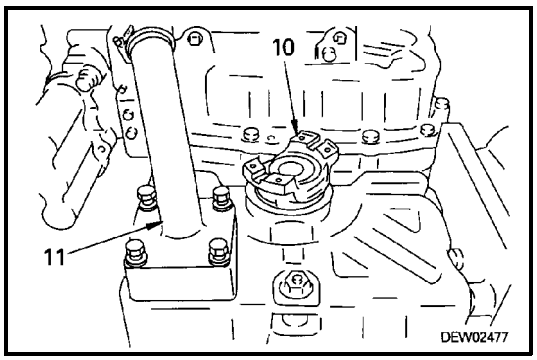
3) Raise transmission assembly (9), and install to assembly stand.
   After installing the transmission assembly to the assembly stand, turn over, then set a support under the REVERSE and 1st side. (To keep it parallel)



3. Strainer, rear coupling

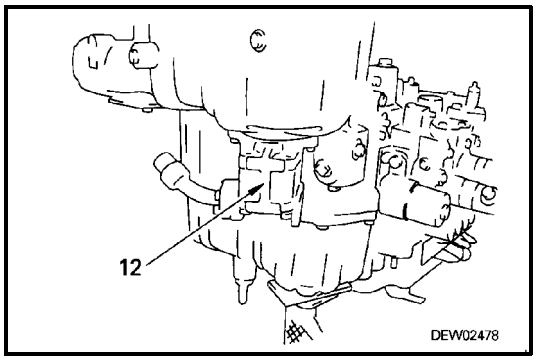
1) Pull out rear coupling (10).
   Fit a cover to prevent dirt or dust from entering.

2) Remove hose and tube (11) between strainer and pump.



4. Charging pump

After removing hoses, remove charging pump assembly (12) and O-ring.

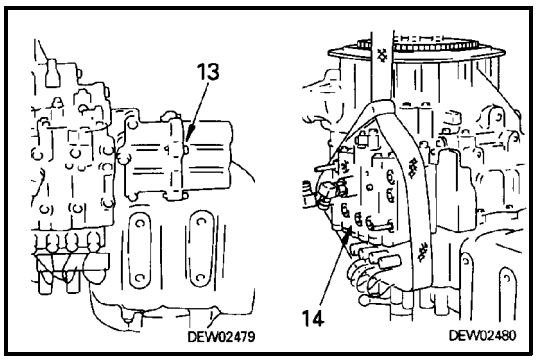


5. Transmission control valve

1) Remove accumulator valve (13).

2) Sling transmission control valve (14), then remove mounting bolts and lift off.
   After removing the mounting bolts, fit 2 guide bolts in the bolt holes.

kg Transmission control valve: **46 kg**



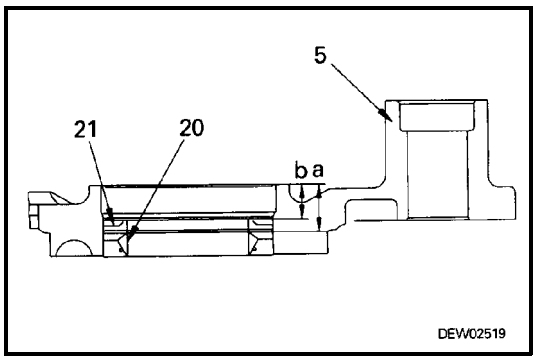
PARKING BRAKE
ASSEMBLY

1. Housing

1) Press fit oil seal (20) and dust seal (21) to housing (5).
   Press-fitting dimension **"a":** 25.8 1.0 mm
   Press-fitting dimension **"b":**
   18.3 1.0 mm

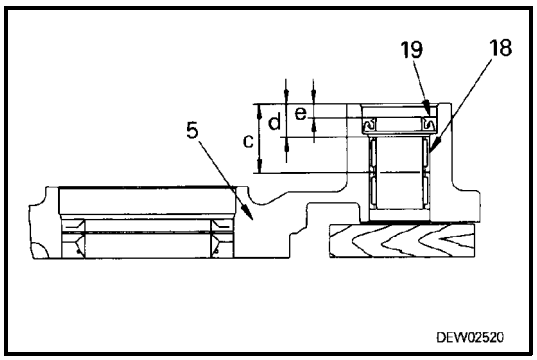
   Lip of oil seal: **Grease (G2-LI)**

   Coat with grease when assembling the housing.



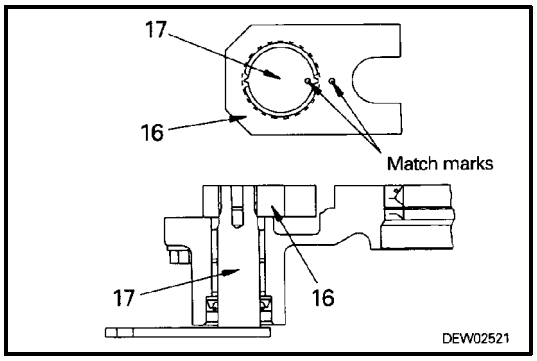
2) Press fit needle bearing (18) and oil seal (19) to housing (5) to specified dimensions.
   Needle bearing press-fitting dimension
   "**c**": 38.5 ± 0.15 mm (1st)
   Needle bearing press-fitting dimension
   "d": 18.0 ± 0.5 mm (2nd)
   Oil seal press-fitting dimension **"e":**
   7.5 ± 0.3 mm

   Lip of oil seal: **Grease (G2-LI)**



3) Insert outside lever (17) from oil seal end.
   Clean and remove all oil and grease from the bolt hole of the outside lever.

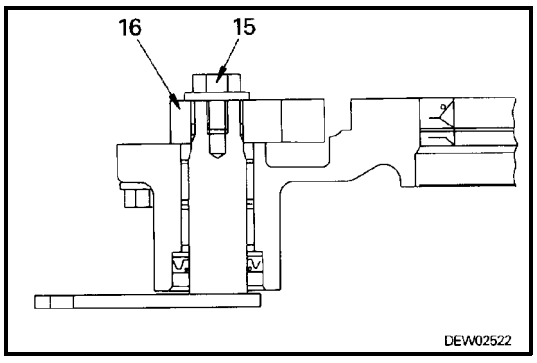
4) Align with match mark and assemble inside lever (16).



5) Tighten lock bolt (15).
   Clean and remove all oil and grease from lock bolt and bolt hole.
   Be sure to assemble the washer.

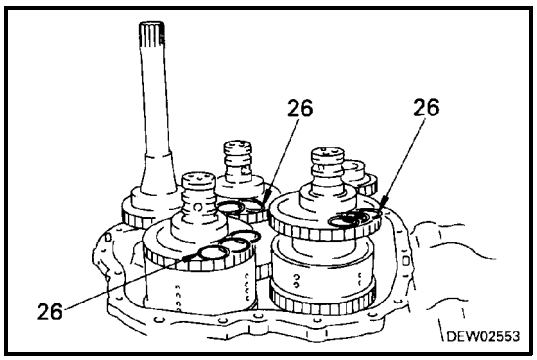
   Lock bolt: **Thread tightener (LT-2)**

   Lock bolt: **30.9 ± 3.4 Nm (3.15± 0.35 kgm)**



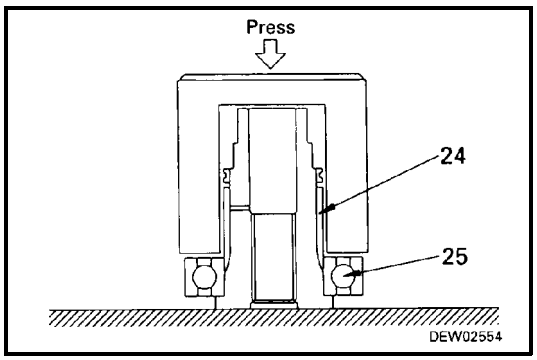
4) Install seal rings (26) to each clutch.
Coat the seal ring thoroughly with oil, then install, and check that it rotates lightly by hand.

Seal ring: **Oil (transmission oil)**

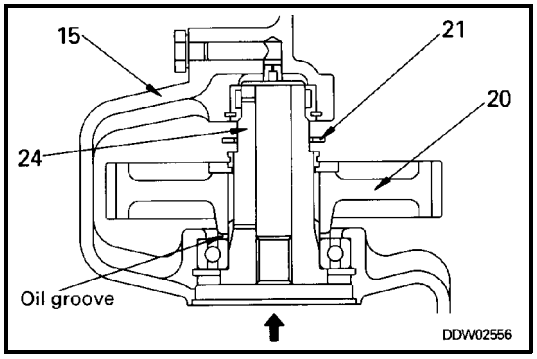


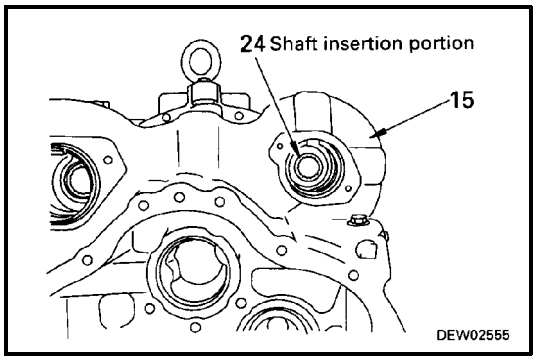
12. Pump (Torque converter, work equipment)

1) Press fit bearing (25) to shaft (24).
Press fit so that there is no clearance at the stepped portion of the shaft.



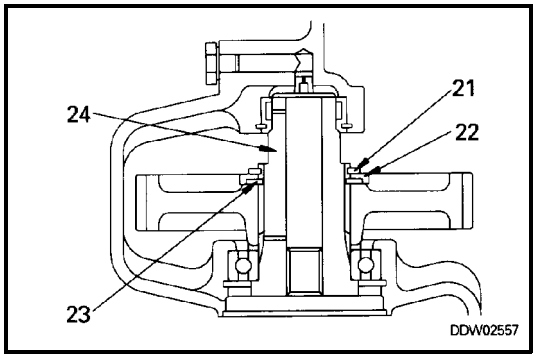
2) Assemble gear (20) and snap ring (21) inside rear housing (15), and insert shaft (24) from pump mount end.

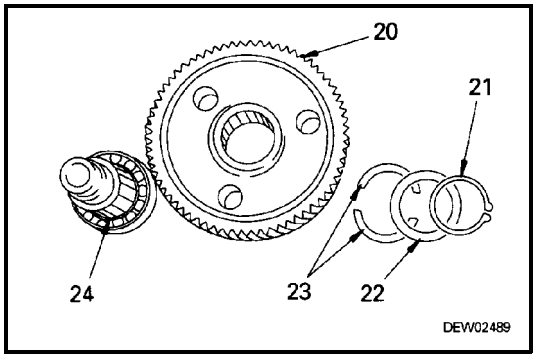




Install the gear so that the oil groove of the gear is on the pump mount side.

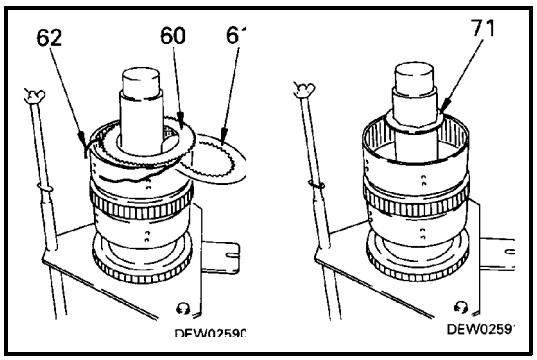
3) Assemble ring washer (22) and split spacer (23) to stepped portion of shaft (24), then install snap ring (21).





4. Clutch plate

1) Remove plate (60), disc (61), and spring (62) from housing.
2) Remove inside thrust washer (71).

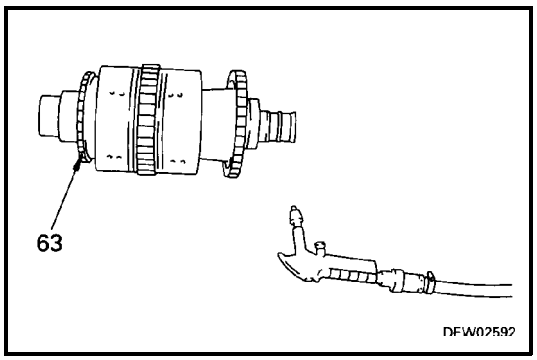


5. Piston

Blow air in through oil hole at 3rd end of shaft and remove piston (63).

If the piston is at an angle and does not come out, push the piston in and try again.

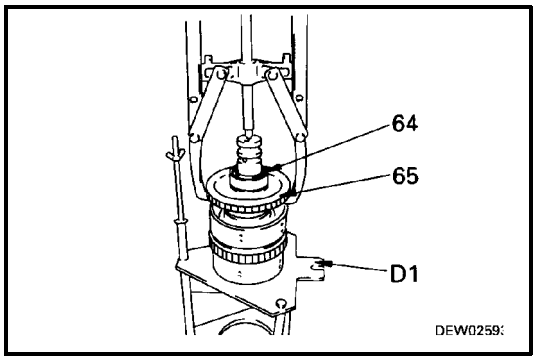
If force is used to remove the piston, the inside circumference of the cylinder will be damaged.



6. Bearing

Set with the 4th side facing up, and set on tool **D1.**

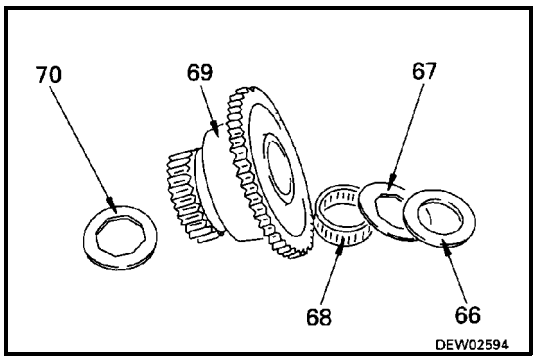
Using puller, remove bearing (64) and 3rd gear (65).



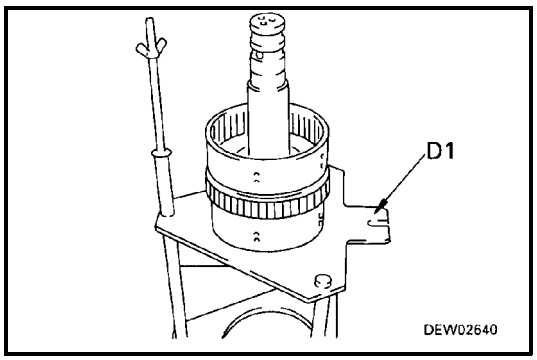
7. 4th gear

Remove spacer (66), thrust washer (67), needle bearing (68), 4th gear (69), and thrust washer (70).

Disassemble the 4th gear in the same way as in Steps 3 - 5 for the 3rd gear.



III. ASSEMBLY OF 3RD, 4TH CLUTCH PACK



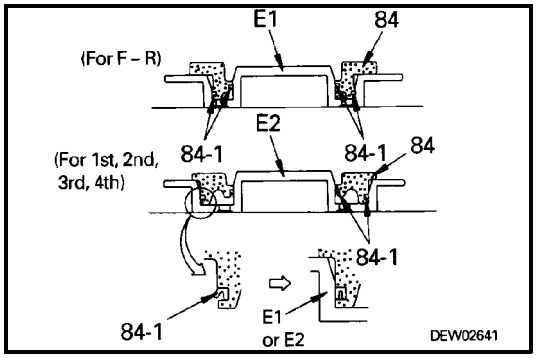
WARNING! When setting the clutch pack on the stand, be careful not to let your hands slip because of oil, and be extremely careful not to get your fingers caught between the stand and the clutch pack.
Set with the 4th side facing up, and set the shaft and housing assembly on tool **D1.**

1. Piston seal

Assemble piston seal (84-1) to piston (84).

When assembling a new piston seal, use seal shaping jig **E1** or **E2** for approx. 2 - 3 minutes, then assemble the piston seal.

If the seal is installed to the piston without being shaped, the seal will be damaged.

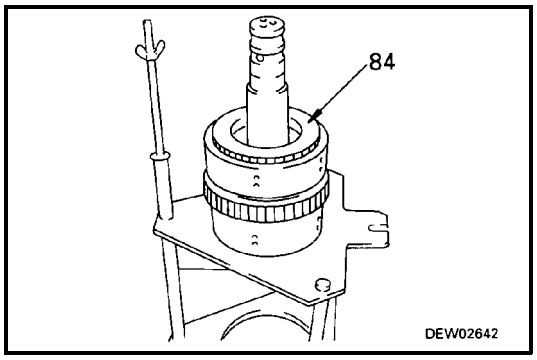


Inside surface of shaping jig:
Oil (transmission oil)

2. 4th piston

Assemble 4th piston (84).

Be careful not to damage the piston seal.



Sliding surface of piston seal:
Oil (transmission oil)

3. Clutch plate

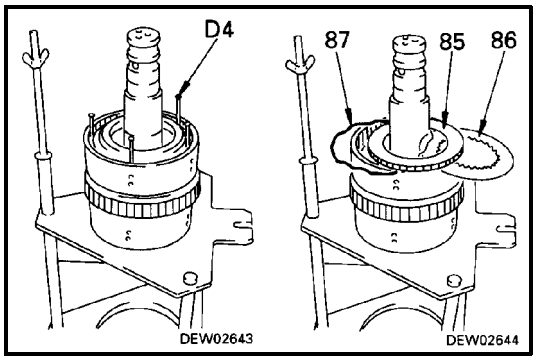
Insert tool **D4** in housing, then assemble plate (85), disc (86), and spring (87) in turn.

Soak disc (86) in clean transmission oil for at least 2 minutes before assembling.

Be careful not to let spring (87) and plate (85) rest on top of each other.

Be careful not to let the plate or spring get caught in the ring groove of the clutch housing when assembling.

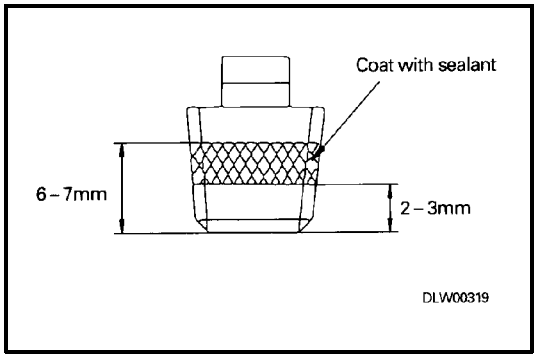
A 3 x 85 mm nail can also be used for tool **D4.**



1. Assembly of lower valve

1) Install orifices (56) to lower valve (2).
   Screw in the orifice at least 2 mm from the valve body.
2) Install plugs (55) to lower valve (2) and cover(43).

Plug: **Sealant (LG-1 or LG-5)**



3) Install plug (54) to F-R selector valve (47).
4) Install O-rings (53) to pilot filter (52), then set in mounting position and tighten mounting bolts.

Mounting bolt: **68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)**

5) Install H-L selector valve (48), range selector valve (49), spacers (51), springs (50), F-R selector valve (47), sleeve (42A), spring (41A), shim (46), and torque converter regulator valve (45), then set gasket (44) in position, and install cover (43).

Mounting bolt: **68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)**

6) Install sleeve (42), spring (41), retainer (40), and spring (39), then set gasket mount, and install solenoid valve assembly (38) to lower valve (2).

Mounting bolt: **68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)**

2. Assembly of upper valve

1) Install plug (36) and main orifice (37) to upper valve (2).
   Screw in the orifice at least 2 mm from the valve body.

Plug: **Sealant (LG-1 or LG-5)**

2) Fit O-ring (35) to adjustment screw (34), then set cover (15) in mounting position, and secure washer (33) and nut (32).
   For details of the adjustment procedure, see TESTING AND ADJUSTING.
3) Fit plug (26) to modulating valve (20), then assemble O-rings (31) to sleeve (30), and install springs (28) and (29) and retainer (27).
4) Install load pistons (24) and (25) to main regulator valve (27) and priority valve (19).
5) Assemble springs (22) and (23), accumulator shaft (21), modulating valve assembly (20), priority valve (19), spring (18), and main regulator valve (17), then set gasket (16) to mount, and install cover (15).

Mounting bolt: **68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)**

6) Assemble plug (14) to sleeve (11), then set ball (13) and spring (12) to quick return valve (8), and assemble sleeve (11).
7) Assemble spring (10), accumulator piston (9), quick return valve assembly (8), priority spring (7), and pilot valve (6),, then set gasket (5) to mount, and install cover (4).

Mounting bolt: **68.6 ± 4.9 Nm (7.0 ± 0.5 kgm)**

3. Connection

Set gasket (3) to mount, then connect lower valve (2) and upper valve (1).

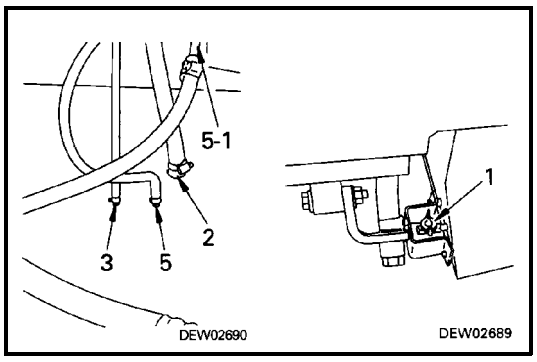
Mounting bolt: **31.4 ± 2.9 Nm (3.2 ± 0.3 kgm)**

REAR AXLE
REMOVAL

WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

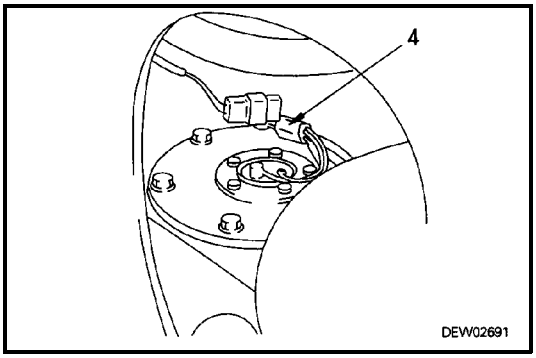
WARNING! Open the side inspection cover and apply the lock.

Loosen drain valve (1) and drain fuel.

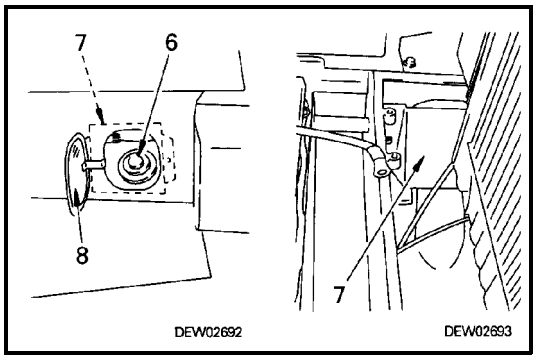


1. **Fuel tank**

1) Disconnect fuel hose (2), fuel return hose(3), and fuel gauge wiring connector (4).
2) Remove return hose (5) from fuel filter.
   Remove the clamp of breather tube (5-1).



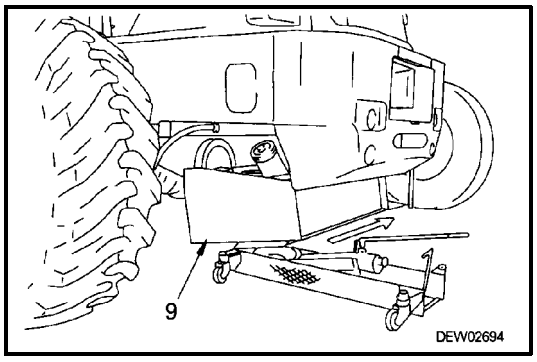
3) Remove inside cover (7), outside cover (8) and rubber of fuel oil filler port (6) at left side of rear frame.



4) Set transmission jack under fuel tank, and support fuel tank (9) lightly.
5) Remove mounting bolts, then lower transmission jack slowly and remove.
   When there is a clearance of approx. 50 mm from the rear frame, stop and check that there is no interference. The oil filler tube will hit the rear frame so move to the right and remove carefully.

   kg Fuel tank (dry): **70 kg**

6) Pull out fuel tank (9) to right side of chassis.

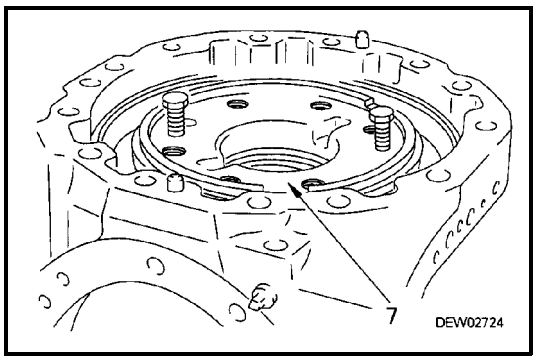


5. Bearing carrier

Screw in forcing screws to raise bearing carrier evenly, and remove bearing carrier (7). Remove angle ring.

Check the number and thickness of the shims, and keep them in a safe place.

Mark the left and right bearing carriers to avoid confusing them.

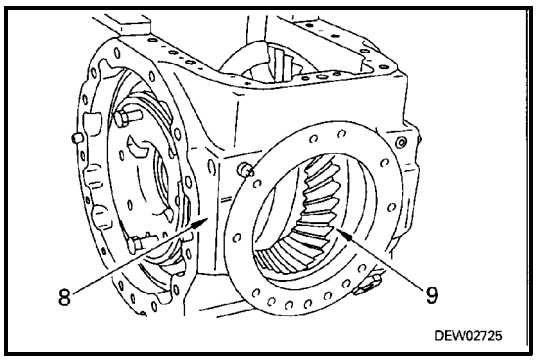


6. Differential carrier

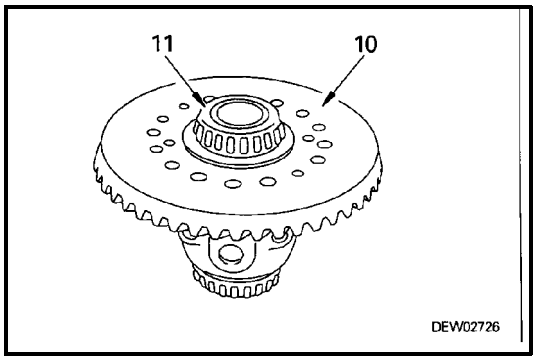
1) Lift off differential carrier assembly (9) from differential housing (8).

When removing the assembly, be careful that the lifting tool does not slip.

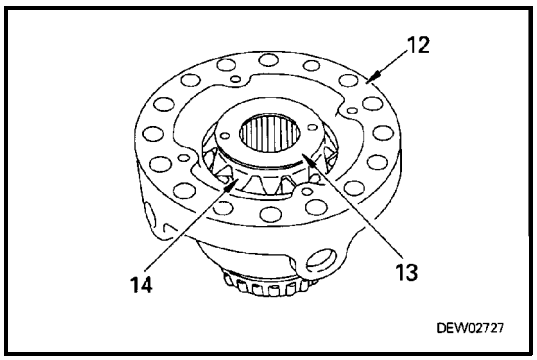
kg Differential carrier assembly: **30 kg**



2) Remove bevel gear (10), then remove bearing (11) from bevel gear.

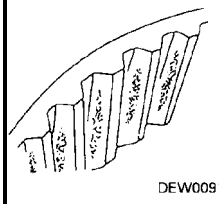
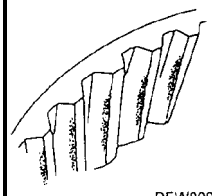
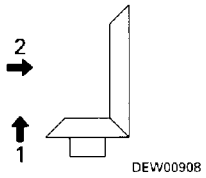
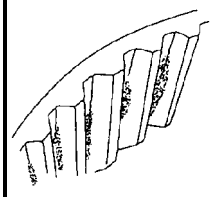
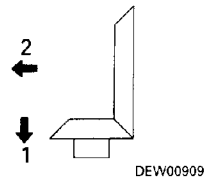
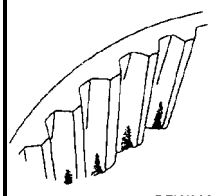
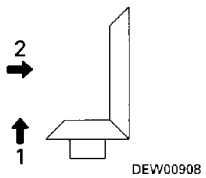
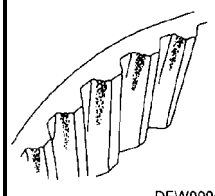
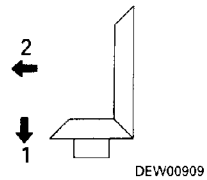


3) Remove thrust washer (13) from differential carrier (12), then remove side gear (14).



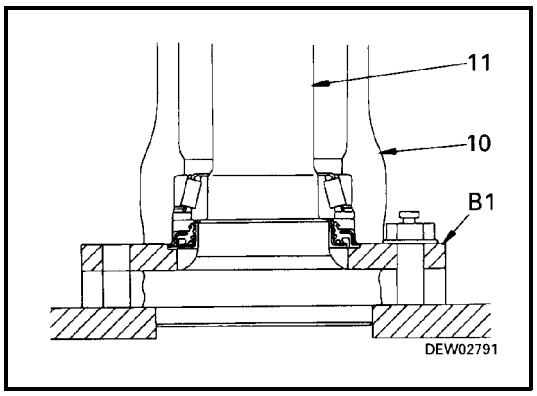
9. Adjusting tooth contact

Coat face of 7 or 8 teeth of bevel gear lightly with red lead. Hold the bevel gear by hand to act as a brake, rotate the pinion gear forward and backward and inspect the pattern left on the teeth.

Tooth contact	Cause	Procedure for adjustment
 DEW00910 **Figure 503**	The tooth contact pattern should start from about 5 mm from the toe of the bevel gear and cover about 50% of the length of the tooth. It should be in the center of the tooth height.	Adjust the pinion gear by adjusting the shims at the cage. Adjust the bevel gear in the same way as when adjusting backlash.
 DEW00904 **Figure 504**	Bevel pinion gear is too far from bevel gear.	1. Reduce shims at pinion gear to bring closer to bevel gear. 2. Move bevel gear further away from pinion gear and adjust backlash correctly.  DEW00908
 DEW00905 **Figure 506**	Bevel pinion gear is too close to bevel gear.	1. Increase shims at pinion gear to move away from bevel ear.. 2. Move bevel gear closer to pinion gear and adjust backlash correctly.  DEW00909
 DEW00906 **Figure 508**	Bevel gear is too close to pinion gear.	1. Reduce shims at pinion gear to bring closer to bevel gear. 2. Move bevel gear further away from pinion gear and adjust backlash correctly.  DEW00908
 DEW00907 **Figure 510**	Bevel gear is too far from pinion gear.	1. Increase shims at pinion gear to move away from bevel gear. 2. Move bevel gear closer to pinion gear and adjust backlash correctly  DEW00909

When adjusting the bevel gear, do not change the pre-load of the bearing. Adjust by moving shims between the left and right. Always keep the same total thickness of shims.

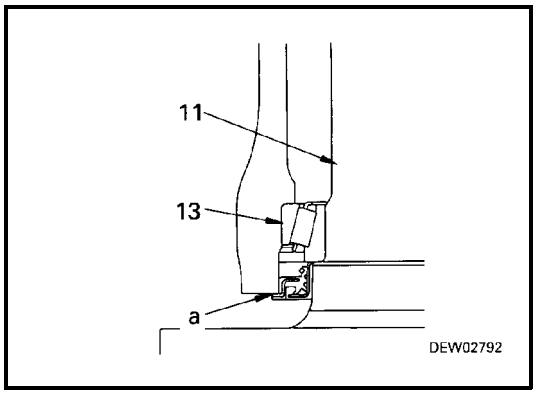
4) Remove tool **B1.**

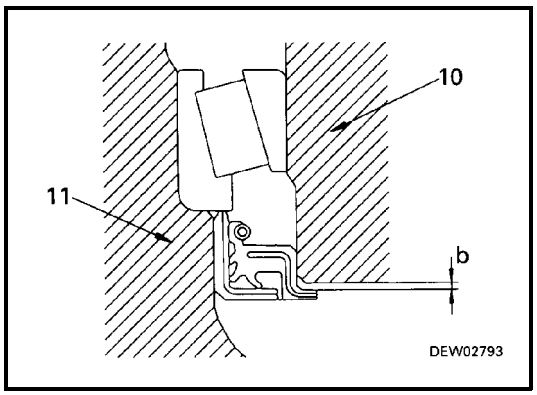


5) Press fit bearing (13) on shaft (11). Rotate housing by hand and press fit until end play is 0.3 mm.
Do not make the end play 0 mm.

Press-fitting portion of bearing cone:
Axle oil

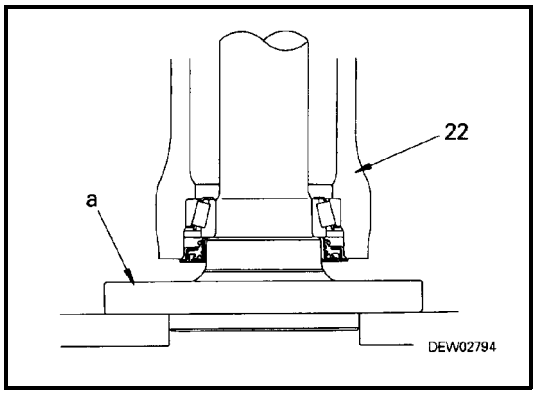
Press force: **Approx. 19.6 KN (2 ton)**
After assembling the housing, the face of the seal must be level with the housing face. If there is any clearance **"b"** at part **"a",** it must be uniform and within the standard range.
Standard range
Clearance **"b": 0.21 - 1.91 mm**





5. Adjusting end play

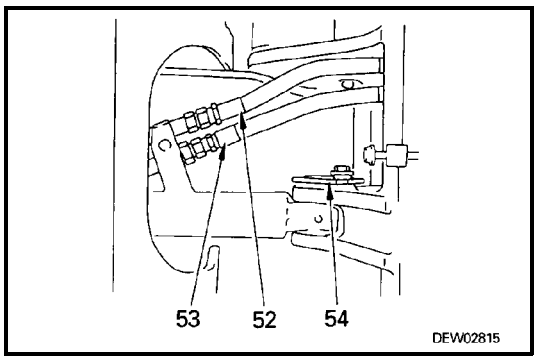
1) Stand axle shaft and housing assembly (22) upright, and hold flange **"a".**



10. **Steering cylinder**

1) Disconnect hoses (52) and (53) between steering valve and steering cylinder from connection with tube.
   Disconnect both the left and right hoses.

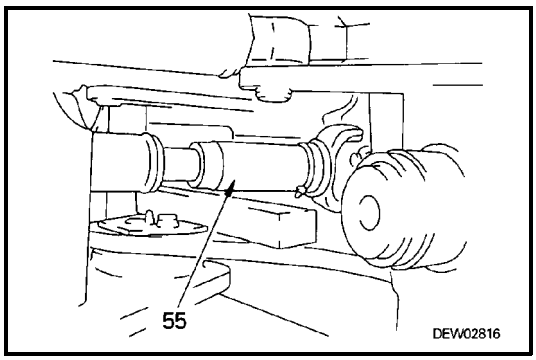
2) Remove bottom lock bolt of steering cylinder, then remove pin (54).



11. **Drive shaft**

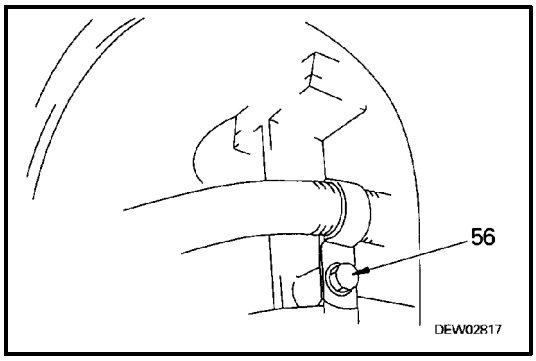
Disconnect center drive shaft (55) at transmission end.

When removing the drive shaft, set a block between the rear frame and the drive shaft to prevent the grease fitting from being crushed.



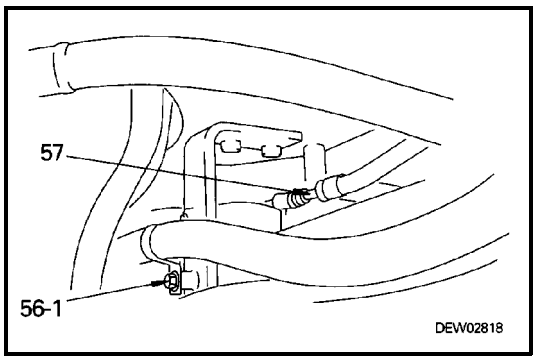
12. Electric wiring

Remove clamp mounting bolts (56) and (56-1) of front frame wiring.



13. Brake tube

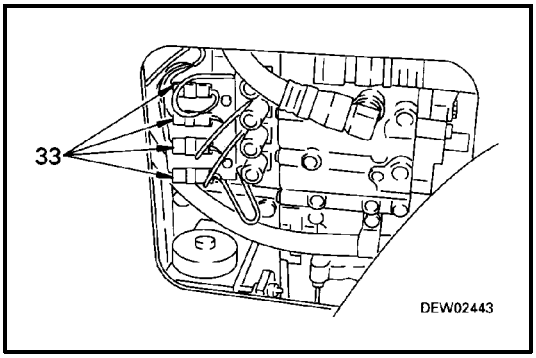
Remove clamp of brake hose and tube (57) for front axle from frame.



16. Transmission valve wiring

Connect each transmission valve wiring connectors (33).

When connecting, check the tags used to identify the wiring

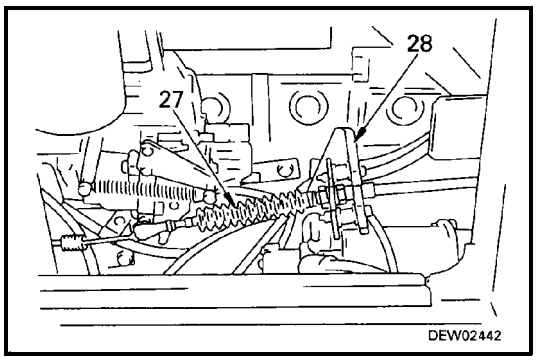


17. Fuel control cable

Connect fuel control cable (27) to engine end, and install bracket (28) to engine.

For machines with cab

- Connect the washer hose to the tank end.

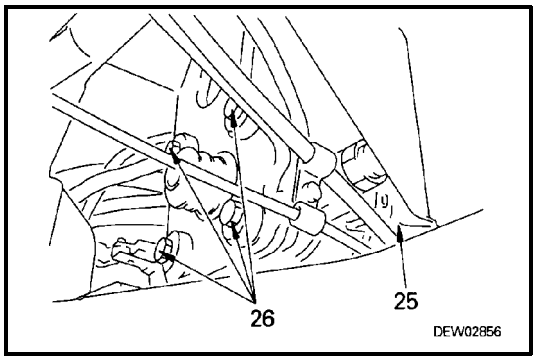


18. Brake booster

1) Remove block under brake booster (25), and install mounting bolts (26).

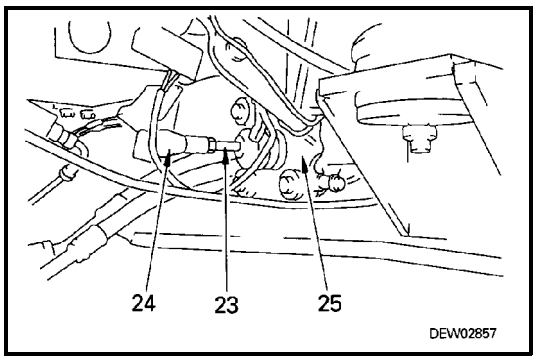
Tighten the mounting bolts uniformly and be careful not to tighten them too much.

Mounting bolt: **110.3 ± 12.3 Nm (11.25 ± 1.25 kgm)**



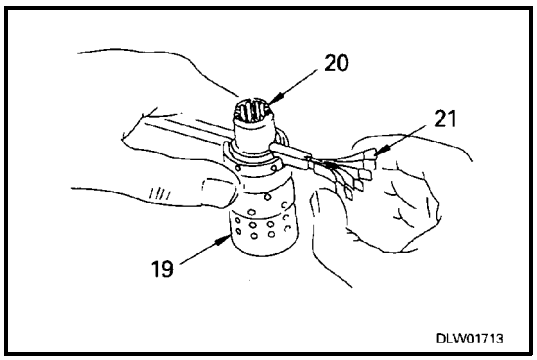
2) Insert brake linkage rod (23) in boot portion of brake booster (25), and connect to linkage lever.
3) Connect ball joint (24) and tighten locknut.

Locknut: **29.4 ± 4.9 Nm (3.0 ± 0.5 kgm)**

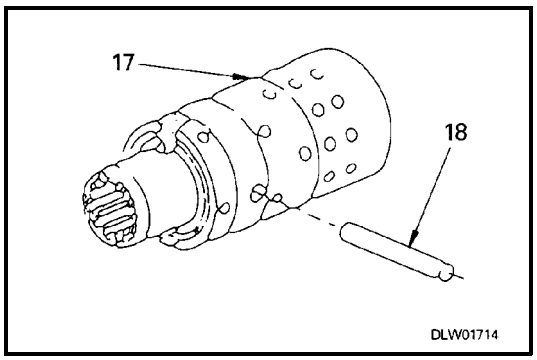


6. Align spring groove positions of spool (20) and sleeve (19), and set on flat plate, then insert spring (21) in spring groove.

Set so that the notches at both ends are at the bottom.

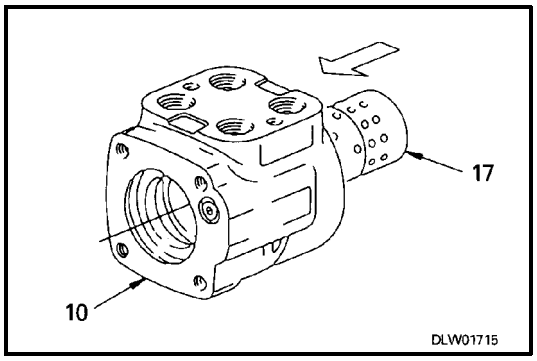


7. Insert pin (18) in spool and sleeve assembly (17).



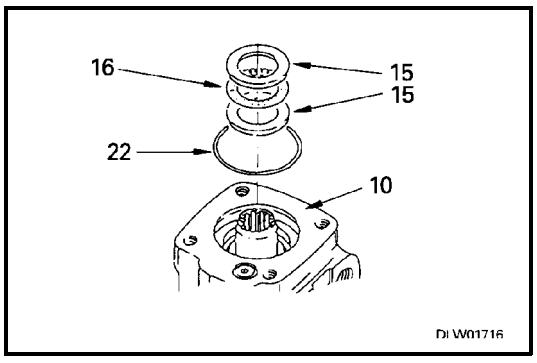
8. Insert spool and sleeve assembly (17) in housing (10) in the direction of the arrow.

1) Keep pin horizontal and rotate to left and right a little at a time to insert.
   Be extremely careful not to get it caught.
2) Make the spool and sleeve assembly flush with the rear end face of the housing.
   If it is inserted beyond the end face, the pin will fall out.
3) Check that spool and sleeve rotate smoothly inside housing.

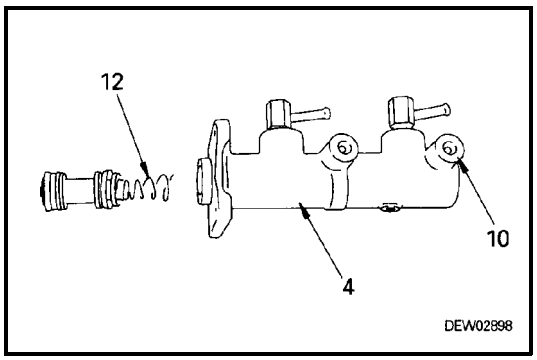


9. Install O-ring (22) to housing (10).

10. Fit 2 bearing races (15) and thrust needle (16) in case (10).

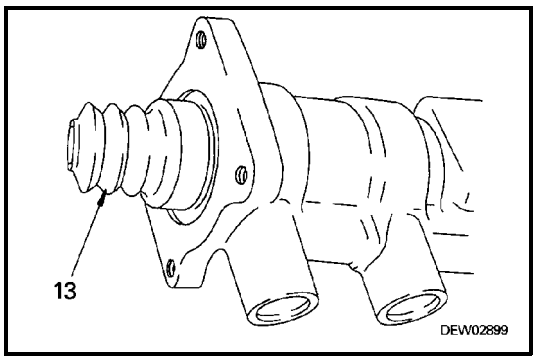


3) Remove spring (12) from inside body (4).
When removing the piston, be careful not to damage the inside diameter of the body or the sliding surface on the outside of the piston.
If there is any problem with the primary or secondary pistons, replace the pistons as an assembly.



3. Fine disassembly of power cylinder

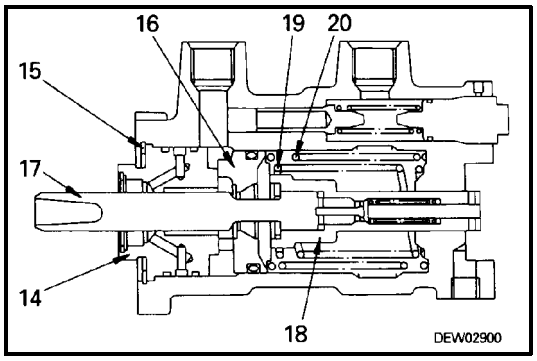
1) Remove dust cover (13).
Remove the elbow first.



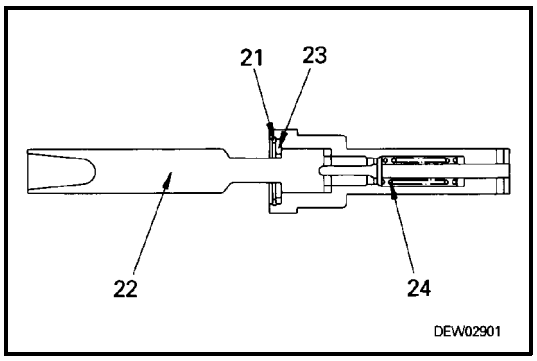
2) Push in cylinder cover (14), remove snap ring (15), then remove power piston (16), connector assembly (17), spring seat (18), and springs (19) and (20).

WARNING! When removing the spring, the cylinder cover is pushed out by the spring, so remove carefully.

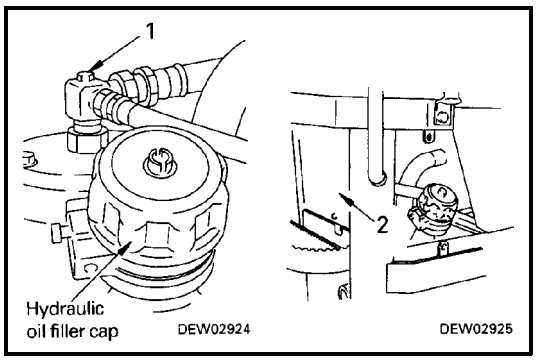
3) Remove power piston (16) from connector assembly (17).



4) Remove snap ring (21), disconnect spool (22) and connector, then remove thrust washer (23) and spring (24).



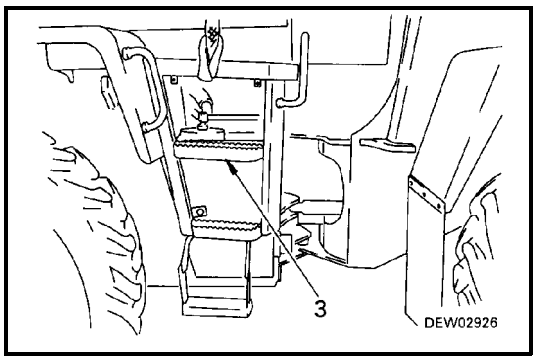
HYDRAULIC TANK
REMOVAL



WARNING! Stop the machine on level ground and install the safety bar on the frame. Lower the bucket to the ground and stop the engine. Then apply the parking brake and put blocks under the wheels to prevent the machine from moving.

WARNING! Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

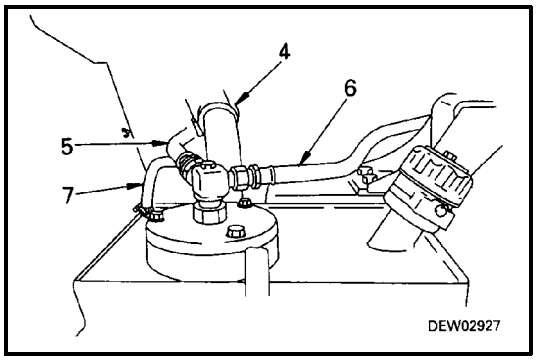
- Loosen plug (1) at the top of the hydraulic tank filter to prevent the oil inside the hydraulic tank from flowing out.
- Remove covers (2) at the side first.



1. Ladder rail

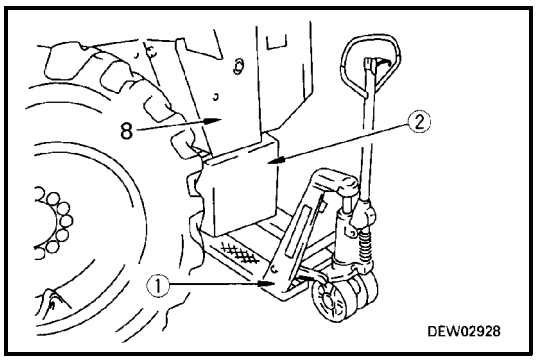
Lift off right ladder rail (3).

kg Ladder rail: **22 kg**



2. Hydraulic piping

1) Loosen clamp of hose (4) between hydraulic tank and pump, and disconnect when removing hydraulic tank.
2) Disconnect hose (5) between main control valve and hydraulic tank from hydraulic tank.
   - Width across flats of hose mouthpiece (5): 36 mm
3) Disconnect hose (6) between steering valve and hydraulic tank and hose (7) between main control valve and hydraulic tank.
   - Width across flats of hose mouthpiece (6): 27 mm

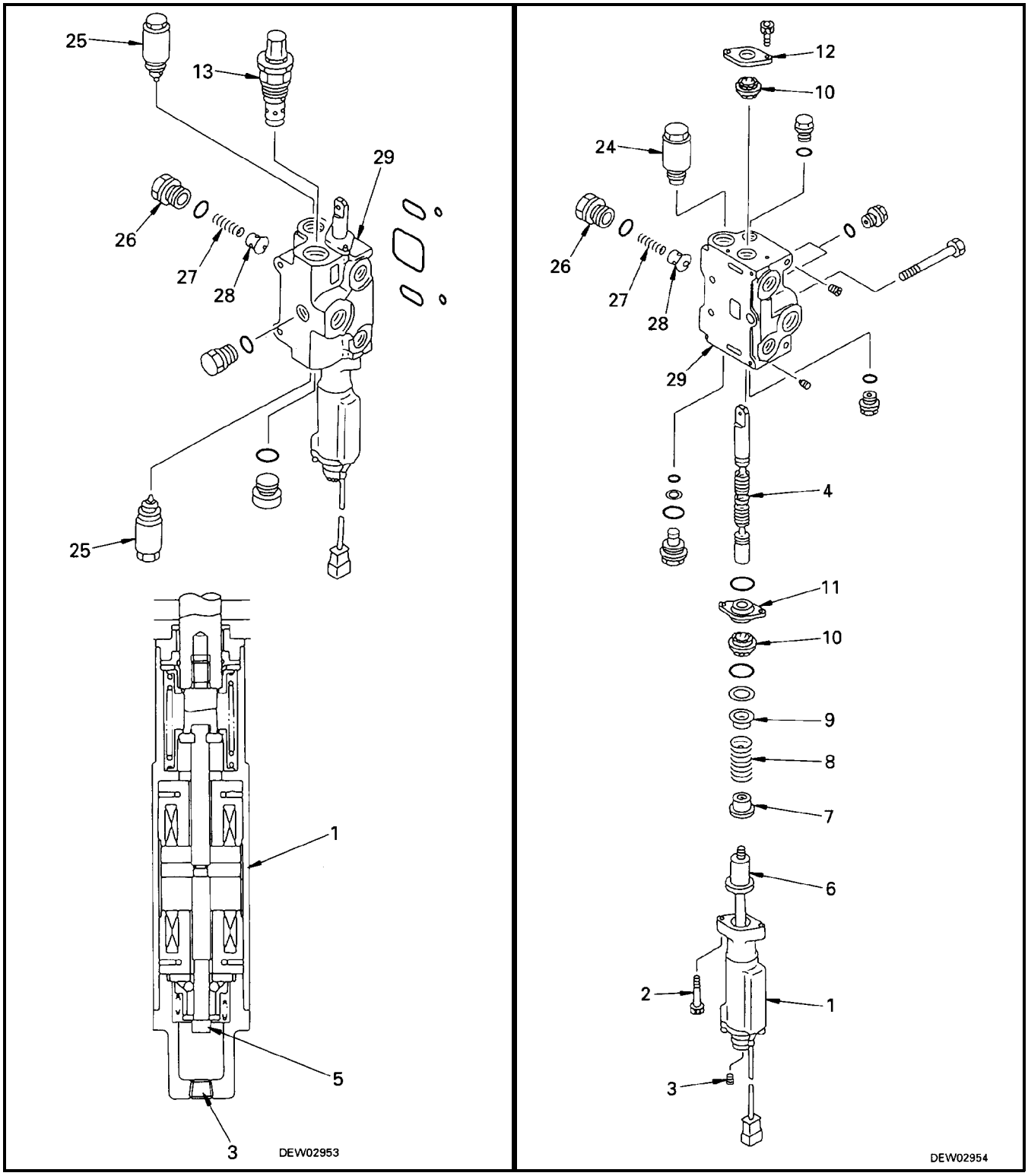


3. Hydraulic tank

1) Set palleter and stand under hydraulic tank (8).
2) Raise palleter slowly to support hydraulic tank (8).

MAIN CONTROL VALVE

ASSEMBLY



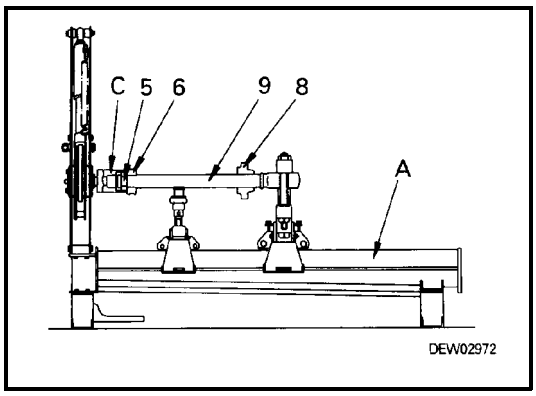
3. Set piston rod (9) to tool **A.**

4. Assemble cylinder head assembly (8) and retainer and piston assembly (6), and install nut (5).
The retainer is for the steering cylinder only.

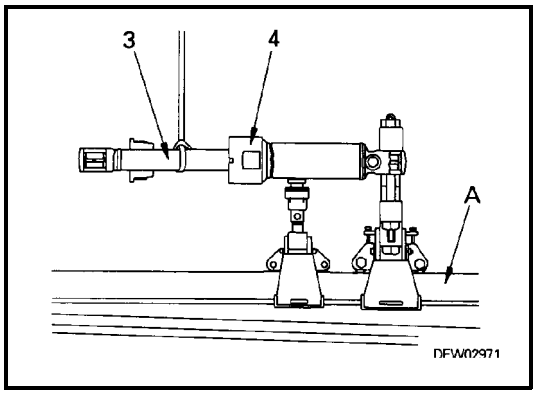
5. Using tool **C,** tighten nut (5).

Rod thread: **Thread tightener (LT-2)**

Nut:



Cylinder	Width across flats (mm)	Tighening Torque Nm (kgm)
Bucket	60 mm	1765 ± 176 (180 ± 18)
Boom	55 mm	1422 ± 142 (145 ± 14.5)
Steering	46 mm	784 ± 78 (80 ± 8)



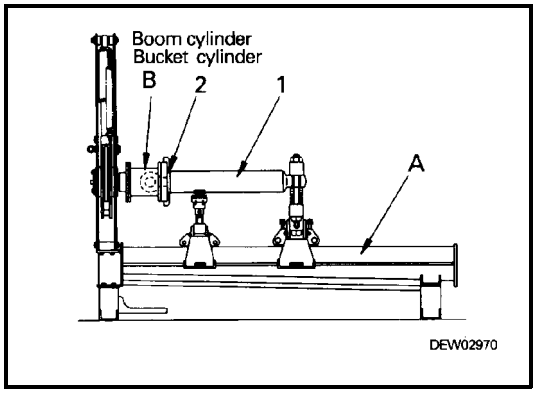
6. Remove piston rod and head assembly from tool **A,** then set cylinder (4) to tool **A.**

7. Raise piston rod and head assembly (3), and assemble to cylinder (4).

8. Using tool **B,** tighten cylinder head nut (2).

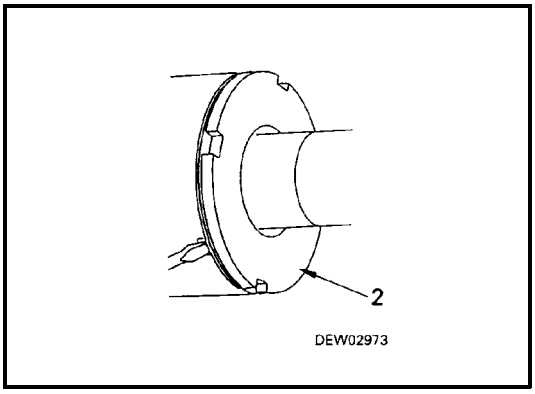
Cylinder head nut:

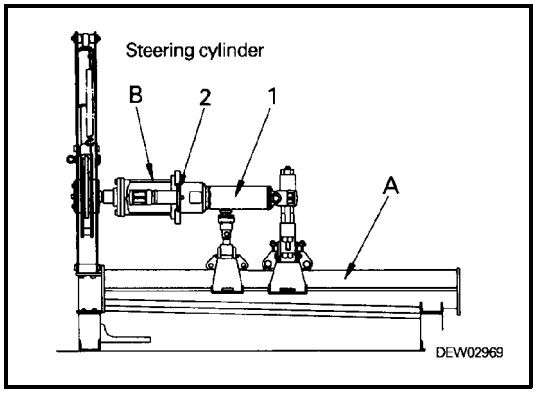
Cylinder	Tightening torque Nm (kgm)
Boom	941 ± 94 (96 ± 9.6)
Bucket	941 ± 94 (96 ± 9.6)
Steering	441 ± 44 (45 ± 4.5)



9. Bend lock into notch at cylinder end.

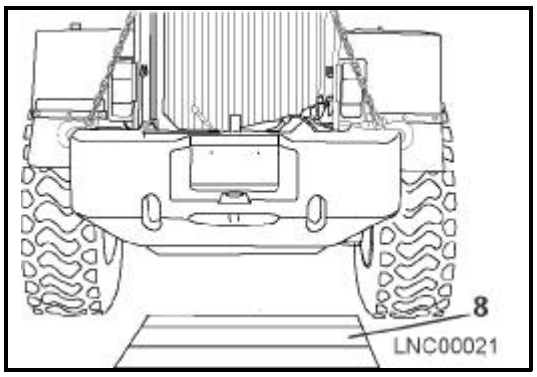
10. Remove cylinder assembly (1) from tool **A.**





4. Rear counterweight.

kg Counterweight: 850 kg



1) Using proper size hook and chain, hoist counter weight (to relieve pressure on mount bolts).

2) Remove four (4) mount bolts.

WARNING! Rear counterweight may **swing out** from machine when the last bolt is removed.

3) Rest rear counterweight on a pallet (8).

INSTALLATION OF REAR COUNTERWEIGHT

Install rear counterweight in reverse order of removal. Refer to “ENGINE SHOP MANUAL”.

Mounting bolt: 927 ±98 N m (95 ±10 kgm)

Unit: mm

No.	Check item	Criteria					Remedy
		Standard size	Tolerance		Standard clearance	Clearance limit	
			Shaft	Hole			
1	Clearance between pump drive shaft and bearing	50	+0.025 -0.009	0 -0.012	-0.037 - -0.009	-	Replace
2	Clearance between pump drive shaft bearing and housing	80	0 -0.013	+0.018 -0.012	-0.012 - 0.031	-	
3	Clearance between pump drive shaft and bearing	35	-0.009 -0.025	+0.041 +0.025	0.034 - 0.066	-	
4	Clearance between pump drive shaft bearing and housing	47	0 -0.011	+0.014 -0.011	-0.011 - 0.025	-	
5	Clearance between input shaft and bearing	35	+0.009 +0.025	0 -0.012	-0.037 - -0.009	-	
6	Clearance between input shaft bearing and housing earing	72	0 -0.013	+0.018 -0.012	-0.012 - 0.031	-	
7	Clearance between input shaft and bearing	50	-0.009 -0.025	0 -0.012	0.037 - 0.009	-	
8	Clearance between input shaft bearing and housing	90	0 -0.0151	+0.022 -0.013	-0.013 - 0.037	-	
9	Clearance between REVERSE, 1st clutch bearing (F) and housing	90	0 -0.015	+0.022 -0.013	--0.013 - 0.037	-	
10	Clearance between REVERSE, 1st clutch bearing (R) and housing	90	0 -0.015	-+0.022 -0.013	--0.013 - 0.037	-	
11	Clearance between FORWARD, 2nd cl;utch clutch bearing (F) and housing	110	0 -0.015	+0.022 -0.013	-0.013 - 0.037	-	
12	Clearance between FORWARD, 2nd clutch bearing (R) and housing	90	0 -0.015	+0.022 -0.013	--0.013 - 0.037	-	
13	Clearance between 3rd, 4th clutch bearing housing (F) and housing	130	0 -0.018	+0.026 -0.014	-0.014 - 0.044	-	
14	Clearance between 3rd, 4th clutch bearing (R) and housing	90	0 -0.015	0 -0.015	--0.013 - 0.037	-	

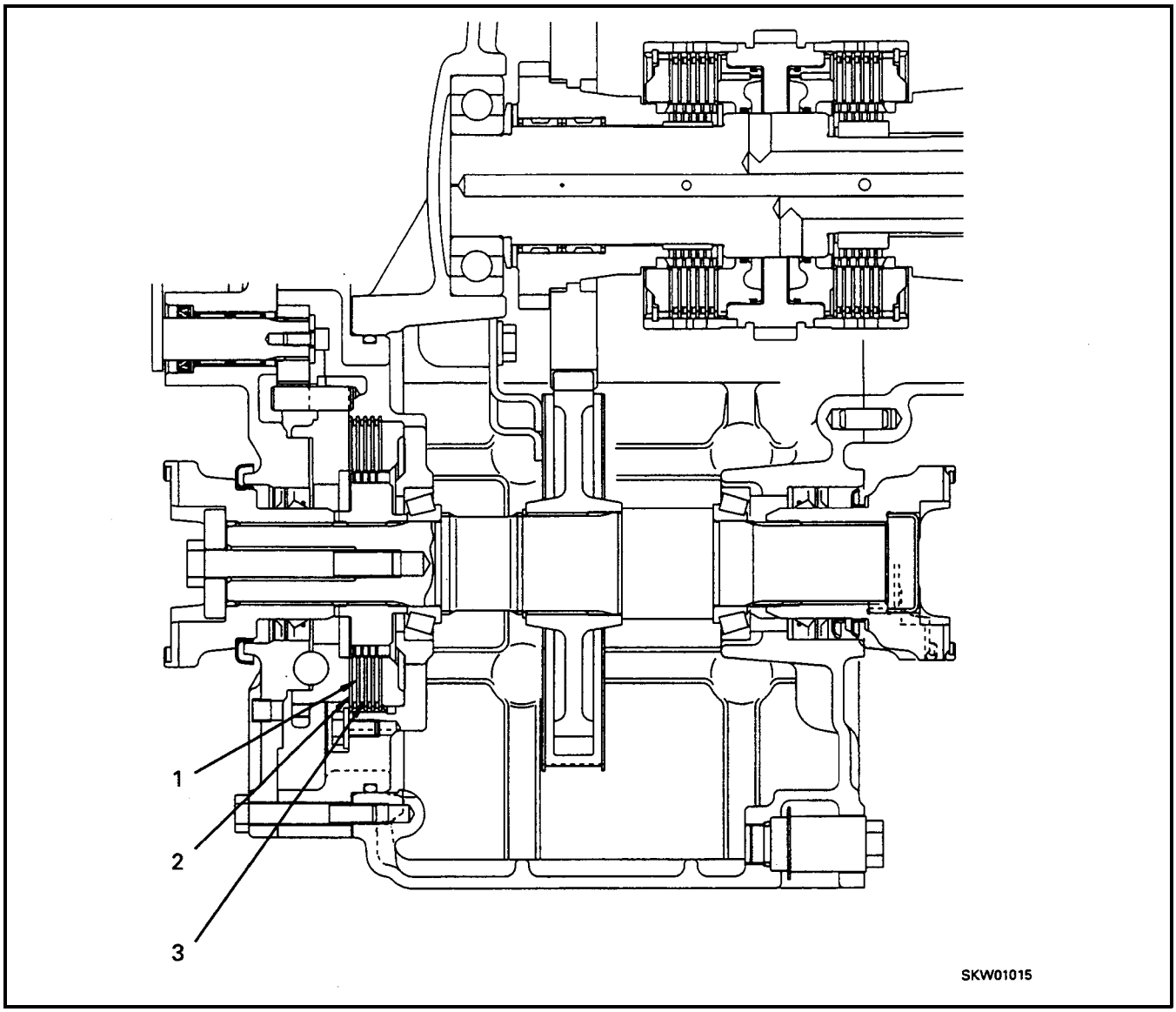
Unit: mm

No.	Check item	Criteria					Remedy
1	Clearance between pilot valve and body	Standard size	Tolerance		Standard clearance	Clearance limit	Replace
			Shaft	Hole			
		19	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
2	Clearance between main regulator valve and body	19	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
3	Clearance between main regulator valve and load piston	13.5	-0.02 -0.03	+0.018 0	0.020 - 0.048	0.055	
4	Clearance between priority valve and body	19	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
5	Clearance between priority valve and load piston	12.5	-0.02 -0.03	+0.018 0	0.020 - 0.048	0.055	
6	Clearance between quick return valve and body	28	-0.020 -0.028	+0.013 0	0.020 - 0.041	0.044	
7	Clearance between modulation fill valve and body	28	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
8	Clearance between modulation fill valve and sleeve	28	-0.02 -0.03	+0.033 +0.020	0.040 - 0.066	0.070	
9	Clearance between modulation fill valve and sleeve	30	-0.04 -0.05	+0.041 +0.025	0.065 - 0.091	0.100	
10	Clearance between sleeve and body	41	-0.050 -0.075	+0.025 0	0.050 - 0.100	0.110	
11	Clearance between accumulator valve and body	28	-0.02 -0.03	+0.013 0	0.020 - 0.043	0.050	
12	Main regulator valve spring	Standard size			Repair limit		
		Free length	Installed length	Installed load	Free length	Installed load	
		82.55	62.6	230 ± 11.5 N (23.46 ± 1.17 kg)	79.3	207 N (21.1 kg)	
13	Priority valve spring	69.5	52.6	254 ± 12.7 N (25.92 ± 1.30 kg)	66.7	228 N (23.3 kg)	
14	Quick return valve spring	48.0	41.0	0.8 ± 0.04 N (0.08 ± 0.004 kg)	46.1	0.7 N (0.072 kg)	
15	Modulation fill valve spring (inner)	41.8	40.0	24.1 ± 1.2 N (2.46 ± 0.12 kg)	40.1	21.7 N (2.21 kg)	
16	Modulation fill valve spring (outer)	43.6	24.3	138 ± 7 N (14.07 ± 0.07 kg)	41.9	125 N (12.7 kg)	
17	Accumulator spring (outer)	99.6	99.6	0	95.6	-	
18	Accumulator spring (inner 1)	35.6	35.6	0	34.2	-	
19	Accumulator spring (inner 2)	40.8	40.8	0	39.2	-	

Unit: mm

No.	Check item		Criteria					Remedy
			Standard size	Tolerance		Standard clearance	Clearance limit	
				Shaft	Hole			
1	Clearance between axle housing and ring gear		276	+0.100 +0.030	+0.100 0	-0.100 - 0.07	-	Replace
2	Clearance of guide pin		12	+0.025 +0.007	+0.187 +0.125	0.100 - 0.180	-	
3	Clearance at axle housing bearing press-fitted section	Outer race	12.661	+0.077 +0.052	-0.038 0	-0.077 - -0.014	-	
		Inner race	69.85	+0.050 +0.025	-0.013 0	-0.050 - -0.016	-	
4	Clearance at axle housing bearing press-fitted section	Outer race	127	+0.025 0	-0.013 -0.051	-0.076 - -0.013	-	
		Inner race	77.788	+0.063 +0.038	+0.025 0	-0.063 - -0.013	-	
5	Axle shaft press-fitted section	Housing	130	-	+0.063 0	-	-	
		Shaft	93.5	0 -0.054	-	-	--	
6	Clearance between pinion gear bearing and shaft		33.338	+0.025 +0.013	+0.013 0	-0.025 - 0	-	
7	End play of axle shaft		Max. 0.98					-
8	Clearance between oil seal and housing		0.21 - 1.91					

PARKING BRAKE



Unit: mm

No.	Check item		Criteria			Remedy
			Standard size	Tolerance	Repair limit	
		Thickness	1.7	± 0.05	1.6	
1	Plate	Distortion	-	0.1	0.1	
		Thickness	2.2	± 0.08	1.97	
		Depth of lining groove	0.45	+0.175 0	0.3	Replace
2	Brake disk	Lining thickness	0.5	± 0.075	-	
3	Wave spring load		1010 N (103 kg) (Height: 2.2 mm)	± 98 N (± 10 kg)	814 N (83 kg)	