CEBM002801

# SHOP MANUAL

# WA600-3L

## WHEEL LOADER

SERIAL NUMBERS **WA600-3L - A52001** and up



It is our policy to improve our products whenever it is possible and practical to do so. We reserve the right to make changes or add improvements at any time without incurring any obligation to install such changes on products sold previously.

Due to this continuous program of research and development, periodic revisions may be made to this publication. It is recommended that customers contact their distributor for information on the latest revision.

**SEPTEMBER 1999**

# 00 FOREWORD

# ELECTRIC WIRE CODE

In the wiring diagrams, various colors and symbols are employed to indicate the thickness of wires. This wire code table will help you understand WIRING DIAGRAMS.

Example: 05WB indicates a cable having a nominal number 05 and white coating with black stripe.

## CLASSIFICATION BY THICKNESS

| Nominal number | Copper wire | | | Cable O.D. (mm) | Current rating (A) | Applicable circuit |
|---|---|---|---|---|---|---|
| | Number of strands | Dia. Of strand (mm) | Cross section ($mm^2$) | | | |
| 0.85 | 11 | 0.32 | 0.88 | 2.4 | 12 | Starting, lighting, signal etc. |
| 2 | 26 | 0.32 | 2.09 | 3.1 | 20 | Lighting, signal etc. |
| 5 | 65 | 0.32 | 5.23 | 4.6 | 37 | Charging and signal |
| 15 | 84 | 0.45 | 13.36 | 7 | 59 | Starting (Glow plug) |
| 40 | 85 | 0.8 | 42.73 | 11.4 | 135 | Starting |
| 60 | 127 | 0.8 | 63.84 | 13.6 | 178 | Starting |
| 100 | 217 | 0.8 | 109.1 | 17.6 | 230 | Starting |

## CLASSIFICATION BY COLOR AND CODE

| Priority | Classification | Circuits | Charging | Ground | Starting | Lighting | Instrument | Signal | Other |
|---|---|---|---|---|---|---|---|---|---|
| 1 | Primary | Code | W | B | B | R | Y | G | L |
| | | Color | White | Black | Black | Red | Yellow | Green | Blue |
| 2 | Auxiliary | Code | WR | --- | BW | RW | YR | GW | LW |
| | | Color | White/Red | --- | Black/White | Red/White | Yellow/Red | Green/White | Blue/White |
| 3 | | Code | WB | --- | BY | RB | YB | GR | LR |
| | | Color | White/Black | --- | Black/Yellow | Red/Black | Yellow/Black | Green/Red | Blue/Red |
| 4 | | Code | WL | --- | BR | RY | YG | GY | LY |
| | | Color | White/Blue | --- | Black/Red | Red/Yellow | Yellow/Green | Green/Yellow | Blue/Yellow |
| 5 | | Code | WG | --- | --- | RG | YL | GB | LB |
| | | Color | White/Green | --- | --- | Red/Green | Yellow/Blue | Green/Black | Blue/Black |
| 6 | | Code | --- | --- | --- | RL | YW | GL | --- |
| | | Color | --- | --- | --- | Red/Blue | Yellow/White | Green/Blue | --- |

# SPECIFICATIONS

| Machine model | | | WA600-3L | |
|---|---|---|---|---|
| Serial number | | | A52001 and up | |
| Weight | Operating weight | | | 44,300 |
| | Distribution (front) | | kg | 21,010 |
| | Distribution (rear) | | | 23,290 |
| Performance | Bucket capacity | | $m^3$ | 6.1 |
| | Rated load | | kg | 10,980 |
| | Travel speed:<br>FORWARD 1st<br>FORWARD 2nd<br>FORWARD 3rd<br>FORWARD 4th<br>REVERSE 1st<br>REVERSE 2nd<br>REVERSE 3rd<br>REVERSE 4th | | <br>km/h<br>km/h<br>km/h<br>km/h<br>km/h<br>km/h<br>km/h<br>km/h | <br>6.4<br>11.1<br>18.8<br>30.3<br>7.1<br>12.2<br>20.5<br>32.7 |
| | Max. Rimpull FORWARD | | kg | 35,500 |
| | REVERSE | | kg | 31,900 |
| | Gradeability | | deg | 25 |
| | Min. Turning radius | Center of outside wheel | mm | 6,980 |
| | | Outside portion of chassis (with tooth) | | 8,265 |
| Dimensions | Overall length (with tooth) | | mm | 10,840 |
| | Overall width (chassis) | | mm | 3,570 |
| | Bucket width (with tooth) | | mm | 3,685 |
| | Overall height (top of ROPS canopy) | | mm | 4,250 |
| | Overall height (bucket raised) | | mm | 7,165 |
| | Wheelbase | | mm | 4,100 |
| | Tread | | mm | 2,650 |
| | Minimum ground clearance | | mm | 495 |
| | Height of bucket hinge pin | | mm | 5,155 |
| | Dumping clearance (tip of cutting edge) | | mm | 3,805 |
| | Dumping reach (tip of cutting edge) | | mm | 1,610 |
| | Bucket dump angle | | deg | 45 |
| | Bucket tilt angle (travel posture) | | deg | 49.5 |
| | Digging depth (10° dump angle) (with tooth) | | mm | 440 |

Each time the coolant is drained and replaced, the coolant must be recharged with supplemental coolant additives. New coolant can be correctly charged with coolant additives by using a replacement coolant filter and/or concentrate.

If coolant is added between drain intervals, additional coolant additives may be required.

**Coolant Testing for Conditioner Concentration**

When the cooling system is maintained as recommended, the conditioner concentration should be satisfactory. The SCA concentration must not fall below 1.0 unit per 3.8 ℓ (1 gal) or exceed 2 units per 3.8 ℓ (1 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.

**NOTE: 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.**

**Replenishing Coolant Conditioner**

Install a "precharge" coolant filter when the coolant is changed or a significant (more than 50%) coolant loss occurs. When antifreeze is added, add coolant conditioner equal to 1.0 unit per 3.8 ℓ (1 US gal) of antifreeze.

**NOTE: Mixing of DCA4 and other supplemental coolant additives is not recommended because there is currently no test kit available to measure concentration levels with mixed chemical solutions.**

**Supplemental Coolant Additive Maintenance Guide**

Use supplemental coolant additives (corrosion inhibitors) to protect the engine cooling system from corrosion. Antifreeze alone does **not** provide enough corrosion protection for a heavy duty diesel engine. Supplemental corrosion protection **must** be supplied through periodic additions of supplemental coolant additives to the coolant.

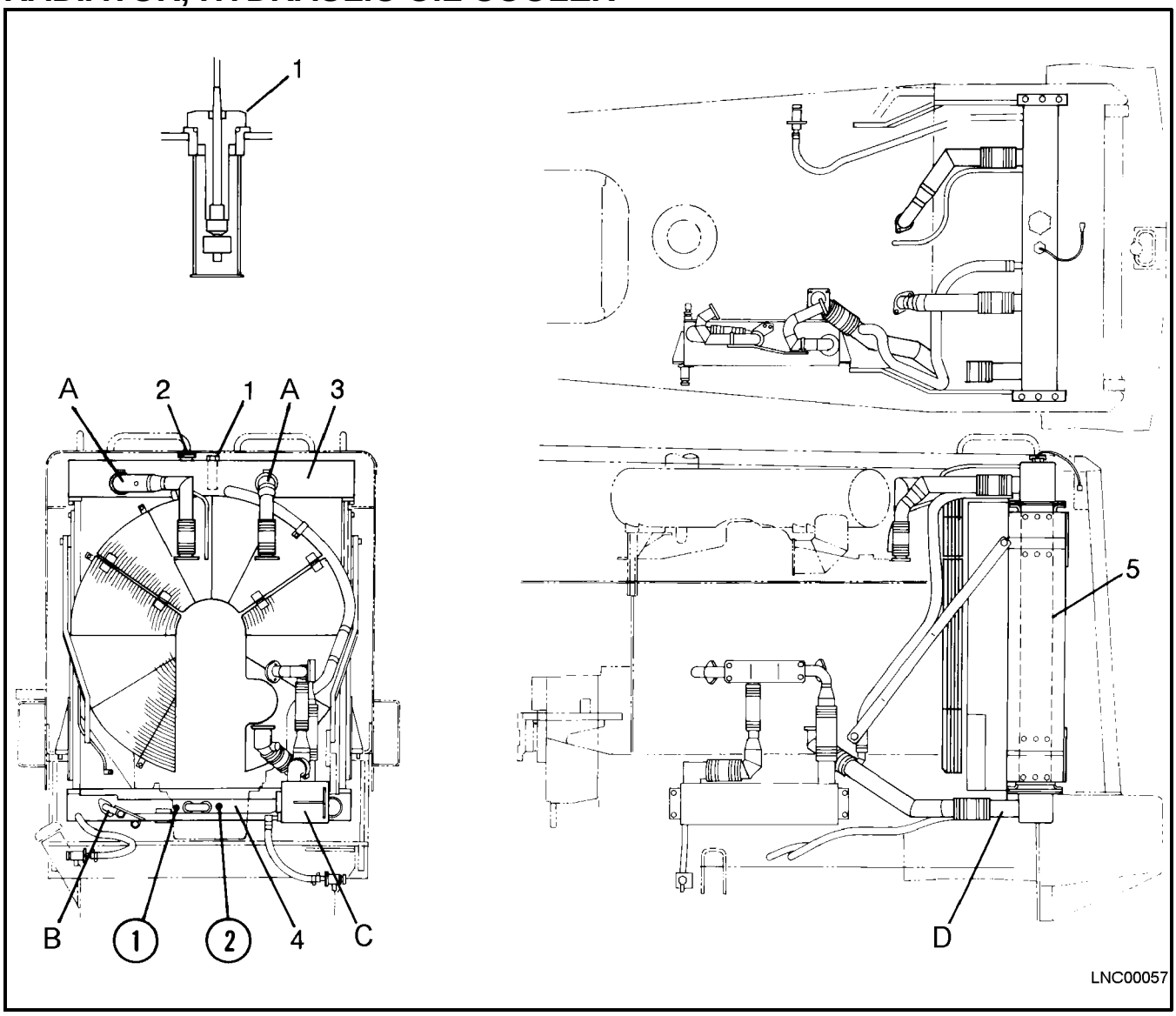
To protect against corrosion, a new coolant charge **must** be brought up to 0.26 SCA unit per liter [one unit per U.S. gallon] of coolant (initial charge). Maintain the correct SCA concentration by changing the service coolant filter at each engine oil and filter change interval.

Each time the coolant is drained and replace, the coolant **must** be recharged with supplemental coolant additives. Use the appropriate replacement coolant filter listed in following tables. The coolant mixture **must** be drained and replaced as defined under "General."

The amount of a replacement inhibitor is determined by the length of the service interval and the cooling system capacity. Refer to the DCA4 Unit Guide for the selection of the correct filter to replenish the SCA.

If coolant is added between drain intervals, additional SCA will be required. Check the coolant DCA concentration level anytime make up coolant is added to the system. The SCA concentration **must not** fall below 0.13 units per liter or exceed 0.5 units per liter [0.5 units per U.S. gallon or exceed 2 units per U.S. gallon].

# RADIATOR, HYDRAULIC OIL COOLER




1. Water level sensor
2. Radiator cap
3. Upper tank
4. Lower tank (hydraulic oil coolers ①, ②)
5. Radiator core

A: Cooling water inlet port
B: Hydraulic oil cooler outlet port
C: Hydraulic oil cooler inlet port
D: Cooling water outlet port

**SPECIFICATIONS**

Radiator
- Core model: PF2-7
- Total heat dissipating area: 124.14 m²
- Cross-sectional area of water flow: 220.91 m²

Hydraulic oil cooler

| | **Oil cooler ①** | **Oil cooler ②** |
|---|---|---|
| **Core type** | PTO-DL | PTO-DL |
| **Heat dissipating area** | 1.396 m² | 1.829 m² |

## RELIEF VALVE

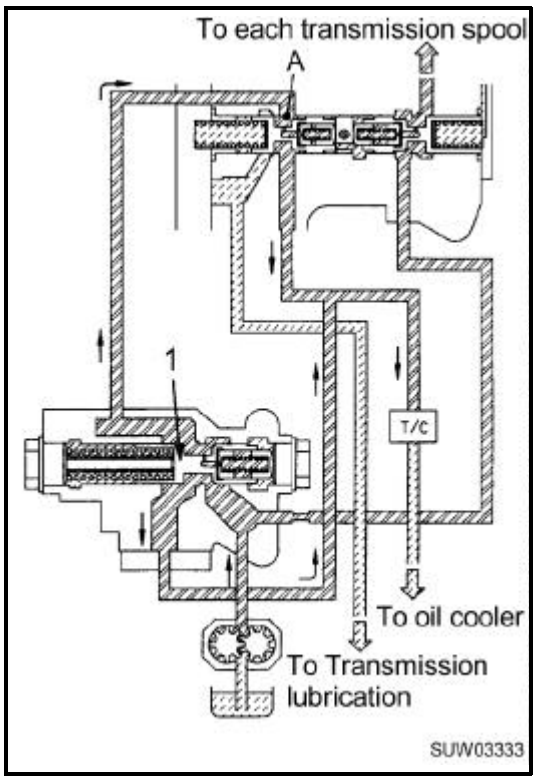
### FUNCTION

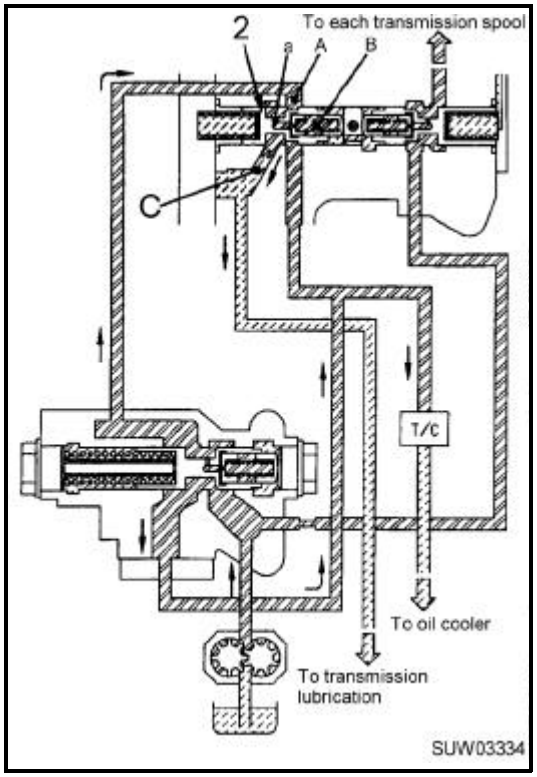
- This valve acts to keep the oil entering the torque converter at a constant pressure. It drains the oil if the pressure goes above the specified pressure.

### OPERATION

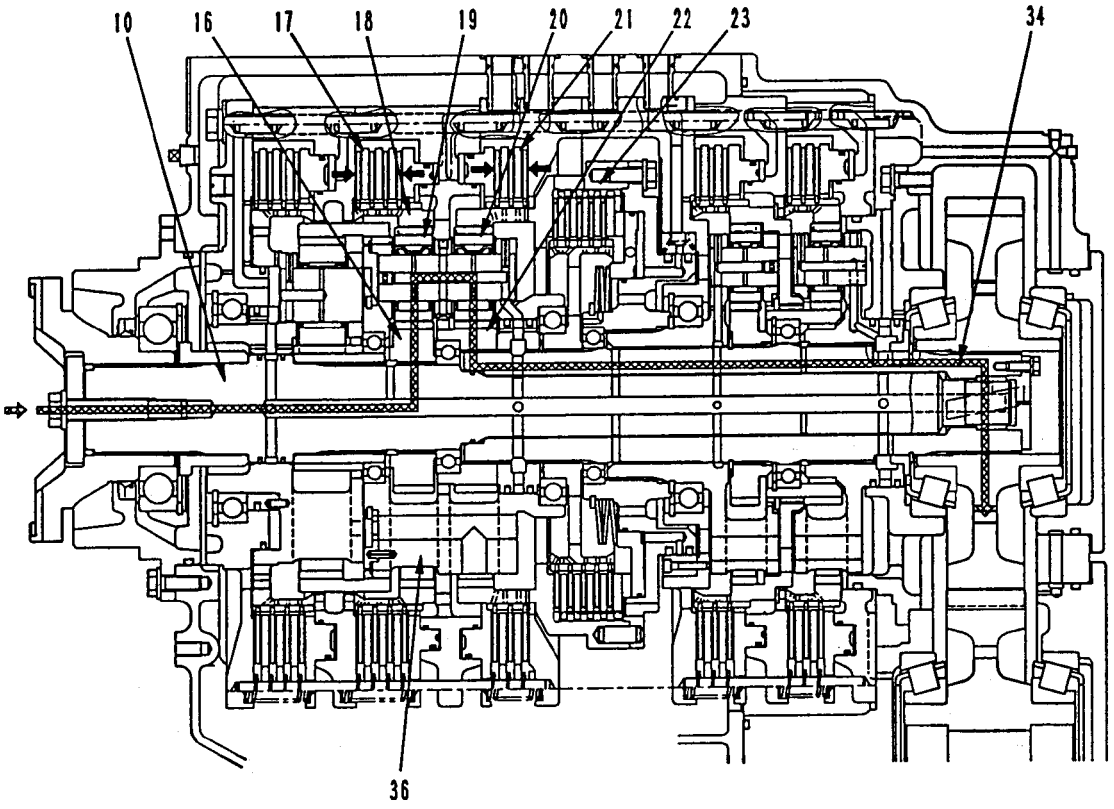
- The oil from the pump passes through main relief valve (1), enters port A, and flows to the torque converter.

- If the oil at port A goes above the set pressure, it enters port B from orifice a in torque converter relief valve (2), and moves torque converter relief valve (2) to the left. As a result, the oil at port A goes to port C, lubricates the transmission, and is drained.



**FORWARD 4TH**




- In the case of FORWARD 4th, FORWARD clutch (17) and 4th clutch (21) are engaged. The power transmitted from the torque converter to input shaft (10) is transmitted to output shaft (34).
- The FORWARD clutch and 4th clutch are actuated by the oil pressure applied by the clutch piston, and hold ring gears (18 and 23) in position.
- The power from the torque converter is transmitted to input shaft (10). The rotation of the input shaft is transmitted through sun gear (16) to planet gear (19).
- Ring gear (18) is held in position by FORWARD clutch (17), so the rotation of planet gear (19) rotates carrier (36) inside ring gear (18). Ring gear (23) is held in position by clutch (21), so the rotation of carrier (36) is transmitted through planet gear (20) to sun gear (22) and rotates output shaft (34).

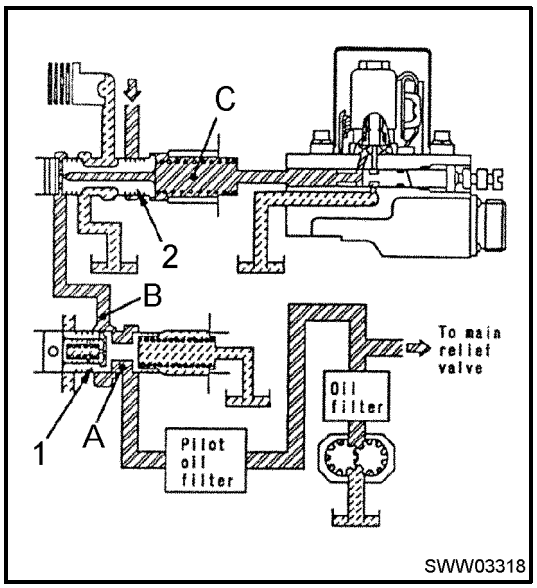
## PILOT REDUCING VALVE

### FUNCTION

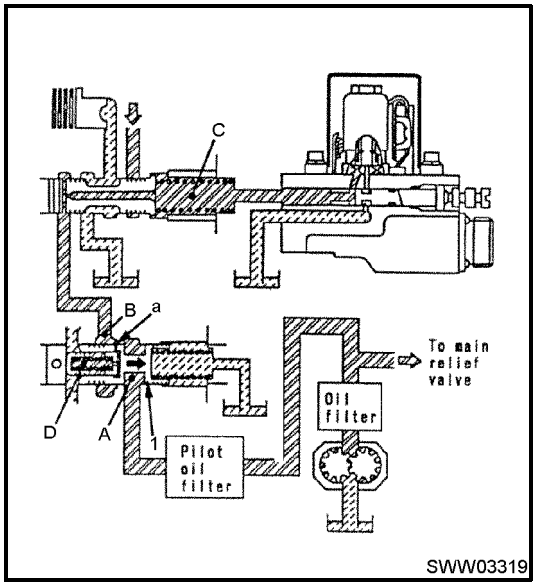
- The pilot reducing valve acts to control the pressure needed to actuate the transmission spools.

### OPERATION

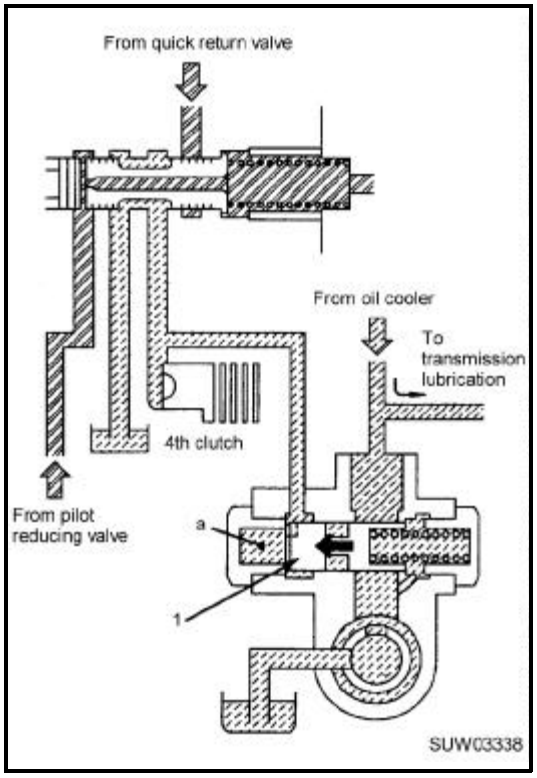
- The oil from the pump passes through the pilot filter and enters port A of pilot reducing valve (1). The oil passes through port B and enters through the orifice of transmission spool (2) to fill the inside of port C.




- When the pressure inside port C rises, pressurized oil flows from orifice “a” of pilot reducing valve (1) and goes to port D. As a result, pilot reducing valve (1) moves to the right, and port A and B are shut off, so the pressurized oil at port C is maintained at the same pressure.



## LUBRICATION BYPASS VALVE

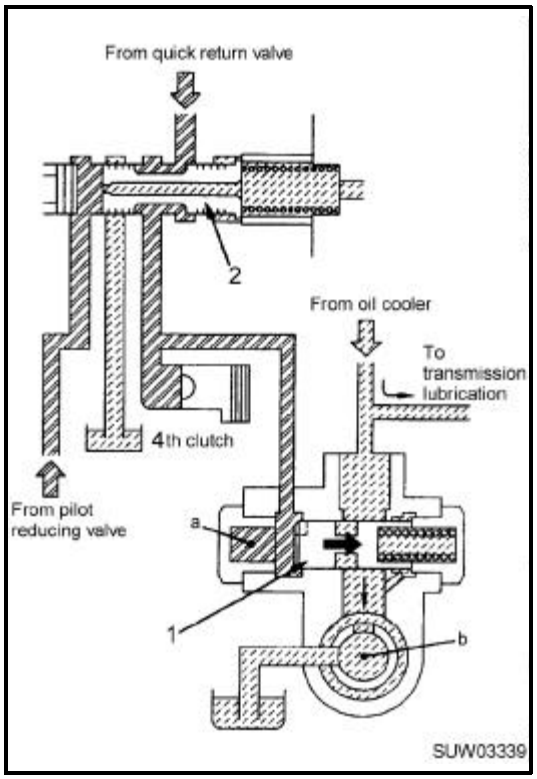



### FUNCTION

- When traveling in 4th gear, the transmission gears are rotating at high speed. Because of this, the churning resistance of the transmission lubrication oil increases. To reduce this power loss, only enough oil to lubricate the gears at 4th speed is kept. The rest of the oil is bypassed to the transmission case.

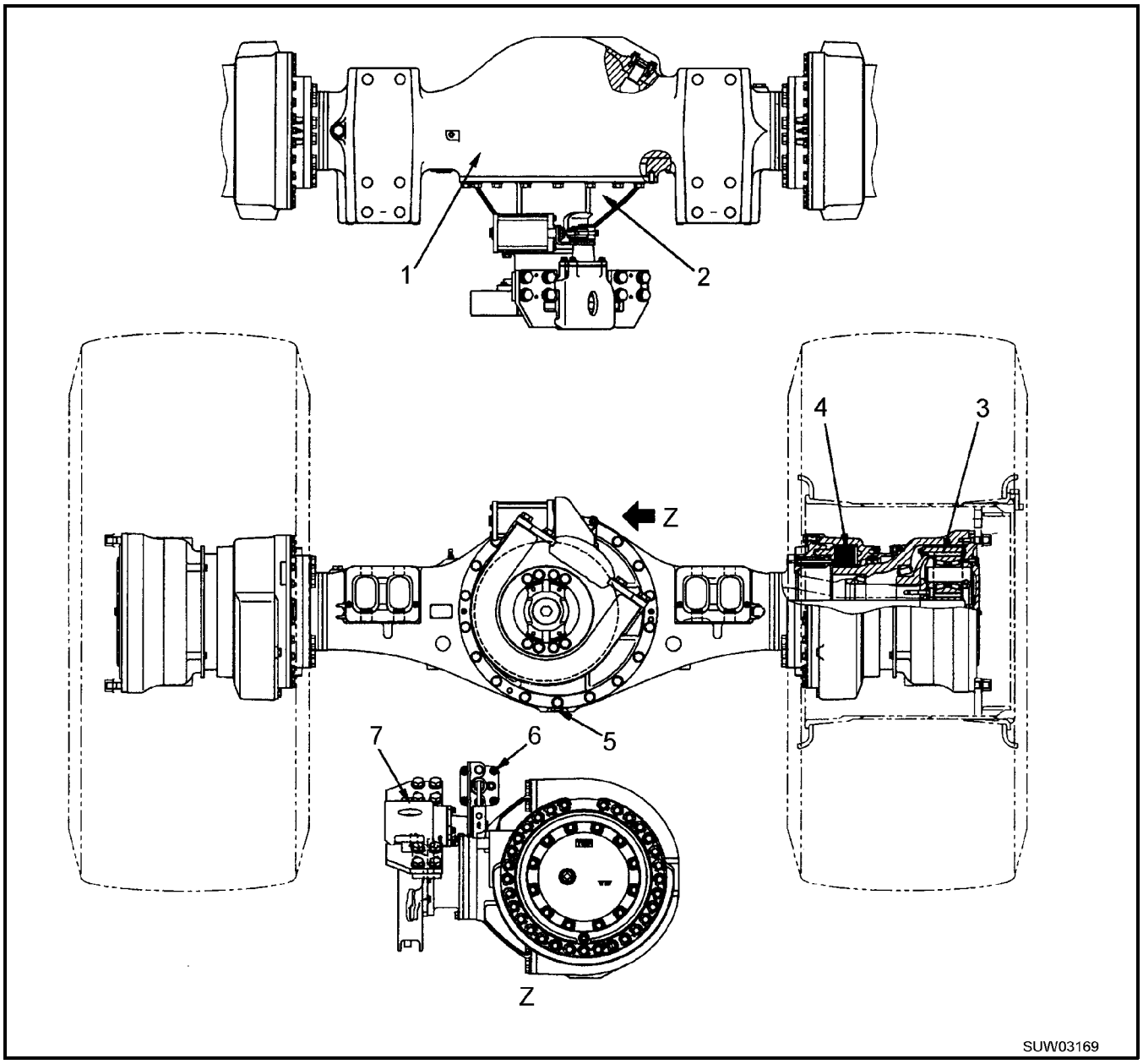
### OPERATION

1) 4th clutch not being operated
   - When the 4th clutch is not being operated, there is no hydraulic pressure at port “a” of spool (1). As a result, spool (1) is pushed to the left by the spring. The oil from the torque converter is stopped by spool (1), so all the oil is used for lubricating the transmission.




2) 4th clutch being operated
   - When oil flows to the 4th clutch, pressurized oil flows from 4th spool (2) to port “a”, it pushed back the spring and moves spool (1) to the right. The oil from the torque converter flows to the transmission lubrication system and drain port “b”.

## FRONT AXLE

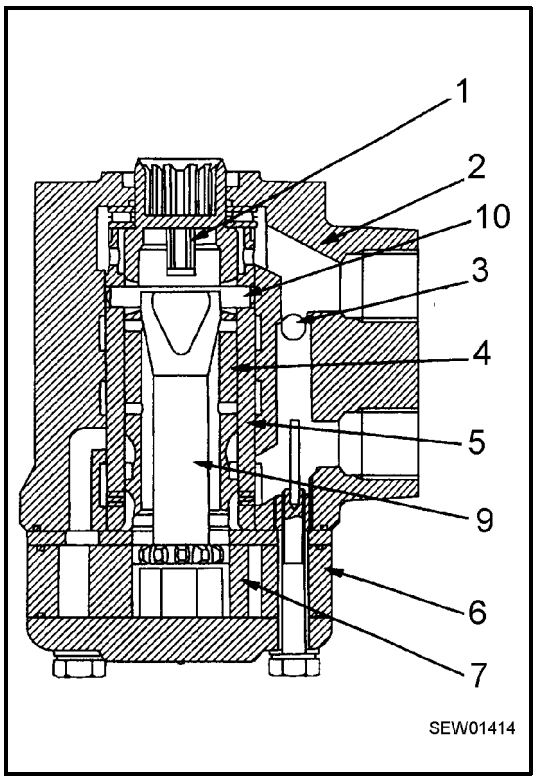



1. Front axle
2. Front differential
3. Final drive
4. Front brake
5. Drain plug
6. Spring cylinder
7. Parking brake

**OUTLINE**

- The steering unit is directly connected to the shaft of the steering wheel. The oil from the PPC pump passes through the steering valve, and is switched to the left and right steering cylinders to determine the direction of travel of the machine.

- The steering unit can be broadly divided into the following: spool (4) and sleeve (5), which have a rotor type direction selection function, and the gear set (combination of gear (7) and gear rim (6)), which acts as a hydraulic motor when the steering is operated.



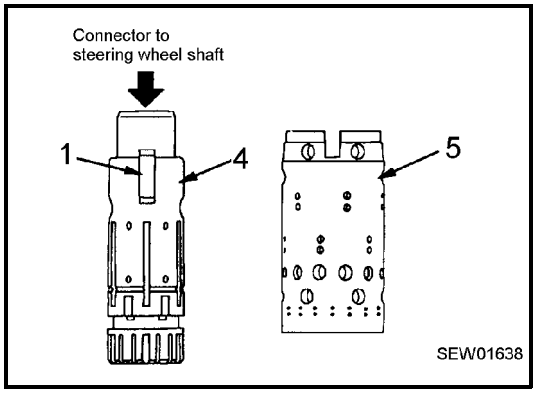

**STRUCTURE**

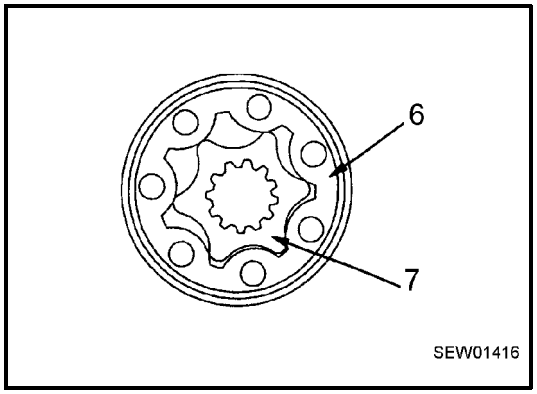
- Spool (4) is interconnected with the drive shaft of the steering wheel and is connected to sleeve (5) by neutral position spring (1) and center pin (10) (when the steering wheel is at neutral, it does not contact the spool).

- The top of drive shaft (9) is meshed with center pin (10) and forms one unit with sleeve (5). The bottom is meshed with the spline of ger (7) of the gear set.

- Valve body (2) has four ports. These are connected respectively to the pump circuit, tank circuit, and pilot circuit of the steering demand valve.

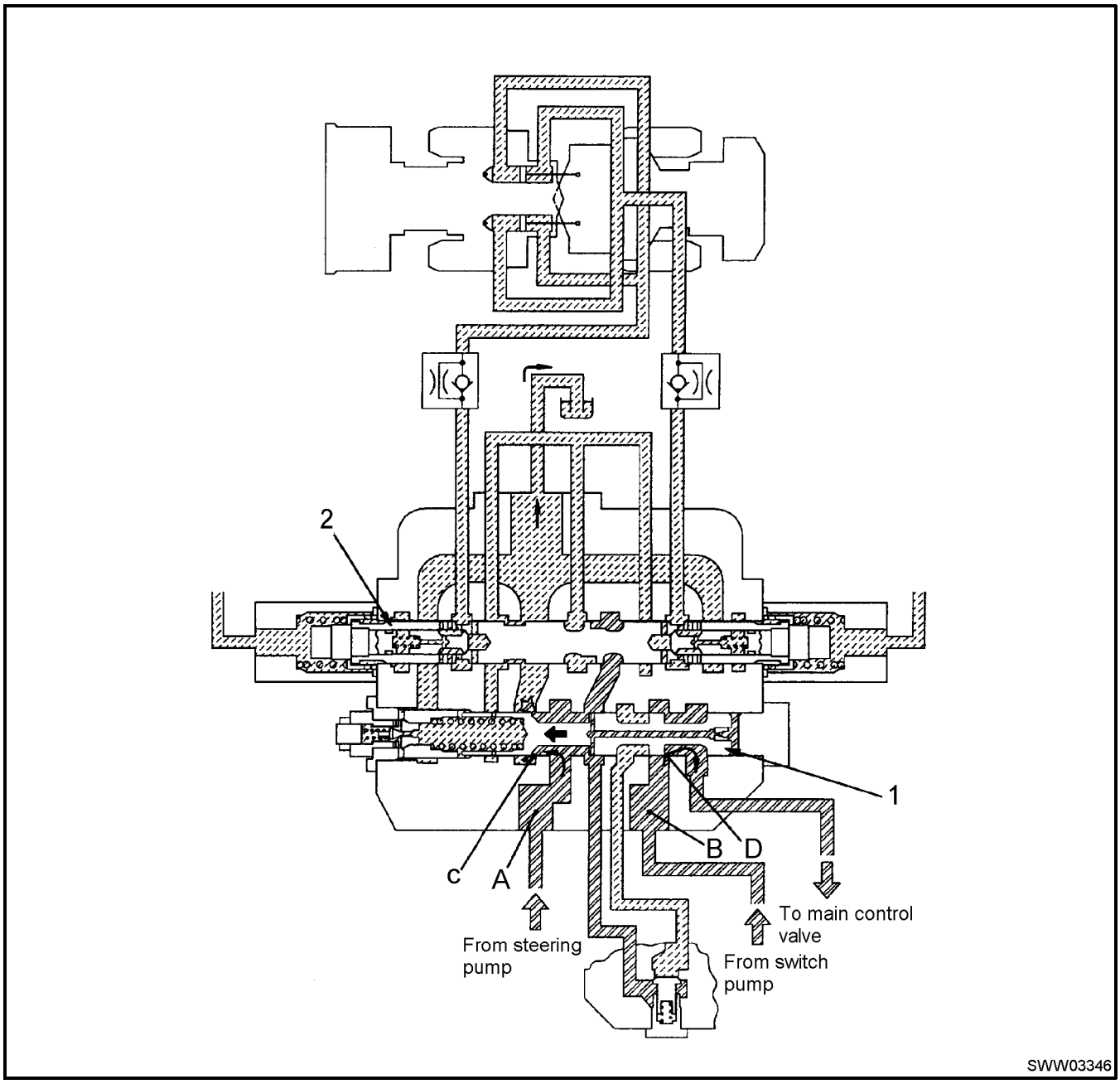
  In addition, the port at the pump end and the port at the tank end are connected by check valve (3) inside the housing. If there is any failure in the PPC pump, oil is sucked in directly from the tank end by the check valve.



### STEERING VALVE OPERATION

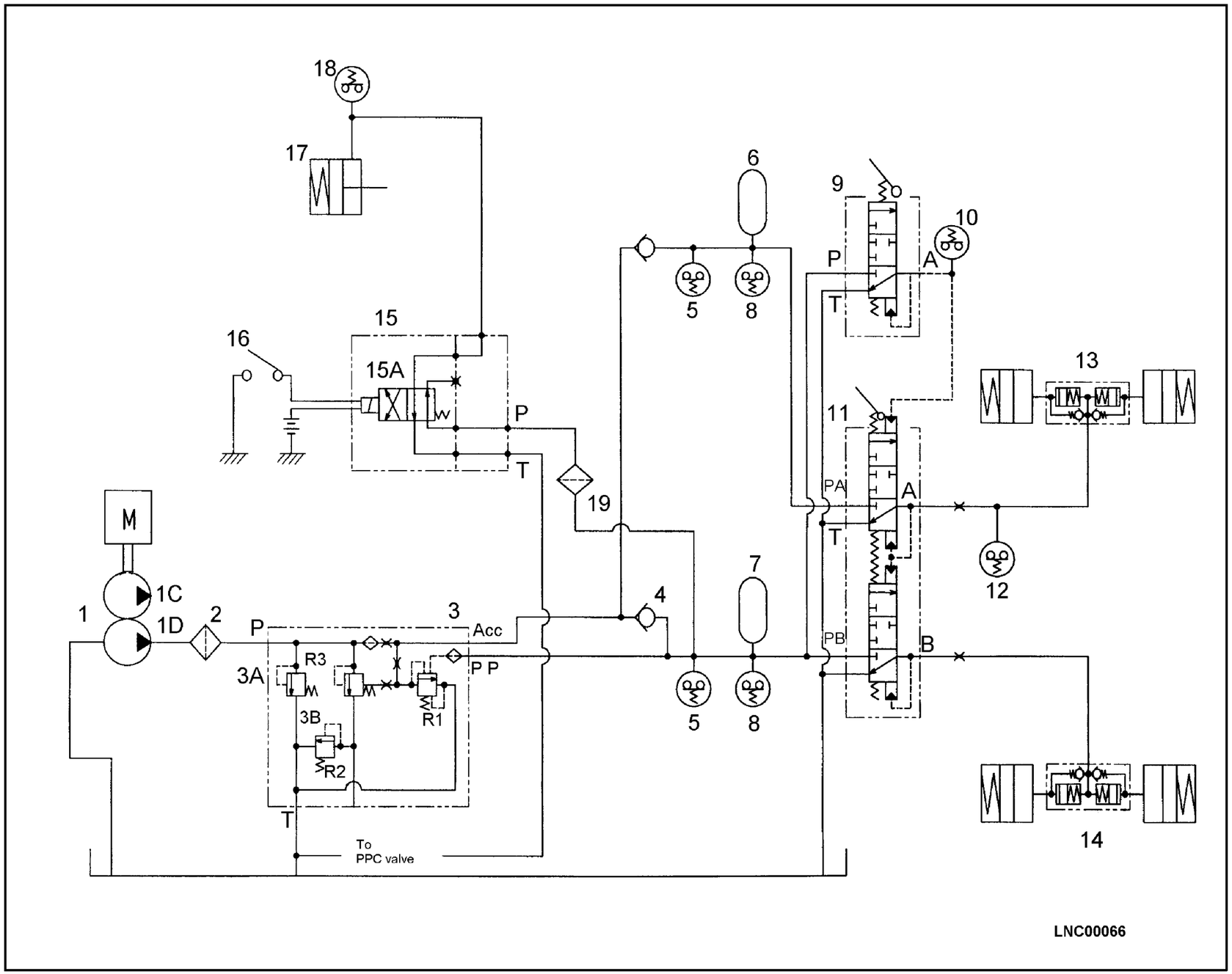
#### NEUTRAL




- The steering wheel is not being operated, so steering spool (2) does not move.
- The oil from the steering pump enters port A. The oil from the switch pump enters port B.
- When the pressure at ports A and B rises, demand spool (1) moves to the left, so the oil from the steering pump passes through port C of the spool and is drained. The oil from the switch pump passes through port D and flows to the main control valve.

## BRAKE CIRCUIT DIAGRAM

**Foldout No. 10-89**




1. Hydraulic pump (tandem)
1C. Torque converter charging pump
1D. PPC pump
2. Strainer
3. Accumulator charge valve
3A. Safety relief valve
3B. PPC relief valve
4. Check valve
5. Low Pressure switch
6. Rear brake accumulator
7. Front brake accumulator
8. Emergency brake switch
9. Brake valve (left)
10. Transmission cut-off switch
11. Brake valve (right)
12. Stop lamp switch
13. Rear slack adjuster
14. Front slack adjuster
15. Parking brake solenoid valve
16. Parking brake emergency release switch
17. Parking brake
18. Parking brake pilot lamp switch
19. Strainer

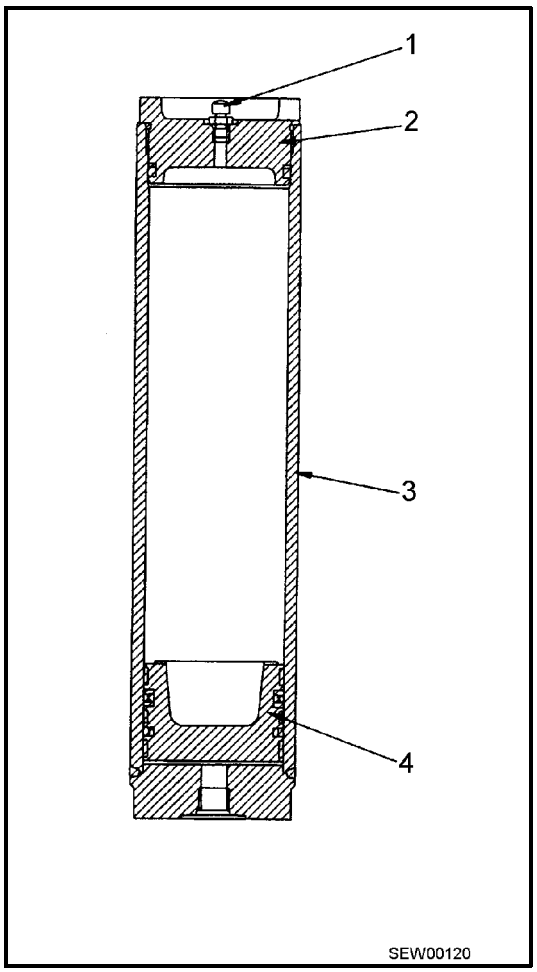
## ACCUMULATOR (FOR BRAKE)

### SPECIFICATIONS

| | |
|---|---|
| Gas used: | Nitrogen gas |
| Charge amount: | 6,000 cc |
| Charging pressure: | 35 ± 1.5 kg/cm² (at 50°C) |

### FUNCTION

- The accumulator is installed between the charge valve and the brake valve. It is charged with nitrogen gas between cylinder (3) and free piston (4), and uses the compressibility of the gas to absorb the pulse of the hydraulic pump or to maintain the braking force and to make it possible to operate the machine if the engine should stop.

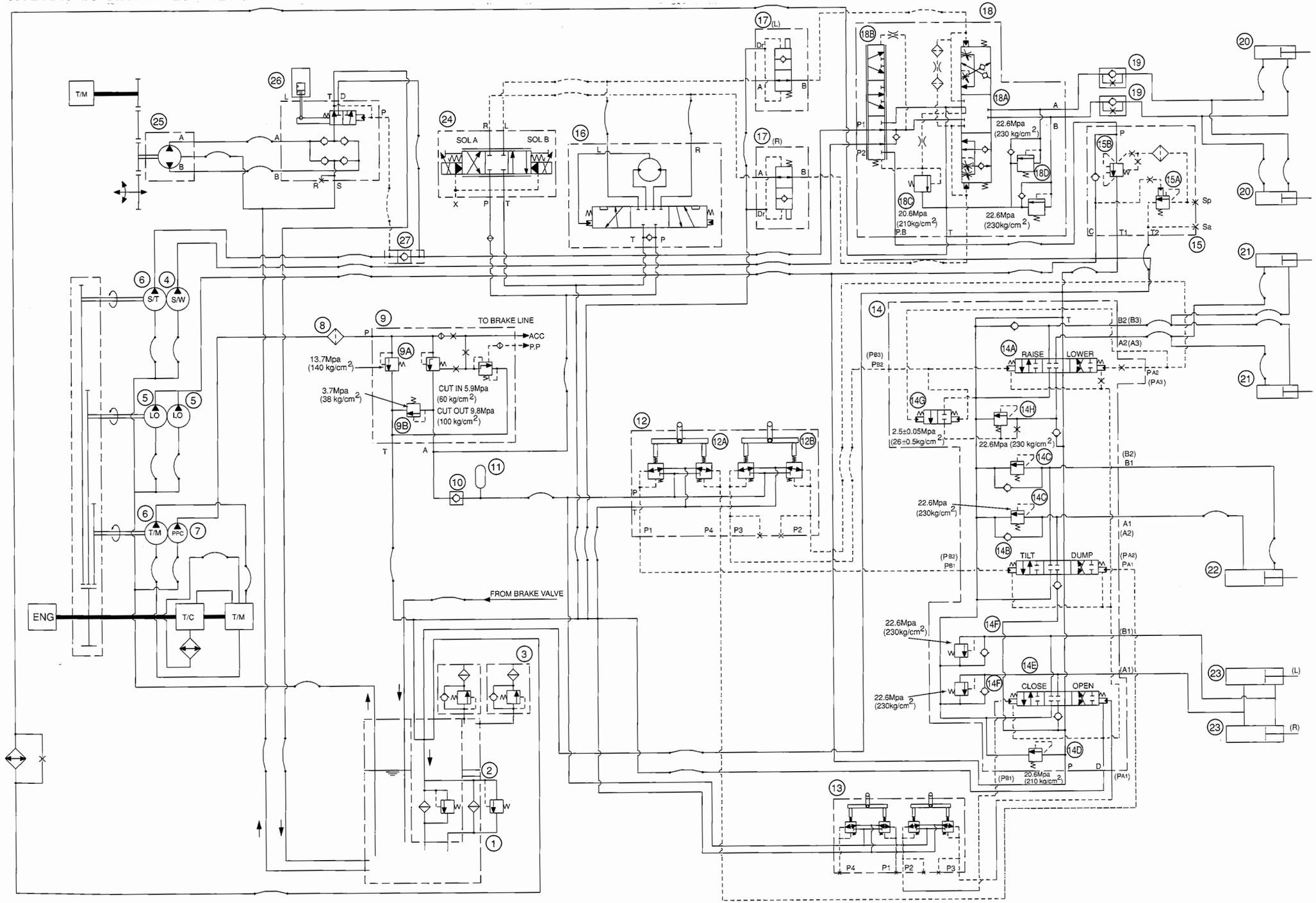



1. Valve
2. Top cover
3. Cylinder
4. Piston

# WORK EQUIPMENT

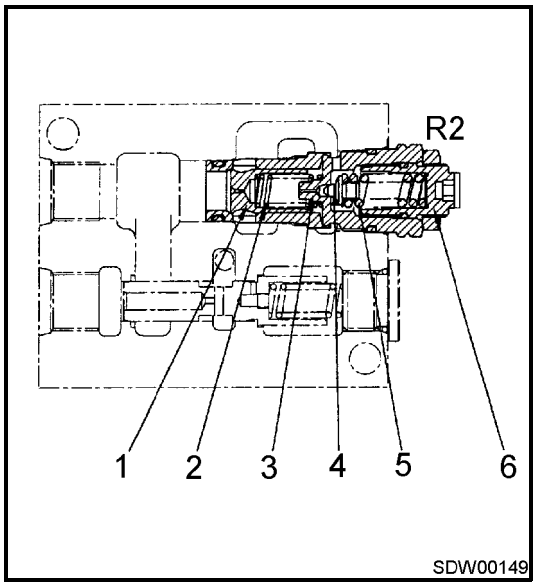
**Foldout No. 10-113**

## HYDRAULIC CIRCUIT DIAGRAM




1. Hydraulic Tank
2. Oil Filter
3. Breather
4. Switch Pump (SAL (4) 100)
5. Hydraulic Pump (SAL (4) 125+125)
6. Steering Pump (SAL (4) 125)
7. PPC Pump (SAL (1) 32)
8. Strainer
9. Accumulator Charge Valve
   - 9A. Safety Relief Valve
   - 9B. PPC Relief Valve
10. Check Valve
11. Accumulator
12. PPC Valve for Attachment
    - 12A. Bucket PPC Valve
    - 12B. Boom PPC Valve
13. PPC Valve
14. Main Control Valve
    - 14A. Boom Spool
    - 14B. Bucket Spool
    - 14C. Safety Valve (with suction)
    - 14D. Relief Valve
    - 14E. Attachment Spool
    - 14F. Safety Valve (with suction)
    - 14G. Float Selector Valve
    - 14H. Unload Valve
15. Cut-off Valve
    - 15A. Cut-off Relief Valve
    - 15B. Unload Valve
16. Steering Unit (Orbit-roll)
17. Stop Valve
18. Steering Valve
    - 18A. Steering Spool
    - 18B. Demand Spool
    - 18C. Main Relief Valve
    - 18D. Overload Relief Valve
19. Two-way Restrictor Valve
20. Steering Cylinder
21. Boom Cylinder
22. Bucket Cylinder
23. Attachment Cylinder
24. Solenoid Valve (for joystick)
25. Emergency Steering Pump
26. Diverter Valve
27. Check Valve

## PPC RELIEF VALVE




1. Main valve
2. Spring
3. Valve seat
4. Pilot poppet
5. Spring
6. Screw

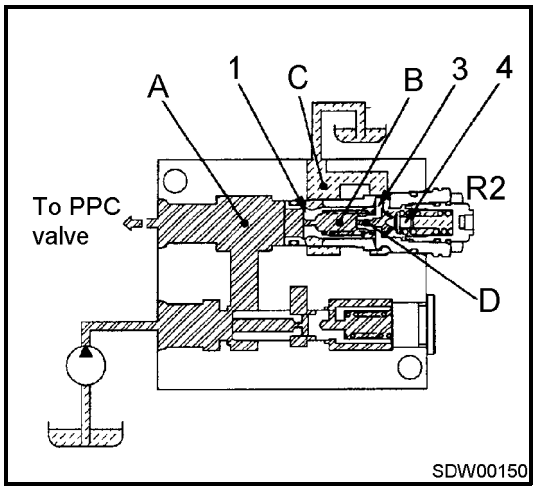
**FUNCTION**

- The PPC relief valve is between the PPC, brake pump and the PPC valve. When the PPC pump is not being actuated, or when any abnormal pressure is generated, the oil sent from the pump is relieved from this valve to prevent any damage to the pump or circuit.

**OPERATION**

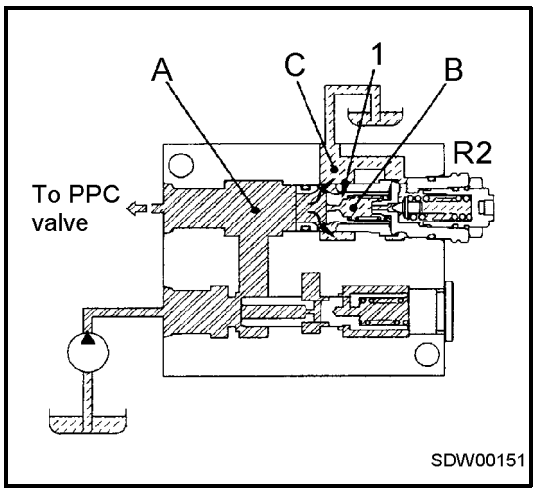
- The relief valve is installed to the charge valve. Port A is connected to the pump circuit and port C is connected to the drain circuit. The oil passes through the orifices in main valve (1) and fills port B.

  In addition, pilot poppet (4) is seated in valve seat (3).




- When the pressure at port A and port B reaches the set pressure, pilot poppet (4) opens and the oil pressure at port B escapes from port D to port C to lower the pressure at port B.

- When the pressure at port B goes down, a difference in pressure is generated at ports A and B by the orifice of main valve (1). Main valve (1) is opened by the pressure port A and the oil at port A is drained to port C to relieve the circuit.



## FLOAT SELECTOR VALVE AND UNLOAD VALVE

### FUNCTION

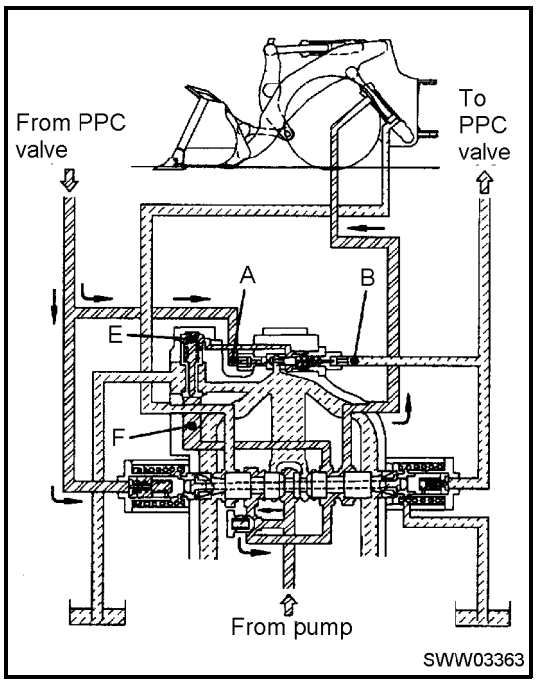
- The float selector valve and unload valve are inside the main control valve. When the boom lever is operated to the FLOAT position, the float selector valve detects this and it actuates the unload valve and set the boom to the FLOAT position.

### OPERATION

- If the boom lever is pushed further from the LOWER position, it is set to the FLOAT position and the PPC valve is set to the same condition as for the LOWER position.

  The pressure at port A becomes high pressure and the pressure at port B becomes low pressure.

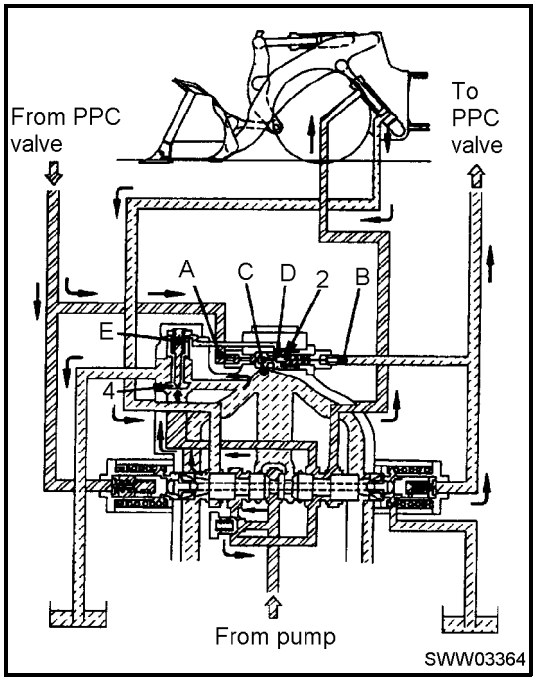
- The oil from the steering valve fills chamber F and chamber E.

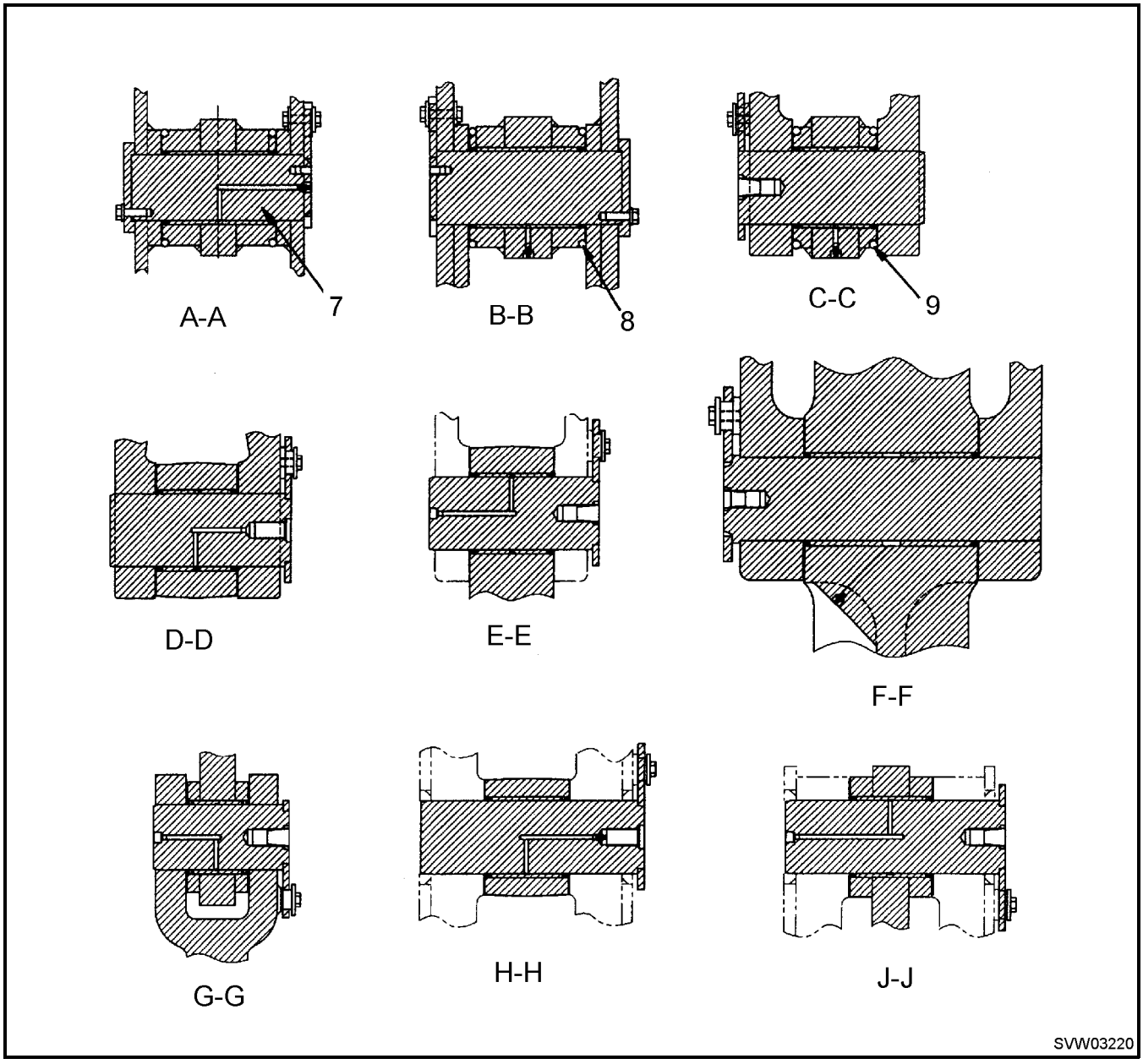



- If the difference in pressure between port A and port B becomes greater than the specified pressure, float selector valve (2) is moved to the right with port C and port D open.

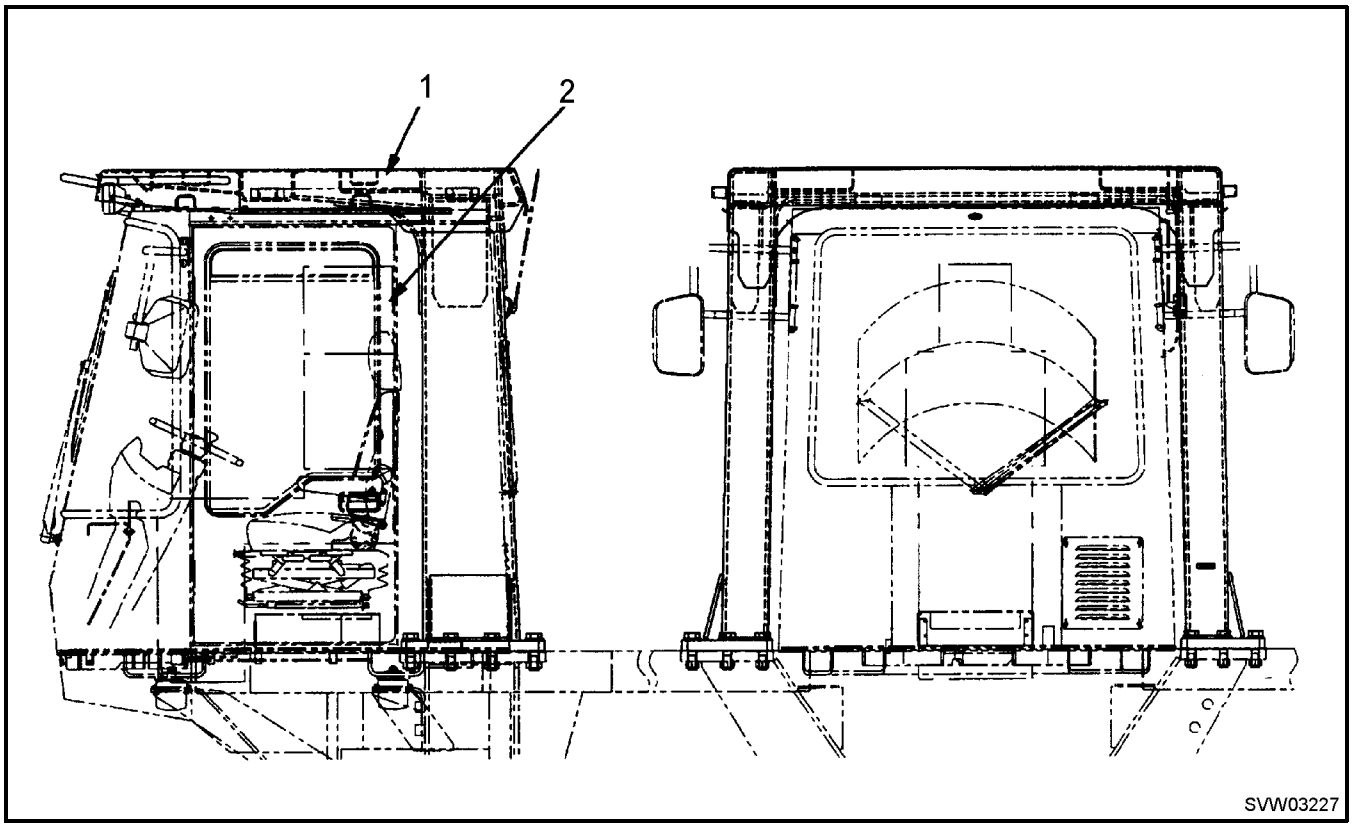
- When port D is opened, the oil pressure in chamber E drops, unload valve (4) is moved up in the direction of the arrow and the oil from the pump flows to the rod end of the boom cylinder.

  The oil at the bottom end of the boom cylinder is connected to the drain circuit and forms the FLOAT position.



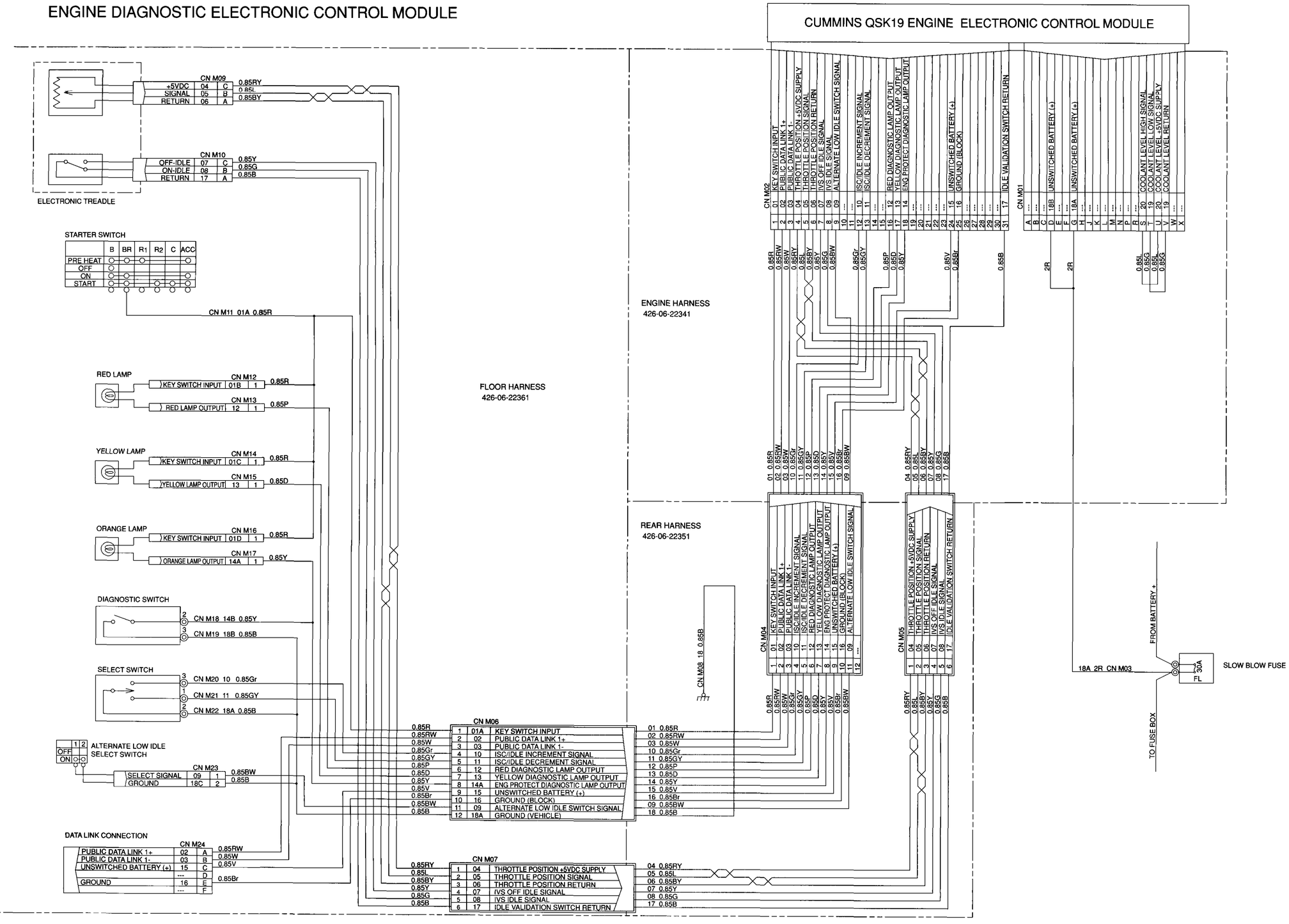

A-A
7
B-B
8
C-C
9
D-D
E-E
F-F
G-G
H-H
J-J
SVW03220

# ROPS CANOPY



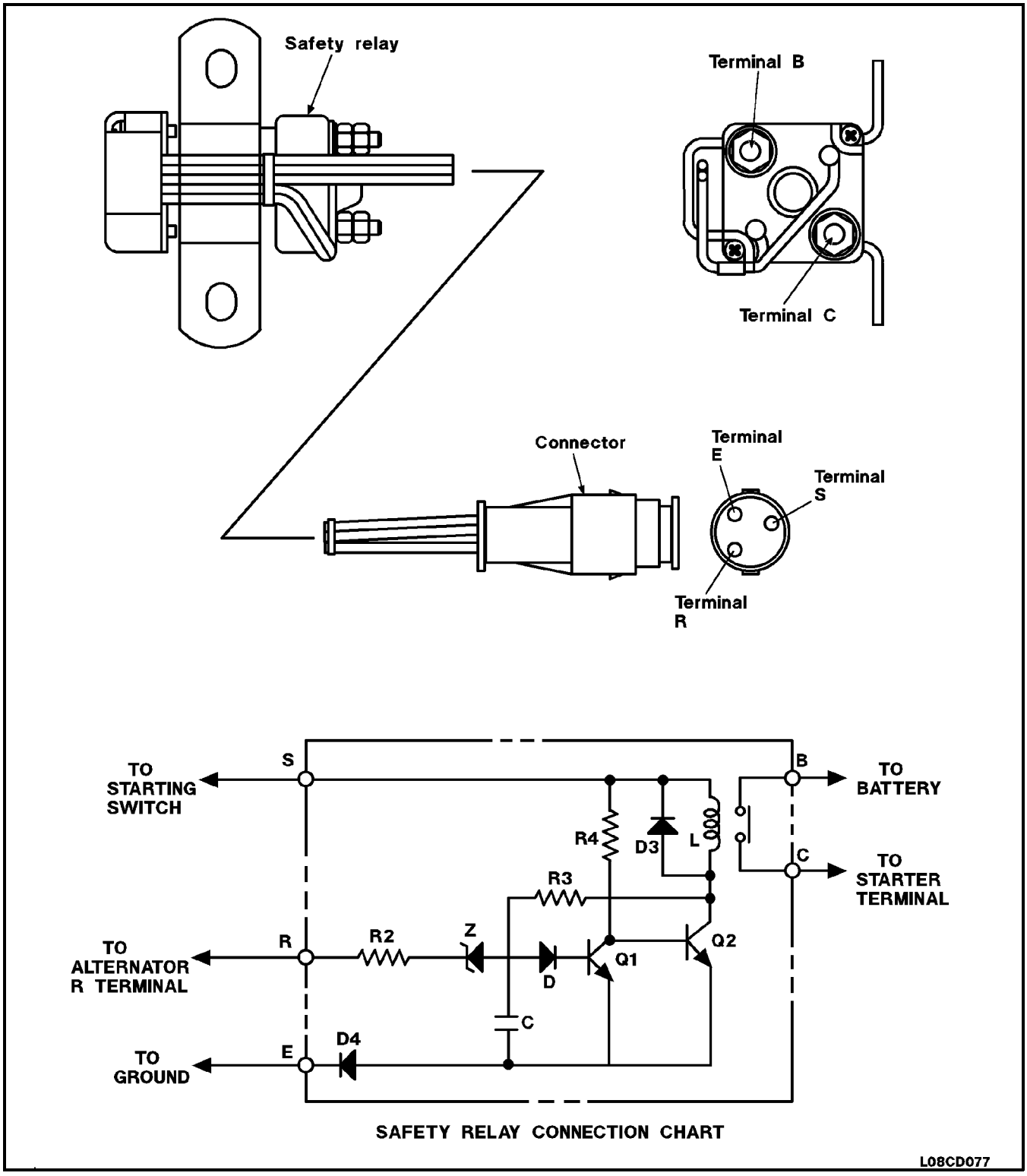

1. ROPS canopy
2. Cab

# WIRING DIAGRAM FOR CUMMINS QSK19 ENGINE DIAGNOSTIC ELECTRONIC CONTROL MODULE

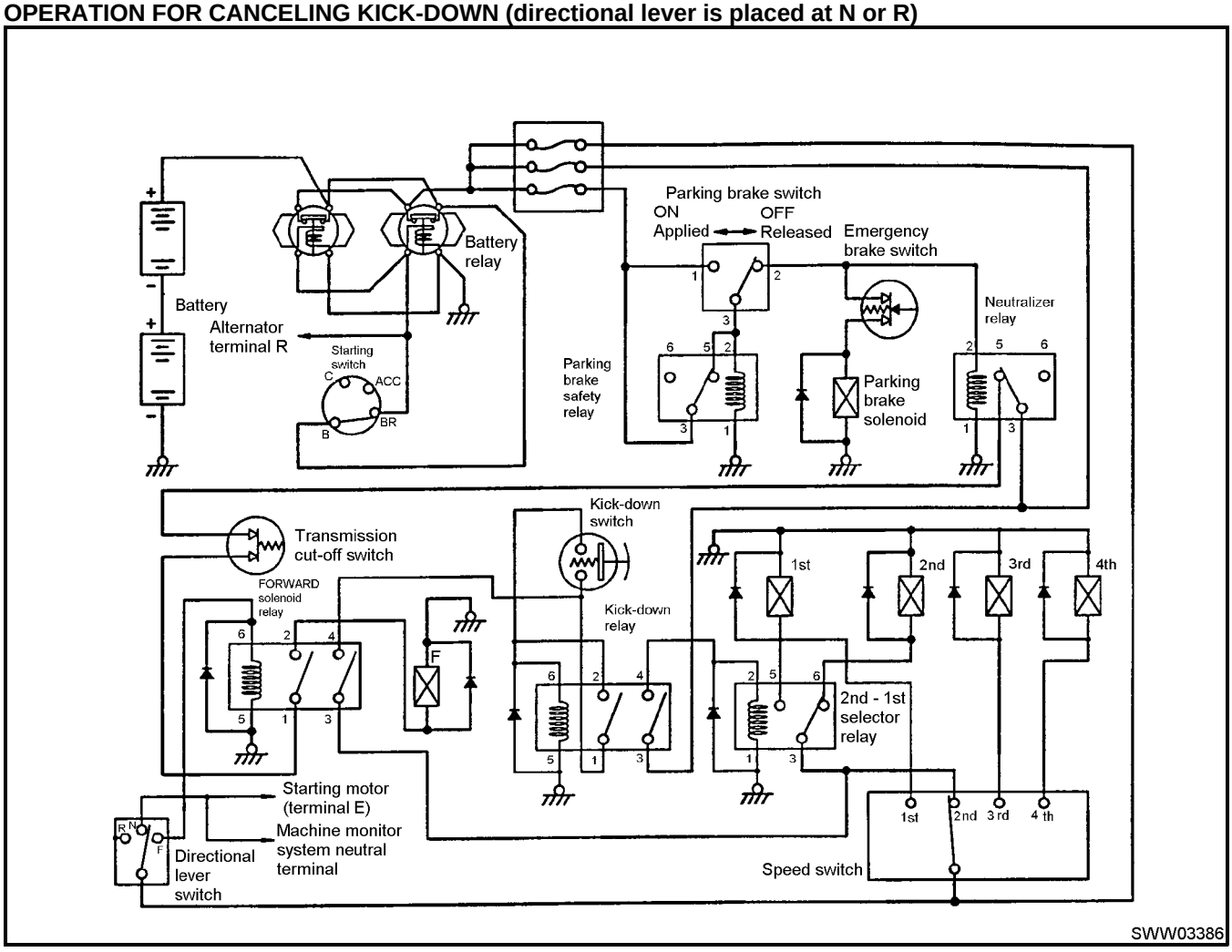



LNC00097

## SAFETY RELAY



**OPERATION FOR CANCELING KICK-DOWN (directional lever is placed at N or R)**




- When the directional lever switch is at a position other than F, the F terminal contact is OFF, so the electric current from the battery is cut off. No electric current flows to FORWARD solenoid relay terminals 6 - 5 and the FORWARD solenoid is reset.

- When this happens, FORWARD solenoid relay terminals 3 - 4 are opened, so the electric current stops slowing to kick-down relay is reset, and the self-hold circuit is canceled.

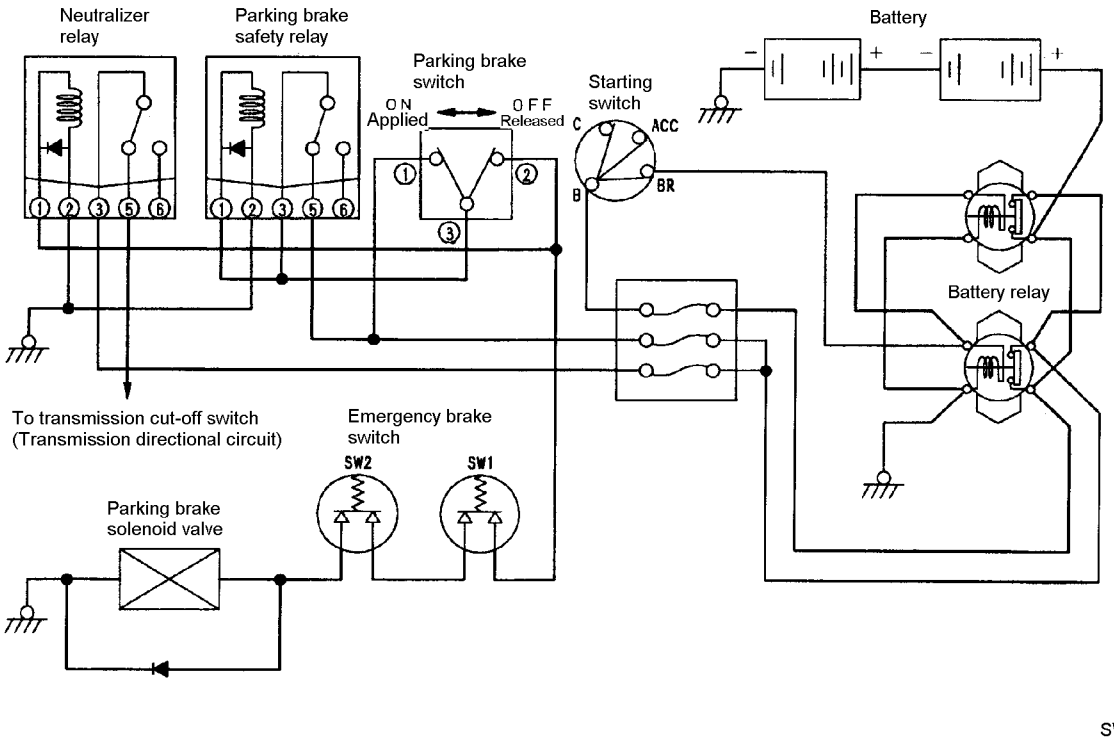
- When this kick-down relay is reset, kick-down relay terminals 3 -4 are opened, so the electric current from the battery is cut off and stops flowing. The 2nd-1st selector relay is reset, the circuit between relay terminals 3 - 5 is opened, and the circuit between terminals 3 - 6 is closed.

- The electric current flowing to the 1st solenoid is cut-off and the kick-down setting to 1st is canceled.

- In addition, the circuit between 2nd-1st selector relay terminal 3 - 6 is closed, so the electric current from the battery flows to the 2nd solenoid and the transmission speed range is set to 2nd, the same as the position of the speed lever.

- In this way, the actuation of the kick-down switch is canceled and travel operations are carried out according to the normal lever commands. If the directional lever is set to R, the machine will travel in R2.

**PARKING BRAKE SWITCH OFF (RELEASED)**




- If the parking brake switch is turned from ON (actuated) to OFF (released), the circuit for terminals 2 and 3 of the parking brake switch is connected and the parking brake safety relay is also actuated. For this reason, electric current flows in circuit ① from the battery (+) battery relay parking brake safety relay parking brake switch and then flows to circuits ② and given below.

  ② This circuit is formed from the emergency brake switch parking brake solenoid valve ground and the parking brake is released.

  This circuit is formed from the (+) battery relay neutralizer relay terminal 3 - 5 transmission directional circuit, so when the directional lever is operated, the machine will move.

# STANDARD VALUE TABLE FOR ENGINE IN CHASSIS

| Machine model | | | WA600-3L | |
|---|---|---|---|---|
| Engine model | | | Cummins QSK19 | |
| Item | Measurement condition | Unit | Standard value | Permissible value |
| Engine speeds | High idle | rpm | 2,100 - 2,200 | |
| | Low idle | | 650 - 850 | |
| Engine rating | Rated gross horsepower/rated speed | kW/rpm (hp/rpm) | 366/2,000 (490/2,000) | |
| Intake manifold pressure | At TC stall and WOT (wide open throttle) | mm Hg | Min. 1,440 | |
| Necessary starting speed | 0 EC (32 EF)<br>-20 EC (-4 EF) | rpm | Min. 150<br>Min. 120 | |
| Intake air restriction | AT TC stall and WOT at restriction indicator port | $mmH_2O$ | New element: 380<br>Used element: 760 | 760 |
| Exhaust gas color (Engine overnight cold) | At sudden acceleration | Bosch index | Max. 6.0 | |
| | At high idle | | Max. 2.0 | |
| Exhaust back pressure | Max at TC stall and WOT | mmHg | 76 | 100 |
| Valve clearance (Engine cold) | Intake (adjust and recheck) | mm (in.) | 0.36 (0.014) | 0.28 - 0.43 (0.011 - 0.017) |
| | Exhaust (adjust and recheck) | | 0.81 (0.032) | 0.74 - 0.89 (0.029 - 0.035) |
| Blow-by pressure | ! Coolant temp: Operating range<br>! Service tool orifice size: 7.67 mm (0.30 in.)<br>! At TC stall and WOT | $mmH_2O$ | Max. 355 | Max. 508 |
| Lubricating oil pressure | ! Water temp: Green range<br>! Engine oil: SAE15W40 | $kg/cm^2$ (psi) | | |
| | Minimum at rated speed and load | | 2.8 (40) | |
| | Minimum at low idle | | 1.4 (20) | |
| Oil temperature | Entire speed range (inside oil pan) | EC (EF) | Max. 120 (248) | |
| Oil consumption | At continuous rated horsepower (% of fuel consumption) | % | Max. 5 | |
| Coolant temperature | Max operating temperature at engine outlet | EC (EF) | 80 - 90 (176 - 194) | Max 100 (212) |
| Radiator pressure valve | Valve cracking pressure (differential pressure) | $kg/cm^2$ (psi) | 0.75 ± 1 (10.7 ± 1.1) | |
| Fuel injection timing | Before top dead center | mm (in.) | 7.72 (0.30) | |

| System | Name of Component | Connector No. | Inspection method | Judgement Table | Measurement Conditions |
|---|---|---|---|---|---|
| Transmission & Joystick Steering Control | Solenoid (R) | T01 | Measure resistance | Table shows normal condition<br>Between (A) - (C): 5 - 15 S<br>Between (A), (C) - chassis: Max. 1 MS | 1. Starting switch OFF.<br>2. Unplug connectors.<br>3. Connect T-adapter. |
| | Engine speed sensor | E03 (male) | | Table shows normal condition<br>Between (1) - (2): 500 - 1,000 S<br>Between (1), (2) - chassis: Max. 1 MS | |
| | (Controller) Engine speed | C4 | Measure voltage | Measure in AC range.<br>Between (2) - (9): Min. 0.5 V | 1. Starting switch OFF.<br>2. Install T-adapter.<br>3. Start engine. |
| | Engine speed | — | Adjust | 1. Thread in sensor until tip contacts gear, then back it out 1 turn.<br>2. Normal sensor operation should result if step 1 is performed correctly. | — |
| | Speed | BC01 (male) | Measure resistance | Table shows normal condition<br>Between (1) - (2): 500 - 1,000 S<br>Between (1), (2) - chassis: Max. 1 MS | 1. Starting switch OFF.<br>2. Unplug connectors.<br>3. Connect T-adapter. |
| | Speed | — | Adjust | 1. Thread in sensor until tip contacts gear, then back it out ¾ - 1 turn.<br>2. Normal sensor operation should result if step 1 is performed correctly. | — |
| | (Controller) Speed control lever (1st) | C3B | Measure voltage | Table shows normal condition between (7) - chassis.<br>Speed control lever at 1st: 20 -30 V<br>Speed control lever not at 1st: Max. 1 V | 1. Starting switch OFF.<br>2. Install T-adapter.<br>3. Starting switch ON. |
| | (Controller) Speed control lever (2nd) | | | Table shows normal condition between (15) - chassis<br>Speed control lever at 2nd: 20 - 30 V<br>Speed control lever not at 2nd: Max. 1 V | |
| | (Controller) Speed control lever (3rd) | | | Table shows normal condition between (8) - chassis<br>Speed control lever at 3rd: 20 - 30 V<br>Speed control lever not at 3rd: Max. 1 V | |
| | (Controller) Speed control lever (4th) | | | Table shows normal condition between (8) - chassis<br>Speed control lever at 4th: 20 - 30 V<br>Speed control lever not at 4th: Max. 1 V | |
| | (Controller) Directional lever (F) | | | Table shows normal condition between (5) - chassis<br>Directional lever at F: 20 - 30 V<br>Directional lever not at F: Max. 1 V | |
| | (Controller) Directional lever (R) | | | Table shows normal condition between (6) - chassis<br>Directional lever at R: 20 - 30 V<br>Directional lever not R: Max. 1 V | |
| | (Controller) Directional lever (N) | | | Table shows normal condition between (13) - chassis<br>Directional lever at N: 20 - 30 V<br>Directional lever not N: Max. 1 V | |

## Measuring the hydraulic stall speed

1. Ensure that the digital optical tachometer sensor is still installed and connected to the portable meter inside the cab.

2. Start the engine and run it at high idle.

3. Extend either the boom cylinder or bucket cylinder, then measure the engine speed when the circuit is relieved.
   - **i** To prevent equipment damage:
     - **!** Do not run the engine at stall speed for more than 20 seconds.
     - **!** Do not allow the torque converter oil temp to exceed 120EC (248EF).

4. Compare your results with the specs given in the Standard Values Table at the beginning of Section 20.

5. For details, see the ENGINE SHOP MANUAL.

## Measuring the torque converter stall speed + the hydraulic stall speed

1. Ensure that the digital optical tachometer sensor is still installed and connected to the portable meter inside the cab.

2. Start the engine.

3. Set the transmission cut-off selector switch (2) to OFF and depress the left brake pedal securely. (Check that the transmission cut-off selector pilot lamp is off.)

4. Set the gearshift lever to either **F4** or **R4**.

   - **i** On machines equipped with automatic transmission, set the main monitor manual switch to ON and set the speed lever to either **F4** or **R4**.

5. Release the parking brake.

6. Perform these actions at the same time:
   - **!** Press the accelerator pedal to run the engine at high idle and stall the torque converter.
   - **!** Extend either the boom cylinder or bucket cylinder.
   - **!** Measure the engine speed when the circuit is relieved.
   - **i** To prevent equipment damage:
     - **!** Do not run the engine at stall speed for more than 20 seconds.
     - **!** Do not allow the torque converter oil temp to exceed 120EC (248EF).

7. Compare your results with the specs given in the Standard Values Table at the beginning of Section 20.

8. For details, see the ENGINE SHOP MANUAL.

# FAN BELT TENSIONER

(*CONTROL ROD TENSIONER*)

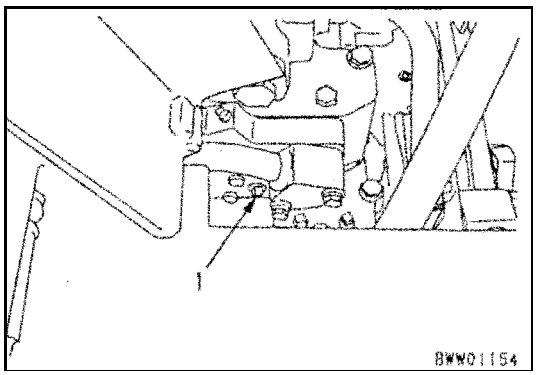
**i** Refer to the ENGINE SHOP MANUAL for tools and proper procedure.

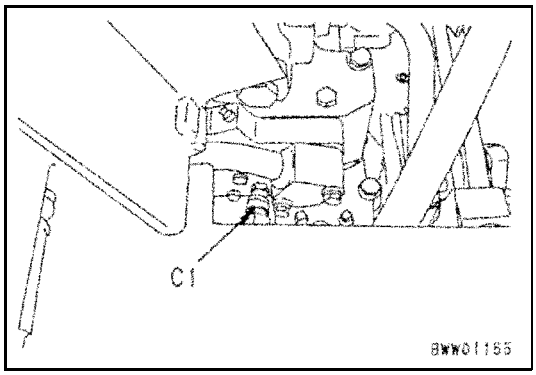
## Pilot pressure (P5)

1. Remove the oil pressure measurement plug PT1/8 (1), then install the oil pressure gauge (C1).

2. Start the engine, then measure the oil pressure with the engine at high idle.
   - ! Place the directional lever at N.
   - ! Operate the speed lever.

3. Compare your results with the specs given in the Standard Values Table at the beginning of Section 20.




## Lubricating pressure (P9)

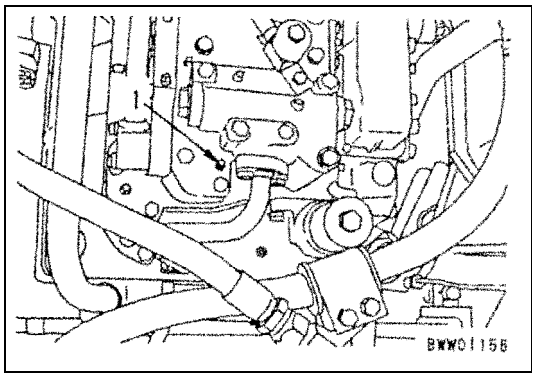
1. Remove the oil pressure measurement plug PT1/8 (1).

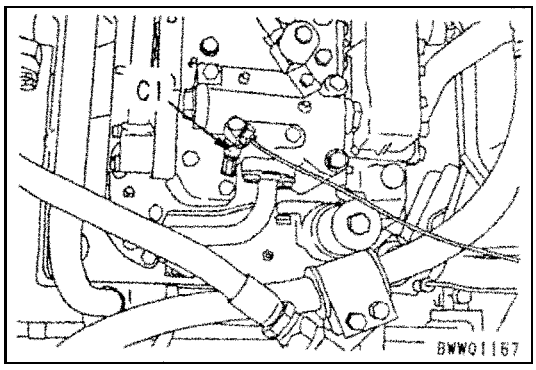
2. Install the nipple PT1/8 (both ends male) and adapter (790-301-1520; included in kit C1)

3. Install the oil pressure gauge (C1).

4. Start the engine, then measure the oil pressure with the engine at high idle.

5. Compare your results with the specs given in the Standard Values Table at the beginning of Section 20.



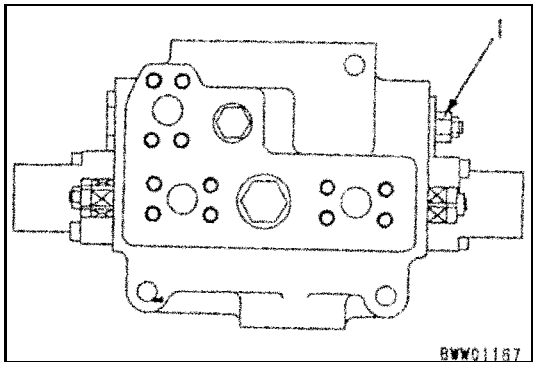
## Adjusting the steering relief valve

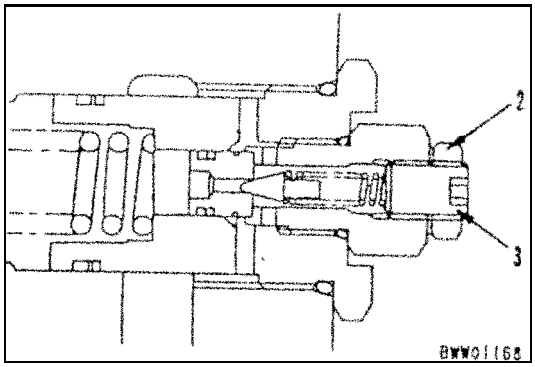
1. Stop the engine and chock the wheels to prevent the machine from moving.

2. Loosen the locknut (2) on the steering relief valve (1).

3. Turn the adjustment screw (3) either right or left to adjust the pressure.
   - **i** Turn the adjustment nut as follows:
     - **!** CLOCKWISE to increase pressure
     - **!** COUNTERCLOCKWISE to decrease pressure
   - **i** Each full turn of the adjustment screw changes the pressure by 145 kg/cm$^2$ (2,062 psi)

4. Tighten the locknut when the desired pressure has been set.
   Locknut: 29.4 ± 2.0 N•m (21.7 ± 1.5 lbf ft).

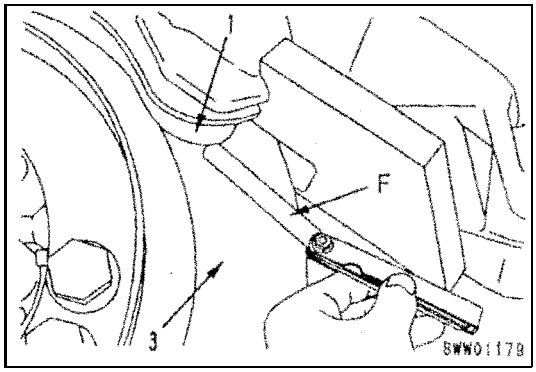


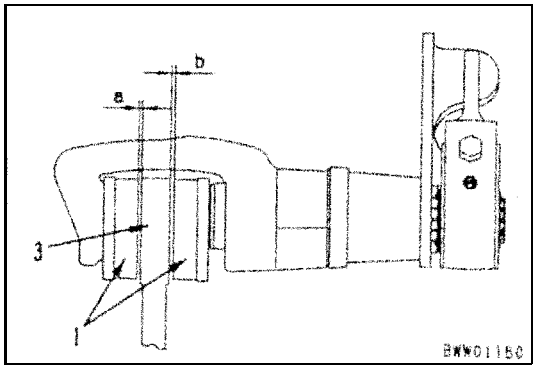



## Measuring the pad-to-disc clearance

1. Turn the parking brake switch OFF to release the parking brake.

2. Insert a feeler gauge (F) between the pad (1) and the disc (3), then measure clearances (a) and (b).
   - **i** The clearance value is the total value of both clearances (a + b).
   - **i** Compare your results with the specs given in the Standard Values Table at the beginning of Section 20. If your measurements do not agree with those in the table, complete the next procedure.



# MEASURING THE WORK EQUIPMENT HYDRAULIC DRIFT

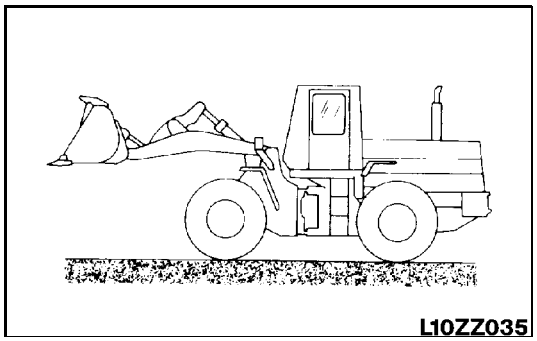
- **i** Measurement conditons:
  - **!** Coolant temperature: Inside operating range
  - **!** Steering position: Neutral
  - **!** Hydraulic oil temperature: 45-55EC (113-131EF)
  - **!** Engine: Off for 5 minutes
  - **!** Bucket: Empty and horizontal
  - **!** Lift arm: Horizontal
- **i** Use a commercially-available stop watch and ruler or scale for this procedure.

**WARNING! Fit the safety locks on the control levers.**

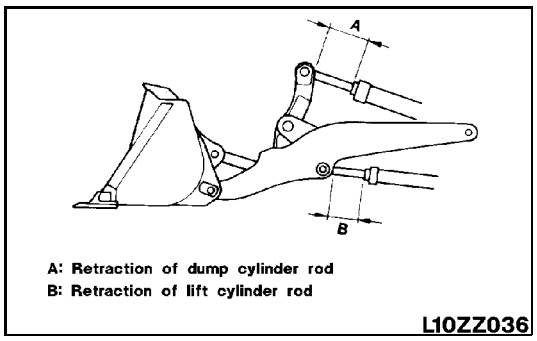
**WARNING! Do not walk or stand under the work equipment during this procedure.**

## Measurement procedure

1. Set the lift arm and bucket horizontal, then stop the engine.


L10ZZ035

2. Stop the engine, wait for 5 minutes, then start the measurement.
3. Measure the amount the lift B and dump cylinder rods A retract in 15 minutes.



A: Retraction of dump cylinder rod
B: Retraction of lift cylinder rod
L10ZZ036

# ADJUSTING THE MACHINE MONITOR (SPEEDOMETER MODULE)

**i** While the speedometer on the machine monitor is common for all models, the input signals for the travel speed differ according to the model. Therefore, it is necessary to adjust the monitor to make the speedometer applicable to the model on which it is being used.

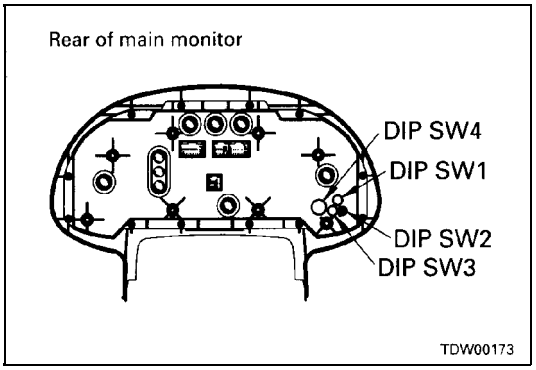
**i** The diameter of the tires differs according to the type of tires fitted, so it is necessary to adjust the travel speed to match the tire diameter

**i** The DIP switches must be reset if the ECSS (Electronically Controlled Suspension System) option is installed.

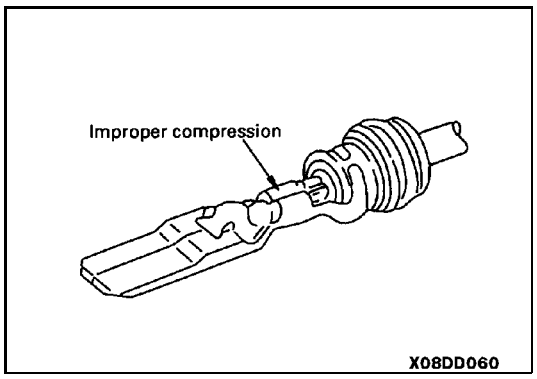
## Preadjustment procedure

**WARNING! Ensure that the engine is switched OFF and that there is no power to the machine monitor.**

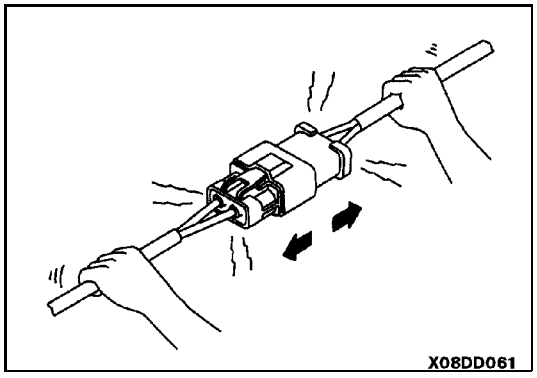
Remove the machine monitor to gain access to the switches on the rear of the speedometer.



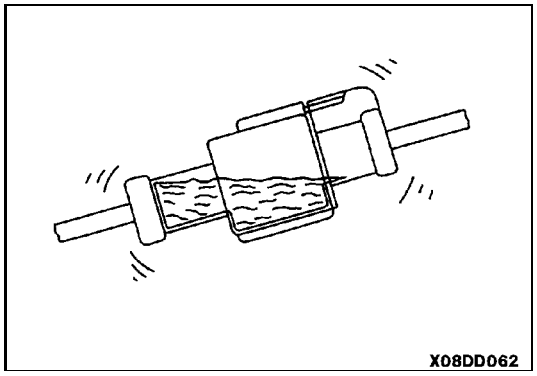
ii. Defective crimping or soldering of connectors. The pins of the male and female connectors are in contact at the crimped terminal or soldered portion, but if there is excessive force brought to bear on the wiring, the plating at the joint will peel and cause improper connection or breakage.



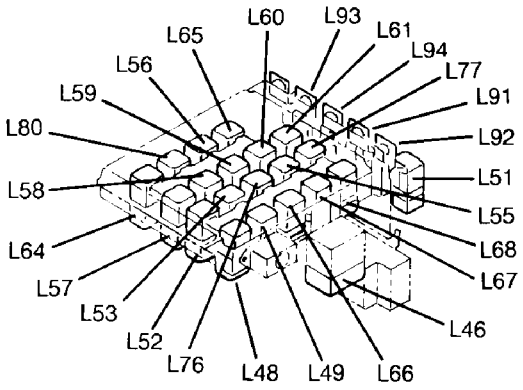

iii. Disconnections in wiring. If the wiring is held and the connectors are pulled apart, or components are lifted with a crane with the wiring still connected, or a heavy object hits the wiring, the crimping of the connector may separate, or the soldering may be damaged, or the wiring may be broken.



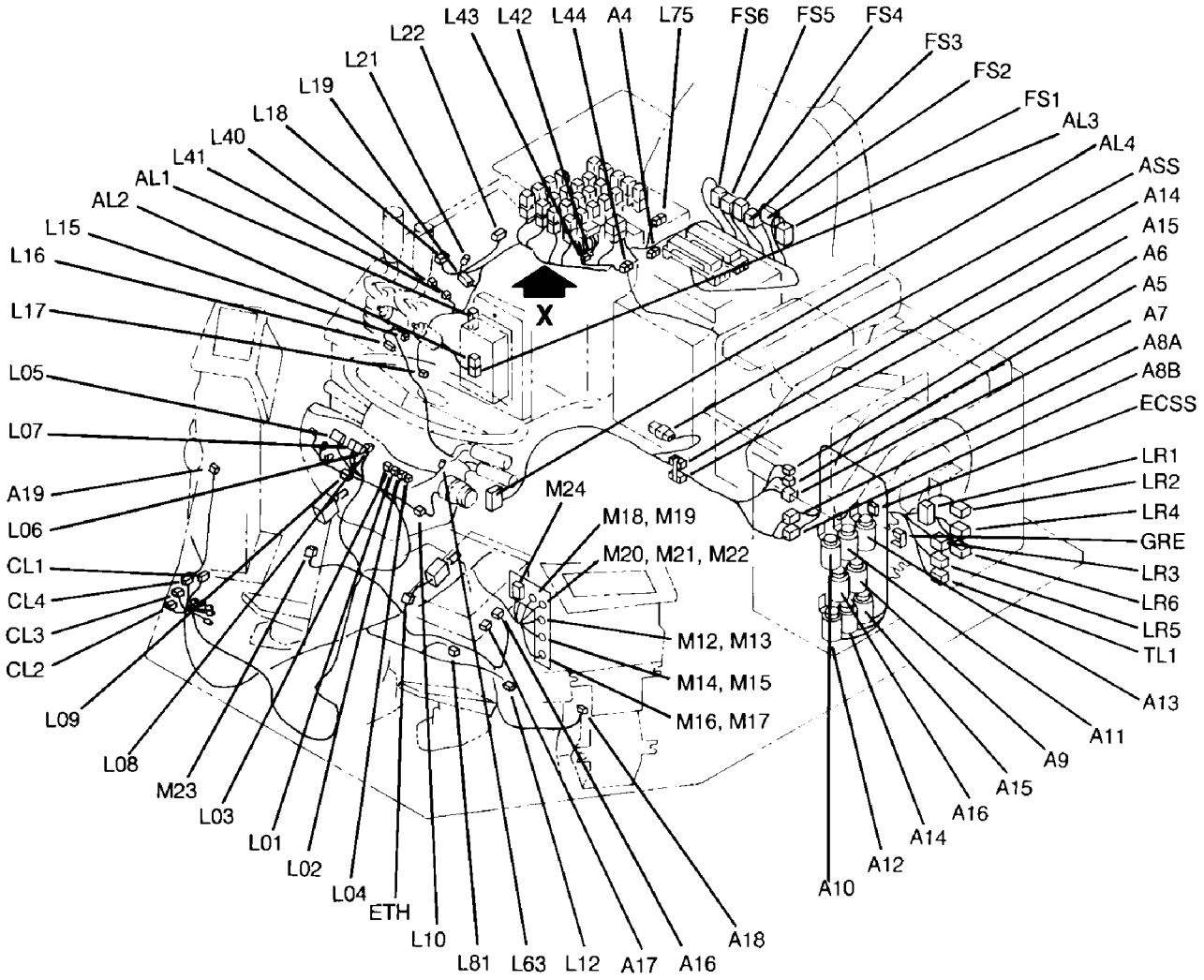

iv. High-pressure water entering connector. The connector is designed to make it difficult for water to enter (drop-proof structure), but if high pressure water is sprayed directly on the connector, water may enter the connector, depending on the direction of the water jet. Since the connector is designed to prevent water from entering, but at the same time, if water does enter, it is difficult for it to be drained. Therefore, it water should get into the connector, the pins will be short-circuited by the water, so if any water gets in, immediately dry the connector or take other appropriate action before passing electricity through it.



| Connector No. | Connector Type | No. of Pins | Mounting Location | Address |
|---|---|---|---|---|
| CL3 | M | 6 | Intermediate connector (air conditioner) | M3 |
| CL4 | M | 6 | Intermediate connector (power window) | M3 |
| CL18 | Connector | 1 | Power window motor (L.H.) | E1 |
| CL19 | Connector | 1 | Power window motor (L.H.) | E1 |
| CL20 | Connector | 1 | Power window motor (R.H.) | C7 |
| CL21 | Connector | 1 | Power window motor (R.H.) | C7 |
| CR1 | X | 4 | Low pressure switch (brake) | I1 |
| E01 | Terminal | 1 | Slow-blow fuse (80 amp) | W3 |
| E02 | X | 4 | Ether injection solenoid | S6 |
| E04 | X | 2 | Coolant temperature sensor | T7 |
| E06 | X | 2 | Engine speed sensor | S4 |
| E07 | X | 2 | Torque converter temperature sensor | S3 |
| E08 | X | 2 | Starting motor | U2 |
| E10 | X | 1 | Engine oil level switch | S2 |
| E11 | Terminal | 1 | Engine oil pressure switch | S5 |
| E12 | X | 1 | Air conditioner compressor switch | V7 |
| E13 | Terminal | 1 | Dust indicator | U7 |
| E14 | Terminal | 1 | Dust indicator | U7 |
| E15 | Terminal | 1 | Alternator (B) | X5 |
| E16 | Terminal | 1 | Alternator (R) | X7 |
| E17 | Terminal | 1 | Alternator (E) | X6 |
| E18 | Terminal | 1 | GND | L3 |
| E19 | KES 1 | 2 | Diode (starting motor) | X4 |
| E20 | KES 1 | 2 | Diode (starting motor) | V3 |
| E23 | KES 1 | 2 | Diode (air conditioner compressor) | V7 |
| ECSS | SWP | 14 | Intermediate connector (ECSS) | R4 |
| ER1 | SWP | 14 | Intermediate connector (engine harness) | U2 |
| ER2 | SWP | 12 | Intermediate connector (engine harness) | V2 |
| F01 | M | 3 | Intermediate connector (head lamp; R.H.) | A6 |
| F02 | M | 3 | Intermediate connector (combination lamp; R.H.) | A6 |
| F03 | M | 3 | Intermediate connector (combination lamp; L.H.) | E1 |



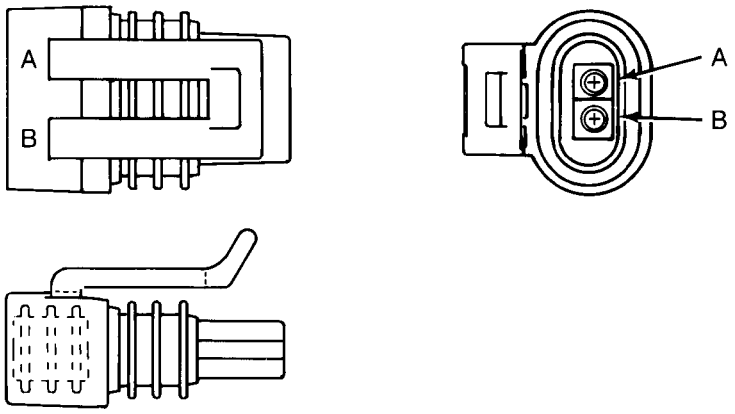
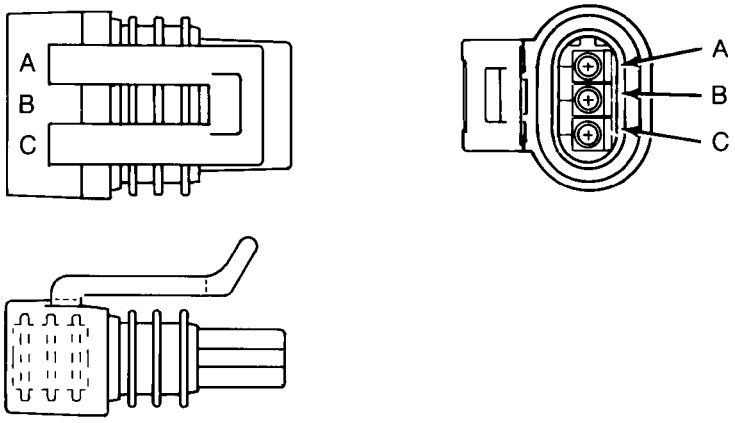

**VIEW-X**

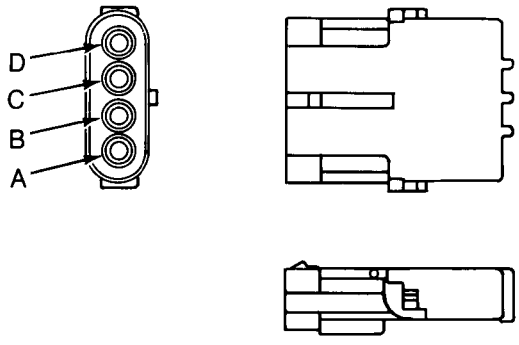



**VIEW-Z**

VLSM0004

## Metri-Pack Connectors

| NO. OF PINS | METRI-PACK CONNECTOR<br>FEMALE TERMINAL (SOCKET) |
|---|---|
| 2 |  |
| 3 |  |

| NO. OF PINS | METRI-PACK CONNECTOR<br>MALE TERMINAL (PIN) |
|---|---|
| 4 |  |

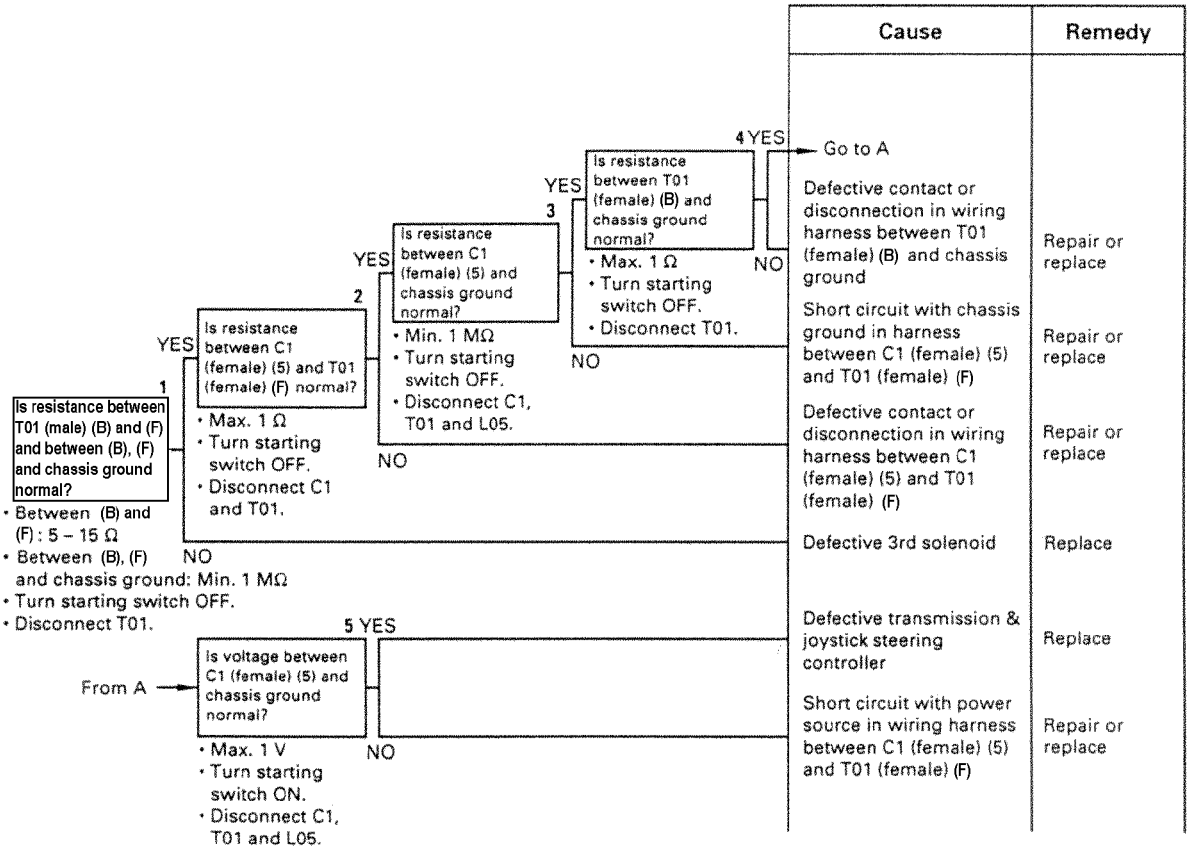
L08ZZ013

| Condition when normal (voltage, current, resistance) | Action by controller when abnormality is detected | Problem that appears on machine when there is abnormality | Trouble-shooting code |
|---|---|---|---|
| 1) Resistance of relay coil: 200 – 400 Ω<br>2) Voltage between transmission & joystick controller C1 (8) and chassis ground at neutral: Less than 1 V<br>3) Resistance in wiring harness between transmission & joystick controller C1 (female) (8) and L76 (female) (1): Max. 1 Ω<br>4) Resistance in wiring harness between back lamp relay L76 (female) (2) and chassis ground: Max. 1 Ω | Neutral (F, R, 1st, 2nd, 3rd, 4th solenoid output: off) | Back lamp is not actuated when driving in reverse | T-1 |
| 1) Resistance between transmission & joystick controller C1 (female) (2) and chassis ground: 5 – 15 Ω<br>2) Voltage between transmission & joystick controller C1 (2) and chassis ground at neutral: Less than 1 V | Neutral (F, R, 1st, 2nd, 3rd, 4th solenoid output: off) | It is impossible to travel | T-2 |
| 1) Resistance between transmission & joystick controller C1 (female) (9) and chassis ground: 5 – 15 Ω<br>2) Voltage between transmission & joystick controller C1 (9) and chassis ground at neutral: Less than 1 V | Neutral (F, R, 1st, 2nd, 3rd, 4th solenoid output: off) | It is impossible to travel | T-3 |
| 1) Resistance between transmission & joystick controller C1 (female) (3) and chassis ground: 5 – 15 Ω<br>2) Voltage between transmission & joystick controller C1 (3) and chassis ground at neutral: Less than 1 V | Neutral (F, R, 1st, 2nd, 3rd, 4th solenoid output: off) | It is impossible to travel | T-4 |
| 1) Resistance between transmission & joystick controller C1 (female) (10) and chassis ground: 5 – 15 Ω<br>2) Voltage between transmission & joystick controller C1 (10) and chassis ground at neutral: Less than 1 V | Neutral (F, R, 1st, 2nd, 3rd, 4th solenoid output: off) | It is impossible to travel | T-5 |
| 1) Resistance between transmission & joystick controller C1 (female) (5) and chassis ground: 5 – 15 Ω<br>2) Voltage between transmission & joystick controller C1 (5) and chassis ground at neutral: Less than 1 V | Neutral (F, R, 1st, 2nd, 3rd, 4th solenoid output: off) | It is impossible to travel | T-6 |
| 1) Resistance between transmission & joystick controller C1 (female) (11) and chassis ground: 5 – 15 Ω<br>2) Voltage between transmission & joystick controller C1 (11) and chassis ground at neutral: Less than 1 V | Neutral (F, R, 1st, 2nd, 3rd, 4th solenoid output: off) | It is impossible to travel | T-7 |

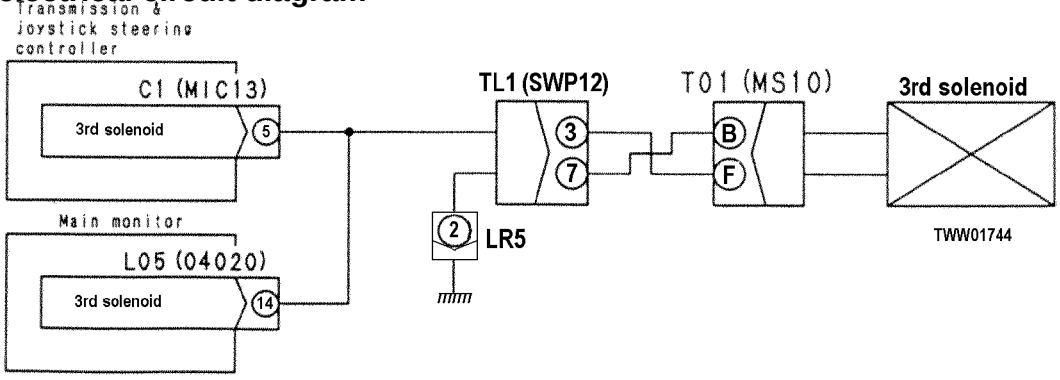
LNC00125

# T-6 Failure code [16] (Short circuit, disconnection, short circuit with power source in 3rd solenoid) is displayed

- **i** This procedure is performed while the abnormality still exists. Therefore, note that if the failure code is no longer displayed on the monitor when unplugging the connector and installing the T-adapter, or when removing the T-adapter and restoring the connector to its original state, the problem has been removed.
- **i** Always turn the starting switch to OFF before disconnecting or reconnecting any electrical plugs, the T-adapter or socket.
- **i** Ensure that all related connectors are properly inserted before troubleshooting.
- **i** Always connect any unplugged connectors before going to the next step.




## Related electrical circuit diagram



# MEMORANDA

# T-21 Abnormality in machine selection wiring harness

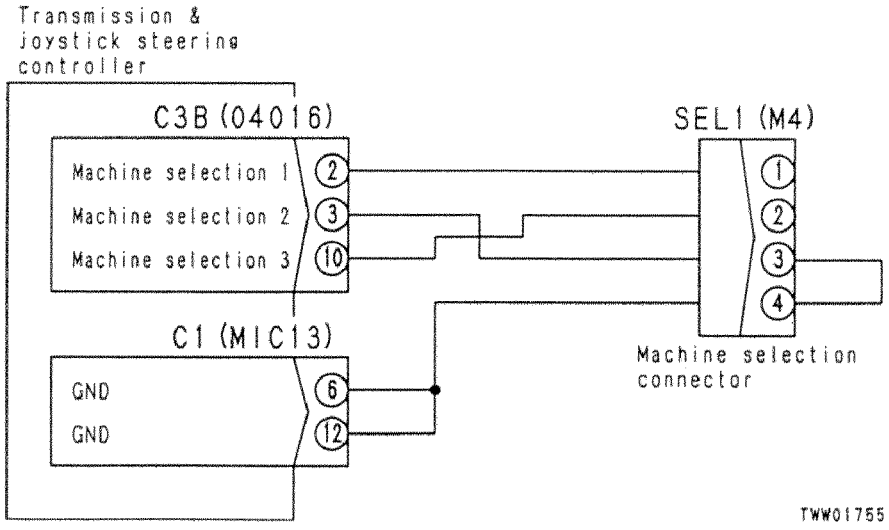
- **i** Always turn the starting switch to OFF before disconnecting or reconnecting any electrical plugs, the T-adapter or socket.
- **i** Ensure that all related connectors are properly inserted before troubleshooting.
- **i** Always connect any unplugged connectors before going to the next step.

| | Cause | Remedy |
|---|---|---|
| 1 Is resistance between C3B (female) (2), (3), (10) and C1 (female) (6), (12) normal? • Turn starting switch OFF. • Disconnect C3B and C1. | | |
| YES | Defective transmission & joystick steering controller | Replace |
| NO | Defective machine selection connector, or defective contact or disconnection in wiring harness | Repair or replace |

Table 1

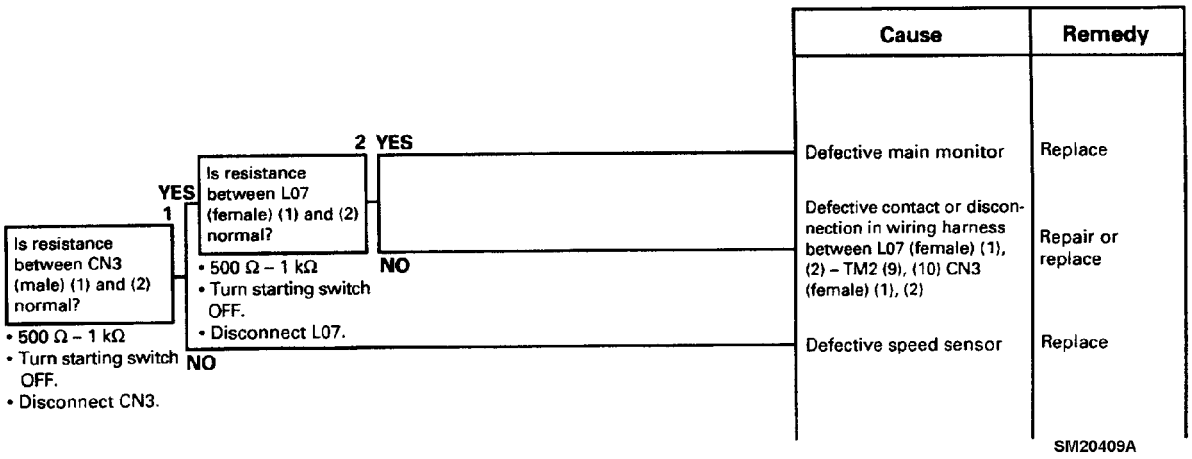
| Connector \ Machine model | WA600-3 |
|---|---|
| Between C3B (female) (2) and C1 (female) (6), (12) | Min. 1 MΩ |
| Between C3B (female) (3) and C1 (female) (6), (12) | **Max.** 1 Ω |
| Between C3B (female) (10) and C1 (female) (6), (12) | Min. 1 MΩ |

### Related electrical circuit diagram

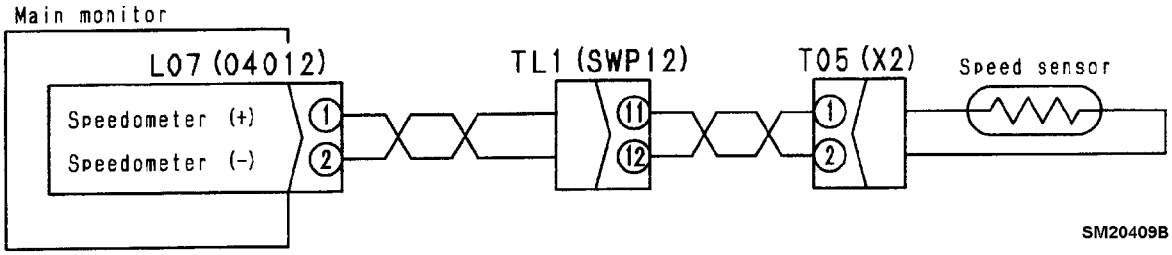


# M-3 Speedometer doesn't display properly

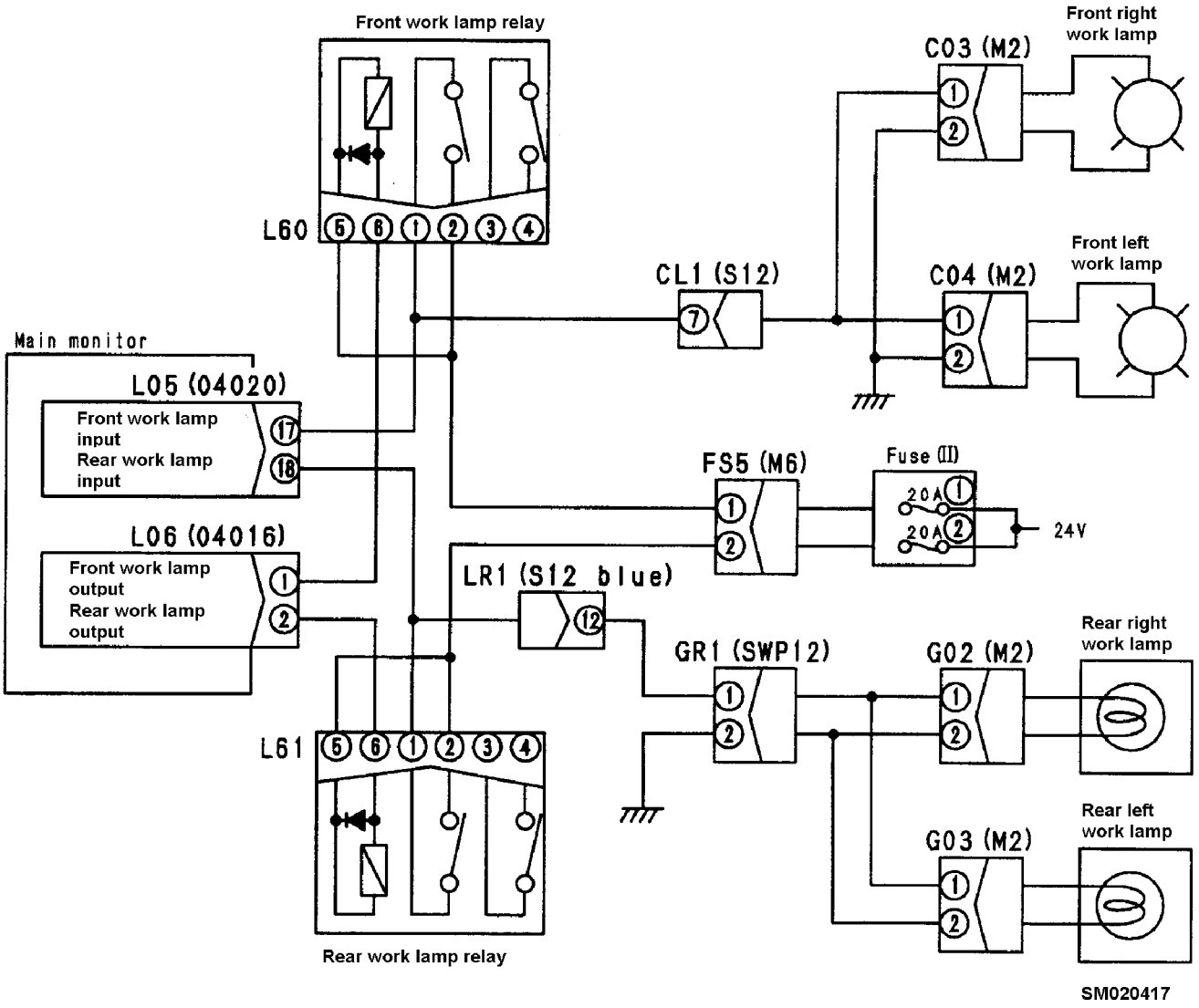
- i Always turn the starting switch to OFF before disconnecting or reconnecting any electrical plugs.
- i Ensure that all related connectors are properly inserted before troubleshooting.
- i Always connect any unplugged connectors before going to the next step.
- i Check that the gap between the speed sensor and the ring gear is normal; see the STANDARD VALUE table at the beginning of this section.




### Related electrical circuit diagram



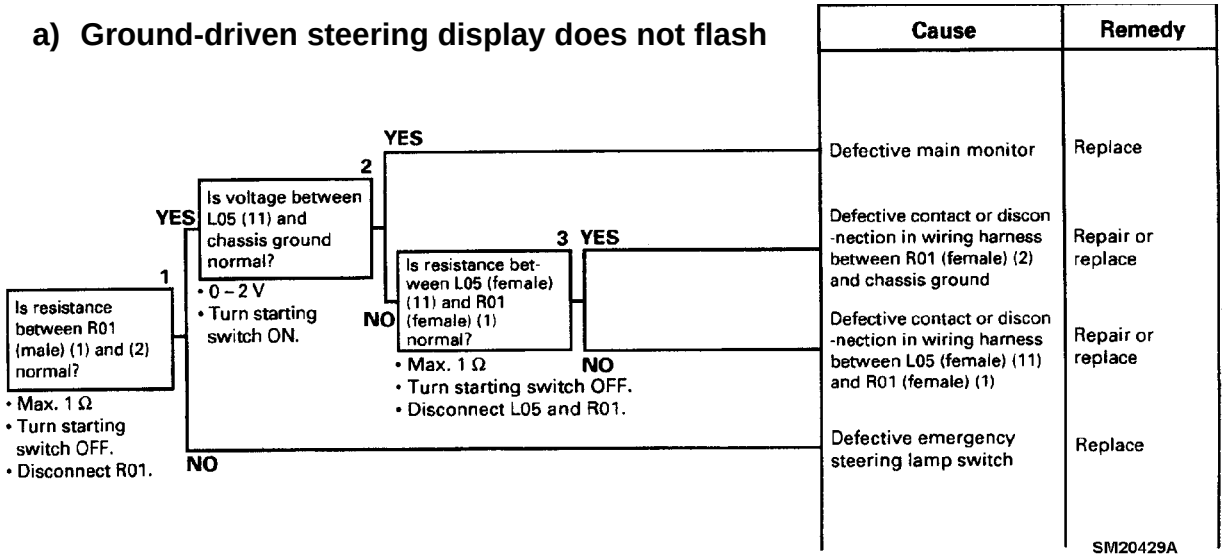
## Related electrical circuit diagram



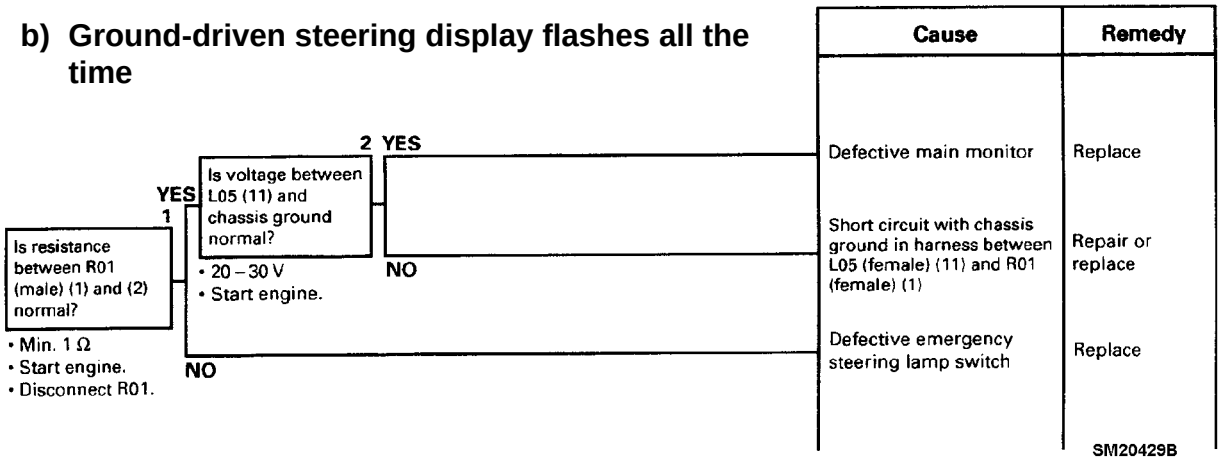
# M-18 Abnormality in ground-driven steering display

i Ensure that all related connectors are properly inserted before troubleshooting.

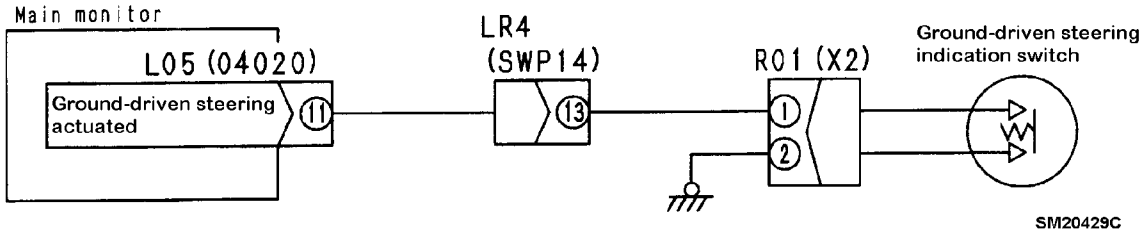
## a) Ground-driven steering display does not flash




## b) Ground-driven steering display flashes all the time




## c) Related electrical circuit diagram

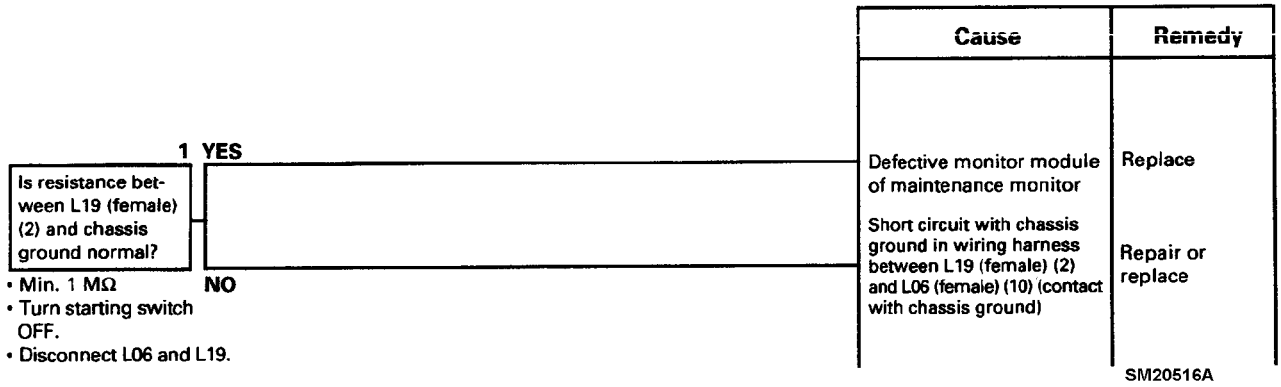


# MEMORANDA

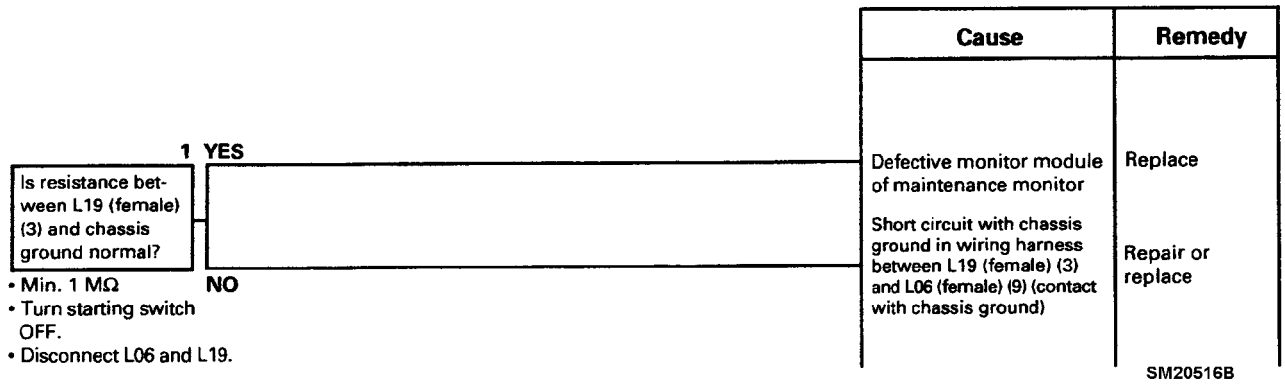
## K-9 No maintenance monitor display lights up, but central CHECK lamp or central CAUTION lamp does light up

- **i** Check that no abnormal display appears on the main monitor before starting the troubleshooting.
- **i** Before troubleshooting, ensure that all related connectors are properly inserted.
- **i** Always connect any unplugged connectors before going to the next step.

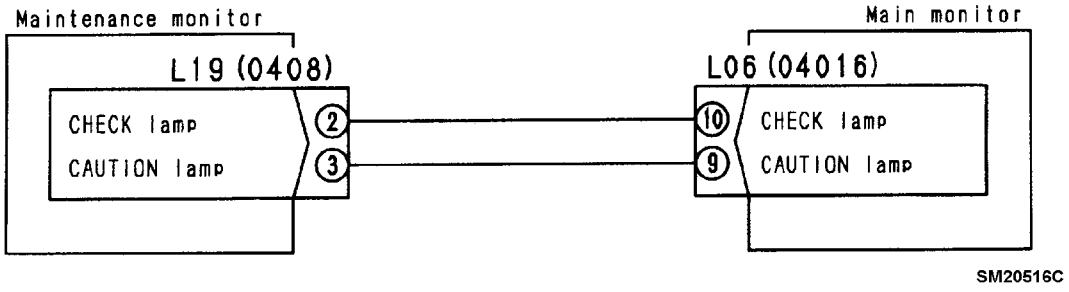
**a) CHECK lamp**



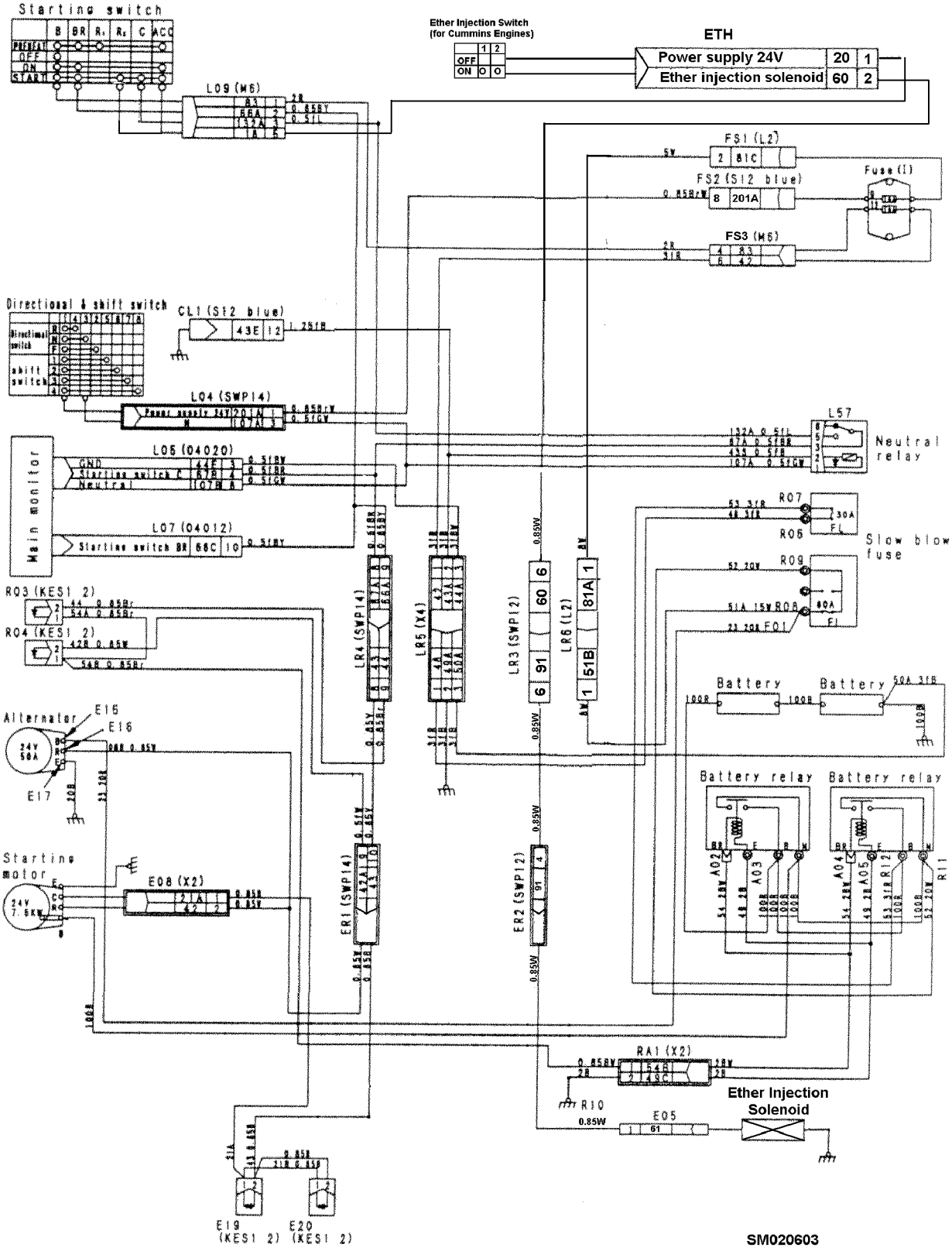

**b) CAUTION lamp**



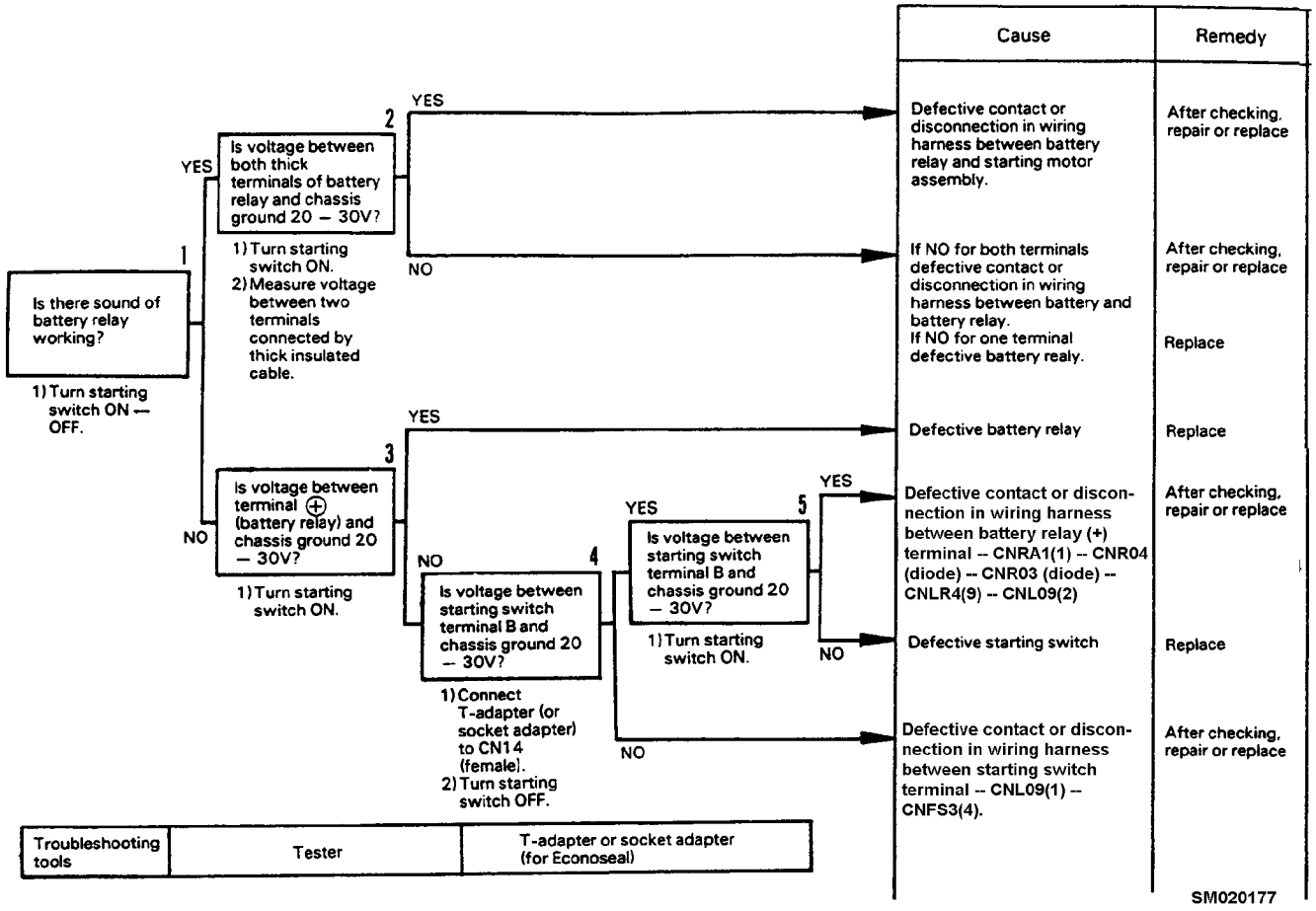

**Related electrical circuit diagram for K-9 a) and b)**



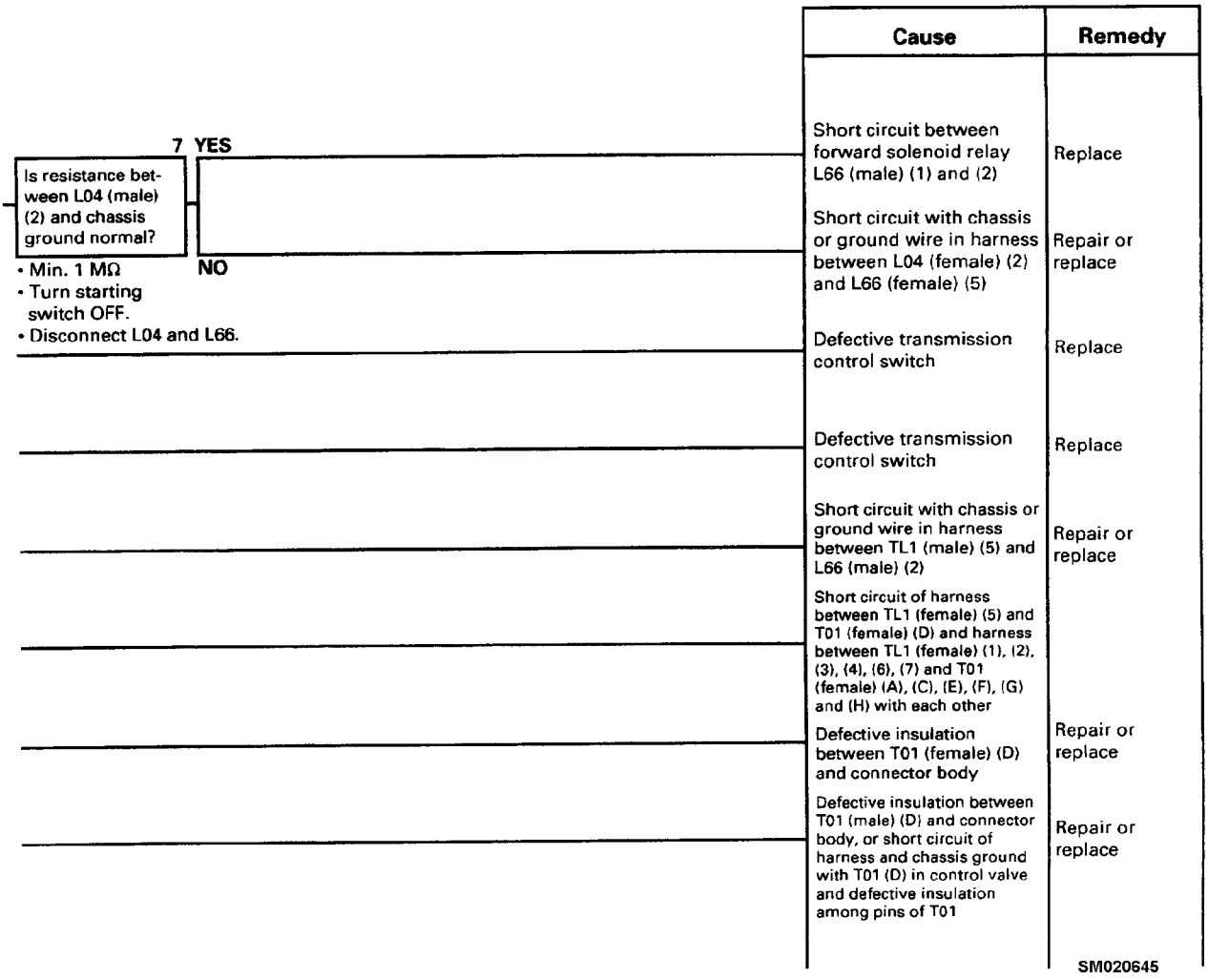
# Power supply, engine starting, engine stopping and ether injection electrical circuit diagram



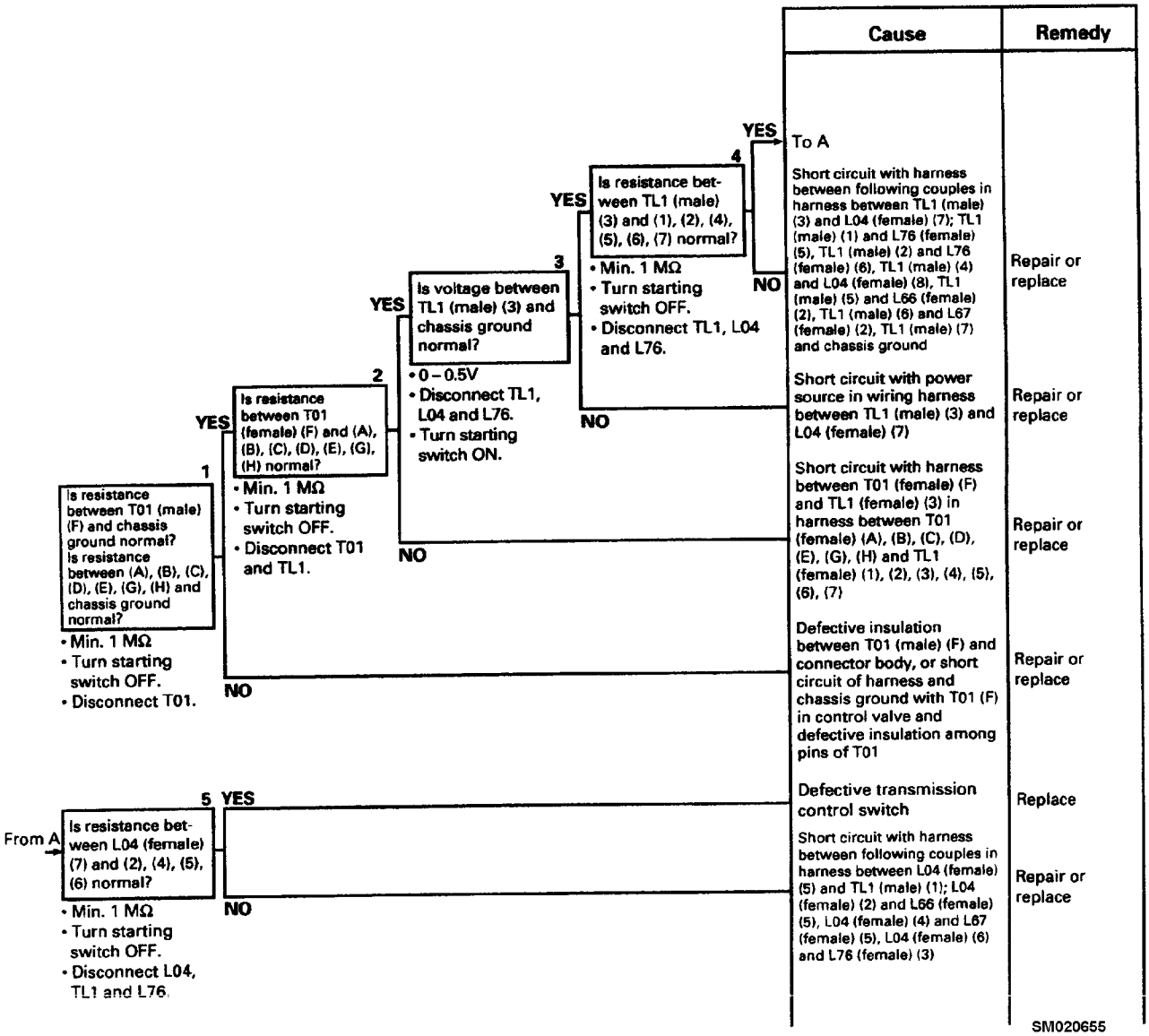
## b) Inspection of battery, battery relay and starting switch



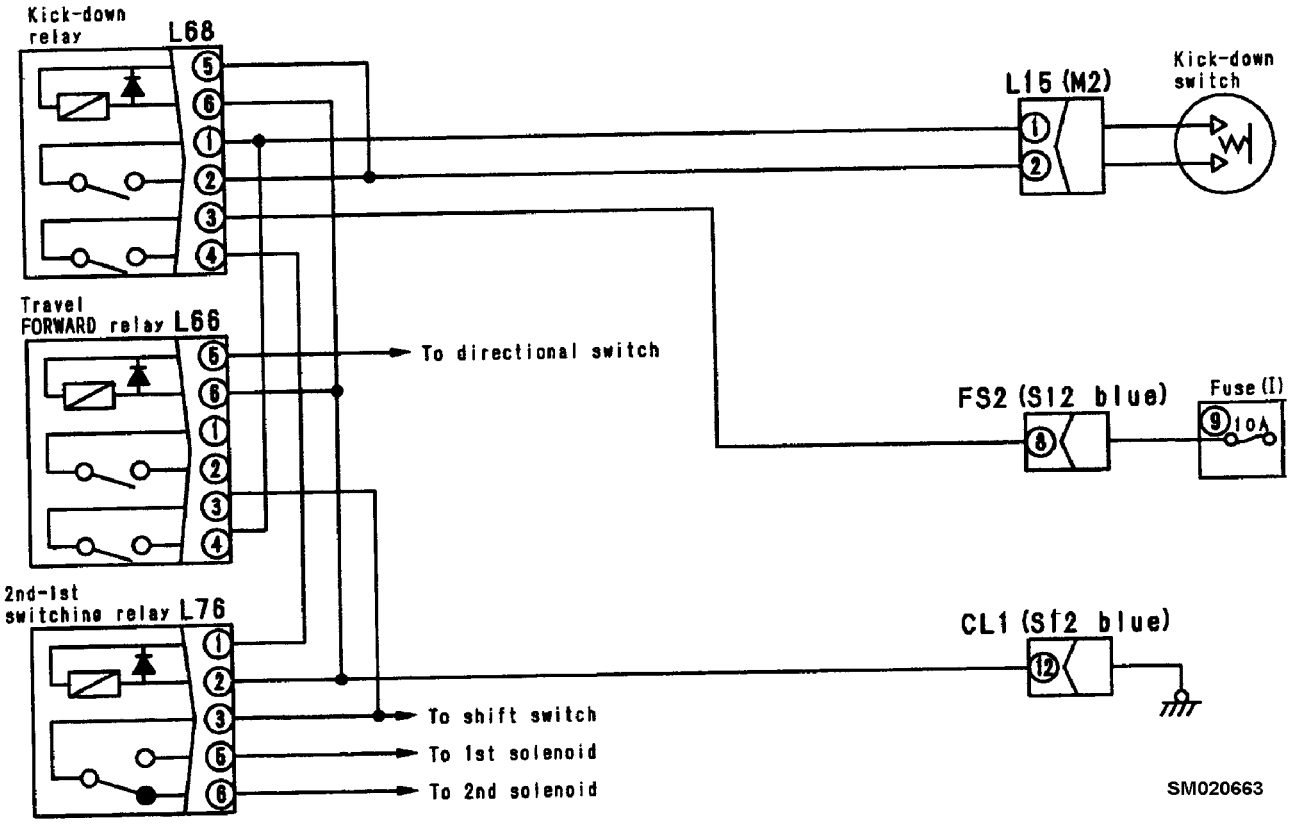
# MEMORANDA


7
Is resistance between L04 (male) (2) and chassis ground normal?
• Min. 1 MΩ
• Turn starting switch OFF.
• Disconnect L04 and L66.
YES
NO
Cause
Remedy
Short circuit between forward solenoid relay L66 (male) (1) and (2)
Replace
Short circuit with chassis or ground wire in harness between L04 (female) (2) and L66 (female) (5)
Repair or replace
Defective transmission control switch
Replace
Defective transmission control switch
Replace
Short circuit with chassis or ground wire in harness between TL1 (male) (5) and L66 (male) (2)
Repair or replace
Short circuit of harness between TL1 (female) (5) and T01 (female) (D) and harness between TL1 (female) (1), (2), (3), (4), (6), (7) and T01 (female) (A), (C), (E), (F), (G) and (H) with each other
Defective insulation between T01 (female) (D) and connector body
Repair or replace
Defective insulation between T01 (male) (D) and connector body, or short circuit of harness and chassis ground with T01 (D) in control valve and defective insulation among pins of T01
Repair or replace
SM020645

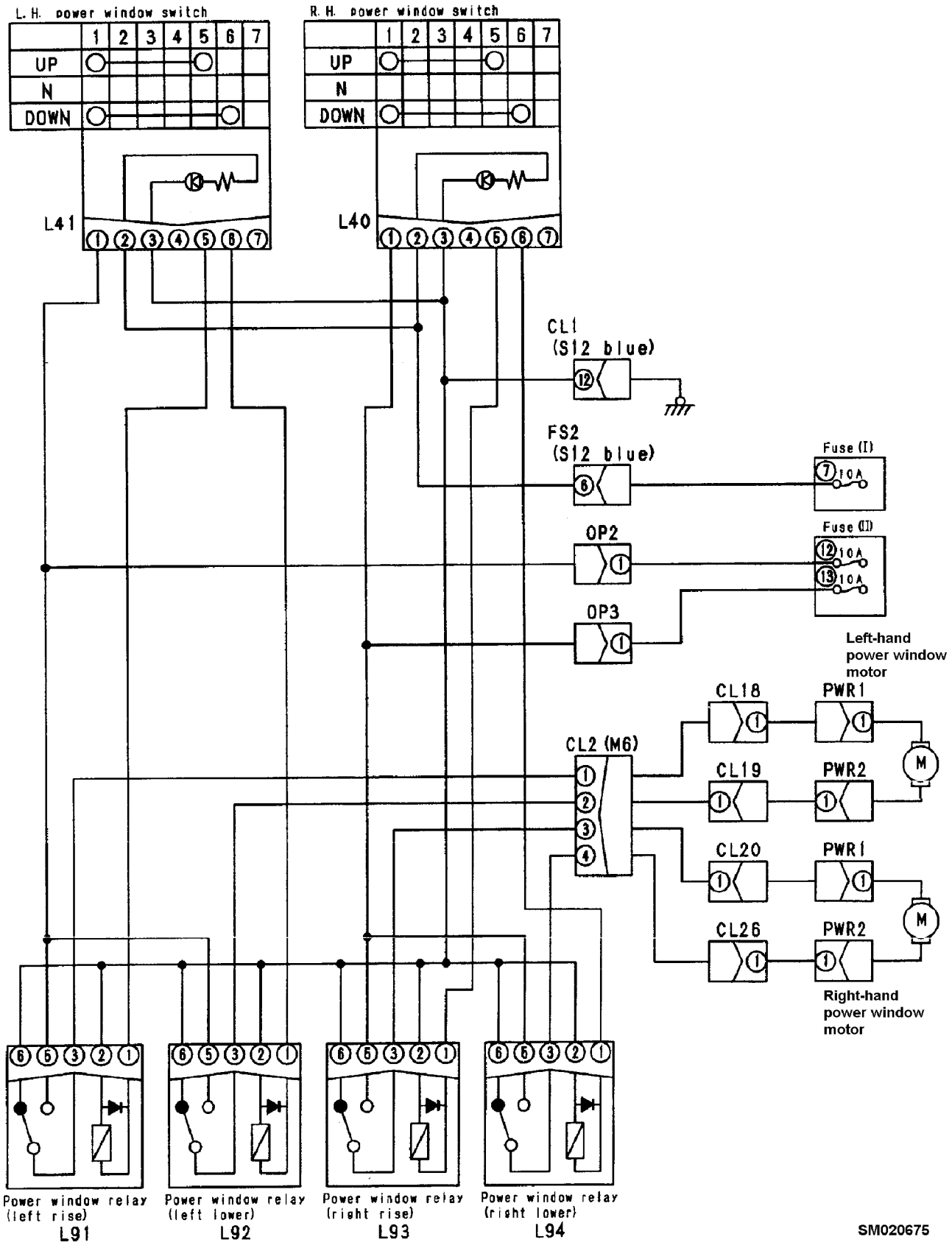
### 3) Short circuit to ground chassis in 3rd solenoid circuit



**Related electrical circuit diagram for E-13**



## Related electrical circuit diagram for E-16



## H-7 Steering is heavy

**Checking for abnormalities**

- ! Is the steering wheel difficult to turn?
  Yes ö Go to procedure H-6
- ! Measure the operating effort and turning speed. Then check the STANDARD VALUE table at the beginning of this section to see if the results are normal.

**Ask the equipment operator the following questions:**

- ! Did the problem start suddenly?
  Yes ö Related equipment broken
- ! Was there previously any symptom, such as heavy steering?
  Yes ö Wear of related equipment, defective seal

**Checks before troubleshooting:**

- ! Is the oil level in the hydraulic circuit correct? Is the correct oil being used?
- ! Is the tire inflation correct?

| No. | Problems | | Remedy / Causes: Defective Orbit-roll (a) | Defective actuation of stop valve (b) | Defective actuation of steering spool (c) | Interference of steering wheel or steering shaft (d) |
|---|---|---|---|---|---|---|
| | | | Orbit-roll | Stop valve | Steering valve | Others |
| | | | △ × | △ × | △ × | △ × |
| 1 | Steering is heavy in both directions (left and right) | | ○ | | ○ | ○ |
| 2 | Steering is heavy in one direction (left or right) | | | ○ | | |
| 3 | Steering is heavy even when joint between steering shaft and Orbit-roll is disconnected | | | | | ○ |
| 4 | When steering relief pressure is measured | Oil pressure is low in both directions (left and right) | ○ | | ○ | |
| 5 | | Oil pressure is low in one direction (left or right) | | ○ | | |
| 6 | Measured Orbit-roll output pressure is low | | ○ | | | ○ |

SM020708

## H-17 Boom is slow or lacks power

**Ask the equipment operator the following questions:**

- **!** Did the problem start suddenly?
  Yes **ö** Related equipment broken
- **!** Did the problem gradually appear?
  Yes **ö** Wear of related parts, defective seal

| No. | Problems | | Causes: Defective PPC valve (PPC valve, a) | Defective actuation of boom spool (Control valve, b) | Defective actuation of load check valve (Control valve, c) | Defective unload valve (Control valve, d) | Defective suction valve (Control valve, e) | Defective cylinder seal (Cylinder, f) | Defective control lever linkage (Others, g) |
|---|---|---|---|---|---|---|---|---|---|
| | Remedy | | △ × | △ × | △ × | △ × | △ × | △ × | A |
| 1 | Does not move normally in both directions (RAISE and LOWER) | | | ○ | ○ | ○ | | ○ | ○ |
| 2 | Does not move normally in one direction (RAISE or LOWER) | | ○ | | | | ○ | | |
| 3 | When boom relief pressure is measured | Oil pressure is low in both directions (RAISE and LOWER) | | ○ | ○ | ○ | | ○ | ○ |
| 4 | | Oil pressure is low in one direction (RAISE or LOWER) | ○ | | | | ○ | | |
| 5 | Measured PPC valve output pressure is low | | ○ | | | | | | |
| 6 | Measured hydraulic drift of boom is excessive | | | | | | | ○ | |
| 7 | Measured operating effort of boom control lever is heavy | | ○ | | | | | | ○ |
| 8 | Measured travel of boom control lever is short | | | | | | | | ○ |

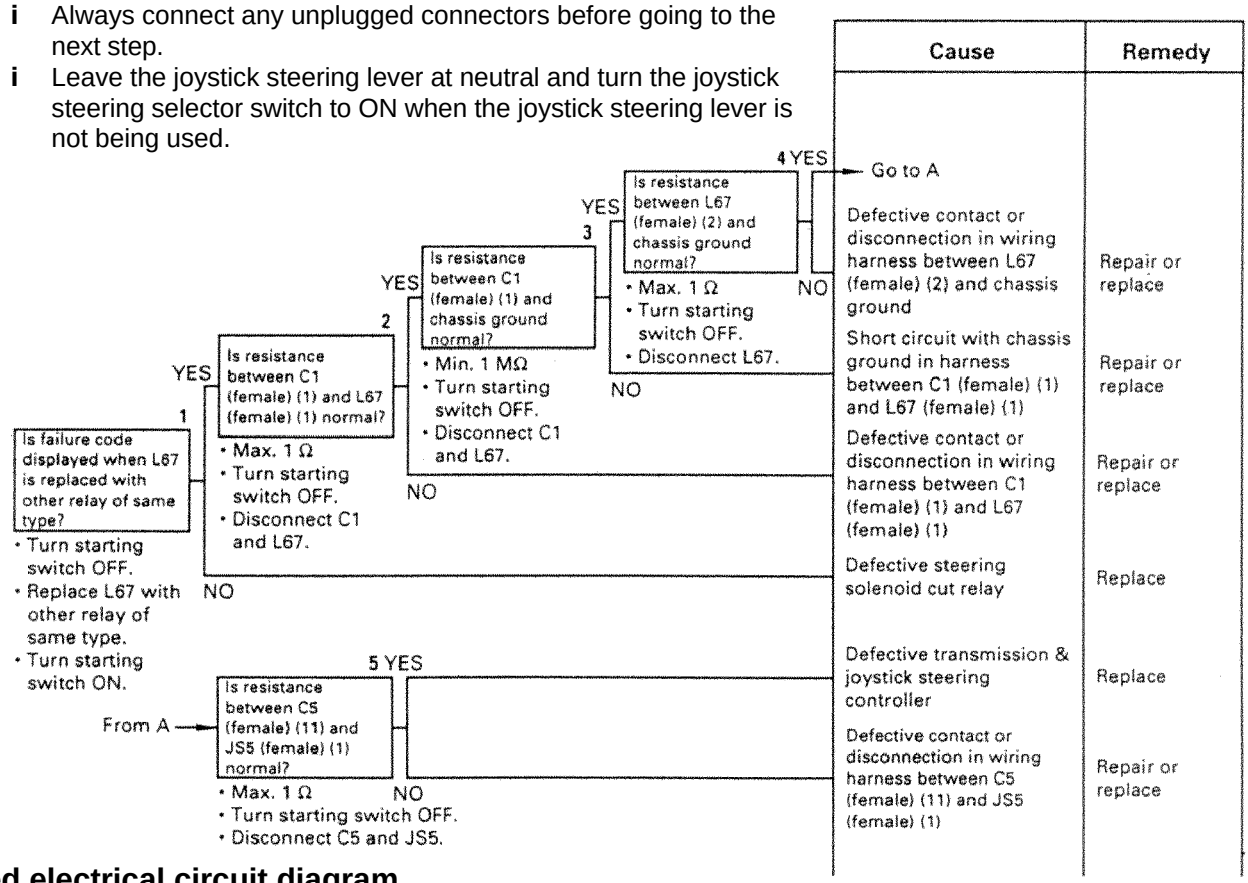
SM20718

| Condition when normal (voltage, current, resistance) | Action by controller when abnormality is detected | Problem that appears on machine when there is abnormality | Trouble-shooting code |
|---|---|---|---|
| 1) Joystick caution relay: ON (voltage between C2 (9) – (19): 20 – 30 V)<br>2) Resistance of relay coil between C2 (female) (9) – (19): 200 – 400 Ω<br>3) Resistance of wiring harness between C2 (female) (9) – L65 (female) (1): Less than 1 Ω<br>4) Resistance of wiring harness between L65 (female) (2) – C2 (19): Less than 1 Ω | Caution output: OFF | Joystick caution actuated | J-1 |
| 1) Steering solenoid cut relay: ON (voltage between C2 (2) and chassis ground: 20 – 30 V)<br>2) Resistance of steering right solenoid: 10 – 20 Ω<br>3) Resistance between C2 (female) (2), (13) – chassis ground: Min. 1 MΩ<br>Resistance of the following wiring harness: Less than 1 Ω<br>4) Wiring harness between C2 (female) (2) – L27 (female) (2)<br>5) Wiring harness between C2 (female) (13) – L67 (female) (3)<br>6) Wiring harness between L67 (female) (5) – L27 (female) (1) | Steering right, left solenoid output: OFF and steering solenoid cut relay output: OFF and caution relay output: OFF | Impossible to use joystick and joystick caution actuated | J-2 |
| 1) Steering solenoid cut relay: ON (voltage between C2 (3) – chassis ground: 20 – 30 V)<br>2) Resistance of steering left solenoid: 10 – 20 Ω<br>3) Resistance between C2 (female) (3), (14) – chassis ground: Min. 1 MΩ<br>Resistance of the following wiring harness: Less than 1 Ω<br>4) Wiring harness between C2 (female) (3) – L26 (female) (2)<br>5) Wiring harness between C2 (female) (14) – L67 (female) (3)<br>6) Wiring harness between L67 (female) (5) – L27 (female) (1) | Steering right, left solenoid output: OFF and steering solenoid cut relay output: OFF and caution relay output: OFF | Impossible to use joystick and joystick caution actuated | J-3 |
| When joystick lever is at neutral<br>Voltage between C2 (female) (2) – chassis ground: Less than 1 V | Steering right, left solenoid output: OFF and steering solenoid cut relay output: OFF and caution relay output: OFF | Impossible to use joystick and joystick caution actuated | J-4 |
| When joystick lever is at neutral<br>Voltage between C2 (female) (3) – chassis ground: Less than 1 V | Steering right, left solenoid output: OFF and steering solenoid cut relay output: OFF and caution relay output: OFF | Impossible to use joystick and joystick caution actuated | J-5 |

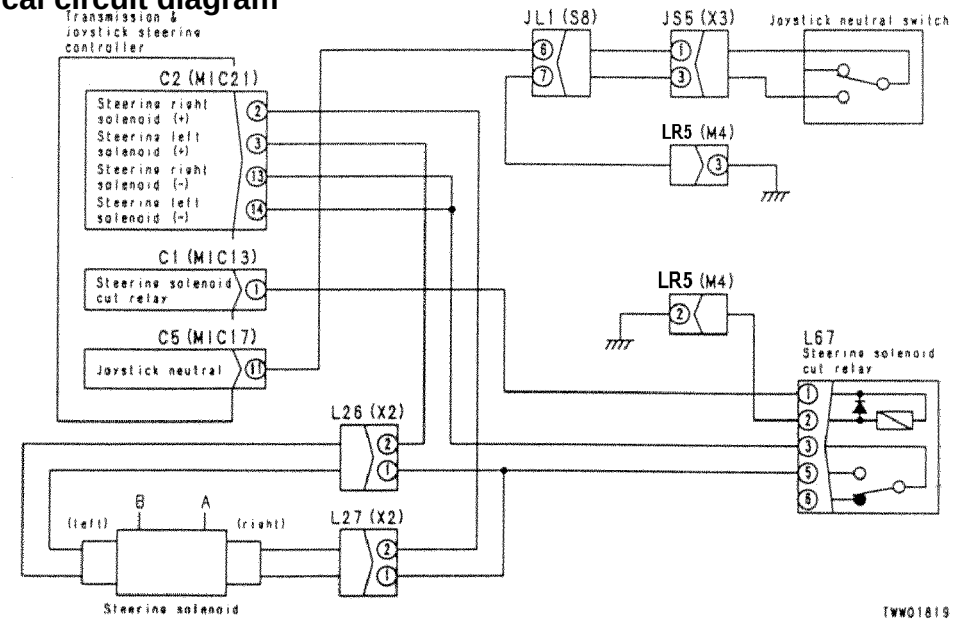
LNC00119

# J-6 Failure code [61] (Short circuit, disconnection in steering solenoid cut relay) is displayed

- **i** This procedure is performed while the abnormality still exists. Therefore, note that if the failure code is no longer displayed on the monitor when unplugging the connector and installing the T-adapter, or when removing the T-adapter and restoring the connector to its original state, the problem has been removed.
- **i** Always turn the starting switch to OFF before disconnecting or reconnecting any electrical plugs.
- **i** Ensure that all related connectors are properly inserted before troubleshooting.
- **i** Always connect any unplugged connectors before going to the next step.
- **i** Leave the joystick steering lever at neutral and turn the joystick steering selector switch to ON when the joystick steering lever is not being used.

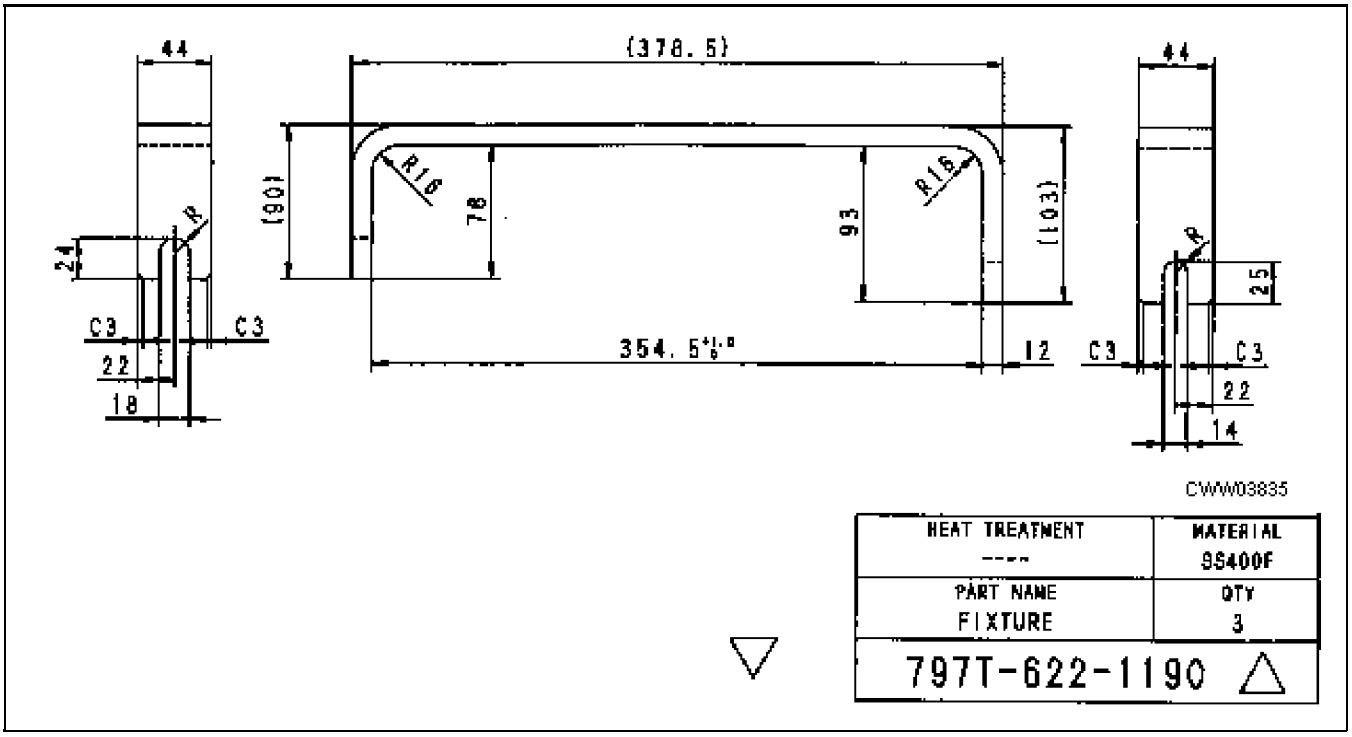



## Related electrical circuit diagram

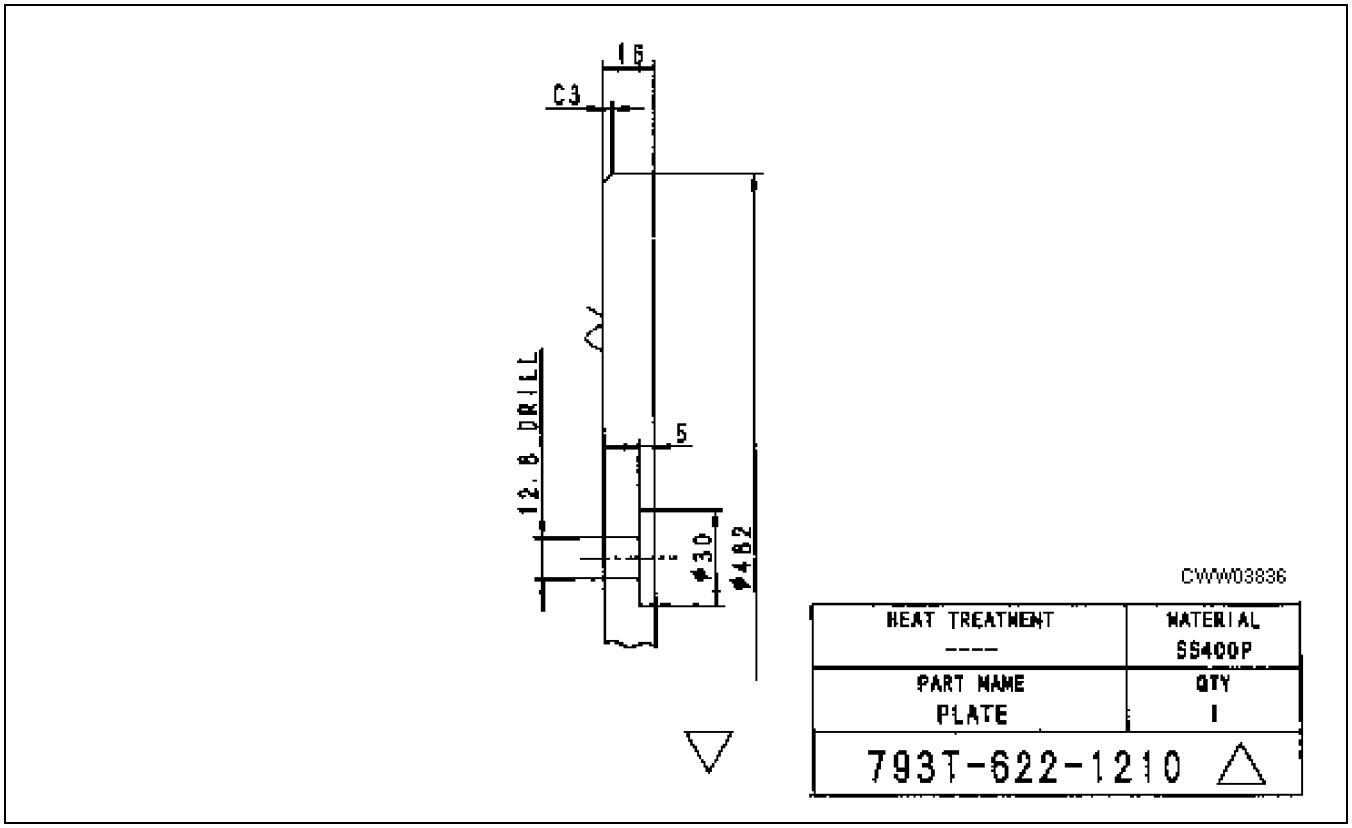


| Component | Symbol | | Part No. | Part Name | Nec. | Qty | N/R | Ill | Nature of Work |
|---|---|---|---|---|---|---|---|---|---|
| Transfer disassembly, reassembly | D | 22 | 790-101-5401 | Push tool kit © | € | 1 | | | Press-fitting bearing outer race into cage |
| | | | • 790-101-5551 | • Plate | | 1 | | | |
| | | | • 790-101-5421 | • Grip | | 1 | | | |
| | | | • 01010-51240 | • Bolt | | 1 | | | |
| | | 23 | 790-101-5401 | Push tool kit © | € | 1 | | | Press-fitting bearing inner race into cage (for No. 3 shaft) |
| | | | • 790-101-5544 | • Plate | | 1 | | | |
| | | | • 790-101-5421 | • Grip | | 1 | | | |
| | | | • 01010-51240 | • Bolt | | 1 | | | |
| | | | 790-201-2760 | Spacer | € | 1 | | | For No. 3 shaft |
| | | 24 | 796-730-2300 | Wrench | € | 1 | | | Adjusting preload of shaft bearing No. 1 |
| | | 25 | 796-720-3800 | Wrench | € | 1 | | | Adjusting preload of shaft bearing No. 2 |
| | | 26 | 793-615-1130 | Wrench | € | 1 | | | Adjusting preload of shaft bearing No. 3 |
| | | | 796-730-2300 | Wrench assembly | € | 1 | | | |
| | | 27 | 796T-426-1130 | Plate | € | 1 | | | Press-fitting oil seal into output shaft cage |
| | | | • 790-101-5421 | • Grip | € | 1 | | | |
| | | | • 01010-51240 | • Bolt | € | 1 | | | |
| | | 28 | 790-101-5401 | Push tool kit © | € | 1 | | | Press-fitting bearing into output shaft cage |
| | | | • 790-101-5551 | • Plate | | 1 | | | |
| | | | • 790-101-5421 | • Grip | | 1 | | | |
| | | | • 01010-51240 | • Bolt | | 1 | | | |
| | | 29 | 790-201-2260 | Plate | € | 1 | | | Press-fitting coupling into cage |
| | | | 790-201-2650 | Plate | € | 1 | | | |
| | | 30 | 790-101-5401 | Push tool kit © | € | 1 | | | Press-fitting bearing outer race into transfer case |
| | | | • 790-101-5481 | • Plate | | 1 | | | |
| | | | • 790-101-5421 | • Grip | | 1 | | | |
| | | | • 01010-51240 | • Bolt | | 1 | | | |
| | | 31 | 793T-659-1110 | Push tool | € | 1 | | | Press-fitting bearing inner race into shaft |
| | | | 790-201-2660 | Plate | € | 1 | | | |
| | | 32 | 790-201-1500 | Push tool kit | € | 1 | | | Press-fitting oil seal into cage |
| | | | • 790-201-1680 | • Plate | | 1 | | | |
| | | | • 790-101-5021 | • Grip | | 1 | | | |
| | | | • 01010-50816 | • Bolt | | 1 | | | |
| | | 33 | 790-438-1120 | Centering tool | € | 1 | | | Centering of transmission - center support |

**J1 Fixture**




**J2 Plate**



# RADIATOR

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

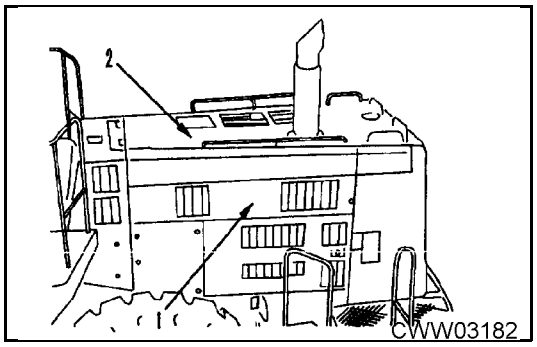
**Warning!** Loosen the oil filler cap slowly to release the pressure inside the hydraulic tank. Then operate the control levers several times to release the remaining pressure in the hydraulic piping.

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

## Removal

1. Open the right and left side engine covers (1), then remove the engine hood (2).

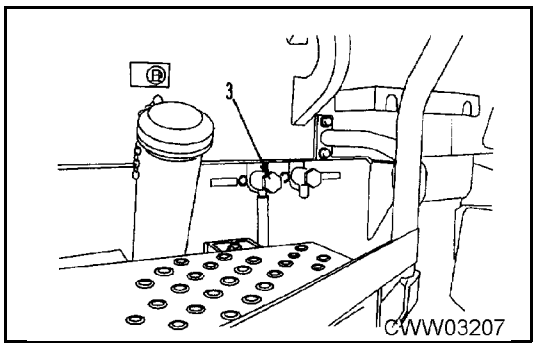
kg Engine hood: 80 kg (176 lb)



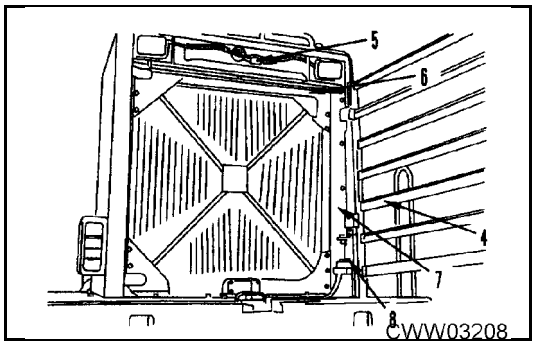

2. Loosen the drain valve (3), then drain the engine coolant.

Coolant: Approximately 155 R (40.9 U.S. gal)

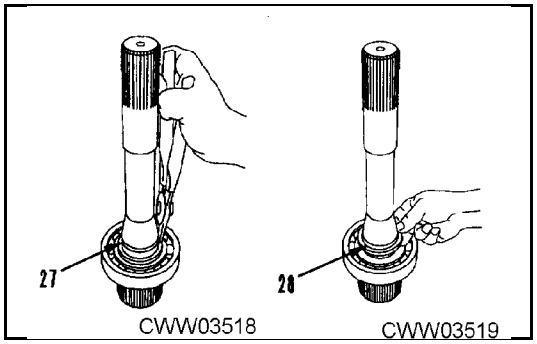
i Follow all applicable regulations when disposing of the coolant.



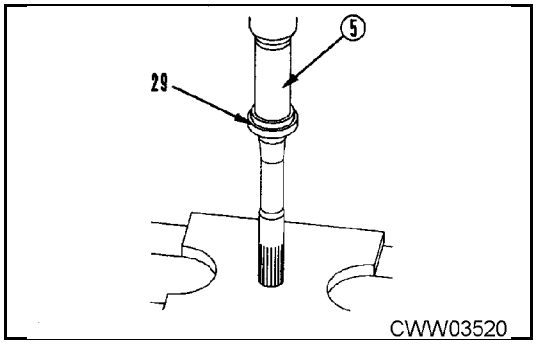

3. Open the radiator grill (4).
4. Unplug the radiator coolant level sensor connector CT01 (5).
5. Remove the baffle plates (6 and 7).
6. Remove the radiator guard mounting bolts (8).



c. Remove the snap ring (27) and plate (28) from the shaft.

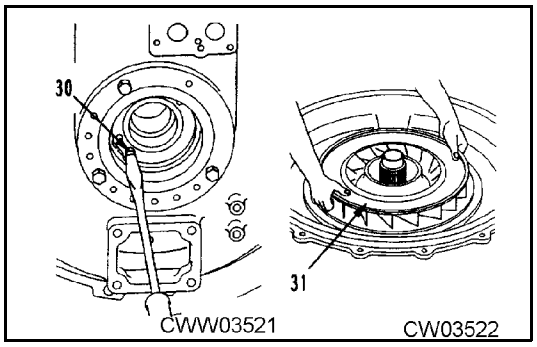



d. Use the push tool **Ò** (I.D.=80 mm) to remove the bearing (29).

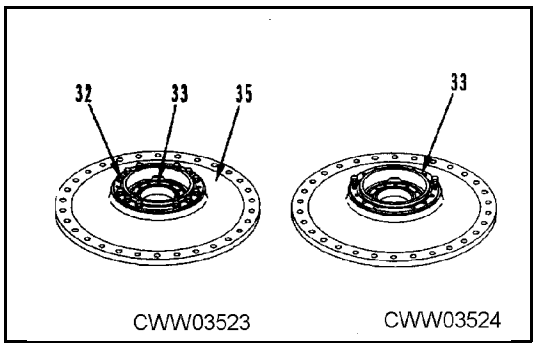



10. Pump

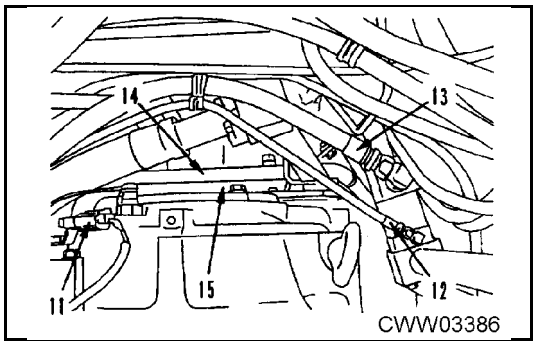
a. Remove the 2 plugs (30), then use a round rod (O.D.=8 mm, R=min. 200 mm) to remove the pump (31).



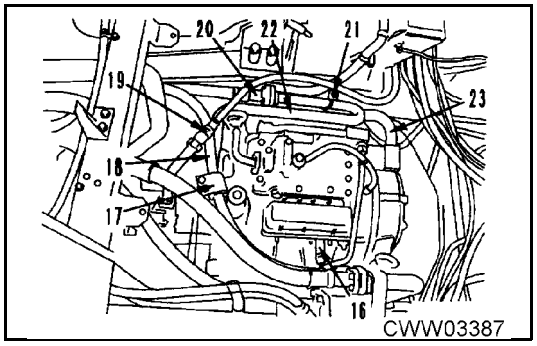

b. Remove the 12 mounting bolts (32), then use jacking screws to remove the retainer (33).



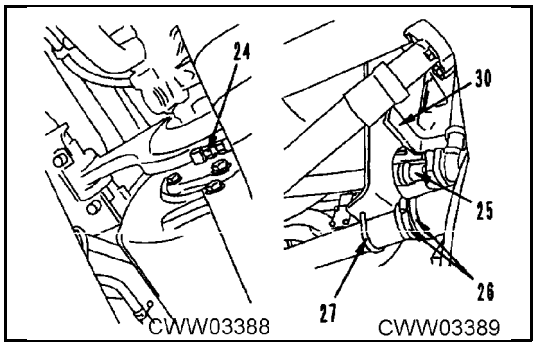
10. Unplug the speed sensor connector R05 (11).
11. Disconnect diverter valve hoses (12 and 13).
12. Disconnect the tubes (14 and 15) that run between the diverter valve and the hydraulic tank.




13. Unplug the transmission connector R01 (16).
14. Remove the bracket (17), then disconnect the hose (18) that runs between the switch pump and steering valve.
15. Disconnect the hose (19) that runs between the PPC pump and the accumulator charge valve.
16. Disconnect the hose (20) and remove the clamp (21), then remove the tube (22).
17. Disconnect the tube (23) that runs between the oil cooler and the transmission.



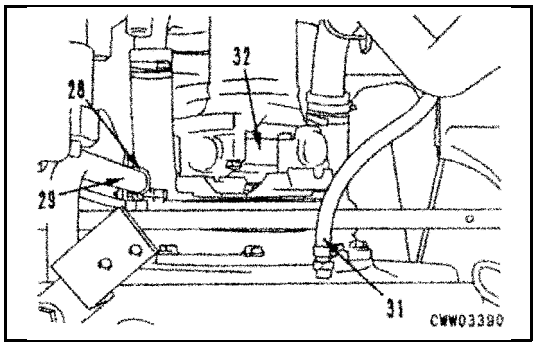

18. Disconnect the trunnion grease hose (24).
19. Disconnect the hose (25).
20. Loosen the bands (26).
21. Remove the clamp (27) from the bracket (30).




22. Remove the clamp (28), then disconnect the tube (29) from the transmission valve.
23. Disconnect the hose (31) that runs between the torque converter and transmission.
24. Disconnect the upper drive shaft (32).

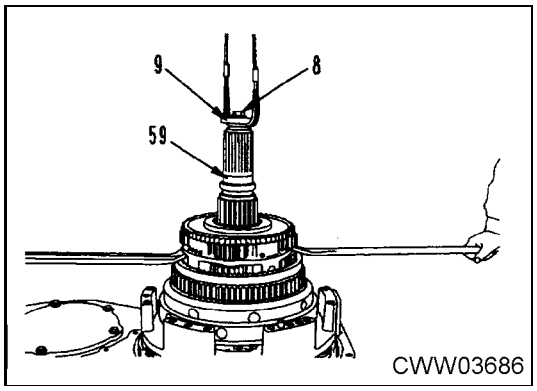
kg Upper drive shaft: 30 kg (66 lbf ft)

※2



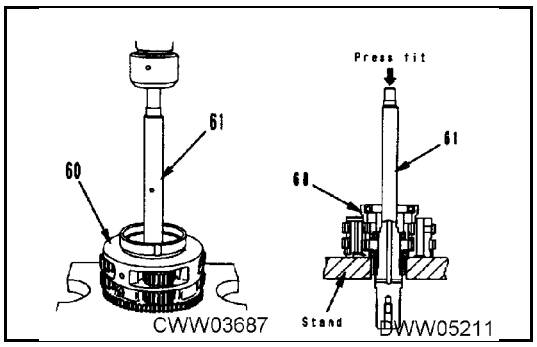
21. Shaft and carrier assembly
    a Use bolt (8) and collar (9) to sling and remove the shaft and carrier assembly (59).

kg Shaft and carrier assembly: 50 kg (110 lb)



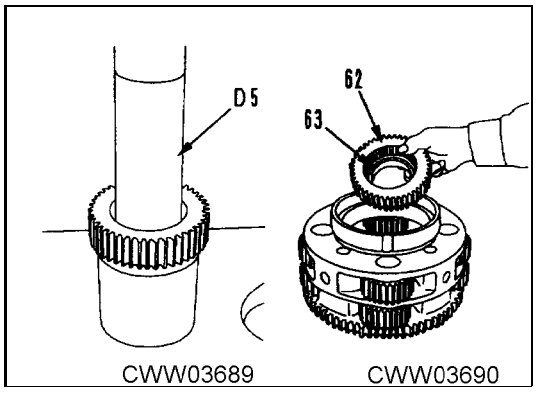

    b. Disassemble the shaft and carrier assembly further as described below:

        1) Install the assembly in a press, then remove the shaft (61) from the carrier (60).

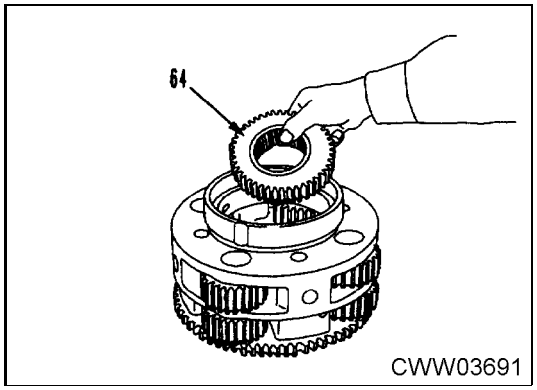



        2) Remove the sun gear (62) from the carrier.

        3) Install the assembly in a press, then use push tool D5 (O.D.=80 mm) to remove the bearing (63).

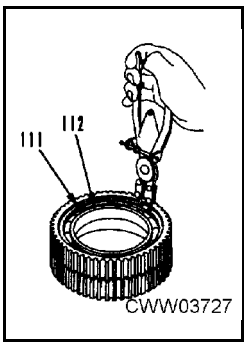



        4) Remove the sun gear (64) from the carrier.



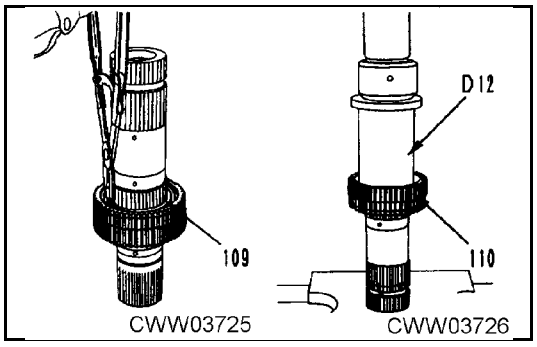
3) Install the assembly in a press, then use the push tool (O.D.=135 mm) to press-fit the bearing (112) to the No. 6 sun gear.

4) Install the snap ring (111) to the bearing (112).



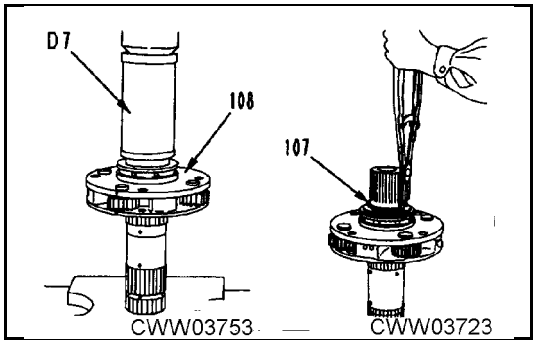

5) Install the snap ring (109) onto the shaft.

6) Install the assembly in a press, then use push tool D12 (I.D.=105 mm) to press-fit the sun gear.



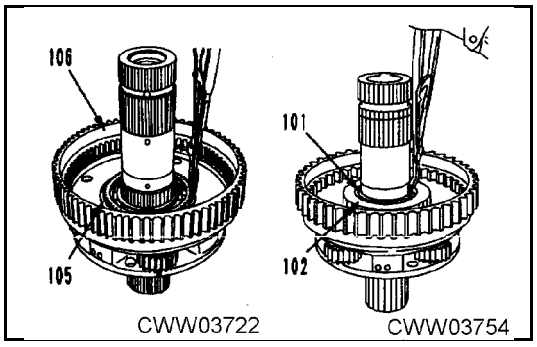

7) Use push tool D7 to install the carrier (108) onto the shaft.

8) Install the snap ring (107).



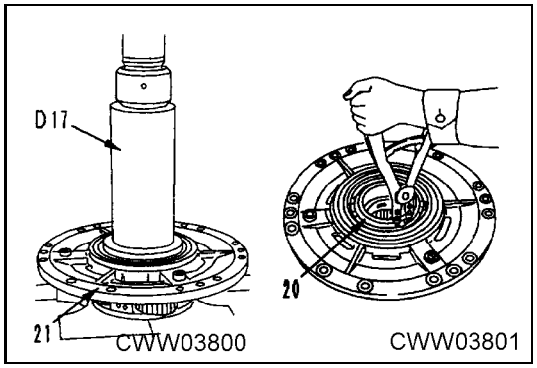

9) Install the ring gear (106), then install the snap ring (105).

10) Install the sun gear (102), then install the snap ring (101).

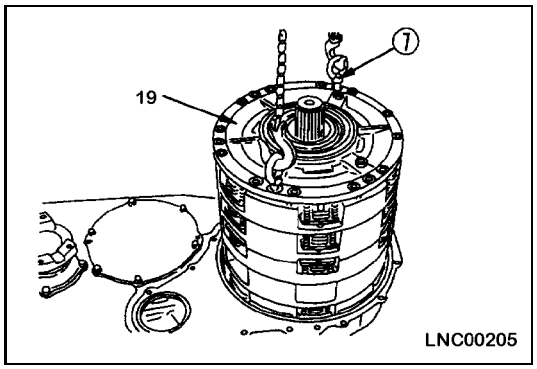


5) Set the assembly to a press, then use push tool D17 (O.D.=145 mm) to install the carrier assembly (22) to the housing (21).

6) Install the snap ring (20).



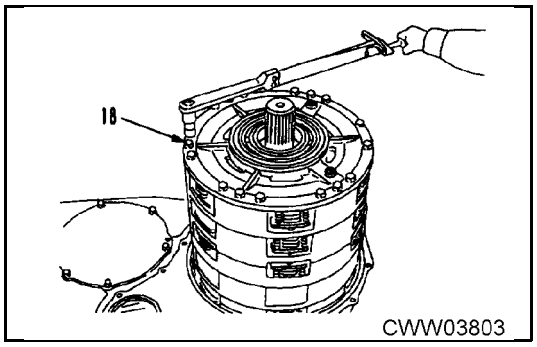

b. Use eyebolts **Ô** (14 mm, P=2.0) to sling install the housing carrier assembly (19), matching the dowel pin.




30. Tie bolts
Install the 17 tie bolts (18).

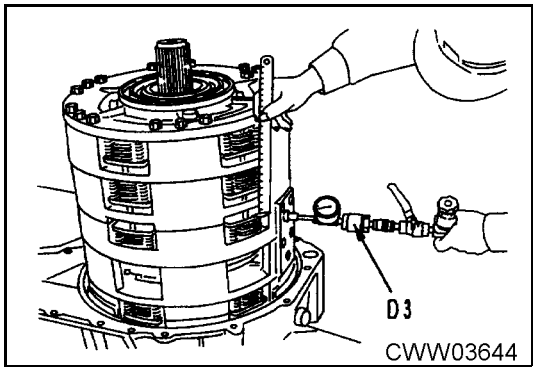
Tie bolt: 166.7 ± 9.8 N ! m (123 ± 7.2 lbf ft)

**i** If the transfer has been removed, install it to the transfer case, as detailed in the transfer installation procedure.

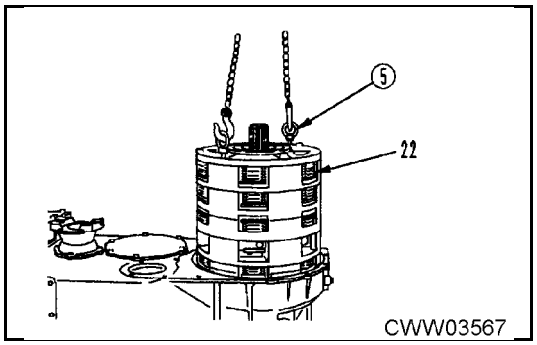



31. Checking piston operation
Use tool D3 to check the operation and stroke of the piston.
**i** Air pressure: 3 - 5 kg/cm$^2$ (42.7 - 71.1 psi)
**i** Piston stroke:

| Piston | Stroke (mm) |
|---|---|
| No. 1 | 4.0 |
| No. 2 | 4.0 |
| No. 3 | 3.2 |
| No. 4 | 3.2 |

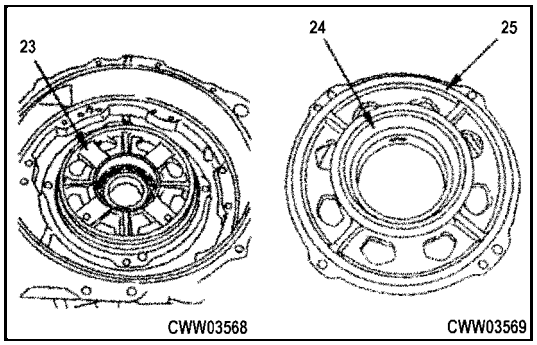


12. Transmission
    Use eyebolts **Ò** (14 mm, P=2.0) to sling and remove the transmission (22).



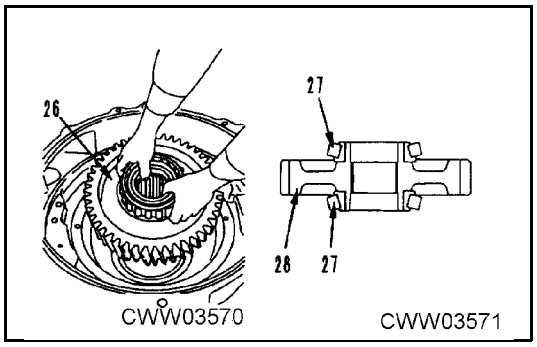

13. Cage
    a. Remove the 4 mounting bolts, then use jacking screws to remove the cage (23).

    b. Remove the outer race (24) from the cage (25).



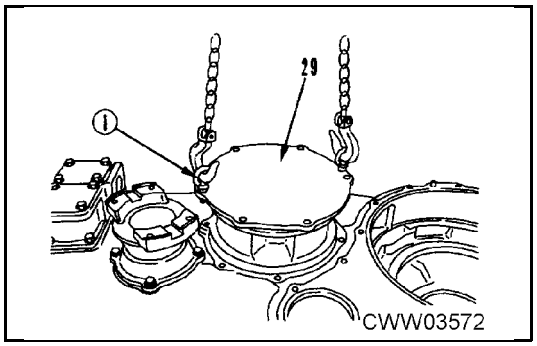

14. No. 1 gear
    a. Remove the gear (26).

    b. Use a puller to remove the 2 bearings (27) from the gear (28).



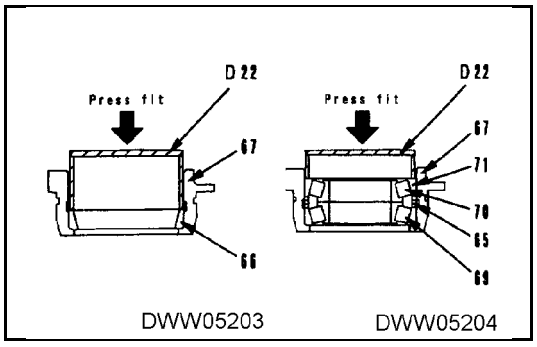

15. Cage
    a. Remove the mounting bolts, then use jacking screws to remove the fitted part of the cage.

    b. Use eyebolts **Î** (10 mm, P=1.5) to sling and remove the cage (29).
       **i** Because the cage is thick, lift it straight up and away from the cage.



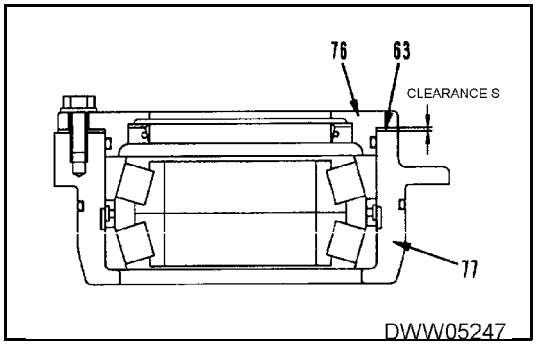
b. Use a push tool D22 (O.D.=185 mm) to press-fit the outer bearing race (66) to the cage (67).

c. Install the bearing (69), collar (65) and other bearing (70), then use push tool D22 (O.D.=185 mm) to press-fit the outer bearing race (71) to the cage (67).



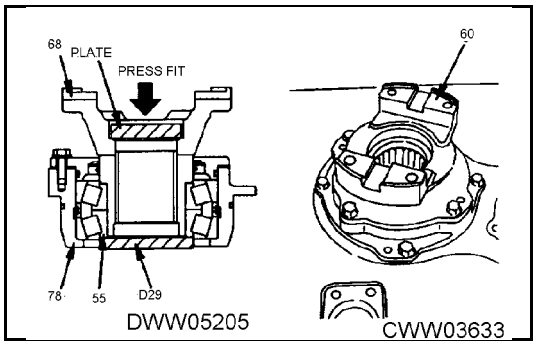

d. Install the o-ring, then install one cage half (76) to the other cage half (77) and use a filler gauge to measure clearance "S".

e. Install the adjustment shim (63).
   - **i** Clearance S=Shim thickness + (0.05 - 0.10 mm/0.002 - 0.0039 in.))

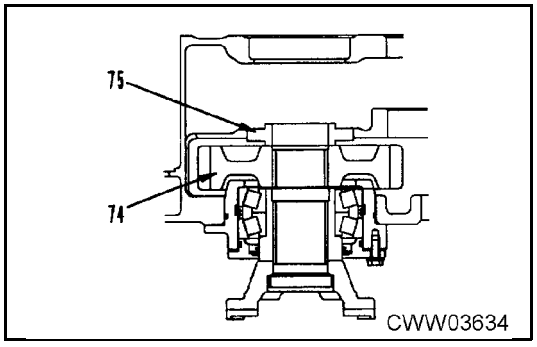



f. Use a push-tool D29 (O.D.=125 mm) to press-fit the coupling (68) to the cage (78).

g. Install the o-ring, then install the cage and coupling assembly (60) to the transfer case.

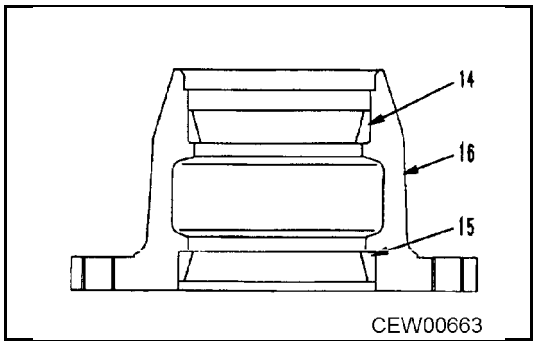



15. No. 4 gear and collar
    Reverse the transfer case, then position No. 4 gear and collar (75).



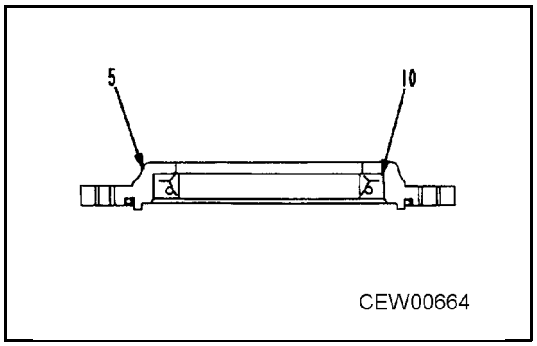
## Assembly

1. Bearing and outer race
   Assemble the bearing outer race (14 and 15) to the case (16).




2. Oil seal
   Assemble the oil seal (10) to the retainer (5).

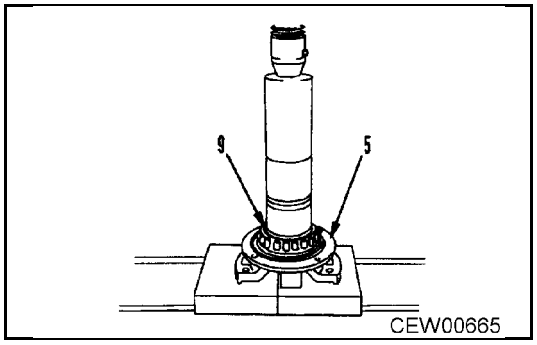
   Outer circumference of oil seal: Grease (G2-LI)



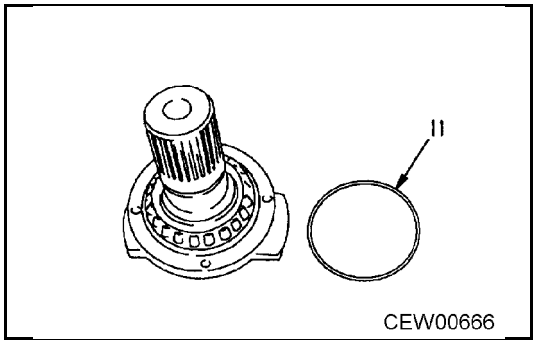

3. Bearing cone
   Assemble the retainer shaft (5), then press-fit the bearing cone (9).
   - **i** After assembling the bearing, check that there is no clearance at the tip of the shaft.
   - **i** Assemble the spacers.

   Lip of seal: Grease (G2-LI)

   Inner circumference of bearing: Grease (G2-LI)

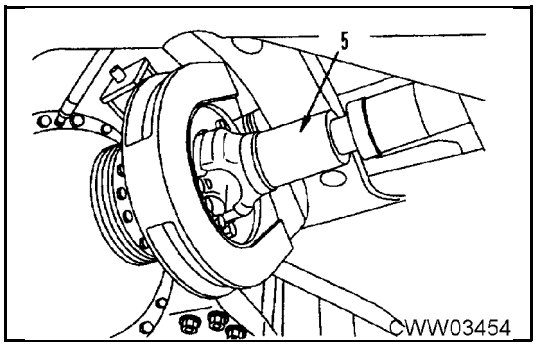



4. Case
   a. Assemble the o-ring (11) in the retainer.
      - **i** Insert the o-ring completely in the groove.



6. Disconnect the front drive shaft (5). ※2
   i Sling the drive shaft with a rope to prevent it from falling and resulting damage.

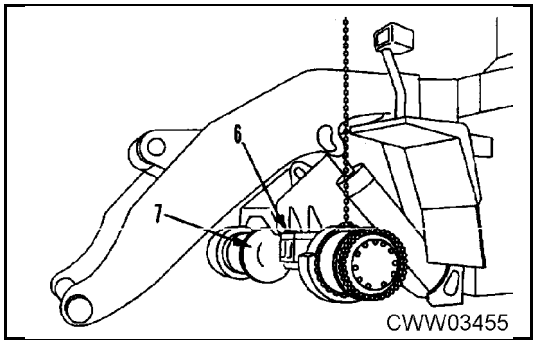
   kg Front drive shaft: 56 kg (123 lb)




7. Sling the front axle (7) temporarily, then remove the mounting bolt (6). ※3

8. Slowly sling and remove the front axle (7).
   i Remove the front axle by operating the crane so that the sling does not interfere with the boom end of the machine.

   kg Front axle: 3,500 kg (7,716 lb)




## Installation

Perform the removal procedures in reverse order to complete installation.

※1

Hub nut: 736-912 N ! m (543-673 lbf ft)

※2

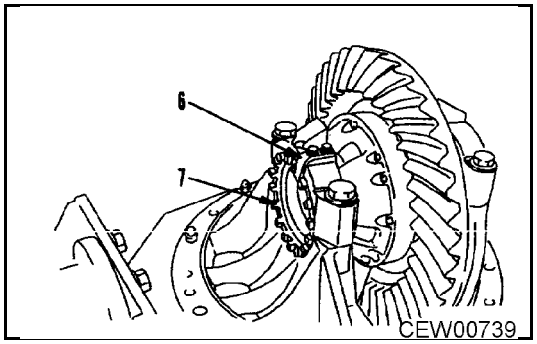
Mounting bolt: 157-196 N ! m (116-145 lbf ft)

※3

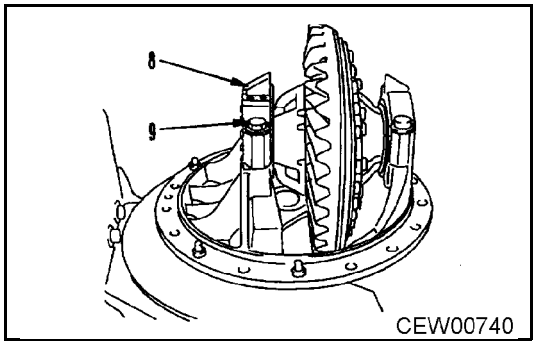
Mounting bolt: 2,450-3,038 N ! m (1,807-2,241 lbf ft)

Bleed air from the front brakes as described under BLEEDING air in Section 20 of this manual.

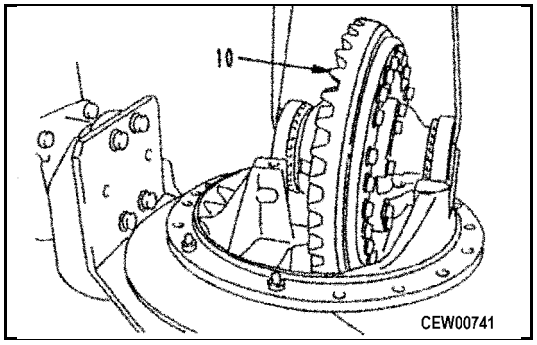
3. Differential gear case assembly
   a. Remove the left and right locks (6), then use a bar to loosen the nut (7).




   b. Remove the mounting bolts (9) from the cap (8).



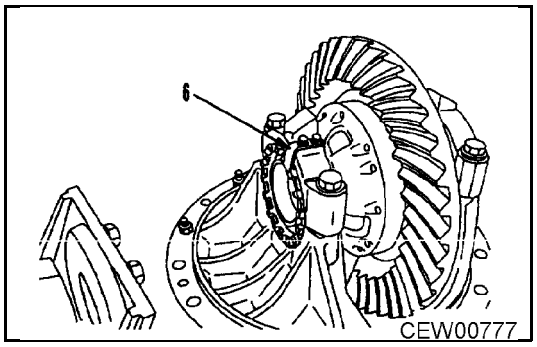

   c. Remove the nut and lift out the differential gear case assembly (10).



14. Lock
    Install the lock (6) after adjusting the tooth contact and backlash

    Mounting bolt: 98±120 N·m (72 ± 89 lbf ft)

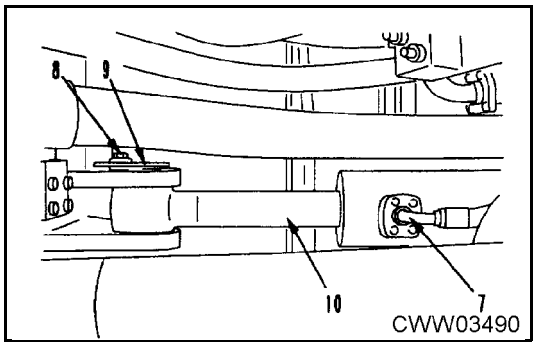
    Mounting bolt: Thread tightener (LT-2)



6. Disconnect the head hose (7).
7. Remove the mounting bolt (8), then pull out the pin (9).
8. Sling and remove the steering cylinder (10).

kg Steering cylinder: 78 kg (172 lb)

**i** Note the number of shims installed on both the head and bottom sides for later reassembly. ※1




## Installation

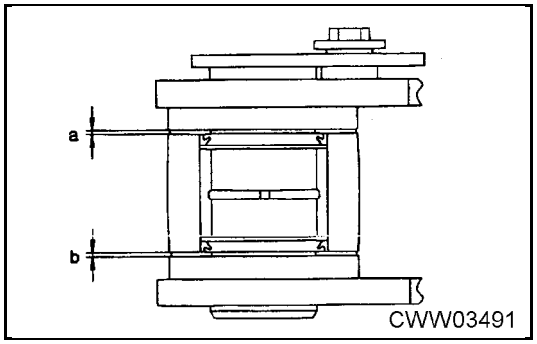
Perform the removal procedures in reverse order to complete installation.

**Warning!** Use a bar or similar tool -- never a finger -- when aligning the pin hole position.

※1

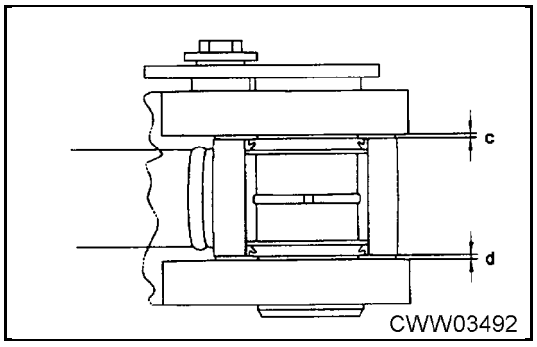
**i** Shim the bottom side until the clearance is the specified value.

Specified values: a + b = 0.5 mm (0.02 in.) max.




**i** Shim the head side until the clearance is the specified value.

Specified value: c + d = 0.5 mm (0.02 in.) max.




**i** Bleed the air from the steering cylinder as described in Section 20 of this manual.

Check steering system operation after the steering cylinder has been installed.

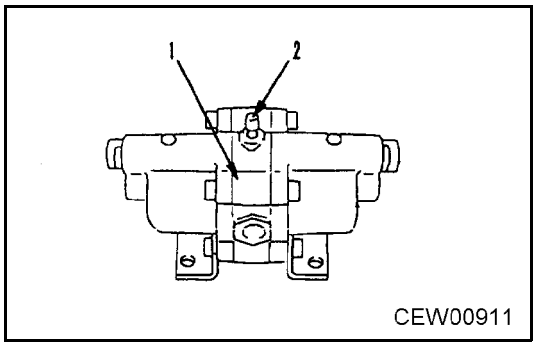
## Installation

Perform the removal procedures in reverse order to complete installation.

**i** Check operation of the brake valve after installation is complete.

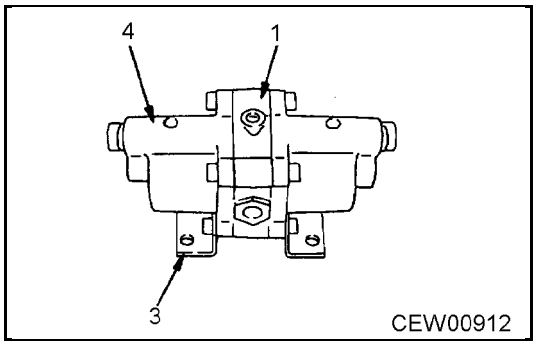
## Disassembly

1. Bleeder
   Remove the bleeder (2) from the slack adjuster body (1).



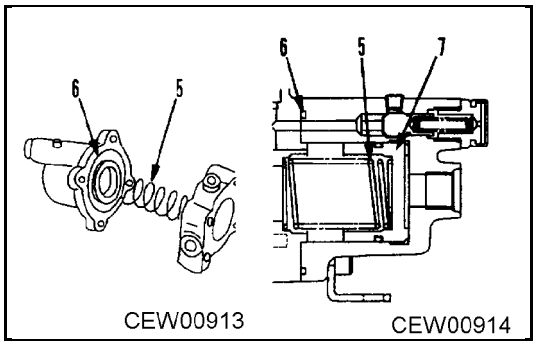

2. Cylinder
   Remove the mounting bolts, then disconnect the body (1) and cylinder (4) together with bracket (3).

   **Warning!** There is spring tension inside the cylinder, so hold the contact surfaces and be careful during removal.



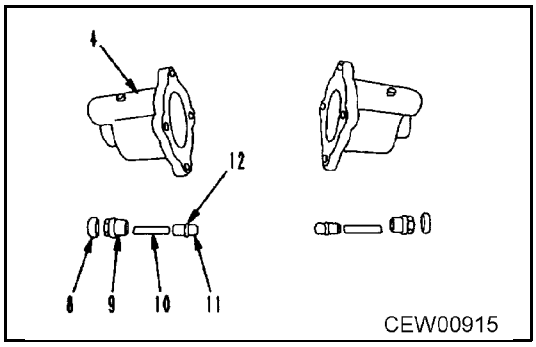

3. Piston
   a. Remove the spring (5) and o-ring (6).

   b. Remove the piston (7), then remove the o-ring.
      - Use a rod (10 mm/0.39 in. diameter) to slowly push out the piston.
      - Be careful not to damage the thread with the rod.



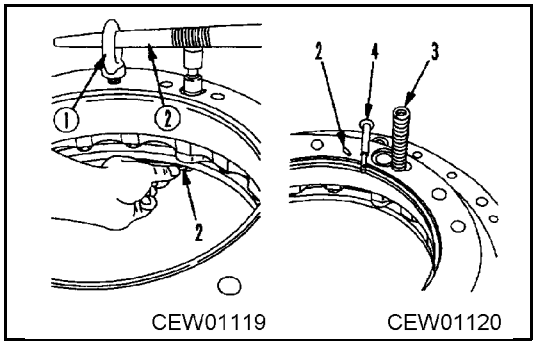

4. Poppet
   a. Remove the cover (8) from the cylinder (4), then remove the plug (9), spring (10), and poppet (11).
      - When removing the poppet, blow in air from the oil hole in the cylinder.
      - Hold the oil port of the cylinder by hand, and do not pump in air suddenly.
      - Be careful to keep the original poppet (11) with its cylinder (4).
      - If replacement is required, replace the poppet and cylinder as an assembly.

   b. Remove the o-ring (12) from the poppet.



b. Install the shaft (4) and spring (3).

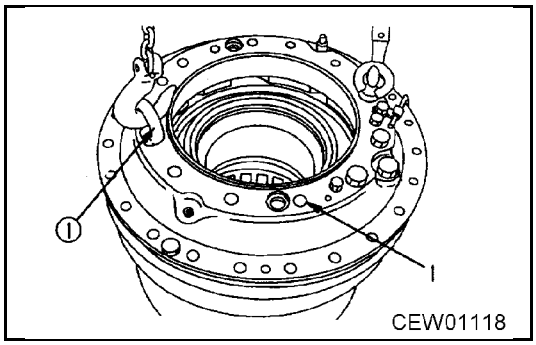
c. Thread in the eyebolts Î (Thread diameter = 6 mm, Pitch = 2.0 mm), push in the spring using the bar (2), then install the pin Ï.




d. Fit the o-ring, then use the eyebolts Î (Thread diameter = 16 mm, Pitch = 2.0 mm) to lift the cylinder assembly (1), match the guide bolt Ñ with the cylinder assembly and install it.

Thread tightener: Thread tightener (LT-2)

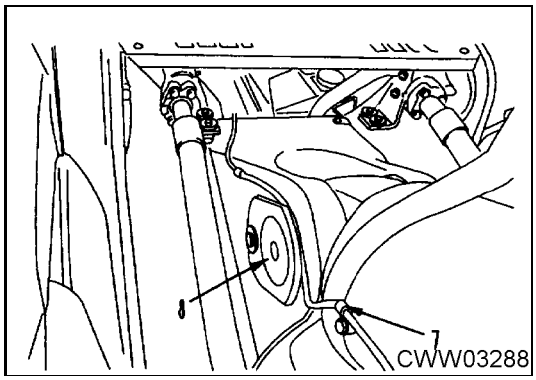
Mounting bolt: 245-309 N!m (181-228 lbf ft)



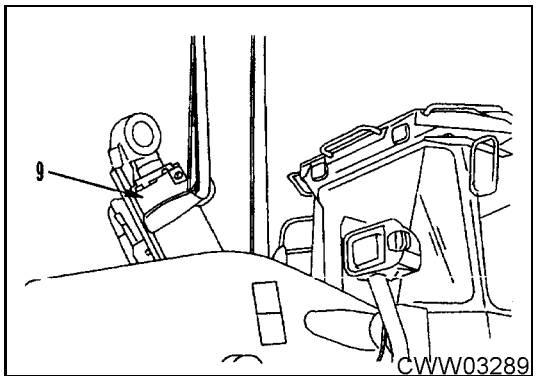
# MEMORANDA

6. Disconnect the leveler wiring clamp (7).

7. Pull out the bottom pin (8) until the cylinder is removed. ※1
   - i Sling and support the cylinder temporarily.
   - i Note the number of any shims installed for future reassembly.




8. Sling and remove the dump cylinder (9).
   kg Bucket cylinder: 524 kg (1,155 lb)



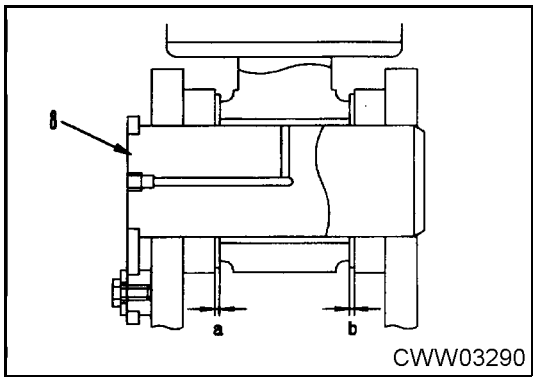

## Installation

Perform the removal procedures in reverse order to complete installation.

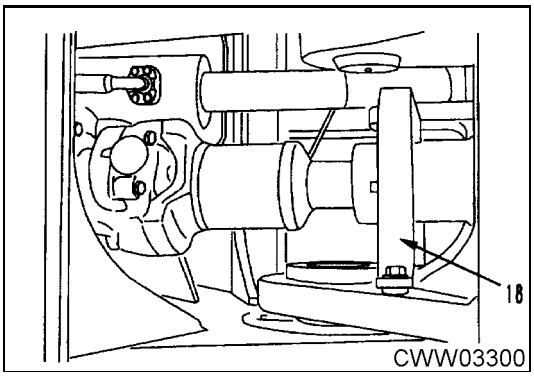
※1

Install the spacer shims so that the total clearance “a” and “b” between the cylinder bottom side and frame is 1.0 mm (0.04 in.), then insert the bottom pin (8).

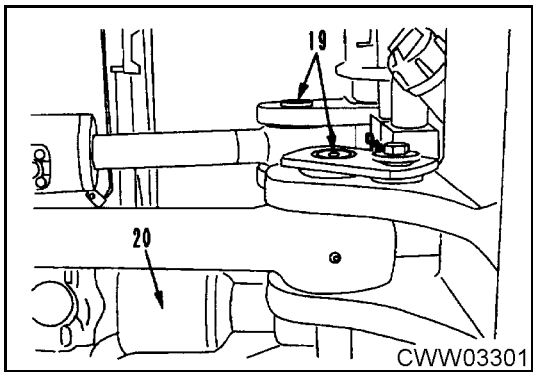
**Warning!** Use a bar to align the position of the pin hole, never your finger.



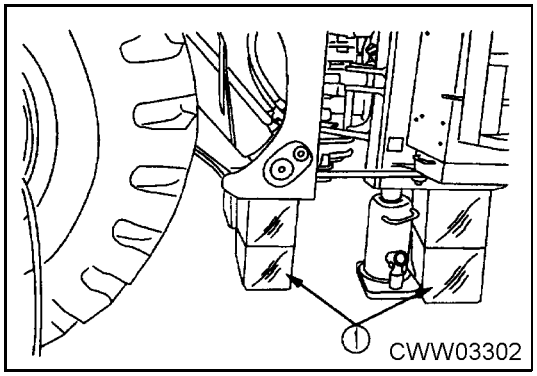
14. Remove the drive shaft guard (18).



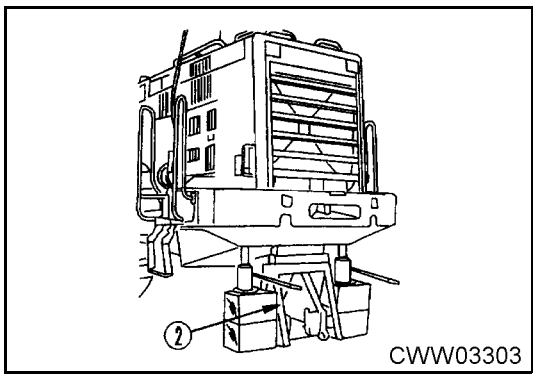

15. Remove the lock bolt of the steering cylinder head pin (19) on the right and left sides, then pull out the pin. ※1
    - **i** Note and store safely away any spacer shims for later reassembly.
    - **i** Cut the hose and push the piston into its cylinder.
16. Disconnect the drive shaft (20). ※2
    kg Drive shaft: 56 kg (123 lb)



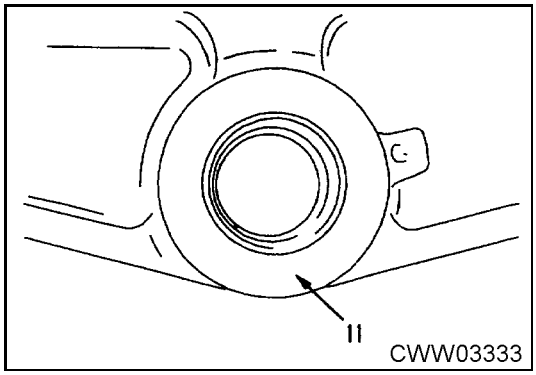

17. Place jacks certified for at least 45,359 kg (50 tons) under the front and rear frames, then raise the frames and set the support stands Î in place.

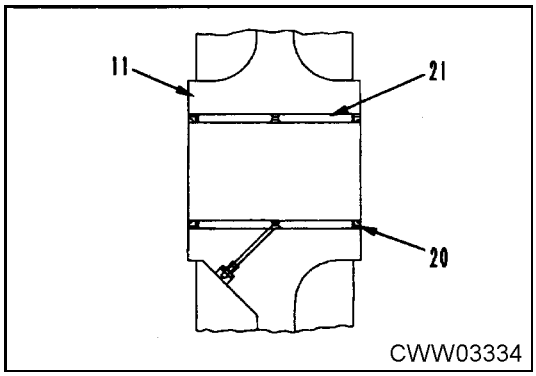



18. Use the jacks to raise the machine at the counterweight and set a support stand in place there.

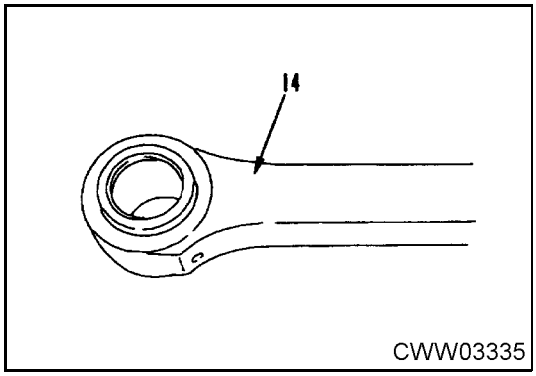


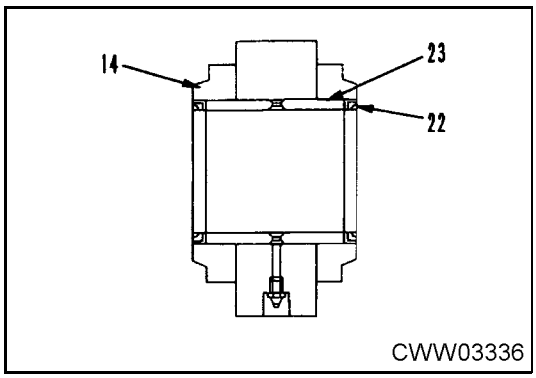
14. Pull the dust seal (20) and bushing (21) out of the bell crank (11).




15. Pull the dust seal (22) and bushing (23) out of the link (14).



# MEMORANDA

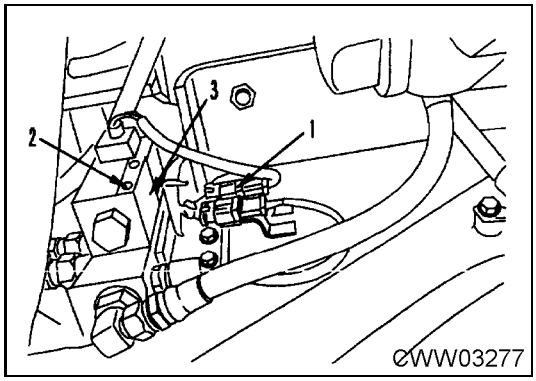
# PARKING BRAKE SOLENOID VALVE

**Warning!** Stop the machine on level ground, lower the work equipment completely to the ground, then stop the engine. Apply the parking brake and block the wheels to prevent the machine from moving.

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

## Removal

1. Unplug the upper connector F14 (1).
2. Remove the 4 mounting bolts (2), then remove the parking brake solenoid valve (3).




## Installation

Perform the removal procedures in reverse order to complete installation.

## Installation

Perform the removal procedures in reverse order to complete installation.

※1

**i** Adjust the parking brake as described in TESTING AND ADJUSTING THE PARKING BRAKE in Section 20 of this manual.

※2

Mounting bolt: Adhesive (LT-2)

Mounting bolt: 824-1,030 N **!** m (608-760 lbf ft)

**i** Match the stud bolts to the holes by turning the tire on the opposite side of the machine

## Installation

Perform the removal procedures in reverse order to complete installation.

| No. | Check Item | | Criteria | | | Remedy |
|---|---|---|---|---|---|---|
| | | | Standard Size | Tolerance | Repair Limit | |
| 6 | Thickness of assembled 4 discs and 3 plates for reverse clutch | | 39 | — | 37.4 | Replace |
| 7 | Thickness of assembled 4 discs and 3 plates for forward clutch | | | | | |
| 8 | Thickness of assembled 3 discs and 2 plates for 4th clutch | | 27.8 | | 26.6 | |
| 9 | Thickness of assembled 5 discs and 4 plates for 2nd clutch | | 45 | | 43.0 | |
| 10 | Thickness of assembled 3 discs and 2 plates for 3rd clutch | | 27.8 | | 26.6 | |
| 11 | Thickness of assembled 3 discs and 2 plates for 1st clutch | | | | | |
| 12 | Thickness of 1 disc | Forward, reverse, 1st, 3rd, 4th | 5.4 | | 5.0 | |
| | | 2nd | 5.0 | | 4.6 | |
| 13 | Thickness of 1 plate | Forward, reverse, 1st, 3rd, 4th | 5.8 | | 5.2 | |
| | | 2nd | 5.0 | | 4.5 | |
| 14 | Inside diameter of the bearing cage | | 170 | +0.018 -0.007 | +0.018 -0.007 | |
| 15 | Inside diameter of the sun gear of 4th clutch | | 110 | +0.016 -0.006 | +0.016 -0.006 | |
| 16 | Inside diameter of the housing of 2nd clutch | | 130 | +0.018 -0.007 | +0.018 -0.007 | |
| 17 | Inside diameter of the sun gear of 1st clutch | | 140 | | +0.018 -0.007 | |
| 18 | Wear of seal ring for input shaft | Width | 3.0 | -0.01 -0.03 | 2.6 | |
| | | Thickness | 3.7 | ±0.12 | 3.55 | |
| 19 | Wear of seal ring for output shaft | Width | 4.5 | -0.01 -0.03 | 3.9 | |
| | | Thickness | 5.2 | ±0.12 | 5.05 | |
| 20 | Wear of seal ring for 2nd clutch | Width | 6.0 | -0.01 -0.03 | 5.3 | |
| | | Thickness | | ±0.15 | 5.85 | |

Unit: N•m

| No. | Check Item | Criteria | Remedy |
|---|---|---|---|
| 1 | Tightening torque of front drive shaft mounting bolt | 214 ±7 | Retighten |
| 2 | Tightening torque of front drive shaft mounting bolt | 177 ±19.6 | |
| 3 | Tightening torque of front drive shaft mounting bolt | | |
| 4 | Tightening torque of front drive shaft mounting bolt | 214 ±7 | |
| 5 | Tightening torque of center support mounting bolt | 549 ±58.8 | |
| 6 | Tightening torque of center drive shaft mounting bolt | 214 ±7 | |
| 7 | Tightening torque of center drive shaft mounting bolt | 177 ±19.6 | |
| 8 | Tightening torque of center drive shaft mounting bolt | | |
| 9 | Tightening torque of center drive shaft mounting bolt | 214 ±7 | |
| 10 | Tightening torque of rear drive shaft mounting bolt | 177 ±19.6 | |
| 11 | Tightening torque of rear drive shaft mounting bolt | 214 ±7 | |
| 12 | Tightening torque of rear drive shaft mounting bolt | 177 ±19.6 | |
| 13 | Tightening torque of rear drive shaft mounting bolt | 214 ±7 | |
| 14 | Tightening torque of upper drive shaft mounting bolt | 108 ±10.8 | |
| 15 | Tightening torque of upper drive shaft mounting bolt | 144 ±12 | |

Unit: mm

| No. | Check Item | Criteria | | | Remedy |
|---|---|---|---|---|---|
| | | Standard Size | Tolerance | Repair Limit | |
| 1 | Thickness of side gear washer | 4.0 | — | 3.5 | Replace |
| 2 | Thickness of pinion gear washer | 1.5 | — | 1.3 | |
| 3 | Wear of oil seal surface | 110 | 0<br>-0.087 | — | |
| 4 | Tightening torque of mounting bolt | 549 ±59 N•m | | | Retighten |
| 5 | Tightening torque of mounting bolt | | | | |
| 6 | Tightening torque of mounting bolt | 927 ±103 N•m | | | |
| 7 | Tightening torque of mounting bolt | 113 ±9.8 N•m | | | |
| 8 | Tightening torque of mounting bolt | 927 ±103 N•m | | | |
| 9 | Tightening torque of mounting bolt (for front) | 279.5 ±29.4 N•m | | | |
| 10 | Tightening torque of mounting bolt | 1716 ±196 N•m | | | |
| 11 | Tightening torque of mounting bolt | 1st step: 3.9 ±1.0 N•m (when measuring clearance (no shim)<br>2nd step: 113 ±10 N•m (shim installed) | | | |

Unit: mm

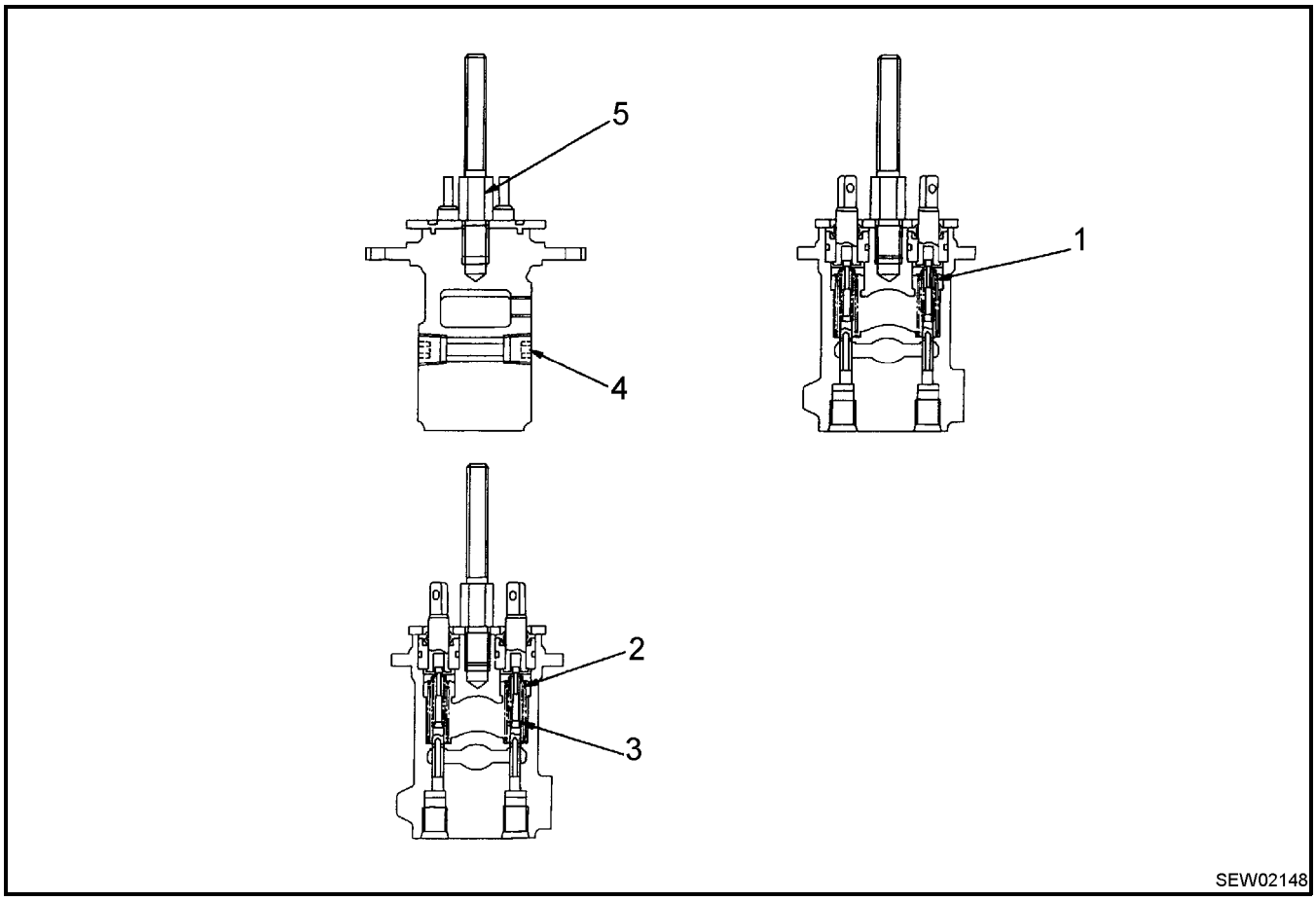
| No. | Check Item | Criteria | | | | | Remedy |
|---|---|---|---|---|---|---|---|
| | | Standard Size | Tolerance | | Standard Clearance | Clearance Limit | |
| | | | Shaft | Hole | | | |
| 1 | Clearance between pedal mounting pin and bracket hole | 10 | -0.025<br>-0.075 | +0.1<br>0 | 0.175<br>0.025 | 0.25 | Replace |
| 2 | Clearance between roller and pin | | | | | | |

| No. | Check Item | Standard Size | Tolerance | Repair Limit | Remedy |
|---|---|---|---|---|---|
| 3 | Outside diameter of roller | 30 | 0<br>-0.5 | 29.2 | Replace |

| No. | Check Item | Standard Size | | | Repair Limit | | Remedy |
|---|---|---|---|---|---|---|---|
| | | Free Length | Test Height | Test Load | Free Length | Test Load | |
| 4 | Control spring | 34 | 33.5 | 0.39 kg | 33 | — | Replace |
| 5 | Control spring | 46.3 | 46 | 1.2 kg | 45.3 | — | Replace |
| 6 | Return spring | 86.2 | 58 | 6.2 kg | 78 | — | Replace |
| 7 | Return spring | 31.5 | 19.5 | 1.7 kg | 28 | — | Replace |

| No. | Check Item | | Remedy |
|---|---|---|---|
| 8 | Tightening torque of nut | 152 ±24.5 N•m | Retighten |
| 9 | Tightening torque of nut | 66.2 ±7.3 N•m | Retighten |
| 10 | Tightening torque of nut | | Retighten |
| 11 | Tightening torque of nut | 7.8 ±2 N•m | Retighten |

## PPC VALVE FOR BOOM AND BUCKET




Unit: mm

| No. | Check Item | Criteria | | | | | Remedy |
|---|---|---|---|---|---|---|---|
| | | Standard Size | | | Repair Limit | | |
| | | Free Length x OD | Install. Length | Installation Load | Free Length | Installation Load | |
| 1 | Centering spring (for bucket DUMP and lift LOWER) | 52.8 x 12.3 | 36.0 | 3.0 kg | —— | 2.4 kg | Replace if damaged or deformed |
| 2 | Centering spring (for bucket TILT and lift RAISE) | | | 4.0 kg | | 3.2 kg | |
| 3 | Metering spring | 31.4 x 7.4 | 29.4 | 1.7 kg | | 1.4 kg | |
| 4 | Tightening torque | 17.7 ±3.9 N•m | | | | | Retighten |
| 5 | Tightening torque | 44.1 ±4.9 N•m | | | | | |