

Shop Manual

HD1500-7

DUMP TRUCK

SERIAL NUMBERS **A30001 & UP**

With SSA16V159 Engine

KOMATSU®

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SECTION A3

GENERAL SAFETY AND OPERATION

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DURING MAINTENANCE

Personnel

- Only authorized personnel may service and repair the machine.

Attachments

- Place attachments that have been removed from the machine in a safe place and manner to prevent them from falling.



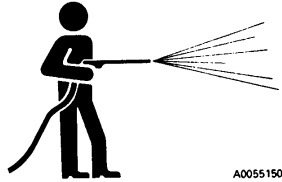
Working Under The Machine

- Always lower all movable work equipment to the ground or to their lowest position before performing service or repairs under the machine.
- Always block the tires of the machine securely.
- Never work under the machine if the machine is poorly supported.




Keep The Machine Clean

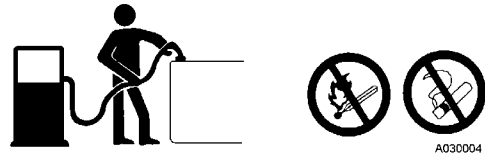
- Spilled oil or grease, scattered tools, etc. can cause you to slip or trip. Always keep the machine clean and tidy.
- If water gets into the electrical system, there is danger that the machine may move unexpectedly and/or damage to components may occur. DO NOT use water or steam to clean any sensors, connectors, or the inside of the operator's compartment.



A0055150

Rules To Follow When Adding Fuel Or Oil

- Spilled fuel and oil may cause slipping. Always clean up spills, immediately. Failure to clean up fuel or oil spills may lead to fires. 
- Always tighten the cap of the fuel and oil fillers securely.
- Never use fuel to wash parts.
- Always add fuel and oil in a well-ventilated area.



A030004

Radiator Water Level

- If it is necessary to add coolant to the radiator, stop the engine, and allow the engine and radiator to cool.
- Depress the pressure release button on the cap to vent cooling system pressure.
- Slowly loosen the cap to relieve any remaining pressure during removal.



A0067380

Use Of Lighting

- When checking fuel, oil, coolant, etc., always use lighting with anti-explosion specifications. If such lighting equipment is not used, there is danger of explosion.



A0055160

7. Apply the brake lock switch at the shovel and dump areas.
8. Proceed slowly on rough terrain to avoid deep ruts or large obstacles. Do not travel along soft edges or the edge of the fill area.
9. Truck operation requires concentrated effort by the driver. Avoid distractions of any kind while operating the truck.
10. When driving at night or when visibility is poor, the headlights must be on. DO NOT travel in these conditions if the headlights are inoperative.
11. DO NOT travel in reverse if the back-up horn or lights are inoperative.
12. When driving in reverse, signal with three honks on the horn. When starting forward, signal with two honks on the horn. Signal each time the truck is moved forward or backward.
13. DO NOT stop or park on a haul road unless unavoidable. If you must stop, move the truck to a safe place. Apply the parking brake and turn off the engine. Block the wheels securely and notify maintenance personnel for assistance.
14. If the low steering pressure warning illuminates during operation, immediately steer the truck to a safe stopping area away from other traffic. Refer to the previous item above.
15. Report adverse haul road conditions, immediately. Muddy or icy roads, pot holes or other obstructions can present hazards.
16. Keep cab doors closed at all times while the truck is in motion or unattended.
17. Check for flat tires periodically during the shift. If the truck has been operating on a flat tire, allow the tire to cool before parking indoors.

LOADING

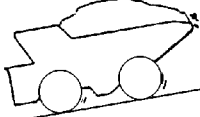
1. Approach the loading area with caution. Remain at a safe distance while the truck ahead is being loaded.
2. DO NOT drive over unprotected power cables.
3. When near loading areas, watch for other vehicles and for personnel working in the area.
4. When approaching a loader or shovel, follow the spotter or shovel operator signals. The loading process may be shortened by following similar patterns of the trucks that have already been loaded.
5. The operator must remain in the truck cab with the engine on during loading. Place the transmission shift lever in NEUTRAL and apply the brake lock switch.



If the operator must leave the truck cab during loading, the engine must be shut off and the parking brake applied. DO NOT use the emergency brake for parking. Remain far enough away from the truck to avoid being struck by flying material.

6. When the truck is loaded, drive away from the shovel as quickly as possible, but with extreme caution.

⚠ WARNING



RETARDING CAPACITY
GVW: 550,000 LBS.
(249,478 kg)
TIRES: 33 X 51

MAX. BRAKE OIL TEMPERATURE: 248°F (120°C)
MAX. ENGINE SPEED: 2100 RPM

MAINTAIN HIGHEST ENGINE SPEED BELOW MAX. SLOW TO NEXT LOWEST GEAR, IF COOLING OIL TEMPERATURE NEEDS TO BE LOWERED.

GEAR	SPEED		CONTINUOUS GRADE %	SHORT LENGTH 1,970 FT. (600m) GRADE %	
	MPH	(KM/H)		GRADE %	GRADE %
1	6.4	(10.3)	22.5 %	26.5 %	
2	8.6	(13.8)	16.5 %	20.5 %	
3	11.4	(18.4)	11.5 %	16.0 %	
4	14.4	(23.2)	9.0 %	13.0 %	
5	19.2	(31.0)	6.0 %	10.0 %	
6	26.1	(42.1)	4.0 %	8.0 %	
7	34.8	(56.1)	2.5 %	6.5 %	

EC4433

A grade/speed plate is located on the left front post of the operator's cab. The decal provides the recommended maximum speeds to be used when descending various grades with a loaded truck.

Always refer to the decal in the operator's cab. This decal may change with optional truck equipment.

AUXILIARY BRAKE

⚠ WARNING

PUSH TO APPLY ALL BRAKES

WB2488

When the auxiliary brake switch is activated, full, unmodulated brake pressure is applied to all wheels. The parking brake will also be applied.

Never actuate the auxiliary brake when the truck is moving, except in the event of an emergency.

⚠ WARNING

KEY SWITCH

DO NOT OPERATE VEHICLE BEFORE READING AND UNDERSTANDING OPERATION MANUALS.

WB2490

A warning decal is located below the key switch on the instrument panel. The warning stresses the importance of reading the operator's manual before operation.

ROPS/FOPS NO. **EL2746** MACHINE MODEL **H01500-7**

AS INSTALLED BY THE MANUFACTURER ON THIS DUMPER HAVING WEIGHT WITHOUT BODY LESS THAN **92450** KG. THIS ROLLOVER PROTECTIVE STRUCTURE AND FALLING OBJECT PROTECTIVE STRUCTURE MEETS THE PERFORMANCE REQUIREMENTS OF SAE-J1040 APR 88, SAE-J231 JAN 81 AND SAE-J1134 MAY 83

⚠ WARNING THE PROTECTION OFFERED MAY BE IMPAIRED IF SUBJECTED TO ANY MODIFICATIONS OR DAMAGE TO MAINTAIN MANUFACTURERS CERTIFICATION ANY REPAIR OR ALTERATION ON THIS STRUCTURE, INCLUDING INSTALLATION OF A NON-STANDARD SEAT, OR RELOCATION OF SEAT MUST HAVE PRIOR WRITTEN APPROVAL

Komatsu America Corporation
 2300 NE Adams St, Peoria, Illinois 61650-0240 U.S.A. EMB402

A plate attached to the right rear corner of the cab states the Roll-Over Protective Structure (ROPS) and Falling Object Protective Structure (FOPS) meet various SAE performance requirements.

⚠ WARNING

DO NOT modify these components. DO NOT attempt to repair damage without written approval from the manufacturer. Unauthorized repairs will void certification.

DIESEL FUEL ONLY

(SEE YOUR OPERATION AND MAINTENANCE MANUAL FOR DETAILS.)

-DRAIN WATER FROM THE FUEL TANK AT THE BEGINNING OF THE DAY'S RUN.

EB9094

A plate is located next to the fill cap on the fuel tank specifying diesel fuel only. Refer to the engine operation and maintenance manual for more information on fuel requirements.

**TABLE 12.
Common Conversion Multipliers
English to Metric**

To Convert From	To	Multiply By
inch (in.)	millimeter (mm)	25.40
inch (in.)	centimeter (cm)	2.54
foot (ft)	meter (m)	0.3048
yard (yd)	meter (m)	0.914
mile (mi)	kilometer (km)	1.61
square inch (in. ²)	square centimeters (cm ²)	6.45
square feet (ft ²)	square centimeters (cm ²)	929
cubic inches (in. ³)	cubic centimeters (cm ³)	16.39
cubic inches (in. ³)	liters (l)	0.016
cubic feet (ft ³)	cubic meters (m ³)	0.028
cubic feet (ft ³)	liters (l)	28.3
ounce (oz)	kilogram (kg)	0.028
fluid ounce (fl oz)	milliliter (ml)	29.573
pound (lb)	kilogram (kg)	0.454
pound (lb)	Newton (N)	4.448
inch pounds (in. lb)	Newton meters (N·m)	0.113
foot pounds (ft lb)	Newton meters (N·m)	1.356
foot pounds (ft lb)	kilogram meters (kg·m)	0.138
kilogram meters (kg·m)	Newton meters (N·m)	9.807
pounds/square inch (psi)	kilopascals (kPa)	6.895
pounds/square inch (psi)	megapascals (MPa)	0.007
pounds/square inch (psi)	kilograms/square centimeter (kg/cm ²)	0.0704
short ton (tn)	kilogram (kg)	907.2
short ton (tn)	metric ton (t)	0.0907
quart (qt)	liters (l)	0.946
gallon (gal)	liters (l)	3.785
horsepower (hp)	Watts (w)	745.7
horsepower (hp)	kilowatts (kw)	0.745

5. After all discrepancies have been corrected, the vehicle is ready for a road test. This test must be performed by a capable and experienced operator. Road test in a large, open area where plenty of maneuvering room is available. Road test checks include:

- ❑ Repeated braking efficiency tests at progressively higher speeds. Start at slow speeds. Don't take chances with higher speeds until the machine has been determined to be completely safe.
- ❑ Progressive upshifting and downshifting through all speed ranges to ensure proper transmission shifting and synchronization.

6. After all tests have been performed and the vehicle is ready for use, perform a final visual check.

7. Check lubricant service items as outlined in Section P, Lubrication and Service.

SHORT TERM ENGINE STORAGE

This procedure describes the proper method for the short term storage of an engine - one to six months.

Preparing the Engine

1. Operate the engine at high idle until the coolant temperature reaches 70° C (160° F).
2. Turn the engine off.
3. Disconnect the fuel lines to the engine fuel filter. Disconnect the injector return line.
4. Use a preservative oil. Use Dauber T Chemical NoxRust No. 518, or equivalent. The oil must meet Military Specification MIL-L-644, Type P-9.
5. Fill two containers, one with diesel fuel, and the second with preservative oil. Put both fuel lines in the container of diesel fuel.
6. Start the engine.
7. After the engine is operating smoothly, transfer the fuel supply line to the container of preservative oil. Operate the engine until the preservative oil flows out of the injector return line.
8. Turn the engine off. Connect the fuel lines to the fuel filter and the injector return line.
9. Drain the oil pan sump, oil filters, and fuel filters.
10. Install the drain plugs in the oil sump. The sump can remain empty until the engine is ready to be returned to service.



Put a warning tag on the engine. The tag must indicate the following:

- ***The engine does not contain oil.***
- ***DO NOT operate the engine.***

11. Disconnect the electrical wiring from the fuel pump solenoid.

**SECTION B3
DUMP BODY
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Cleaning

The fuel tank is equipped with a drain and a cleaning port. These items enable steam or solvent to be used to clean tanks that have accumulated foreign material.

It is not necessary to remove the tank from the truck for cleaning of sediment. However, rust and scale on the walls and baffles requires complete tank removal. Rotating the tank in various positions enables cleaning solutions to contact all interior surfaces.

Prior to a cleaning procedure of this type, remove the fuel gauge, vents, and hose connections. The tank must be completely sealed. After all scale, rust, and foreign material has been removed, the temporary plugs can be removed.

When a tank is to remain idle for a long period of time, spray a small amount of rust preventive oil into the tank to prevent rust formation. Seal all openings for rust prevention.

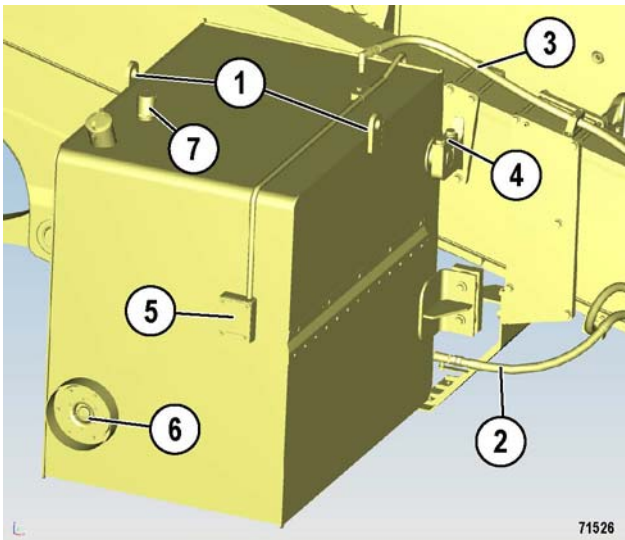


FIGURE 4-2. FUEL TANK

- | | |
|---------------------|--------------------------------|
| 1. Lift Brackets | 5. Fuel Gauge and Sending Unit |
| 2. Fuel Supply Hose | 6. RH Fuel Receiver |
| 3. Fuel Return Hose | 7. Fuel Tank Breather |
| 4. Trunnion Cap | |

Repair

Clean the fuel tank before and after repairs are performed.

WARNING

If a tank is to be welded, special precautions are necessary to prevent fire or explosion. Consult local authorities for safety regulations before proceeding.

Installation

1. Thoroughly clean the fuel tank mounting brackets and cap screw hole threads. Repair the threads if damaged. Install rubber dampener (7, Figure 4-1) in each mount.
2. Attach an appropriate lifting device to the fuel tank lift brackets. The weight of the empty fuel tank is approximately 932 kg (2055 lb).
3. Lift the fuel tank into position over the trunnion mounts and lower into position. Place the trunnion caps into position. Install cap screws and washers (4, Figure 4-2), but do not torque at this time.
4. Place lower mounting brackets into position. Install cap screw (5, Figure 4-1), flat washer (8), flat washer (9), flat washer (6), and nut (4). Refer to Figure 4-1 for positioning. Tighten the cap screws to standard torque.
5. Place the trunnion caps on the upper mounts. There is a chamfer on one edge of each cap. The chamfered edge must face the fuel tank. Install the cap screws and washers (4, Figure 4-2). Tighten the cap screws to standard torque.
6. Connect fuel supply hose (2) and return hose (3).
7. Reconnect all electrical connections to the tank.

18. Loosen the clamps that secure hump hose (8). Pry the hump hose off of the radiator tube.
19. Loosen the clamps that secure hump hose (10). Pry the hump hose off of the radiator tube.
20. Attach a lifting sling and hoist to the top right fan guard. Remove the hardware that secures the section to the radiator and fan guard assembly. Lift the guard from the truck and repeat for the remaining fan guard sections.
21. Attach an appropriate lifting device to the radiator assembly. The weight of the radiator is 1191 kg (2626 lb).
22. Loosen mounting hardware (9) at the lower mounts and then disconnect upper support rods (7, Figure 3-3).
23. Remove the cap screws from the lower mounts. Before removing the radiator, verify that all hoses and wiring harnesses are disconnected from the radiator.
24. Carefully slide the radiator forward until the shroud is clear of the fan blades. Verify the condenser will not interfere in the path of the radiator.
25. Lift the radiator off the frame. Move the radiator to a storage or repair area. Remove the shims from the lower radiator mount location and save for use during installation.
26. Remove the remaining hoses and clamping from the radiator as necessary.
27. Inspect all hoses, clamps, tube connectors, etc. Replace damaged or worn parts.

RADIATOR REPAIR

Internal Inspection

If desired, an internal inspection can be performed on the radiator before complete disassembly. The inspection entails removing tubes in the radiator core and cutting them open. This type of inspection can indicate overall radiator condition, as well as coolant and additive breakdown.

To perform this inspection, remove about four random tubes from the air inlet side of the radiator. Remove tubes from both the top and bottom cores, and near each end of the radiator. Refer to Disassembly and Assembly in this section for proper instructions for tube removal and installation. Analyze any contaminant residue inside the tube to determine the cause. Flush the system before returning the radiator to service. Contact your nearest L&M Radiator facility for further instruction or visit the L&M website for further information at www.mesabi.com.

External Cleaning

Many radiator shops use a hot alkaline soap, caustic soda, or chemical additives in their boil-out tanks which can attack solders. These tanks are generally not recommended.



Before such tanks are used for cleaning, ensure that the cleaning solutions are not harmful to solder. Otherwise, damage to the radiator will result.

Completely rinse the cleaned tube/core in clean water after removing from the boil-out tank.

As an alternative to boil-out tanks, radiators can be cleaned externally with a high pressure washer and soap. In most cases, it may be best to blow out any dry dirt with a high pressure air gun prior to washing the core with the high pressure washer.

Pressure washers must not exceed 8274 kPa (1200 psi). Unlike conventional cores, it is recommended to hold the spray nozzle directly next to the core. Starting from the air exit side, place the high pressure washer nozzle next to the fins. Concentrate on a small area, slowly working from the top to the bottom. Spray straight into the core, not at an angle. Continue washing until the exit water is free of dirt. Repeat from the opposite side.

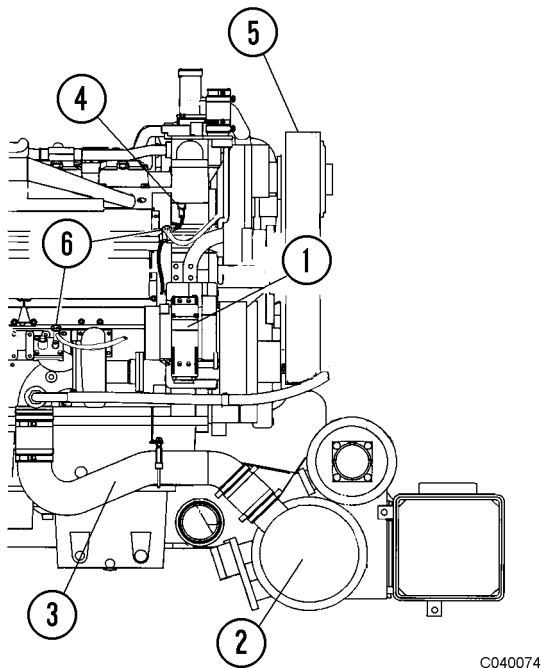


FIGURE 4-2. COOLER ASSEMBLY PIPING

- | | |
|-------------------------------|--------------------------|
| 1. Alternator | 5. Fan Clutch |
| 2. Cooler Assembly | 6. Heater Shutoff Valves |
| 3. Water Pump Inlet Pipe | |
| 4. Coolant Temperature Sensor | |

10. Remove water pump inlet pipe (3, Figure 4-2) between the engine and cooler assembly (2).
11. Close heater shut-off valves (6) and disconnect the hoses.
12. Disconnect the heater hoses and remove the clamps to allow the hoses to be positioned away from the engine.
13. Disconnect the suction and discharge hoses from air conditioning compressor (2, Figure 4-3).
14. Disconnect compressor clutch connector (5). Remove harness clamps (6). Disconnect the tri-nary switch from the receiver/drier.
15. Disconnect coolant temperature sensor (2, Figure 4-4) from the front right side of the engine.

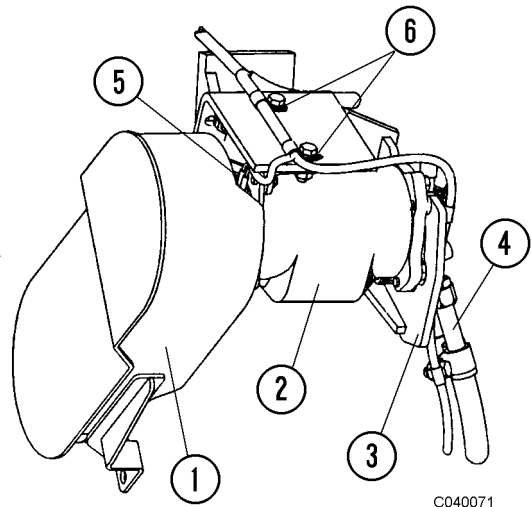


FIGURE 4-3. AIR CONDITIONER COMPRESSOR

- | | |
|---------------------|---------------------|
| 1. Belt Guard | 4. Suction Hose |
| 2. A/C Compressor | 5. Clutch Connector |
| 3. Mounting Bracket | 6. Harness Clamps |

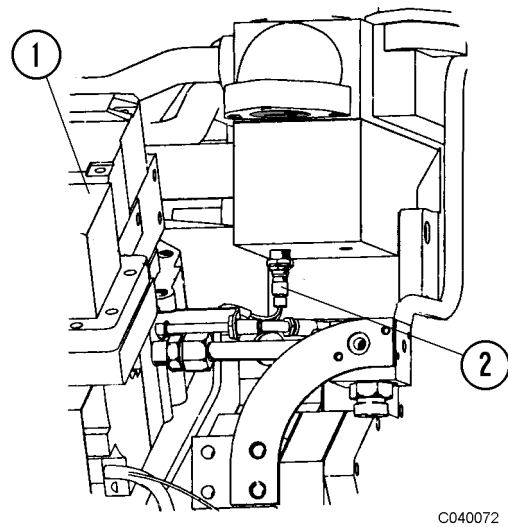
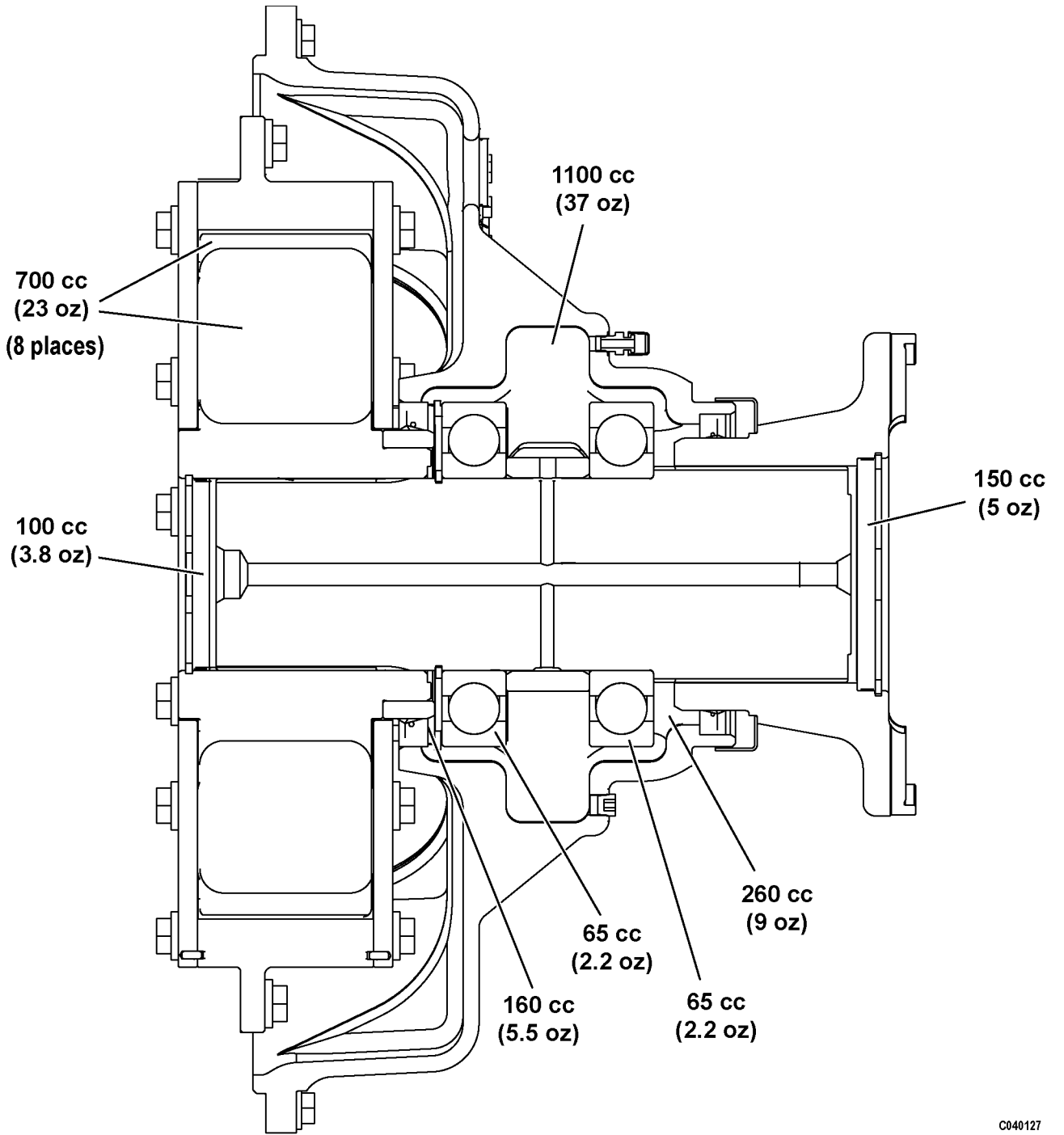


FIGURE 4-4. COOLANT TEMPERATURE SENSOR

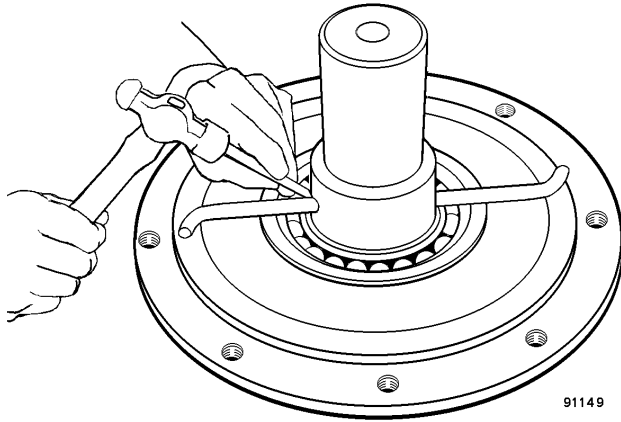
- | | |
|------------------------------|-------------------------------|
| 1. Right Front Cylinder Head | 2. Coolant Temperature Sensor |
|------------------------------|-------------------------------|



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FIGURE 4-28. GREASE MAP

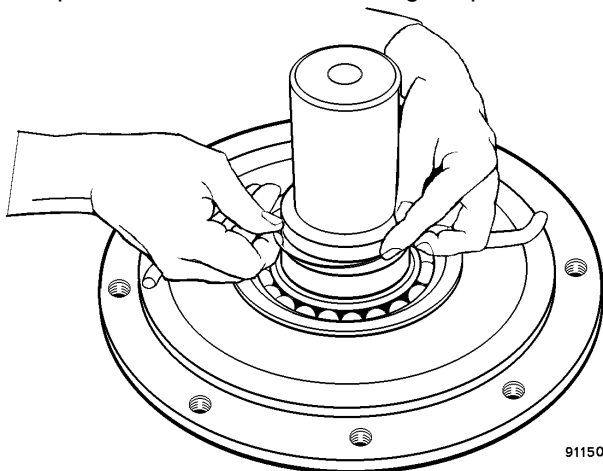
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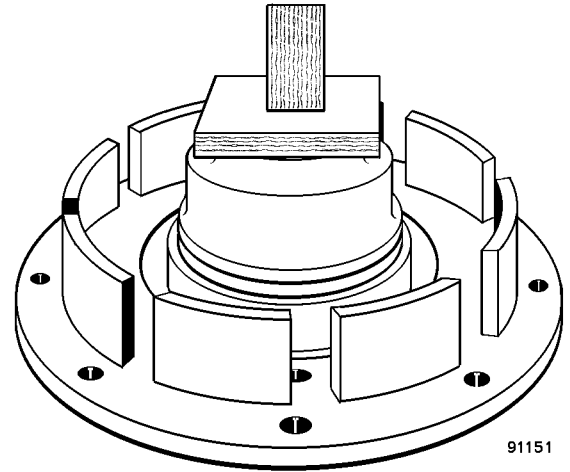
40. Ensure the pitot tube holes in the shaft are clean and free of burrs and staking material, to allow the pitot tubes to fit into the holes and seat completely to the bottom. Apply a thin coating of Loctite® #609, or equivalent, on the straight end of one pitot tube (33). Coat the tube to approximately 20 mm (0.75 in.) from the end.

Push the pitot tubes to the bottom of the hole. The outer end of the tube must be located well within the pulley-locating shoulder of the bearing retainer. Rotate the tube so the open, bent end faces in a counter-clockwise direction, and is exactly parallel to the surface of the bearing retainer. A large Phillips-head screwdriver inserted in the end of the tube can be conveniently used as an alignment gage.

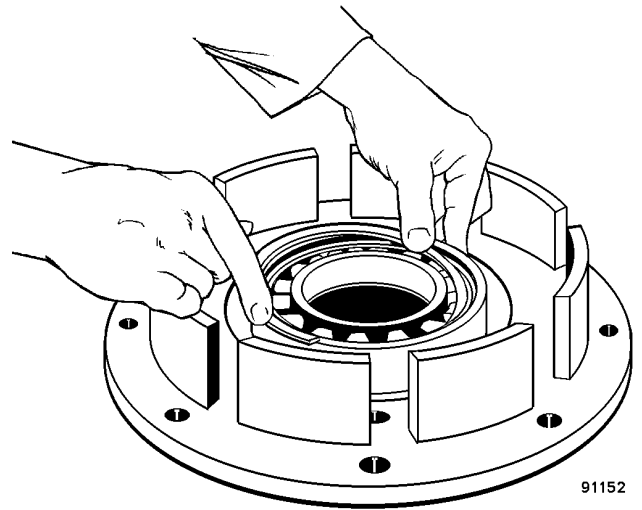
Install the second pitot tube in the same manner as the first. Stake each pitot tube in three places, (at the 9, 12, and 3 o'clock positions) to prevent the tubes from rotating in operation.



41. Install both hook-type seal rings (32) in the grooves in the shaft.



42. Install front bearing (5) in front bearing retainer (12). Press only on the outer race of the bearing, and press it to the bottom of the bore.



43. Install internal snap ring (28).

NOTES

Disassembly

Only disassemble the cranking motor as far as necessary to repair or replace defective parts.

1. Note the relative position of solenoid (53, Figure 2-5), lever housing (78), nose housing (69), and Commutator End (CE) frame (1). The motor must be reassembled in the same manner.
2. Disconnect field coil connector (42) from the solenoid motor terminal. Remove the lead from the solenoid ground terminal.
3. Remove brush inspection plates (52) and brush lead screws (15).
4. Remove bolts (34) and separate commutator end frame (1) from field frame (35).
5. Remove bolts (70). Separate nose housing (69) and field frame (35) from lever housing (78).
6. Remove armature (45) and drive assembly (71) from lever housing (78).
7. Pull solenoid (53) from the lever housing.

Cleaning and Inspection

1. Drive (71, Figure 2-5), armature (45) and fields (46) can not be cleaned with degreaser or grease dissolving solvents. Solvents would dissolve the lubricant in the drive and damage the insulation in the armature and field coils.
2. Clean all parts, except the drive, with mineral spirits and a clean cloth.
3. If the commutator is dirty, it may be cleaned with number 00 sandpaper.

NOTE: DO NOT use emery cloth to clean the commutator.

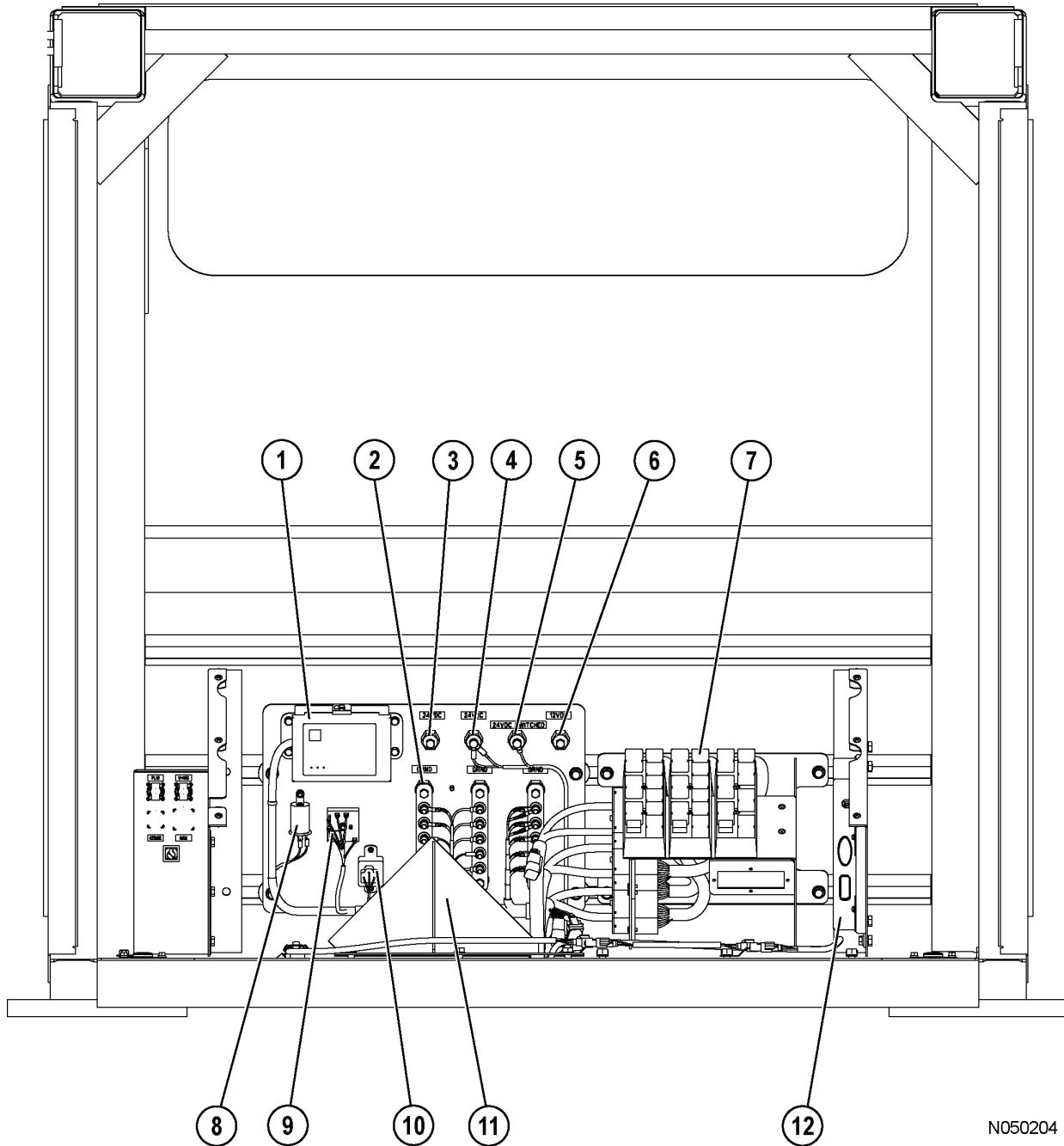
4. Inspect brushes (13) for wear.
 - a. Compare the brushes with a new brush. If worn excessively, replace with new brushes.
 - b. Ensure brush holders (10) are clean and the brushes are not binding in the holders.
 - c. The full brush surface should ride on the commutator. Check by hand to ensure that brush springs (16) are providing firm contact for the brushes against the commutator.
 - d. If springs (16) are distorted or discolored, replace with new springs.

Armature Servicing

If the armature commutator is worn, dirty, out of round, or has elevated insulation, use a lathe to machine armature (45). Machine the insulation to 0.79 mm (0.031 in.) wide and 0.79 mm (0.031 in.) deep. Clean the slots to remove any trace of dirt or copper dust. As a final step in this procedure, lightly sand the commutator with number 00 sandpaper to remove any burrs resulting from machining.

Check the armature for opens, short circuits and grounds as follows:

1. Opens are usually caused by excessively long cranking periods. The most likely place for an open to occur is at the commutator riser bars. Inspect the points where the conductors are joined to the commutator bars for loose connections. Poor connections cause arcing and burning of the commutator as the cranking motor is used. If the bars are not badly burned, repair can often be effective by soldering or welding the leads in the riser bars (using rosin flux), and machining the commutator in a lathe to remove the burned material. The insulation must then be undercut.
2. Short circuits in the armature are located by use of a growler. When the armature is revolved in the growler with a steel strip such as a hacksaw blade held above it, the blade will vibrate above the area of the armature core in which the short circuit is located. Shorts between bars are sometimes produced by brush dust or copper between the bars. These shorts can be eliminated by cleaning out the slots.
3. Grounds in the armature can be detected by the use of a 110-volt test lamp and test points. If the lamp lights when one test point is placed on the commutator with the other point on the core or shaft, the armature is grounded. Grounds occur as a result of insulation failures. These failures are often caused by overheating of the cranking motor produced by excessively long cranking periods. Accumulation of brush dust between the commutator bars and the steel commutator ring can also cause this type of failure.



N050204

FIGURE 3-2. REAR ELECTRICAL COMPARTMENT
(Enclosure Removed)

- | | |
|------------------------------------------------|-------------------------------------------------|
| 1. Automatic Lubrication System Timer | 7. Relay Centers |
| 2. Ground Bus Bars | 8. Turn Signal Flasher |
| 3. Power Bus # 1, 24V Battery Direct Power | 9. Steering Bleeddown Timer |
| 4. Power Bus # 2, 24V Battery Disconnect Power | 10. Windshield Wiper Delay Timer |
| 5. Power Bus # 3, 24V Key Controlled Power | 11. External Harness Interface Connection Panel |
| 6. Power Bus # 4, 12V Key Controlled Power | 12. ORBCOMM Modem |

BODY POSITION SWITCHES

Two magnetically activated proximity switches sense the position of the truck dump body. Body-up switch (5, Figure 3-13) is located inside the left frame rail, forward of the body pivot. This switch provides a "body seated" signal to the transmission controller when the body is resting on the frame. When the body is raised above the frame rail, the magnetic field is removed from the switch sensing area. The switch sends a "body float" signal to the transmission controller. A warning lamp in the left pod illuminates to inform the operator.

NOTE: The body float lamp will also illuminate if the hoist control is not in the FLOAT position or if there is an open circuit between the switch and the transmission controller.

Hoist limit switch (9) is located on the left frame rail just behind the pivot. The hoist limit switch sends a signal to the hoist limit solenoid in the hydraulic cabinet. The solenoid activates and blocks oil flow from the hoist pilot valve to the hoist valve. The "power up" oil supply is blocked to prevent full hoist cylinder extension, and possible damage to the cylinders. Proper switch adjustment ensures the hoist cylinder travel stops slightly before full extension.

If either the body up switch or the hoist limit switch do not function as described above, adjust the switches according to the procedure on the following pages.

Proximity Switch Operation

The body position switches on these trucks are magnetic field change switches. The switches sense a ferrous material target, as well as a specific pole (south pole) magnet field. When a switch is activated by ferrous material, the maximum sensing distance is approximately 13 mm (0.5 in.). When a magnet is used instead of ferrous material, maximum sensing distance is approximately 95 mm (3.75 in.). Therefore, use of a magnet target allows the switch to activate at greater sensing distances.

Inside the switches, there are two magnets of slightly varying strengths in line with one another. The magnets are located on separate ends of a rocker lever assembly which contains the functional switch contacts. In the non-actuated or rest state, in which there is no disturbance in the internal switch natural magnetic fields, the stronger magnet dominates the rocker into the "normal" position. Refer to Figure 3-12.

When the field of the dominate magnet becomes distracted by a target, (a ferrous plate, or an opposite polarity magnet field (south pole)), the weaker magnet in the switch will then become more dominate and move the rocker lever. The switch is then considered to be actuated or in the "sensed" position.

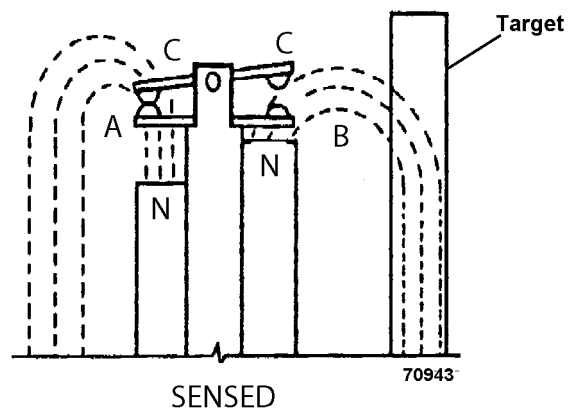
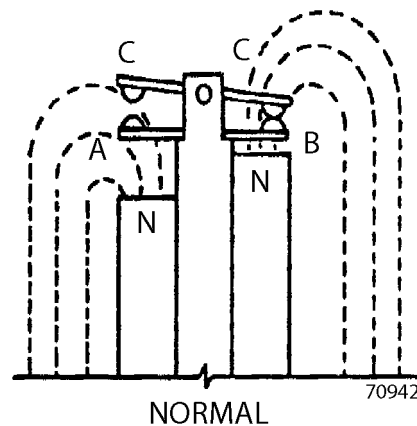


FIGURE 3-12. SWITCH CONTACTS - NORMAL AND SENSED POSITIONS

Installation

1. Ensure the battery disconnect switch on the battery box is open in order to isolate battery power from the truck.
2. Place the alternator into position on the mounting bracket. Install mounting cap screws (2, Figure 10-7)
3. If removed, install pulley (2, Figure 10-2), and secure with nut (1) and the washer. Tighten to **102 ± 7 N·m (75 ± 5 lb ft)**.
4. Attach the cable and wire connections at the rear of the alternator.
5. Use a breaker bar to rotate the belt tensioner to allow installation of the drive belt. Install the belt and ensure the belt is aligned and positioned properly in the grooves.
6. Place belt guard (2, Figure 10-1) into position over the alternator. Install the cap screws that secure the guard to the engine.
7. Connect battery power to the truck by closing the battery disconnect switch on the battery box.
8. Verify the alternator is charging properly. Refer to Alternator Performance Test.

TABLE 1. LIMP HOME CONDITIONS AND PROCEDURES

Failure Code	Condition When Problem Occurred	Limp Home Procedure	Starting Gear Speed Set With Lever Position After Escape Operation	Remarks
DF10KB	Condition 5	Procedure 7	If display becomes normal, machine can travel normally (Note 1).	<p>Condition 1 Gear speed is kept fixed even after restart. If lever is set to N position, gear is set in neutral.</p> <p>Condition 2 Transmission shifts to neutral suddenly during travel. Once the truck stops, the transmission remains in neutral, but the truck will not start when lever is operated.</p> <p>Condition 3 Transmission shifts to neutral suddenly during travel.</p> <p>Condition 4 After engine is started, gear is kept in neutral and machine does not start when lever is operated.</p> <p>Condition 5 Lever responds abnormally and does not work. If lever is operated, gear is set in neutral.</p> <p>Condition 6 Gear speed is kept fixed and gear is not shifted from fixed gear after machine restarts. If lever is set to N position, gear is set in neutral but cannot be shifted any more.</p> <p>Condition 7 Proper clutch for travel is used and gear speed is fixed. If there is not proper clutch, gear is set in neutral. If lever is in N position, gear is set in neutral.</p>
DLE2KA	Condition 1	Procedure 1	D – L: F1, R: R	
DLE2LC	Condition 1	Procedure 1	D – L: F1, R: R	
DLF1KA	Condition 1	Procedure 1	D – L: F2, R: R	
DLF1LC	Condition 1	Procedure 1	D – L: F2, R: R	
DLF2KA	Condition 1	Procedure 1	D – L: F2, R: R	
DLF2LC	Condition 1	Procedure 1	D – L: F2, R: R	
DLT3KA	Condition 6	Procedure 3	D – L: F2, R: R	
DLT3LC	Condition 6	Procedure 3	D – L: F2, R: R	
DXH1KA	Condition 1	Procedure 1	D – L: F2, R: R	
DXH1KB	Condition 1	Procedure 1	D – L: F2, R: R	
DXH1KY	Condition 1	Procedure 1	D – L: F2, R: R	
DXH2KA	Condition 7	Procedure 1	D – L: F2, R: R	
DXH2KB	Condition 7	Procedure 1	D – L: F2, R: R	
DXH2KY	Condition 7	Procedure 1	D – L: F3	
DXH3KA	Condition 7	Procedure 1	D – L: F2, R: R* (M,R)	
DXH3KB	Condition 7	Procedure 1	D – L: F2, R: R* (M,R)	
DXH3KY	Condition 7	Procedure 1	D – L: F1, R: R	
DXH4KA	Condition 7	Procedure 1	D – L: F1, R: R	
DXH4KB	Condition 7	Procedure 1	D – L: F1, R: R	
DXH4KY	Condition 7	Procedure 1	D – L: F2	
DXH5KA	Condition 7	Procedure 1	D – L: F2, R: R	
DXH5KB	Condition 7	Procedure 1	D – L: F2, R: R	
DXH5KY	Condition 7	Procedure 1	D – L: F1	
DXH6KA	Condition 7	Procedure 1	D – L: F2, R: R	
DXH6KB	Condition 7	Procedure 1	D – L: F2, R: R	
DXH6KY	Condition 7	Procedure 1	D – L: F3* (L,3rd)	
DXH7KA	Condition 3	Procedure 1	D – L: F2	
DXH7KB	Condition 3	Procedure 1	D – L: F2	
DXH7KY	Condition 7	Procedure 1	R: R	
DXJ7KA	Condition 3	Procedure 1	D – L: F1, R: R	
DXJ7KB	Condition 3	Procedure 1	D – L: F1, R: R	
DXJ7KY	Condition 7	Procedure 1	D – L: F2, R: R* (M,R)	

Real Time Monitoring Codes

TABLE 2. REAL TIME MONITORING CODES					
No.	Controller	Description	Code	Output	Unit
1	RCM	Part number of software	20214	Part number	--
2	RCM	Application version	20231	Application	--
3	RCM	Data Version	20232	Version data	--
4	RCM	ARSC set switch	37701	0.00~5.00	V
5	RCM	Front brake cooling valve	39800	ON [1] OFF [0]	--
6	RCM	Rear brake cooling valve	39801	ON [1] OFF [0]	--
7	RCM	Brake lock switch sense	39900	ON [1] OFF [0]	--
8	RCM	Front PPC valve output (command)	33700	0~1000	mA
9	RCM	Rear left PPC valve output (command)	33802	0~1000	mA
10	RCM	Rear right PPC valve output (command)	33804	0~1000	mA
11	RCM	Front PPC valve output	33701	0~1000	mA
12	RCM	Rear left PPC valve output	33803	0~1000	mA
13	RCM	Rear right PPC valve output	33805	0~1000	mA
14	RCM	Brake apply switch	35100	ON [1] OFF [0]	--
15	RCM	Front brake apply switch	35102	ON [1] OFF [0]	--
16	RCM	Retard cooling oil temp (front)	30201	0~160	°C
17	RCM	Retard cooling oil temp (front)	30204	0.00~5.00	V
18	RCM	Retard cooling oil temp (rear left)	30207	0~160	°C
19	RCM	Retard cooling oil temp (rear left)	30209	0.00~5.00	V
20	RCM	Retard cooling oil temp (rear right)	30208	0~160	°C
21	RCM	Retard cooling oil temp (rear right)	30210	0.00~5.00	V
22	RCM	Brake pedal signal	44700	ON [1] OFF [0]	--
23	RCM	Front brake cooling filter	35701	ON [1] OFF [0]	--
24	RCM	Brake cooling filter - left	35702	ON [1] OFF [0]	--
25	RCM	Brake cooling filter - right	35703	ON [1] OFF [0]	--
26	RCM	Emergency auto apply switch	32101	ON [1] OFF [0]	--
27	RCM	Emergency Brake switch sense	32102	ON [1] OFF [0]	--
28	RCM	Empty or loaded	39400	Loaded [1] Empty [0]	--
29	RCM	Hydraulic filter	35700	ON [1] OFF [0]	--
30	RCM	PPC cut valve	34105	ON [1] OFF [0]	--
31	RCM	PPC cut valve switch	34106	ON [1] OFF [0]	--
32	RCM	Front retard apply switch	34102	ON [1: Brake apply, PPC active] OFF [0]	--
33	RCM	Left retard apply switch	34103	ON [1: Brake apply, PPC active] OFF [0]	--
34	RCM	Right retard apply switch	34104	ON [1: Brake apply, PPC active] OFF [0]	--
35	RCM	Retard lever	33900	0.00~5.00	V
36	RCM	Retard lever (off)	33901	0.00~5.00	V
37	RCM	Retard lever (on)	33902	0.00~5.00	V
38	RCM	Steering accumulator pressure 1	44800	ON [1] OFF [0]	--

LIMP HOME MODE

In some instances, electrical failures in the engine or transmission systems may prevent the truck from operating. If this occurs, the operator may be able to operate the machine by following the limp home procedure.

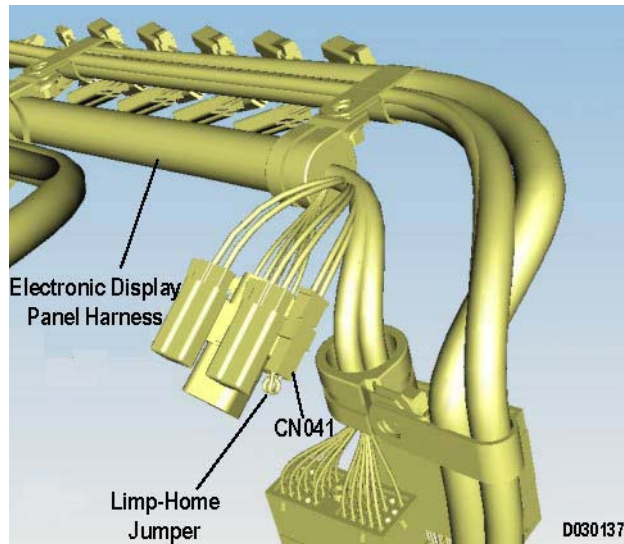


FIGURE 20-1. LIMP HOME JUMPER

1. Move the shift lever to N and apply the parking brake.
2. Locate connector CN041 in the operator cab behind the electronic display panel (EDP).
3. The key switch must be in the ON position and/or the engine must be on to switch into limp home mode. Momentarily disconnect the limp home jumper from connector CN041 to put the machine in limp home mode. Plug the jumper back into the connector.
4. Start the engine. The truck will stay in the limp home mode until the key switch is turned OFF.

Fuse And Circuit Breakers

Before troubleshooting, verify that circuit breakers and fuses are present and working properly.

Failure codes	Description	Applicable controller	Action code	History classification
DAF9KM	Machine Monitor: Poor Connection	MON	E03	Electrical system
DAFRKR	Machine monitor: Communication error	TM	E03	Electrical system
DAQ0KK	Transmission controller power: Source voltage low	TM	E03	Electrical system
DAQ2KK	Transmission controller/ECMV power: Source voltage low	TM	E03	Electrical system
DAQ9KQ	Transmission controller: Model Selection Error	MON	E03	—
DAQRKR	Transmission controller: Communication error	MON	E03	Electrical system
DAQRMA	Transmission controller: Option Setting Error	MON	E03	—
DASOMA	Engine Malfunction: Red indicator light	MON	E03	Electrical system
DASOMC	Engine Malfunction: Amber indicator light	MON	E01	Electrical system
DASRKR	Engine: Communication error	MON	E03	Electrical system
DB10KT	Retarder controller non-volatile memory: Controller error	BK	E01	Electrical system
DB12KK	Retarder controller solenoid power source: Malfunction	BK	E03	Electrical system
DB13KK	Retarder controller battery direct power source: Source voltage low	BK	E03	Electrical system
DB19KQ	Retarder controller: Model selection error	MON	E03	—
DB1RKR	Retarder controller: Communication error	TM	E03	Electrical system
DB1RMA	Retarder controller: Option setting error	MON	E03	—
dBBRKR	VHMS Communication Error	MON	E01	Electrical system
DDB4MA	Brake Sensor: Open or short circuit	BK	E01	Electrical system
DDD7KX	ARSC switch: Input signal out of range	BK	E03	Electrical system
DDD8KA	ARSC switch: Open circuit	BK	E03	Electrical system
DDD8KB	ARSC switch: Short circuit	BK	E03	Electrical system
DDDAKA	ASR Cut switch: Open circuit	BK	E01	Electrical system
DDDAKB	ASR Cut switch: Short circuit	BK	E01	Electrical system
DDP6MA	Brake Switch: Open or short circuit	BK	E01	Electrical system
DDTHKA	High clutch fill switch: Open circuit	TM	E03	Electrical system

NOTES

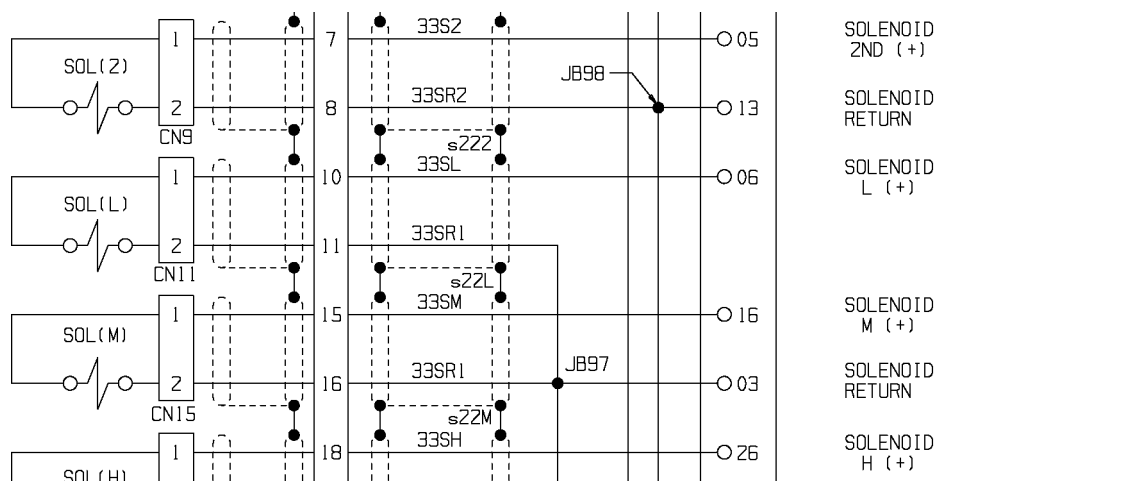
FAILURE CODE[15SBMA] R CLUTCH ECMV: MALFUNCTION

Action code	Failure code	Description	R clutch ECMV: Malfunction (R command holding pressure, R clutch fill switch OFF, slipping detected) (Transmission controller system)
E03	15SBMA		
Contents of trouble	<ul style="list-style-type: none"> The signal from the fill switch stays "OFF" during an output to the R clutch ECMV and an abnormality exists in the value calculated from the signals of transmission input shaft speed sensor, transmission intermediate shaft speed sensor and transmission output shaft speed sensor. 		
Controller response	<ul style="list-style-type: none"> The controller sets the gear is neutral. Turns lock up to OFF. 		
Problem that appears on machine	<ul style="list-style-type: none"> Machine cannot restart until it stops. 		
Related information	<ul style="list-style-type: none"> Electric current of output to ECMV can be checked by monitoring function (code: 31606 (mA)) If the electrical system is normal, check for a failure in the hydraulic or mechanical system for R clutch or pressure control valve. 		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
		1	Defective R clutch ECMV	1) Turn starting switch OFF. 2) Connect T-adapter to connector CN12 (male).	
Between CN5 (R,PS) (male) (1) – (2)				Resistance	5 – 15 Ω
Between CN5 (R,PS) (male) (1), (2) – ground				Resistance	Min. 1 MΩ
2		Disconnection in wiring harness (Disconnection or defective contact)	1) Turn starting switch OFF. 2) Connect T-adapter to connectors ATC3 (female) and CN5 (R,PS) (female).		
			Wiring harness between ATC3 (female) (25) – CN5 (R,PS) (female) (1)	Resistance	Max. 1 Ω
			Wiring harness between ATC3 (female) (23) – CN5 (R,PS) (female) (2)	Resistance	Max. 1 Ω
3		Defective speed sensor detection	<ul style="list-style-type: none"> Troubleshooting by failure code DL**KA, DL**LC 		
4		Defective transmission controller	1) Turn starting switch OFF. 2) Connect T-adapter to connector ATC3 (female).		
			Wiring harness between ATC3 (female) (25) – (23)	Resistance	5 – 15 Ω

TABLE 1					
Speed when trouble was detected		Failed clutch	Remedy against trouble		
			Action of controller (Selected clutch, gear speed)		ON/OFF state of lockup clutch
F7	3rd High	3rd	OFF	NEUTRAL	OFF
		High	OFF	NEUTRAL	OFF
F6	3rd Mid	3rd	OFF	NEUTRAL	OFF
		Mid	3H	F7	OFF
F5	2nd High	2nd	3M	F6	OFF
		High	3M	F6	OFF
F4	2nd Mid	2nd	3M	F6	OFF
		Mid	2H	F5	OFF
F3	1st High	1st	2M	F4	OFF
		High	2M	F4	OFF
F2	1st Mid	1st	2M	F4	OFF
		Mid	1H	F3	OFF
F1	2nd Low	2nd	1M	F2	OFF
		Low	1M	F2	OFF
R	Reverse Low	Reverse	OFF	NEUTRAL	OFF
		Low	RM	R*	OFF

* Combination not normally used



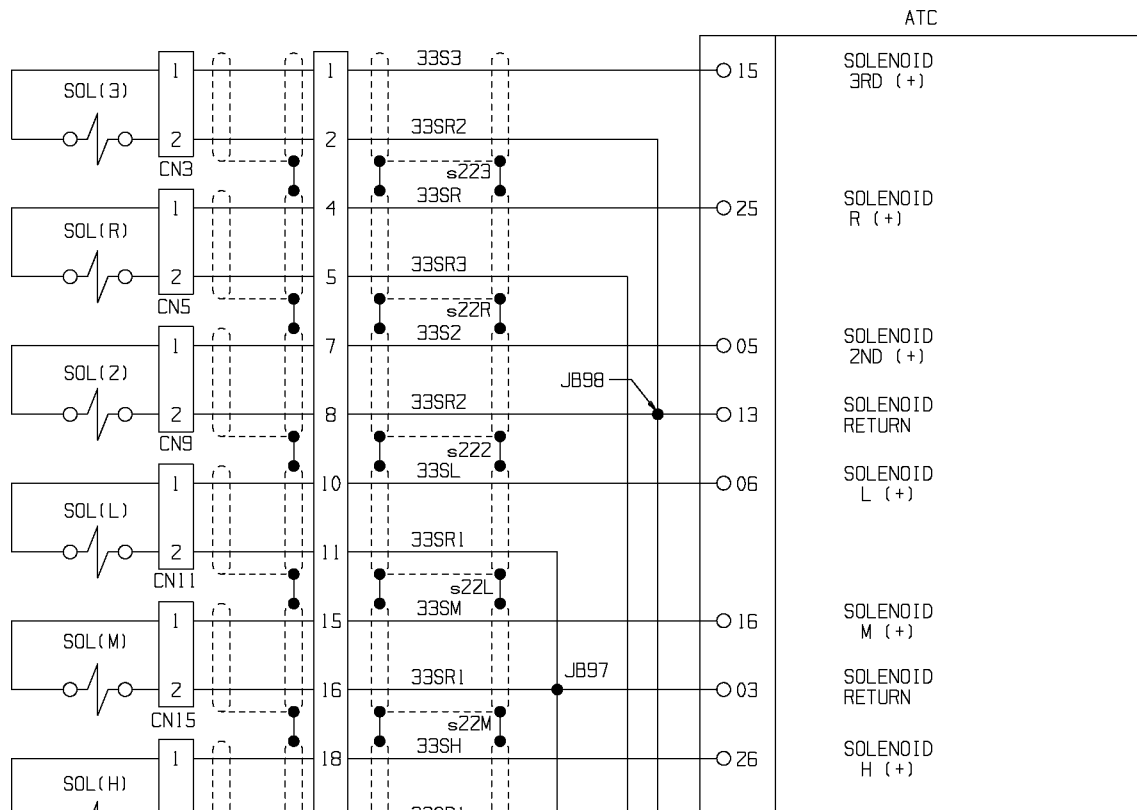
FAILURE CODE [15SGL1] 3rd CLUTCH ECMV: FILL SIGNAL ON, COMMAND CURRENT OFF

Action code	Failure code	Description	3rd clutch ECMV: Fill signal ON, command current OFF (Transmission controller system)
E03	15SGL1		
Contents of trouble	<ul style="list-style-type: none"> Even when output to the 3rd clutch ECMV is turned "OFF", the signal from the fill switch stays "ON" and the clutch is not released. 		
Controller response	<ul style="list-style-type: none"> Shifts up and holds the gear speed as shown in Table 2 depending on the gear speed before failure. Turns lock up to OFF. 		
Problem that appears on machine	<ul style="list-style-type: none"> Machine travels at gear speeds which use 3rd clutch. Machine cannot travel in reverse. 		
Related information	<ul style="list-style-type: none"> Electric current of output to ECMV can be checked by monitoring function (code: 31604 (mA)) Fill switch input signal can be checked with code: 31520 (0: OFF, 1:ON). If electrical system is normal, check hydraulic and mechanical systems of 3rd clutch or pressure control valve for defect. 		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting			
		1	Defective 3rd clutch fill switch	1) Turn starting switch OFF. 2) Connect T-adapter to connector CN4 (3,SW) (male).		
Between CN4 (3,SW) (male) (1) – ground				When 3rd is released	Resistance	Min. 1 MΩ
				When 3rd is engaged	Resistance	Max. 1 Ω
2		Defective harness grounding (Contact with ground circuit)	1) Turn starting switch OFF. 2) Disconnect connectors ATC3 and CN4 (3,SW). 3) Connect T-adapter to ATC3 (female).			
			Between ground and wiring harness between ATC3 (female) (19) – CN4 (3,SW) (female) (1)	Resistance	Min. 1 MΩ	
3		Defective transmission controller	1) Turn starting switch OFF. 2) Connect T-adapter to connector ATC3 (female).			
	Between ATC3 (female) (19) – ground		When 3rd is released	Resistance	Min. 1 MΩ	
			When 3rd is engaged	Resistance	Max. 1 Ω	

TABLE 1					
Speed when trouble was detected		Failed clutch	Remedy against trouble		
			Action of controller (Selected clutch, gear speed)		ON/OFF state of lockup clutch
F7	3rd High	3rd	OFF	NEUTRAL	OFF
		High	OFF	NEUTRAL	OFF
F6	3rd Mid	3rd	OFF	NEUTRAL	OFF
		Mid	3H	F7	OFF
F5	2nd High	2nd	3M	F6	OFF
		High	3M	F6	OFF
F4	2nd Mid	2nd	3M	F6	OFF
		Mid	2H	F5	OFF
F3	1st High	1st	2M	F4	OFF
		High	2M	F4	OFF
F2	1st Mid	1st	2M	F4	OFF
		Mid	1H	F3	OFF
F1	2nd Low	2nd	1M	F2	OFF
		Low	1M	F2	OFF
R	Reverse Low	Reverse	OFF	NEUTRAL	OFF
		Low	RM	R*	OFF

* Combination not normally used



FAILURE CODE [B@BFZK] FUEL SYSTEM: FUEL LEVEL LOW

Action code	Failure code	Description	Fuel system: fuel level low (Machine monitor system)
–	B@BFZK		
Contents of trouble	<ul style="list-style-type: none"> Fuel level sensor signal indicates lowering of fuel level (Resistance of 70 Ω or higher is detected). 		
Controller response	<ul style="list-style-type: none"> Does not display this failure code, if DJF1KA is detected. Turns fuel level caution lamp ON. 		
Problem that appears on machine	<ul style="list-style-type: none"> None in particular. 		
Related information	<ul style="list-style-type: none"> When fuel level is below LOW and fuel is added, if failure code disappears, fuel was insufficient. Signal from fuel level sensor can be checked with monitoring function. (Monitoring code: MONITOR PANEL - FUEL SENSOR - 04200 (V) / 04201 (Ω)) Method of reproducing failure code: Turn starting switch ON. 		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting
	1	Lack of fuel (When system is normal)	
2	Defective fuel level sensor	When not recover by above 1, then perform troubleshooting for failure code [DJF1KA] .	

NOTES

FAILURE CODE [DB1RKR] RETARDER CONTROLLER: COMMUNICATION ERROR

Action code	Failure code	Description	Retarder controller: Communication error (Between retarder controller – transmission controller) (Transmission controller system)
E03	DB1RKR		
Contents of trouble	<ul style="list-style-type: none"> Updating of received data from retarder controller has stopped. 		
Controller response	<ul style="list-style-type: none"> AISS is locked in LOW. (until starting switch is turned OFF.) Keep the information at the time when abnormality occurred. Turns on centralized warning lamp and sounds alarm buzzer. 		
Problem that appears on machine	<ul style="list-style-type: none"> The information and special functions which are retrieved from retarder controller do not work or display. 		
Related information			

Refer to pages 10 of the electrical schematic.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting	
		1	Defective CAN terminal resistor (Internal defect)	Prepare with starting switch OFF, then perform troubleshooting without turning starting switch ON.
CAN01-2 (male)				Resistance
Between (A) – (B)				Approx. 120 ± 12 Ω
2		Disconnection in wiring harness (Disconnection in wiring or defective contact in connector)	Prepare with starting switch OFF, then perform troubleshooting without turning starting switch ON.	
	Wiring harness between CAN06 (A) – CAN05-3 (A), CAN05-2 (A), CAN05-1 (A); Wiring harness between CAN07 (E) – CAN04-3 (A), CAN04-2 (A), CAN04-1 (A); Wiring harness between ATC2 (32) – CAN03-3 (A), CAN03-2 (A), CAN03-1 (A); Wiring harness between RCM2 (32) – CAN02-3 (A), CAN02-2 (A), CAN02-1 (A); Wiring harness between HM4A (04) – CAN08-3 (A), CAN08-2 (A), CAN08-1 (A); Wiring harness between CN062 (3) – CAN01-3 (A), CAN01-2 (A), CAN01-1 (A), CN4 (3)		Resistance	Max. 1 Ω
		Wiring harness between CAN06 (B) – CAN05-3 (B), CAN05-2 (B), CAN05-1 (B); Wiring harness between CAN07 (D) – CAN04-3 (B), CAN04-2 (B), CAN04-1 (B); Wiring harness between ATC2 (22) – CAN03-3 (B), CAN03-2 (B), CAN03-1 (B); Wiring harness between RCM2 (22) – CAN02-3 (B), CAN02-2 (B), CAN02-1 (B); Wiring harness between HM4A (12) – CAN08-3 (B), CAN08-2 (B), CAN08-1 (B); Wiring harness between CN062 (10) – CAN01-3 (B), CAN01-2 (B), CAN01-1 (B), CN4 (8)	Resistance	Max. 1 Ω

NOTES

FAILURE CODE [DDTRKA] MID CLUTCH FILL SWITCH: OPEN CIRCUIT

Action code	Failure code	Description	Mid clutch fill switch: Open circuit (Command is Holding pressure, fill switch is OFF, and slip is not sensed) (Transmission controller system)
E03	DDTRKA		
Contents of trouble	<ul style="list-style-type: none"> When the output to the Mid clutch ECMV is turned ON, the clutch is engaged but the signal from the fill switch is not turned ON. 		
Controller Response	<ul style="list-style-type: none"> The controller keeps the current gear speed. If the shift lever is set in the "N" position, the controller keeps the gear in Neutral. 		
Problem that appears on machine	<ul style="list-style-type: none"> The gear cannot be shifted. If the shift lever is set in the "N" position, the machine cannot start until it is stopped. 		
Related information	<ul style="list-style-type: none"> This failure can be checked in the monitoring function (Code: 31520). 		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting			
		1	Defective R clutch fill switch	1) Turn the starting switch OFF. 2) Disconnect connector CN16 (M,SW). 3) Connect T-adapter.		
Between CN16 (M,SW) (male) (1) – ground				When dis-engaged	Resistance	Min. 1 MΩ
				When engaged	Resistance	Max. 1 Ω
2		Disconnection in wiring harness (Disconnection or defective contact)	1) Turn the starting switch OFF. 2) Disconnect connectors ATC3 and CN16 (M,SW). 3) Connect T-adapter.			
			Wiring harness between ATC3 (female) (20) - CN16 (M,SW) (female) (1)	Resistance	Max. 1 Ω	
3		Defective transmission controller	1) Turn the starting switch OFF. 2) Disconnect connector ATC3. 3) Connect T-adapter.			
	Between ATC3 (female) (20) – ground		When dis-engaged	Resistance	Min. 1 MΩ	
			When engaged	Resistance	Max. 1 Ω	

FAILURE CODE [DGR3KZ] RETARDER OIL TEMPERATURE SENSOR (LEFT REAR): OPEN OR SHORT CIRCUIT

Action code	Failure code	Description	Retarder oil temperature sensor (left rear): Open or short circuit (Retarder controller system)
E01	DGR3KZ		
Contents of trouble	<ul style="list-style-type: none"> Signal circuit voltage of retarder oil temperature sensor has become above 4.721 V. 		
Controller Response	<ul style="list-style-type: none"> None in particular. 		
Problem that appears on machine	<ul style="list-style-type: none"> Oil temperature gauge does not work because of failure mode of sensor. 		
Related information	<ul style="list-style-type: none"> Input signal from oil temperature sensor can be checked with monitoring function (codes: 30207 (?) and 30209 (V)). 		

Refer to pages 7 of the electrical schematic.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
		1	Defective retarder oil temperature sensor	Prepare with starting switch OFF, disconnect connector CN139 and troubleshooting with starting switch still OFF.	
CN139 (male)				Retarder oil temperature (?)	Resistance (kΩ)
Between (1) – (2)				25	42.7
				30	35.13
				80	6.556
				90	4.925
100		3.75			
2		Disconnection in wiring harness (Disconnection or defective contact)	Prepare with starting switch OFF, disconnect connector RCM1 and troubleshooting with starting switch still OFF.		
			RCM1 (female)	Retarder oil temperature (?)	Resistance (kΩ)
			Between (9) – (21)	25	42.7
				30	35.13
				80	6.556
				90	4.925
100		3.75			
3		Short circuit of harness (Contact with ground circuit or contact between harnesses)	Prepare with starting switch OFF, disconnect connector RCM1 and troubleshooting with starting switch still OFF.		
			RCM1 (female)	Retarder oil temperature (?)	Resistance (kΩ)
	Between (9) – (21)		25	42.7	
			30	35.13	
			80	6.556	
			90	4.925	
100	3.75				
4	Defective retarder controller (In normal system)	Prepare with starting switch OFF and troubleshooting with starting switch still ON.			
		Check with monitoring function code: 30207	Oil temperature	Actual oil temperature and displayed temperature are same.	

FAILURE CODE [DHT7L6] TORQUE CONVERTER OUTLET OIL PRESSURE SENSOR: MALFUNCTION

Action code	Failure code	Description	Torque converter outlet oil pressure sensor: Malfunction (Transmission controller system)
E01	DHT7L6		
Contents of trouble	<ul style="list-style-type: none"> While the engine is stopped, an oil pressure signal is input to the signal circuit of the torque converter outlet oil pressure sensor. 		
Controller Response	<ul style="list-style-type: none"> The controller controls the machine, fixing the torque converter outlet oil pressure to the set pressure itself. 		
Problem that appears on machine	<ul style="list-style-type: none"> Large shocks are made when the lockup system is operated. 		
Related information	<ul style="list-style-type: none"> Input state from torque converter outlet oil pressure sensor can be checked with monitoring function (Code: 32603 (MPa), 32604 (V)). 		

Refer to page 5 in the electrical schematic for reference.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
		1	Defective hot short in wiring harness (a contact with 24 V circuit)	<ol style="list-style-type: none"> Turn the starting switch OFF. Disconnect connector ATC1 and TC OUT. Connect T-adapter. Turn the key switch to ON. 	
Wiring harness between ATC1 (female) (1) - TC OUT (female) (3)				Voltage	Max. 1.2 V
2		Defective torque converter inlet oil pressure sensor	<ol style="list-style-type: none"> Turn the starting switch OFF. Disconnect connector TC OUT. Connect T-adapter. Turn the key switch to ON. 		
			Between TC OUT (1) - (2)	Voltage	20 - 30 V
			Between TC OUT (1) - (3)	Voltage	0.8 - 2.0 V
3		Defective transmission controller	<ol style="list-style-type: none"> Turn the starting switch OFF. Disconnect connector ATC1. Connect T-adapter. Turn the key switch to ON. 		
			Between ATC1 (16) - (21)	Voltage	20 - 30 V
			Between ATC1 (1) - (21)	Voltage	0.8 - 2.0 V

FAILURE CODE [DLF2LC] TRANSMISSION INTERMEDIATE SHAFT SPEED SENSOR: MALFUNCTION

Action code	Failure code	Description	Transmission intermediate shaft speed sensor: Disagreement of revolution speed signal (Transmission controller system)
E03	DLF2LC		
Contents of trouble	<ul style="list-style-type: none"> The speed calculated from the engine speed sensor signal, transmission input shaft speed sensor signal, and transmission output shaft speed sensor signal is different from the signal speed of the transmission intermediate shaft speed sensor. 		
Controller Response	<ul style="list-style-type: none"> The controller keeps the current gear speed. If the shift lever is set in the "N" position, the controller keeps the gear in Neutral. 		
Problem that appears on machine	<ul style="list-style-type: none"> The gear cannot be shifted. If the shift lever is set in the "N" position, the machine cannot start until it is stopped. 		
Related information	<ul style="list-style-type: none"> This failure can be checked in the monitoring function (Code: 31300 (rpm)). 		

Refer to page 5 in the electrical schematic for reference.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
		1	Transmission intermediate shaft speed sensor defective	1) Turn the starting switch OFF. 2) Disconnect connector N2. 3) Connect T-adapter.	
Between N2 (male) (1) – (2)				Resistance	500 – 1,000 Ω
Between N2 (male) (1), (2) – ground				Resistance	Min. 1 MΩ
2		Grounding fault in wiring harness (Contact with ground circuit)	1) Turn the starting switch OFF. 2) Disconnect connectors ATC2 – N2. 3) Connect T-adapter.		
			Between ground and wiring harness between ATC2 (female) (20) – N2 (female) (1)	Resistance	Min. 1 MΩ
3		Defective hot short in wiring harness (a contact with 24 V circuit)	1) Turn the starting switch OFF. 2) Disconnect connectors ATC2 and N2. 3) Connect T-adapter. 4) Turn the starting switch ON.		
			Between ground and wiring harness between ATC2 (female) (20) – N2 (female) (1)	Voltage	Max. 1 V
4		Defective transmission controller	1) Turn the starting switch OFF. 2) Disconnect connector ATC2. 3) Connect T-adapter.		
			Between ATC2 (female) (20) – (39)	Resistance	500 – 1,000 Ω

FAILURE CODE [DW7FMA] MANUAL EMERGENCY BRAKE VALVE: FAILURE

Action code	Failure code	Description	Manual emergency brake valve: Failure (Retarder controller system)
E03	DW7FMA		
Contents of trouble	<ul style="list-style-type: none"> Emergency brake does not operate even though the driver works the manual emergency brake. 		
Controller Response	<ul style="list-style-type: none"> None in particular 		
Problem that appears on machine	<ul style="list-style-type: none"> Emergency brake does not operate 		
Related information	<ul style="list-style-type: none"> Input state can be checked with monitoring function (Code: 32101). 		

Refer to page 7 & 8 of the electrical schematic for reference.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
		1	Defective manual emergency valve	Disconnect CN169. Connect CN169 (2) - ground. Connect 24V supply to CN169 (1).	The solenoid should energize.
2		Grounding fault in wiring harness (Contact with ground circuit) (Emergency auto apply sw failure)	Prepare with starting switch OFF, then perform troubleshooting without turning starting switch ON.		
			Wiring harness between CN222 (female) (1) – RMC3 (30)	Resistance	Min. 1 MΩ
3		Defective hot short in wiring harness (a contact with 24 V circuit) (Emergency brake sw sense failure)	Prepare with starting switch OFF, then turn starting switch ON and perform troubleshooting.		
	Wiring harness between EBS (female) (3) – RCM2 (25)		Voltage	Max. 1 V	
4	Defective retarder controller	Check with monitoring function code: 32101.			
		Emergency brake switch ON	ON		
		Emergency brake switch OFF	OFF		

FAILURE CODE [DX12MA] FRONT BRAKE PPC SOLENOID VALVE: MALFUNCTION (VALVE DOES NOT OPERATE)

Action code	Failure code	Description	Front brake PPC solenoid valve: Malfunction (valve does not operate) (Retarder controller system)
E03	DX12MA		
Contents of trouble	<ul style="list-style-type: none"> Front brake proportional pressure reducing solenoid valve and solenoid keep operating and do not return or their condition cannot be judged normally because of defect in sensor switch after they return. 		
Controller Response	<ul style="list-style-type: none"> Continues control. 		
Problem that appears on machine	<ul style="list-style-type: none"> If solenoid is defective, front brake drags. If switch is defective or switch input circuit has disconnection, condition does not change. 		
Related information	<ul style="list-style-type: none"> Condition of front retarder oil pressure switch can be checked with monitoring function (Code: 34102). 		

Refer to page 7 & 8 of the electrical schematic for reference.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting			
		1	Defective front brake proportional pressure reducing solenoid valve	<ul style="list-style-type: none"> Check front brake proportional pressure reducing solenoid valve. If there is an abnormality (mechanical failure), repair or replace it. 		
2		Defective front brake proportional pressure reducing solenoid	1) Turn starting switch OFF. 2) Connect T-adapter to connector CN230.			
			Between CN230 (male) (1) – (2)	Oil pressure is ON.	Resistance	Max. 1 Ω
Oil pressure is OFF.		Resistance		Min. 1 MΩ		
3		Defective retarder pressure switch Front retard apply sw	1) Turn starting switch OFF. 2) Insert T-adapter in connector CN230. 3) Start engine.			
			CN236	Retarder	Voltage	
			Between (1) – (2)	When not operated	8 ± 1 V	
When operated		Max. 1 V				
4		Disconnection in wiring harness Front retard apply sw	1) Turn starting switch OFF. 2) Disconnect connectors RCM3 and CN230. 3) Connect T-adapter to RCM3.			
			Between ground and wiring harness between RCM3 (female) (29) – CN236 (female) (1)		Resistance	Min. 1 MΩ
5	Defective retarder controller	1) Turn starting switch OFF. 2) Insert T-adapter in connector RCM3. 3) Turn starting switch ON.				
		Between RCM3 (26) – (13)	Oil pressure is ON.	Voltage	Max. 1 V	
			Oil pressure is OFF.	Voltage	8 ± 1 V	

FAILURE CODE [DXH1KA] LOCKUP CLUTCH ECMV OUTPUT CIRCUIT: OPEN CIRCUIT

Action code	Failure code	Description	Lockup clutch ECMV output circuit: Open circuit (Transmission controller system)
E03	DXH1KA		
Contents of trouble	<ul style="list-style-type: none"> When signal is output to lockup clutch ECMV, no current flows. 		
Controller Response	<ul style="list-style-type: none"> Keeps gear speed used for travel. Turns lockup operation OFF. Even if cause of failure disappears, system does not reset itself until starting switch is turned OFF. 		
Problem that appears on machine	<ul style="list-style-type: none"> Lockup system does not operate. If gearshift lever is set in N, machine cannot restart until it stops. 		
Related information	<ul style="list-style-type: none"> As ECMV detects disconnection while output is ON, be sure to turn output ON to check operation after repair. Output current to lockup ECMV can be checked with monitoring function (Code: 31609 (mA)). Since output is turned ON and self-check is performed for 5 seconds after starting switch is turned ON, wait for 5 seconds without starting the engine. If trouble has not been repaired, error is detected again. 		

Refer to page 6 of the electrical schematic for reference.

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
		1	Defective lockup clutch ECMV	1) Turn starting switch OFF. 2) Connect T-adaptor to connector CN17 (L/U,PS) (male).	
Between CN17 (L/U,PS) (male) (1) – (2)				Resistance	5 – 15 Ω
Between CN17 (L/U,PS) (male) (1), (2) – ground				Resistance	Min. 1 MΩ
2		Disconnection in wiring harness (Disconnection or improper contact)	1) Turn starting switch OFF. 2) Connect T-adaptor to connectors ATC3 (female) and CN17 (L/U,PS) (female).		
			Wiring harness between ATC3 (female) (35) – CN17 (L/U,PS) (female) (1)	Resistance	Max. 1 Ω
			Wiring harness between ATC3 (female) (23) – CN17 (L/U,PS) (female) (2)	Resistance	Max. 1 Ω
3	Defective transmission controller	1) Turn starting switch OFF. 2) Connect T-adaptor to connector ATC3 (female).			
		Between ATC3 (female) (35) – (23)	Resistance	5 – 15 Ω	

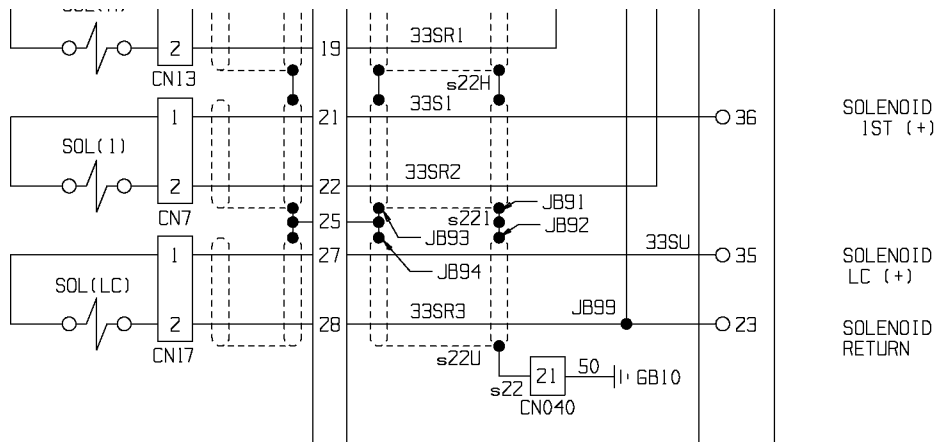


TABLE 1					
Speed when trouble was detected		Failed clutch	Remedy against trouble		
			Action of controller (Selected clutch, gear speed)		ON/OFF state of lockup clutch
F7	3rd High	3rd	OFF	NEUTRAL	OFF
		High	OFF	NEUTRAL	OFF
F6	3rd Mid	3rd	OFF	NEUTRAL	OFF
		Mid	3H	F7	OFF
F5	2nd High	2nd	3M	F6	OFF
		High	3M	F6	OFF
F4	2nd Mid	2nd	3M	F6	OFF
		Mid	2H	F5	OFF
F3	1st High	1st	2M	F4	OFF
		High	2M	F4	OFF
F2	1st Mid	1st	2M	F4	OFF
		Mid	1H	F3	OFF
F1	2nd Low	2nd	1M	F2	OFF
		Low	1M	F2	OFF
R	Reverse Low	Reverse	OFF	NEUTRAL	OFF
		Low	RM	R*	OFF

*Combination not normally used

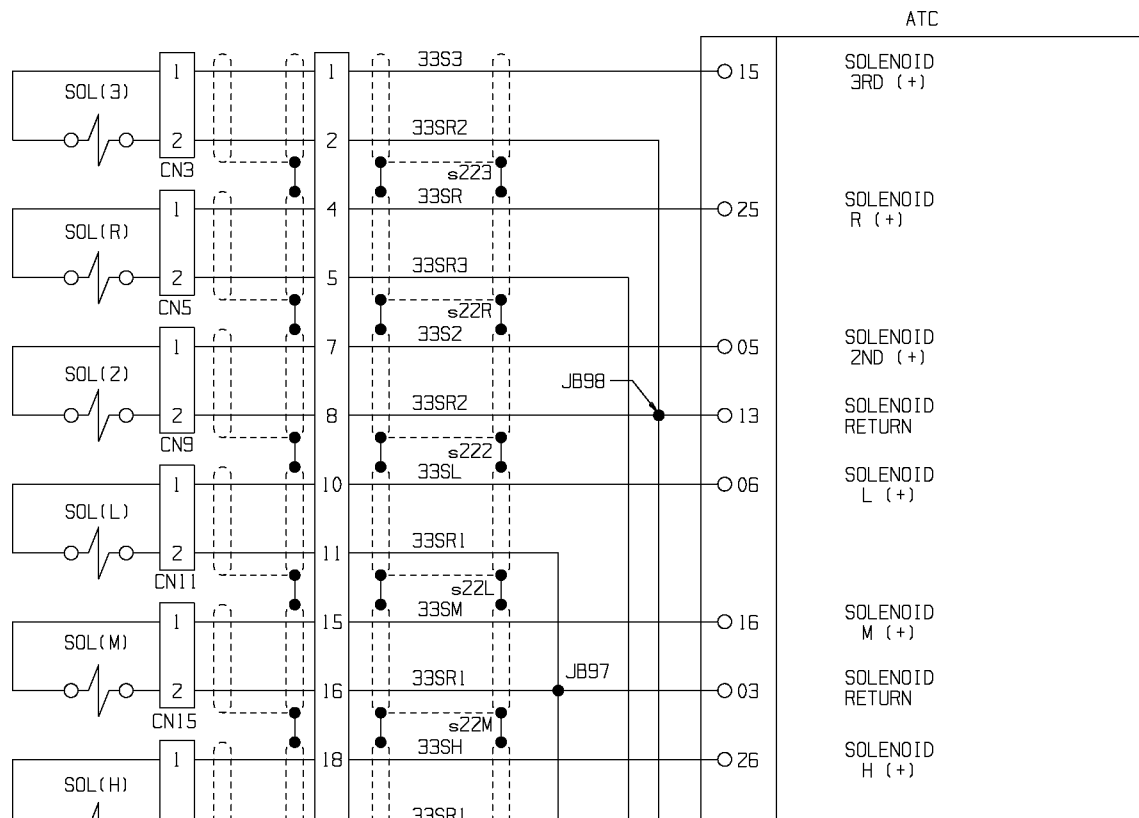


TABLE 2

Speed when trouble was detected		Failed clutch (Fill switch ON)	Remedy against trouble		
			Action of controller (Selected clutch, gear speed)		ON/OFF state of lockup clutch
N	— Mid	3rd	OFF	NEUTRAL*	OFF
		2nd	OFF	NEUTRAL*	OFF
		1st	OFF	NEUTRAL*	OFF
		High	OFF	NEUTRAL*	OFF
		Low	OFF	NEUTRAL*	OFF

* Combination not normally used, M clutch also off

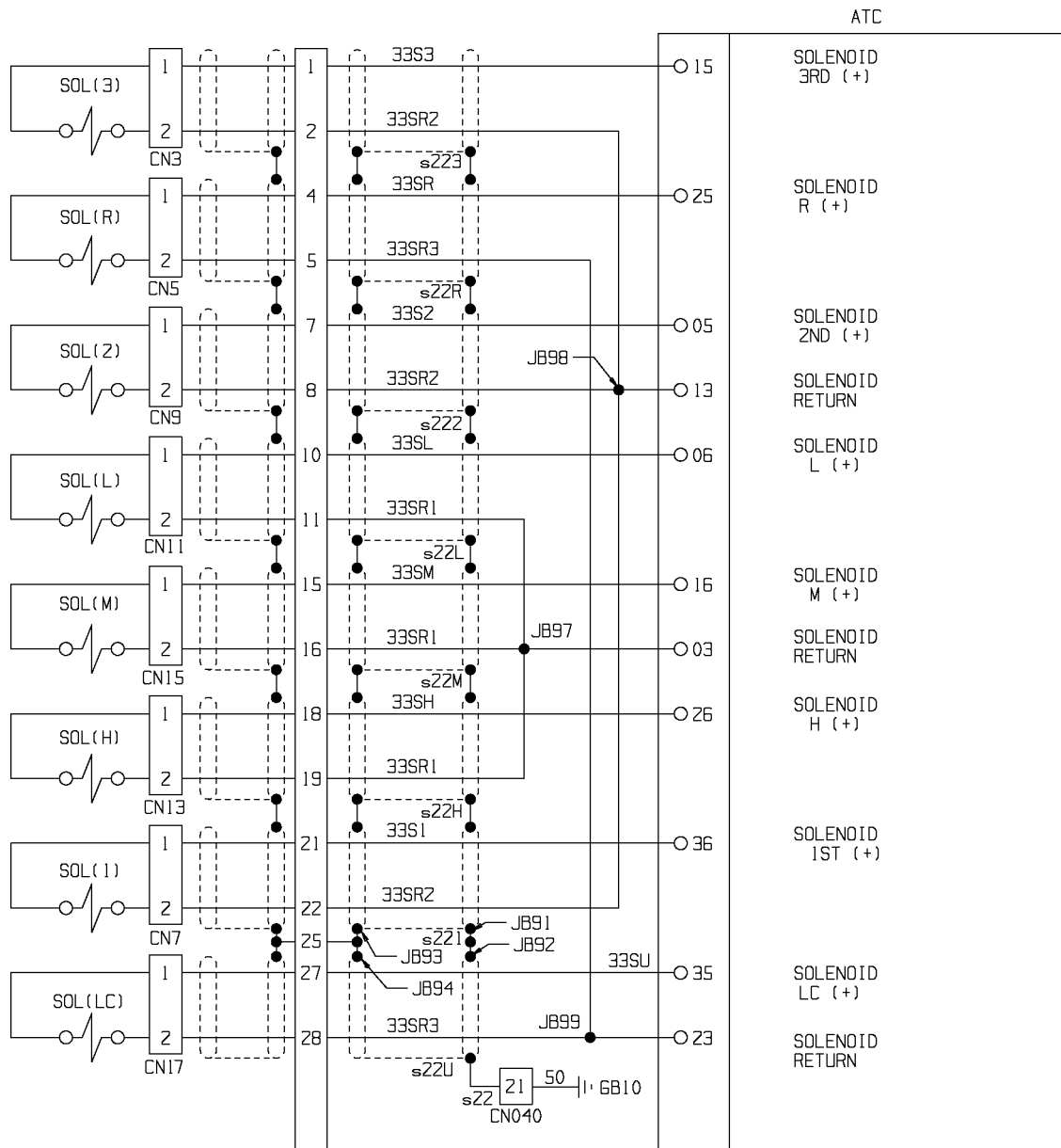
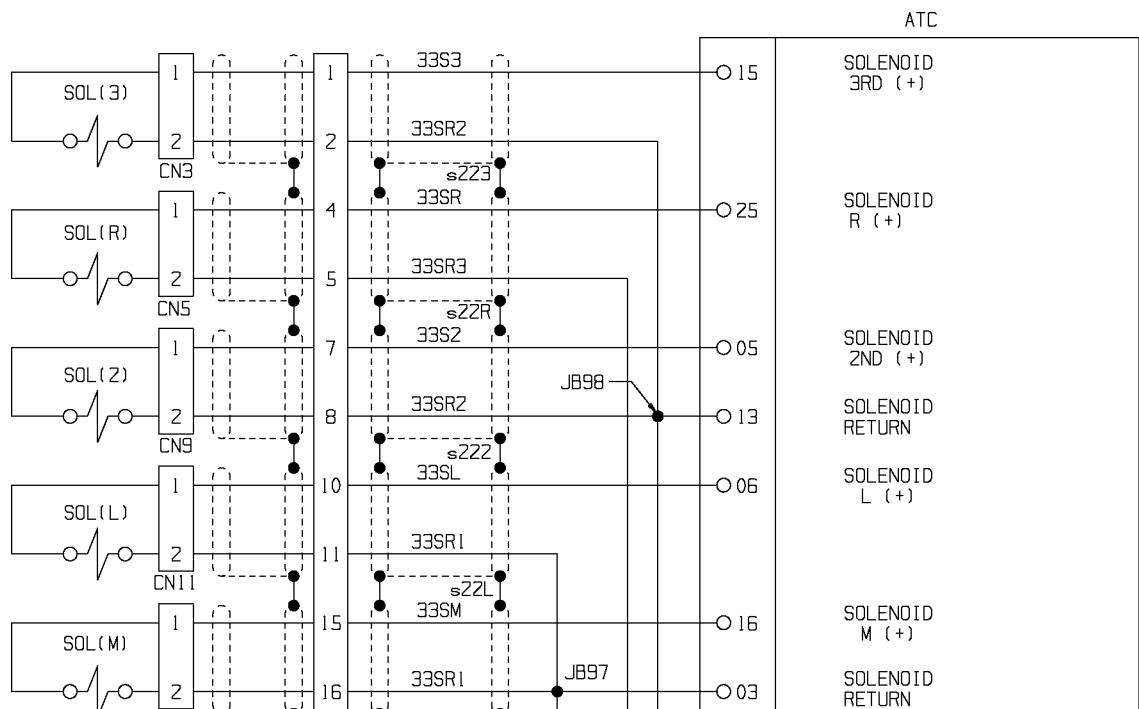


TABLE 1					
Speed when trouble was detected		Failed clutch	Remedy against trouble		
			Action of controller (Selected clutch, gear speed)		ON/OFF state of lockup clutch
F7	3rd High	3rd	OFF	NEUTRAL	OFF
		High	OFF	NEUTRAL	OFF
F6	3rd Mid	3rd	OFF	NEUTRAL	OFF
		Mid	3H	F7	OFF
F5	2nd High	2nd	3M	F6	OFF
		High	3M	F6	OFF
F4	2nd Mid	2nd	3M	F6	OFF
		Mid	2H	F5	OFF
F3	1st High	1st	2M	F4	OFF
		High	2M	F4	OFF
F2	1st Mid	1st	2M	F4	OFF
		Mid	1H	F3	OFF
F1	2nd Low	2nd	1M	F2	OFF
		Low	1M	F2	OFF
R	Reverse Low	Reverse	OFF	NEUTRAL	OFF
		Low	RM	R*	OFF

*Combination not normally used



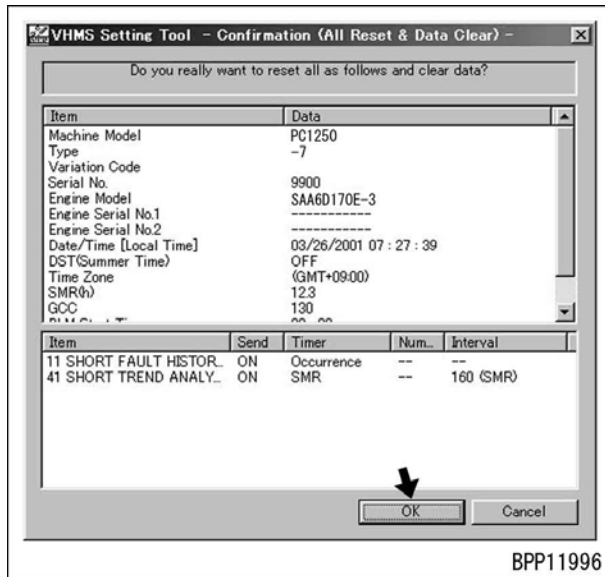
FAILURE CODE [DXJ7KA] MID CLUTCH ECMV OUTPUT CIRCUIT: OPEN CIRCUIT

Action code	Failure code	Description	Mid clutch ECMV output circuit: Open circuit (Transmission controller system)
E03	DXJ7KA		
Contents of trouble	<ul style="list-style-type: none"> Current does not flow when output to Mid clutch ECMV is ON. 		
Controller Response	<ul style="list-style-type: none"> Shifts up and holds the gear speed as shown in Table 1 depending on the gear speed before failure Turns lock up to OFF. 		
Problem that appears on machine	<ul style="list-style-type: none"> Once the gear shift lever is set to neutral, the machine cannot move off in any gear speeds. 		
Related information	<ul style="list-style-type: none"> As ECMV detects disconnection while output is ON, be sure to turn output ON to check operation after repair. Electric current of output to ECMV can be checked with monitoring function (code: 31640 (mA)). Since output is turned ON and self-check is performed for 5 seconds after starting switch is turned ON, wait for 5 seconds without starting the engine. If trouble has not been repaired, error is detected again. 		

Possible causes and standard value in normal state	Cause		Standard value in normal state/Remarks on troubleshooting		
		1	Defective Hi clutch ECMV	1) Turn starting switch OFF. 2) Connect T-adapter to connector CN15 (M,PS) (male).	
Between CN15 (M,PS) (male) (1) – (2)				Resistance	5 – 15 Ω
Between CN15 (M,PS) (male) (1), (2) – ground				Resistance	Min. 1 MΩ
2		Disconnection in wiring harness (Disconnection or defective contact)	1) Turn starting switch OFF. 2) Connect T-adapter to connectors ATC3 (female) and CN15 (M,PS) (female).		
			Wiring harness between ATC3 (female) (16) – CN15 (M,PS) (female) (1)	Resistance	Max. 1 Ω
			Wiring harness between ATC3 (female) (3) – CN15 (M,PS) (female) (2)	Resistance	Max. 1 Ω
3		Defective transmission controller	1) Turn starting switch OFF. 2) Connect T-adapter to connector ATC3 (female).		
			Between ATC3 (female) (16) – (3)	Resistance	5 – 15 Ω

13. After the data in [Machine Information] has been checked and corrected, press the [Apply] button to finalize the setting. After the [Apply] button is pressed, a message confirming the setting will appear on the screen. Check the setting again, and if the setting is correct, press the [OK] button.

a. ORBCOMM installation requires the settlement operation after [Communication Setting] is completed.

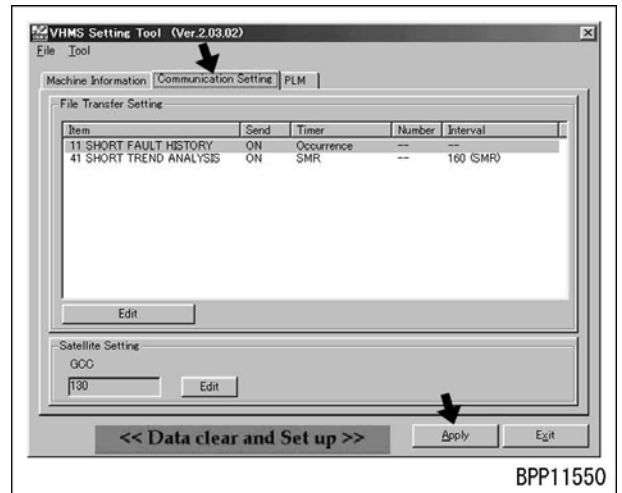


BPP11996

14. [Communication Setting] [ORBCOMM installation specification only]

a. This setting shall be implemented after the request for station opening has been made and station of ORBCOMM has been opened.

15. Open the [Communication Setting] tab. Check the data and verify that it is correct.



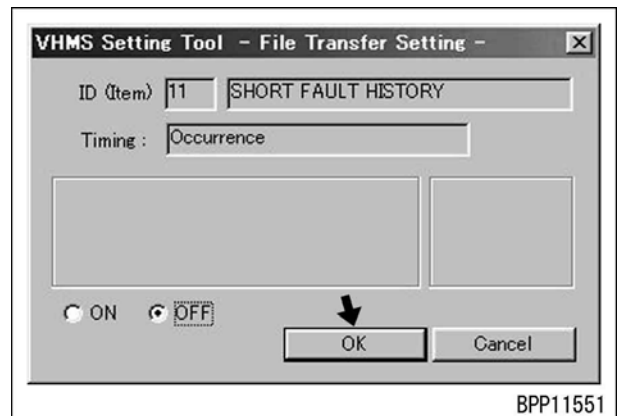
BPP11550

16. When modifying the setting of [SHORT FAULT HISTORY], use the following procedure:

a. Select [SHORT FAULT HISTORY] from the screen. Press the [Edit] button in the lower left side of [File Transfer Setting] block to display the setup screen.

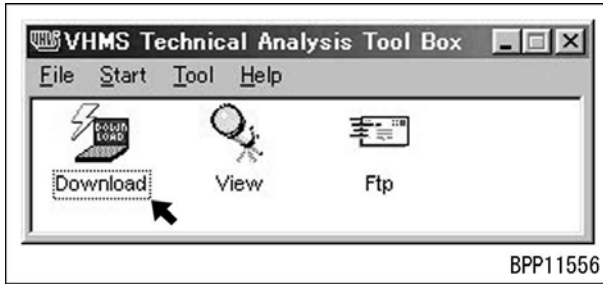
b. Correct the setting and, press the [OK] button.

During the initial setting, select [Occurrence] from the [Timing] box and then set the function to ON.



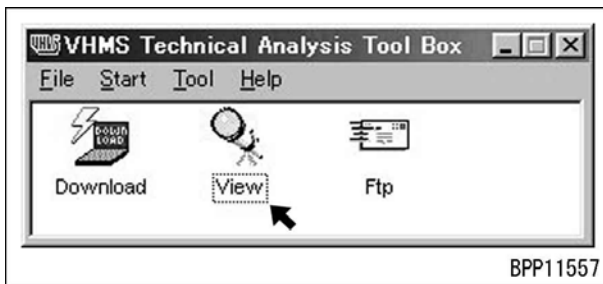
BPP11551

- Using the [Download] function, download the data currently recorded in VHMS to the PC. Verify that the download is complete and proceed to the next step.



Confirmation of Downloaded Data

- Confirm the setting data using the [View] function.
 - Ensure that the [MFA0] code, which was used in the quick snapshot, is indicated in [Fault History].
 - Verify that the snapshot data was recorded.



- When finished, close out of the [VHMS analysis tool].

Disconnecting the PC

- Turn the key switch to the OFF position.



Before connecting or disconnecting the PC, turn the key switch to the OFF position.

- End all applications on the PC and turn off the power.
- Disconnect the harness from the download connector and the PC.

Reporting to Komatsu

Complete and send the VHMS/WebCARE report to the VHMS/WebCARE Support Center at Komatsu Headquarters.

This report is for satellite communications to occur.

In this case, send VHMS data via Notes (LAN) or E-mail (WAN).

Komatsu VHMS/WebCARE Support Center

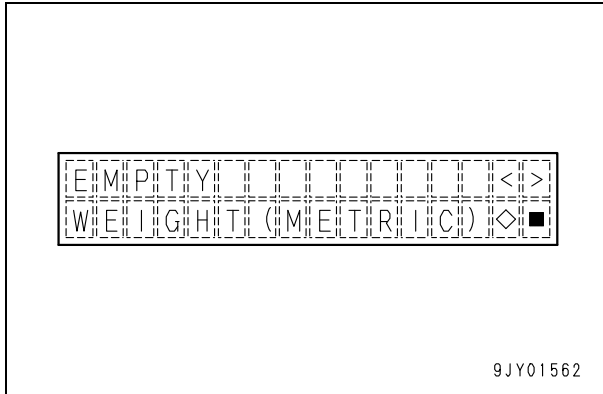
2-3-6, Akasaka Minato-Ku Tokyo, Japan

FAX: 81-3-5561-4766 (from outside of Japan)

FAX: 03-5561-4766 (Domestic user)

E-mail: webcare@komatsu.co.jp

3. Select "EMPTY WEIGHT".



[>], [<] : Select "EMPTY WEIGHT" or "LOADED WEIGHT"

[◇] : Accept the selection and go to the next step

[■] : Return to the previous screen

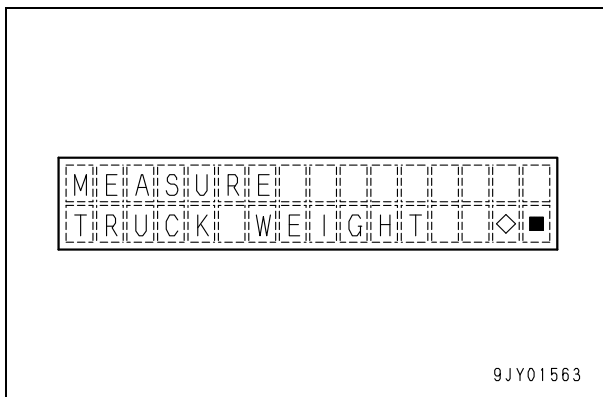
If the weight of the empty machine has been entered and the machine has been driven for about 3 minutes, "LOADED WEIGHT" is displayed when the menu is selected.

Confirm the unit of measurement. It is indicated in the () on the right side of WEIGHT.

(METRIC): metric ton

(SHORT): short ton

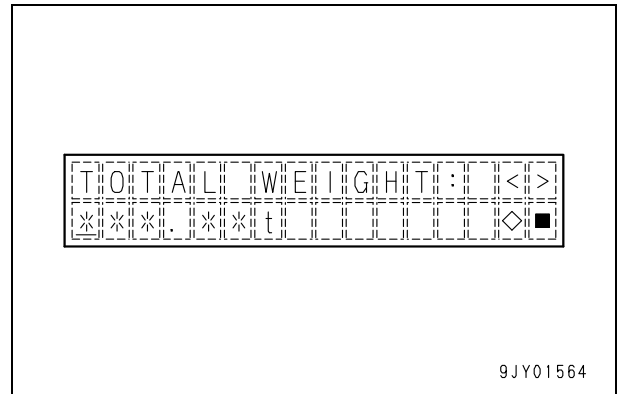
4. Confirm that the weight of the empty machine has been measured correctly.



[◇] : Accept the weight measurement and go to the next step

[■] : Return to the previous screen

5. Enter the measured weight of the empty machine.



[>] : The number at the cursor increases in value

[<] : The number at the cursor decreases in value

[◇] : Accept the number at the cursor and go to the next step

[■] : Return to the highest numerical placeholder to enter the value again. If this button is pressed again, the editing data process data is stopped and the previous screen appears.

Input range

HD1500-7:

105.3 [t] (Empty weight ± 13%)

(metric ton)

NORMAL OPERATION DISPLAY

Machine condition		Machine monitor display	External display lamps
When starting switch is ON		---	Illuminates for 30 seconds
When empty	Stopped (*1)	Standard display (*2)	OFF
	Traveling	Standard display	OFF
During loading	Stopped	Payload display (*3)	Payload display
	Traveling	Standard display	OFF
When loaded	Stopped	Payload display	Payload display
	Traveling	Standard display	OFF
When dumping	Stopped	Payload display → standard display	Payload display → OFF
	Traveling	Standard display	OFF

(*1) Stopped = shift lever is in the N position and the travel speed signal is 0.

(*2) For details of the standard display on the machine monitor, refer to Section D15, Machine Monitor.

(*3) The machine starts off empty and is being loaded. It is necessary to wait for the load to go above approximately 15% of the rated payload and for the change in the load to stabilize when the machine is stopped.

Example of payload display

P	L	M						1	0	.	0	t
0	D	0						7	6	.	0	k m

D310085

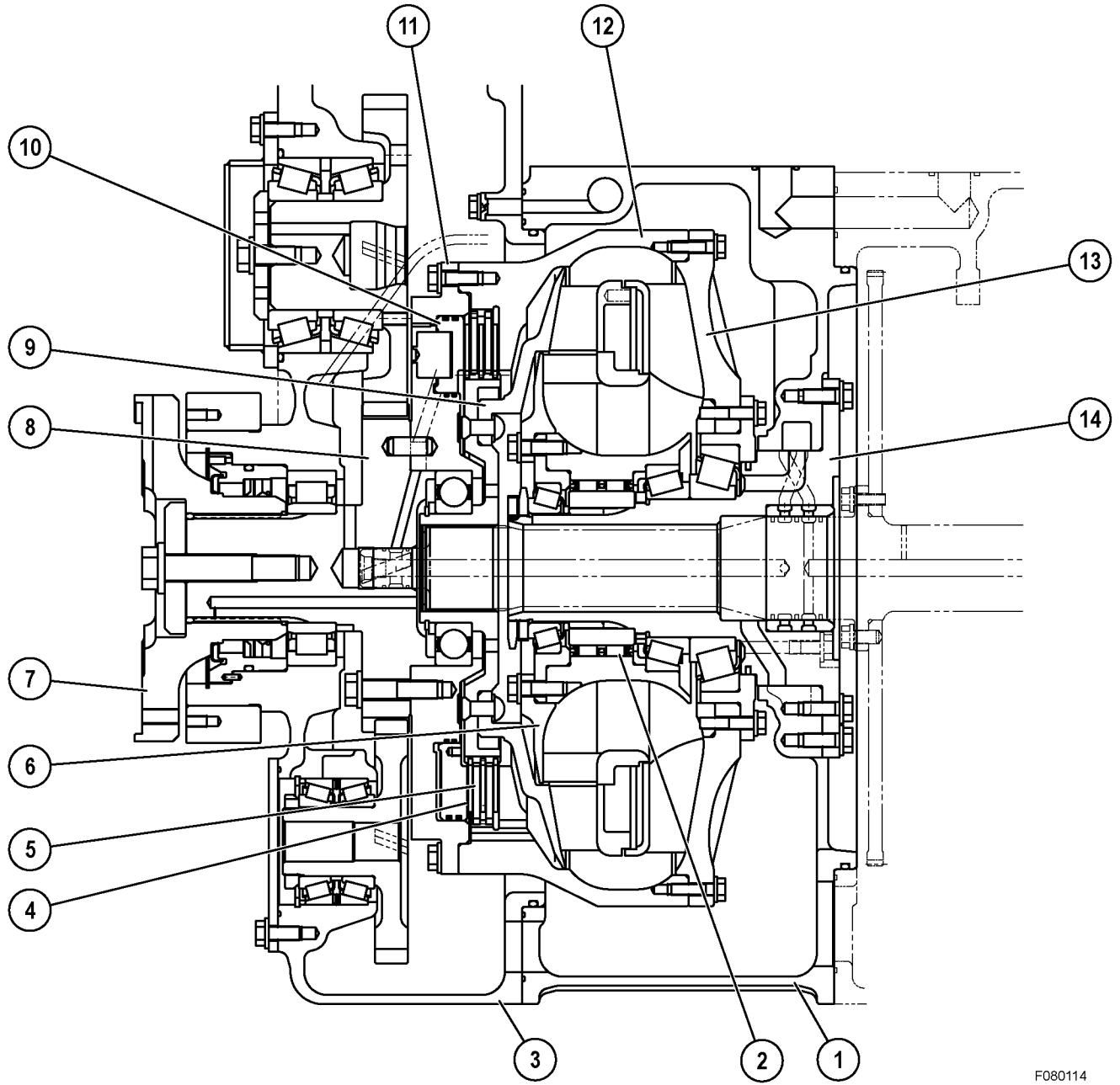
When the machine is stopped during loading, the service meter will not be displayed on the character display.

If it is desired to display the service meter, keep the machine monitor inspection switch pressed. The software version and service meter will be displayed in turn on the bottom line of the character display.

The payload at the loading point may differ slightly from the display at the dumping point. This is caused by the effect of the friction in the suspension, and is normal. Slight differences in payload from point to point do not indicate any failure in the payload meter.

Example of payload display when error occurs

If an error occurs in the suspension pressure sensors or in the inclinometer sensor, it becomes impossible to calculate the payload. The display will show [----].



F080114

FIGURE 2-4. TORQUE CONVERTER

- | | | |
|-------------------|----------------|----------------------------|
| 1. Rear Housing | 6. Stator | 11. Lock-Up Clutch Housing |
| 2. One-Way Clutch | 7. Coupling | 12. Housing |
| 3. Front Housing | 8. Input Shaft | 13. Pump |
| 4. Disc | 9. Turbine | 14. Shaft |
| 5. Plate | 10. Piston | |

ECMV's consists of two valves, a pressure control valve and a flow sensor valve.

Pressure Control Valve

The pressure control valve contains a proportional solenoid. The solenoid uses the current sent from the transmission controller and converts it into hydraulic pressure. Refer to Figure 2-19.

Flow Sensor Valve

The flow sensor valve is actuated by a trigger from the pressure control valve. The flow sensor valve has the following functions:

1. The valve is opened until the clutch is filled with oil, reducing the time taken for oil to fill the clutch.
2. When the clutch fills with oil, the valve closes. A full signal is sent to the controller.
3. While there is hydraulic pressure applied to the clutch, a full signal is sent to the controller to indicate whether there is hydraulic pressure present.

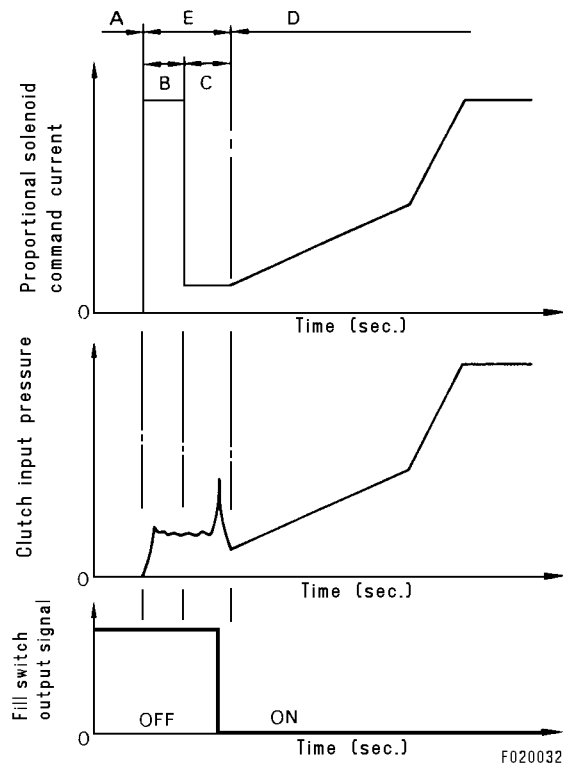


FIGURE 2-19.

- A range: Before Gear Shifting (drained)
- B range: Filling Starts (trigger issued)
- C range: Filling Completed
- D range: Regulation
- E range: Filling

ECMV and Proportional Solenoid

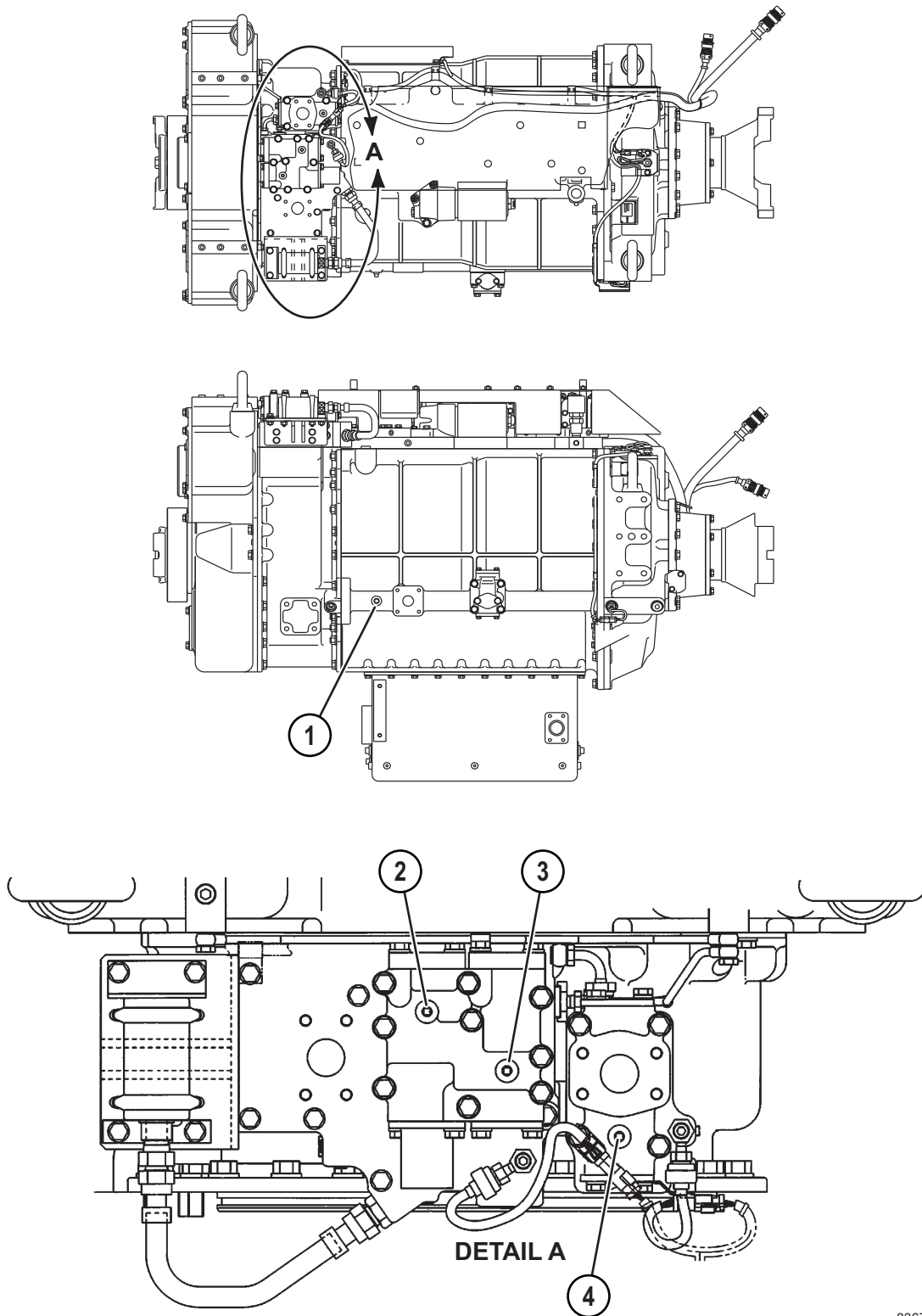
Each ECMV is equipped with one proportional solenoid.

The propulsion force shown in the diagram in Figure 2-20 is generated according to the command signal from the controller.

The propulsion force generated by the proportional solenoid acts on the pressure control valve spool. This generates the hydraulic pressure shown in the diagram. Therefore, by controlling the command current, the propulsion force is changed. This acts on the pressure control valve to control the oil flow and hydraulic pressure.

ECMV and Fill Switch

Each ECMV is equipped with one fill switch. When the clutch is completely filled, the flow sensor valve sends a signal to turn the fill switch on. As a result of this signal, the oil pressure starts to build up.



83672

FIGURE 2-37. TRANSMISSION OIL PRESSURE PORTS

1. Lubrication Oil Pressure Port
 2. Main Pressure Port

3. Torque Converter Inlet Pressure Port
 4. Torque Converter Outlet Pressure Port

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Removal

1. Drain the transmission oil. The capacity of the transmission is approximately 153 liters (41 gal).
2. Remove cap screws (5, Figure 3-2) and cover (3).
3. Remove magnetic strainer (1) and inspect.

⚠ IMPORTANT ⚠

Careful inspection of the oil pan interior, drained oil, and screen/magnets immediately after removal can provide valuable information regarding the condition of the transmission internal components. Perform the following inspections prior to cleaning.

Inspection

- Inspect the oil pan and drained oil. Check internal metal parts in the screen for a clogged or fouled condition with metallic particles. When the amount of foreign material has significantly increased compared to previous inspections, an internal failure probably exists. Immediate corrective action is required.

Black foreign material (2, Figure 3-3) in the screen element* indicates clutch disc wear. When the clogged area reaches approximately 10 mm (0.40 in) in width and about 60 mm (2.4 in) around the circumference, transmission repair is considered necessary within 200 operating hours. If the clogged area is more extensive, immediate repair is necessary.

If all magnets are fouled with iron particles, internal metal parts have worn excessively and may be damaged. Immediate repair is necessary.

NOTE: Check the oil pan interior and drained oil for foreign material or for metallic powder.

- If a large amount of metallic debris is found in an oil sample, immediate action is necessary.

Record small or trace amounts and check at the next interval for a trend.

- Contamination of oil by water or anti-freeze is considered serious. Record trace amounts to determine a trend. If a large percentage of content is found in an oil sample, check the oil cooler for leakage. Repair the source of the leak and rebuild the transmission.

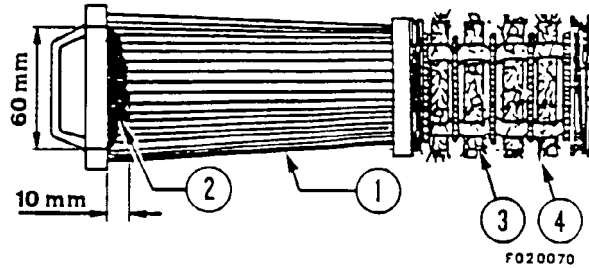


FIGURE 3-3. MAGNETIC STRAINER

- | | |
|-------------------------------------------|-------------------|
| 1. Screen Element | 3. Magnets |
| 2. Black Foreign Matter
(non-metallic) | 4. Iron Particles |

Installation

1. Install each magnetic strainer (1, Figure 3-2) into the transmission oil pan.
2. Install new O-rings (2) in the cover. Install the cover using cap screws (5) and washers (4). Tighten the cap screws to standard torque.
3. Fill the transmission with oil. Refer to Section P, Lubrication And Service, for oil specifications.

TORQUE CONVERTER REBUILD

The following information provides instructions for removing the torque converter from the transmission, torque converter rebuild, and reinstalling the torque converter. Refer to Section F2, Torque Converter and Transmission, for instructions on removing the transmission/torque converter from the truck.

- Special tools for aiding in torque converter and transmission rebuild are listed at the end of this chapter in Special Tools.
- Unless otherwise specified, use standard torque specifications for fasteners. Refer to Section A5 for standard torque specifications.

REMOVAL

1. Remove the transmission and torque converter from the truck. Refer to Transmission Removal in Section F2 for instructions.
2. Thoroughly clean the transmission and torque converter to remove any dirt accumulation.
3. Remove hydraulic pumps (2, 3, 4, & 5, Figure 8-1). Remove trunnion (6).

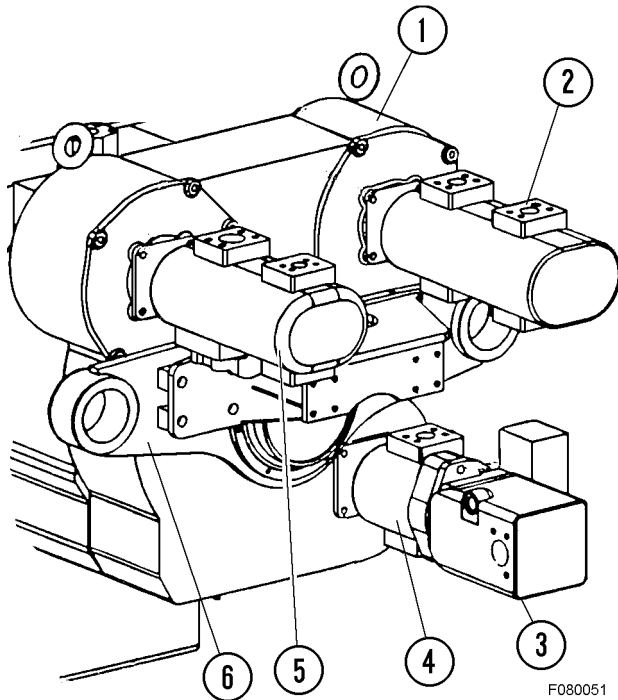


FIGURE 8-1. HYDRAULIC PUMPS

- | | |
|------------------------|-----------------------|
| 1. Torque Converter | 4. Transmission Pump |
| 2. Hoist Pump | 5. Brake Cooling Pump |
| 3. Steering/Brake Pump | 6. Trunnion |

4. If the transmission is to be disassembled, remove the cap screw on the output shaft and remove drive shaft flange (5, Figure 8-2).
5. Remove cover (4) from the ECMV valve assembly.
6. Disconnect inlet pressure sensor (2) and outlet pressure sensor (3).

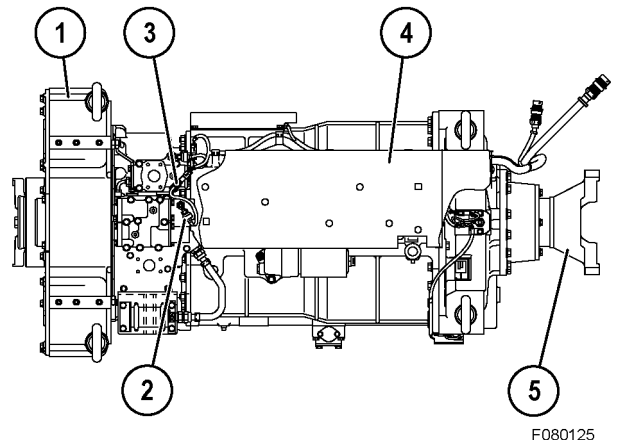


FIGURE 8-2. SENSOR WIRING

- | | |
|---------------------------|------------------|
| 1. Torque Converter | 4. ECMV Cover |
| 2. Inlet Pressure Sensor | 5. Output Flange |
| 3. Outlet Pressure Sensor | |

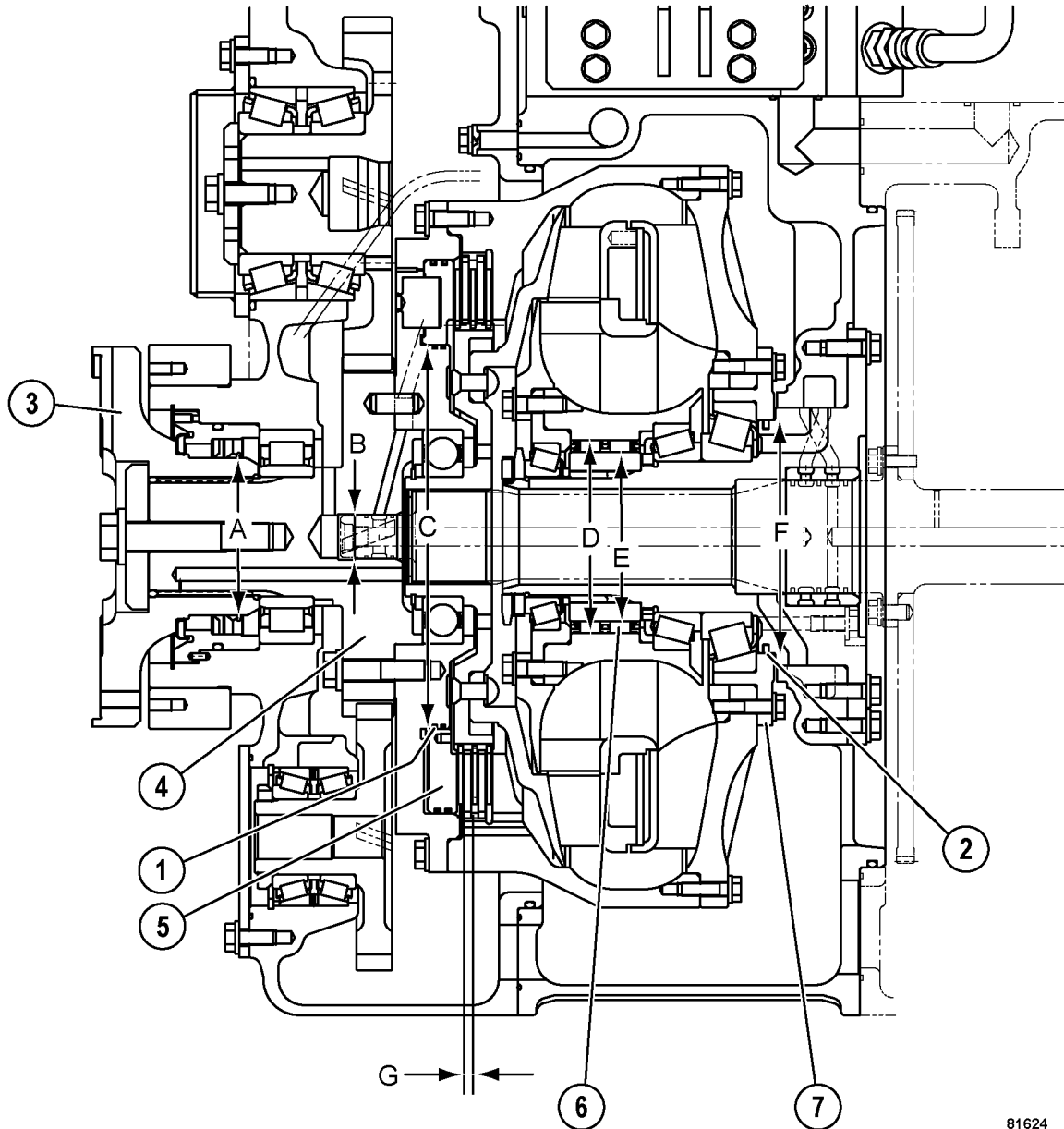
7. Disconnect lubrication tubes (1, Figure 8-3) and remove.
8. Remove cap screws (2) securing main relief valve (3). Remove the valve with the lockup accumulator attached.
9. Remove cap screws (2, Figure 8-4) that secure torque converter regulator valve (1). Remove O-rings (3).
10. Remove cap screws (4) that secure valve seat (5) to the housing. Remove the valve seat and O-ring (6).

CLEANING & INSPECTION

After disassembly, thoroughly clean all parts and inspect. Determine whether the parts are within specifications. Refer to Table 1 - Component Wear Limits.

Refer to Figure 8-41 for location of areas to be measured. The standard dimension of the item, and the maximum permissible wear is listed in Table 1.

Install new O-rings during assembly. Inspect all cap screws for cracks or thread damage. Replace any damaged parts.



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FIGURE 8-41. COMPONENT PARTS INSPECTION (SEE TABLE 1)

- | | | |
|------------------------------------|----------------------------|--------------------------|
| 1. Clutch Housing/Piston Seal Ring | 4. Input Shaft | 7. Pump Bearing Retainer |
| 2. Pump Seal Ring | 5. Lockup Clutch Piston | |
| 3. Input Flange | 6. One-Way Clutch Assembly | |

77. Install gear (5) on boss (11).
78. Apply thread lock (p/n 09940-00030) to the threads of cap screws (1, Figure 8-71) Install the cap screws and tighten to **110 ± 12 N·m (81 ± 9 lb ft)**.

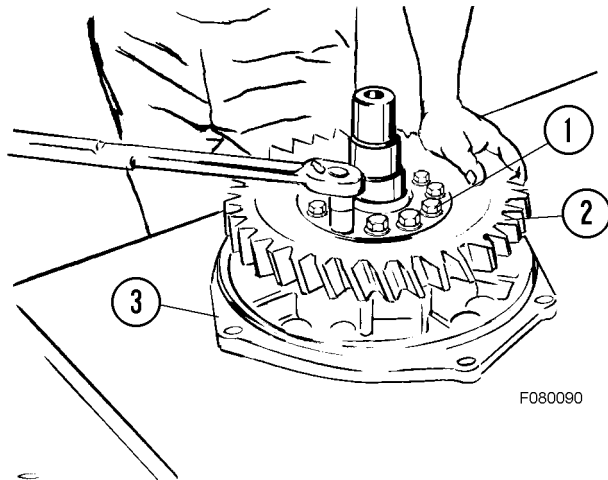


FIGURE 8-71. PUMP DRIVE GEAR INSTALLATION

- | | |
|---------------|----------|
| 1. Cap Screws | 3. Cover |
| 2. Gear | |

79. Install a new O-ring (14, Figure 8-70) in cover (12). Coat the O-ring and mating bore in the front housing with petroleum jelly.
80. Install the pump drive gear assembly into the housing. Install cap screws (13) and the washers and tighten to **110 ± 12 N·m (81 ± 9 lb ft)**.
81. Install a new O-ring (6) onto cover (4). Install the cover. (Applicable to the RH pump drive, only.)
82. Repeat the previous steps for the remaining, upper pump drive components.
83. If previously removed, install dowel pin (3, Figure 8-72).
84. Apply sealant p/n 790-129-9070 to the outer diameter of oil seal (1). Install the seal in retainer (5). Apply grease p/n 790-129-9080 to the seal lip and retainer bore in the front housing.

85. Coat a new O-ring (2) with petroleum jelly and install it onto retainer (5).
86. Position retainer (5) over the front housing. Align the hole for dowel pin (3) and install the retainer in the housing. Install snap ring (4).
87. Heat and install the collar (10).
88. Coat a new O-ring (9) with petroleum jelly and install it onto input flange (6) and holder (7). Place the assembly into position. Apply thread lock (p/n 09940-00030) to the threads of cap screw (8). Install the cap screw and the washer. Tighten the cap screw to **696 ± 34 N·m (514 ± 25 lb ft)**.

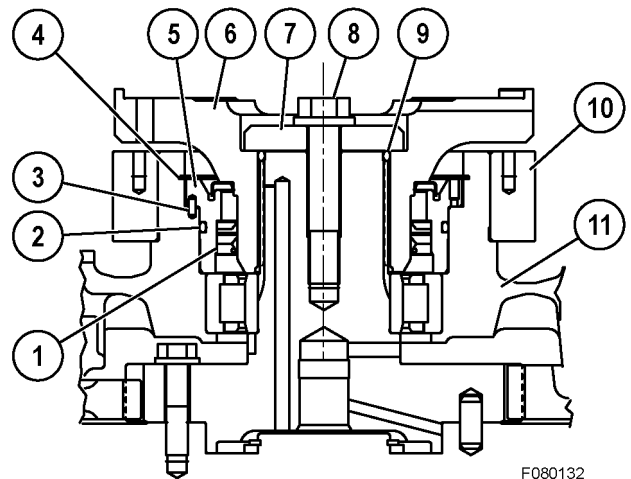


FIGURE 8-72. INPUT SHAFT DETAIL

- | | |
|-----------------|-------------------|
| 1. Oil Seal | 7. Holder |
| 2. O-Ring | 8. Cap Screw |
| 3. Dowel Pin | 9. O-ring |
| 4. Snap Ring | 10. Collar |
| 5. Retainer | 11. Front Housing |
| 6. Input Flange | |

33. Remove clutch discs & plates (5), springs (4) and guide pins (3).
34. Use the hole in bearing cage (1, Figure 9-17) to access the cover mounting cap screws. Remove the cap screws, the bearing cage and the cover.
35. Remove tie bolts (5) and housing (2).
36. Remove the number four ring gear.

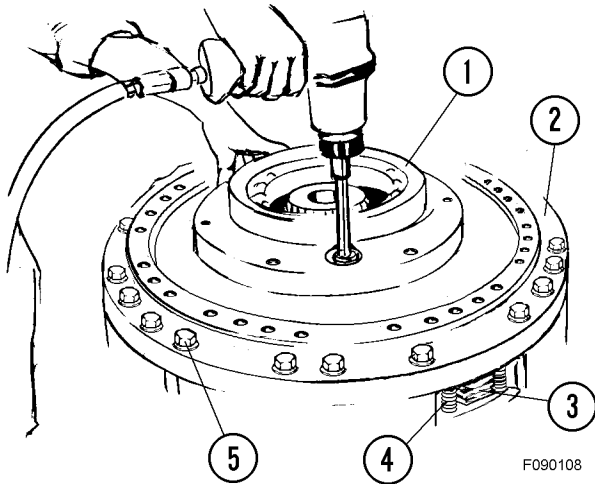


FIGURE 9-17. NUMBER FOUR RING GEAR REMOVAL

- | | |
|-------------------|--------------|
| 1. Bearing Cage | 4. Springs |
| 2. Housing | 5. Tie Bolts |
| 3. Discs & Plates | |

37. Remove discs/plates (3) and springs (4).
38. Remove the snap ring retaining the number four sun gear to the intermediate shaft.
39. Remove the number four sun gear.

Bearing Cage & Cover Disassembly

40. Remove seal rings (2 & 9, Figure 9-18).
41. Remove snap ring (8). Separate bearing cage (1) from cover (6).
42. Remove seal ring (5).
43. Remove bearing (7) from the cover.
44. Remove snap ring (3). Remove bearing (4) from the cage.

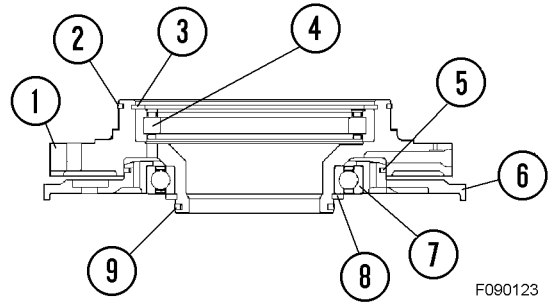


FIGURE 9-18. BEARING CAGE DISASSEMBLY

- | | |
|-----------------|--------------|
| 1. Bearing Cage | 6. Cover |
| 2. Seal Ring | 7. Bearing |
| 3. Snap Ring | 8. Snap Ring |
| 4. Bearing | 9. Seal Ring |
| 5. Seal Ring | |

45. Attach lift eyes (M12 x 1.75), lifting chains and a hoist to number four carrier (1, Figure 9-19). Remove the carrier and the number five ring gear.

46. Remove number five clutch housing (2).

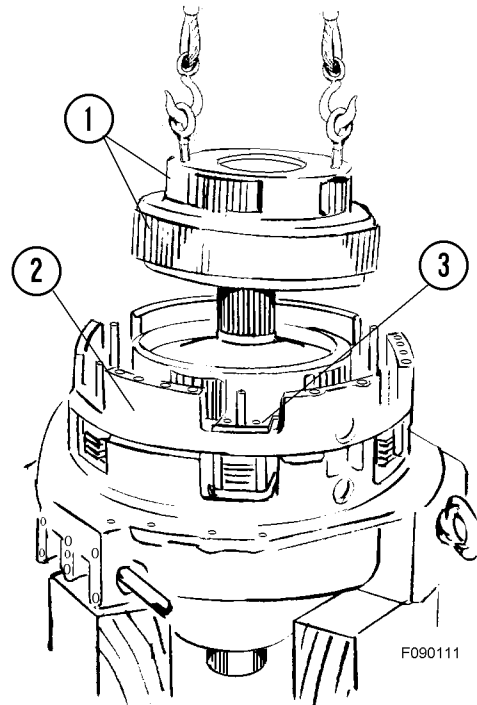


FIGURE 9-19. NUMBER FOUR CARRIER ASSEMBLY REMOVAL

- | | |
|---------------------------------|-------------------------------|
| 1. Number Four Carrier Assembly | 2. Number Five Clutch Housing |
| | 3. Clutch Plates & Discs |

Number Seven Clutch Assembly

15. Install two seal rings (11, Figure 9-34) in the grooves in number seven clutch hub (10). Coat the seal rings with petroleum jelly.

16. Carefully lower the hub into number five carrier assembly (12).

NOTE: In the following step, apply TO-30 or TO-10 power line oil to the clutch discs as they are installed.

17. Install a clutch disc (9) over the hub teeth until seated in the carrier. Alternately install clutch plates (8) and the remaining discs. Install wave springs (7) around the discs. There are three plates, four discs, and four springs.

18. Coat a new O-ring (13) with petroleum jelly. Install the O-ring in the hub groove. Install spacer (14).

19. Lift the output shaft assembly and lower it onto the carrier assembly. Install plates (6).

20. Apply thread lock (p/n 09940-00030) to cap screws (5). Install the cap screws and tighten to **110 ± 12 N·m (81 ± 9 lb ft)**.

21. Install speed sensor gear (4). Apply thread lock (p/n 09940-00030) to cap screws (3). Install the cap screws and tighten to standard torque.

22. Install seal rings (2) in the collar grooves. Coat the seals with petroleum jelly to secure during

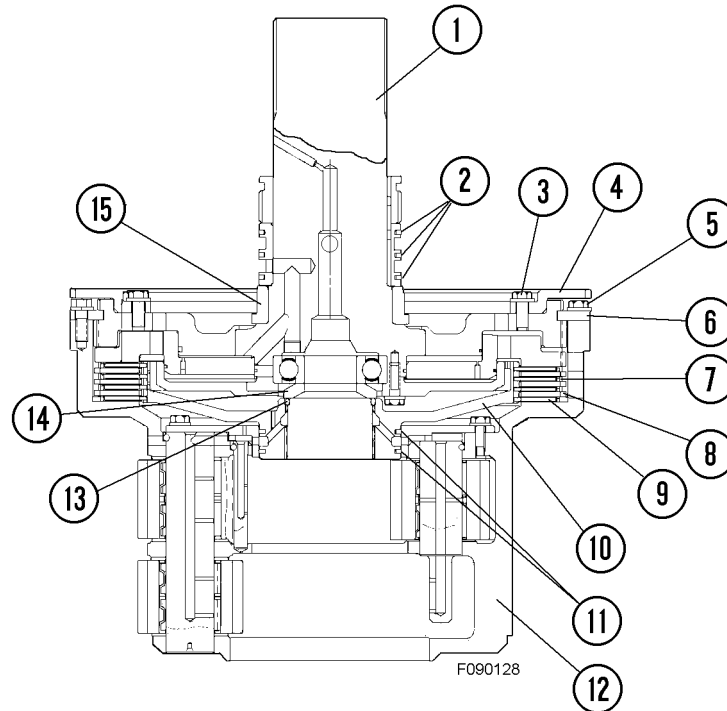


FIGURE 9-34. NUMBER SEVEN CLUTCH ASSEMBLY

- | | |
|-------------------------|-------------------------|
| 1. Output Shaft | 9. Clutch Disc (4 ea.) |
| 2. Seal Rings | 10. Hub |
| 3. Cap Screw | 11. Seal Ring |
| 4. Speed Sensor Gear | 12. Number Five Carrier |
| 5. Cap Screw | 13. O-ring |
| 6. Plate | 14. Spacer |
| 7. Spring (4 ea.) | 15. Bearing Inner Race |
| 8. Clutch Plate (3 ea.) | |

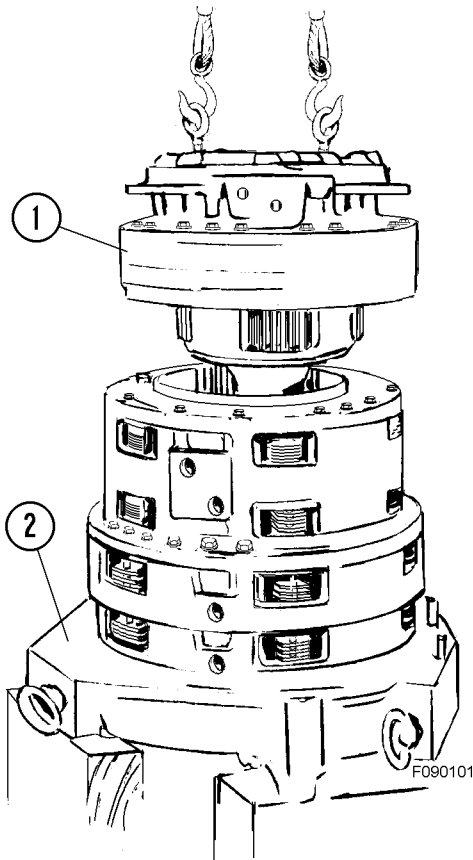


FIGURE 9-60. FRONT PLANETARY & CLUTCH INSTALLATION

1. Front Planetary & Clutch Assembly 2. Rear Housing

Checks Prior to Final Assembly

109. After front planetary and clutch assembly (1, Figure 9-60) is installed, verify clearance exists between the number three carrier and the number three clutch housing plate. Refer to Figure 9-61.
110. Rotate the number three carrier by hand to check for smooth rotation.

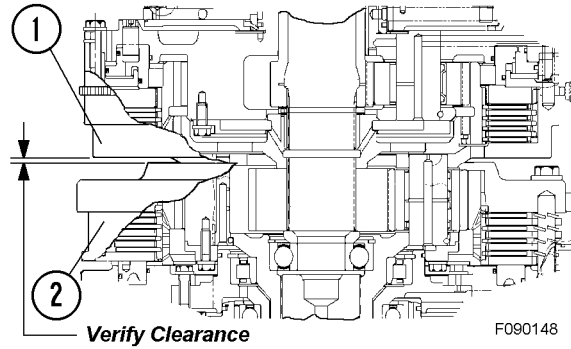


FIGURE 9-61. CLEARANCE CHECK

1. Number Three Carrier 2. Number Three Clutch Housing Plate

111. Pressurize the number one and number two clutches through the hydraulic oil port. Use a shop air supply of 586 kPa (85 psi) and oil leak tester (P/N 799-301-1600).
- Number one clutch: Pressurize to 483 kPa (70 psi) or more to check for normal operation.
 - Number two clutch: Pressurize to 297 kPa (43 psi) or more to check for normal operation.

Final Assembly

112. Install new O-rings in the hydraulic oil ports on the face of the rear transmission case.
113. Attach lifting apparatus and a hoist to the transmission case. Coat a new O-ring (4, Figure 9-62) with petroleum jelly. Install the O-ring in the groove at the rear of the case. Carefully lower the case over the power train.
114. Install 21 cap screws (2) and the washers that secure the main case to the rear case. Install the six nuts and washers. Tighten the cap screws and nuts to standard torque.

Installation

1. Clean all tire mounting surfaces. Ensure all contact surfaces are free of damage and debris.
2. Move the tire handler into position and install the inboard tire. Align the notched groove in the wheel hub with the rim stopper.

NOTE: Use caution when installing the wheel. The air valve is susceptible to damage.

3. Install three clamps (13, Figure 2-7) and nuts (12). Tighten the nuts to the following torques:
 - Threads coated with LM-P anti friction compound: **1715 ± 197 N·m (1265 ± 145 lb ft)**
 - Dry threads: **2210 ± 245 N·m (1630 ± 181 lb ft)**

4. Install spacer (2, Figure 2-6). Use the tire handler or other lifting device to lift the spacer. The weight of the spacer is approximately 93 kg (205 lb).
5. Move the tire handler into position and install the outboard wheel. Align the notched groove in the wheel hub with the rim stopper.

NOTE: Use caution when installing the wheel. The air valve is susceptible to damage.

6. Install wedge ring (7). Position the wedge ring so that the protrusion of the ring from the cover surface is equal around the entire circumference. Install clamps (10) and nuts (9). Only tighten enough to prevent the tire/rim assembly from moving.
7. Install air valve lock plate (2, Figure 2-5)
8. Remove the blocking and lower the truck to the ground.
10. Use the sequence shown in Figure 2-8 to tighten the nuts (9, Figure 2-7). Tighten to the following torques:
 - Threads coated with LM-P anti friction compound: **1715 ± 197 N·m (1265 ± 145 lb ft)**
 - Dry threads: **2210 ± 245 N·m (1630 ± 181 lb ft)**

11. Rotate the wheel and verify the lateral runout of the rim is within 5 mm. (0.20 in.)
12. After installation, operate the truck for one haul cycle (loaded). Then tighten the clamp nuts again to the specifications listed earlier in this procedure.
13. Check the torque daily until the specified torque value listed above is maintained on each nut. Check the torque intermittently, thereafter.



FIGURE 2-8. REAR TIGHTENING SEQUENCE

3. Remove retainer (1), and measure retainer thickness C. Then, select a shim thickness equal to B.

$$B = (A-C) + 0.3 \text{ mm (0.012 in.)}$$

When removing the retainer, use caution to prevent bearing (15, Figure 3-1) from being removed.

NOTE: Select the combination of shims (12, 13, & 14, Figure 3-1) that gives the minimum number of shims.

4. Apply thread tightener, Three Bond #1374, to cap screws (9). Install the shim pack and retainer (11). Tighten the capscrews evenly, in an alternating pattern, to **929 ± 98 N·m (685 ± 72 lb ft)**.
5. Rotate the hub 20-30 times. Check the torque on the cap screws. If necessary, tighten the cap screws again to the specified torque. Repeat this step until the proper torque is maintained.
6. Install O-ring (17) into hub cover (10). Place the hub cover into position and secure with cap screws & washers (18).
7. Rotate plug (16) to the 12 o'clock position. Remove the plug and fill the hub with clean hydraulic oil. Install a new O-ring onto the plug and install the plug.
8. Connect the brake apply lines and brake cooling lines to brake assembly.
9. Install the front tire and rim. Refer to Front Tire and Rim Installation in this Section.



Bleed the brakes before releasing the truck for operation. Refer to Brake Bleeding, Section J.

10. After engine start-up, check the oil level in the hydraulic tank and fill.

FRONT SPINDLE

The spindles are part of the front suspension cylinder housings. To remove or install a spindle, refer to Section H, Suspensions.

A-ARM

Removal

1. Refer to Section G, Front Tire and Rim Removal and remove front tires.
2. Refer to Section H, Front Suspension Removal and remove the front suspension.
3. Use a suitable lifting device and support the A-arm. Remove the retaining capscrew and pin (7, Figure 3-4) and spacers (3).
4. Remove the A-arm from the frame.

Inspection

1. Inspect bushings (1, Figure 3-4). If damaged, remove old bushings and install new parts.

NOTE: Bushings (1) are a tight fit in frame ears (2). When installing new bushings, apply a small amount of heat to the frame ears and freeze the bushings before attempting to press the new bushings into the bores.

2. Inspect pin (7) and bearing (6). Replace if parts are damaged or wear is excessive.
3. Inspect snap ring/seal (4). Replace if damaged or if new bearing is installed.

Installation

1. Install new O-Rings (5, Figure 3-4) in bearing (6).
2. Position the A-arm onto the frame and install spacers (3) and pins (7). Install the retaining capscrews, and tighten to standard torque.
3. Refer to Section H, Front Suspension Installation and install the front suspension.
4. Refer to Section G, Front Tire and Rim Installation and install the front tires.

SECTION G5
REAR AXLE AND FINAL DRIVE ASSEMBLY
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- Remove snap ring (2, Figure 5-23). Remove bearing (1) from differential case (3).

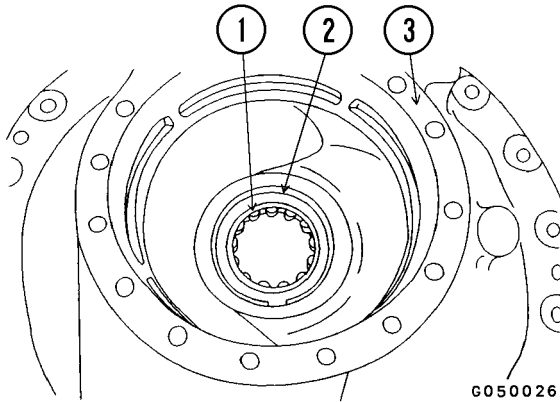


FIGURE 5-23. DIFFERENTIAL BEARING

- | | |
|--------------|----------------------|
| 1. Bearing | 3. Differential Case |
| 2. Snap Ring | |

- If bevel gear (3, Figure 5-22) is to be replaced, remove gear retaining capscrews and separate the gear from case (2).

NOTE: The bevel gear and pinion gear must be replaced as a matched set.

Cleaning and Inspection

- Clean all parts and thoroughly inspect.
- Check for damaged or worn parts. Replace parts as necessary.
- Use an oil stone to polish each mating flange on the differential gear case halves. Clean the case halves after polishing.

Assembly

Differential Bearing

- Set the differential case in tool repair stand (2, Figure 5-4).
- Using a push tool, press fit bearing (1, Figure 5-23) in differential case (3). Install snap ring (2).

Assembly Of Differential Gear Assembly

- Align bevel gear (3, Figure 5-22) with the dowel pins on differential gear case (2) and install. Apply Three Bond #1374 thread tightener to the capscrew holes in the ring gear as shown in Figure 5-24. Applying the thread tightener to the holes prevents splatter onto critical areas.

Install the capscrews and washers and tighten to **1322 N·m (975 lb ft)**.

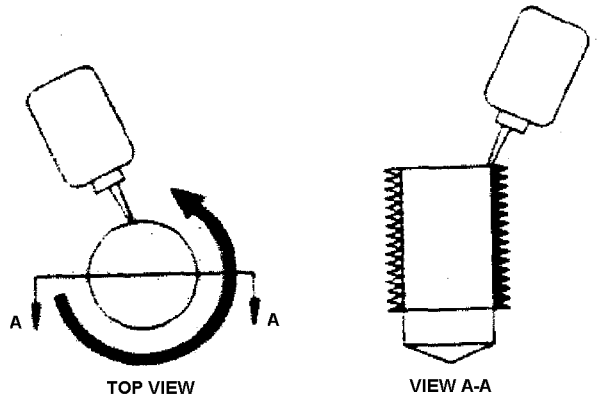


FIGURE 5-24. APPLYING THREAD SEALANT

- Install side bearing (1). Fit the bearing by heating to 100° C (212° F).

NOTE: Use heat lamps, an oil bath, or induction heaters to heat the bearings. DO NOT use a torch or heat greater than 176° C (350° F). After the bearing cools, check that there is no clearance between the end face of the case and the bearing.

- Turn the case over. Align with dowel pins, and install thrust washer (1, Figure 5-21).
 - Ensure the head of the dowel pin is 0.5 [+0.2/-0.0] mm (0.020 [+0.008/-0.00] in.) lower than the surface of the washer.

FINAL DRIVE PLANETARIES AND WHEEL HUBS

FINAL DRIVE

The final drives are mounted on the outer ends of the rear axle. Each final drive uses a planetary gear configuration to reduce the rotation speed of the drive train and produce a greater driving torque. Of all the components in the drive train, the final drive bears the greatest stress. Final drive lubrication must be properly maintained to ensure the long life of the gears and bearings.

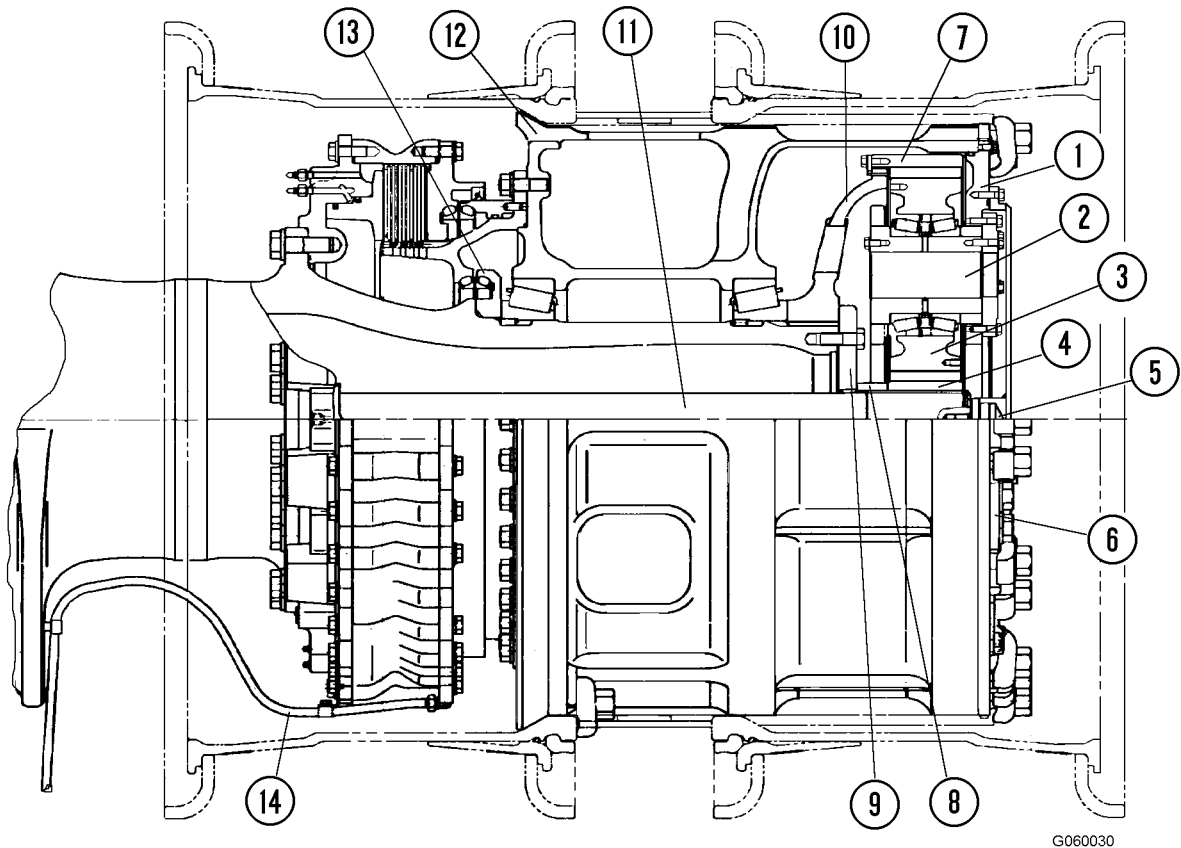


FIGURE 6-1. FINAL DRIVE PLANETARY

- | | | |
|---------------------------|--------------------------|---------------------|
| 1. Carrier | 6. Cover | 11. Drive Shaft |
| 2. Planet Gear Shaft | 7. Ring Gear (106 Teeth) | 12. Wheel Hub |
| 3. Planet Gear (43 Teeth) | 8. Spacer | 13. Seal Assembly |
| 4. Sun Gear (17 teeth) | 9. Retainer | 14. Seal Drain Hose |
| 5. Button | 10. Inner Hub | |

SPECIFICATIONS: Splash-type Lubrication
Ratio: 7.235
Oil: 120 L (32 gal) - each side

The inside of the suspension cylinder contains oil (B, Figure 2-2), and is charged with nitrogen gas (A). Oil (B) and oil chamber (C) are connected by tube (9) and valve assembly (10).

When the machine is in motion, the wheels follow the unevenness of the road surface. The external vertical forces from the road surface are absorbed by the suspension cylinder. When this happens, the volume of the nitrogen in the gas chamber is compressed by the input force, and absorbs the external force. The nitrogen gas is sealed by the rod chamber and the oil, so it is always subjected to a pressure corresponding to the external force. The pressurized nitrogen allows the suspension to function as a spring, extending and retracting as the road surface changes.

The damping force is produced inside valve assembly (10) with orifice plate (12) and leaf springs (11). They restrict the flow of oil between oil chamber (B) and oil chamber (C), and create a damping force.

- When retracting, the nitrogen gas is compressed by the external force from the road surface. The oil in chamber (B) flows through valve assembly (10) in direction (Y). The oil flows through tube (9) to oil chamber (C). The oil flowing through the valve is throttled by orifices to generate a damping force.
- When extending, the external force from the road surface weakens, the pressure of the nitrogen gas extends the rod, and the oil in chamber (C) passes through tube (9) and valve assembly (10) to oil chamber (B). The oil flowing through the valve flows in direction (Z) and passes through orifices in the orifice plate to generate a damping force.

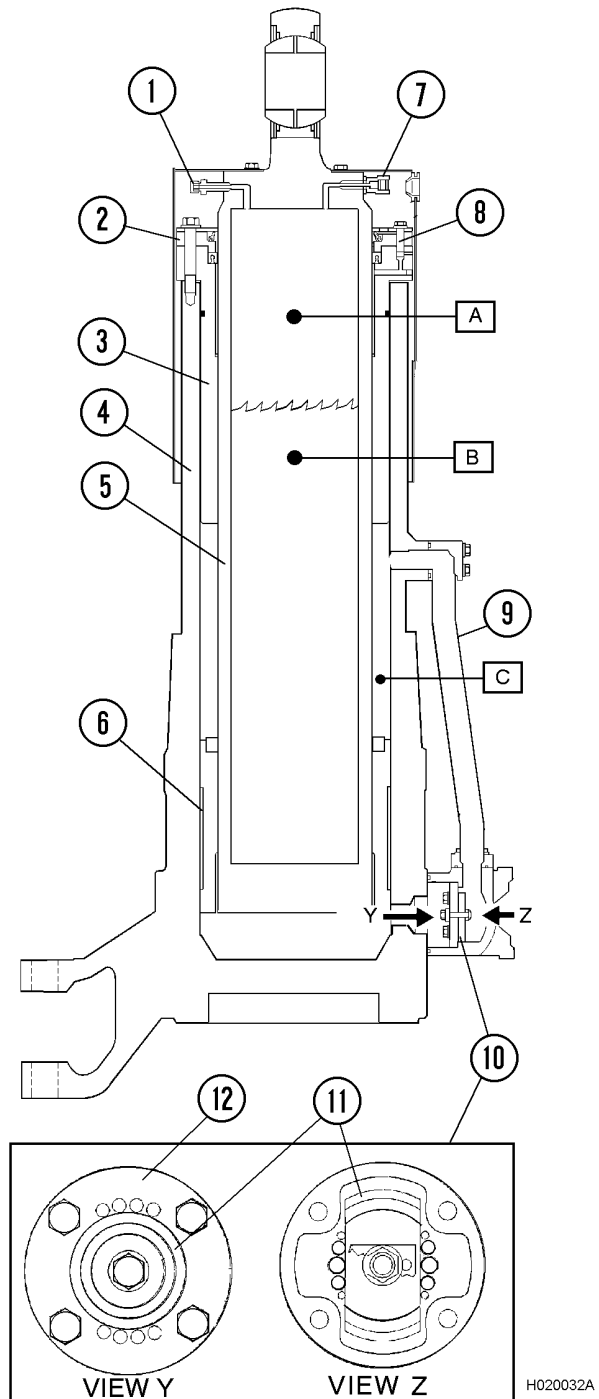


FIGURE 2-2. FRONT SUSPENSION

- | | |
|-------------------------|--------------------|
| 1. Charging Valve | 9. Tube |
| 2. Retainer | 10. Valve Assembly |
| 3. Flange | 11. Leaf Springs |
| 4. Cylinder (with axle) | 12. Orifice Plate |
| 5. Rod | |
| 6. Wear Ring | A. Gas Chamber |
| 7. Discharge Plug | B. Oil Chamber |
| 8. Air Bleed Plug | C. Oil Chamber |

Removal

1. Park the unloaded truck on hard, level surface. Apply the parking brake and chock the wheels.
2. Raise and support the rear of the truck frame.
3. Wear a face mask or goggles, and discharge the nitrogen pressure from the suspension. Refer to Section H, Oiling and Charging Procedures, for the proper procedure for discharging nitrogen.
4. Remove pressure sensor (5, Figure 3-3) and remove the clamps securing the sensor harness to the suspension.
5. Remove the upper pin retainer and remove upper pin (1).
6. Attach an appropriate lifting device to the suspension. The suspension weighs approximately 500 kg (1100 lb).
7. Remove the lower pin retainer and remove lower pin (2). Lift the suspension from the truck.
8. Move the suspension to a clean work area.

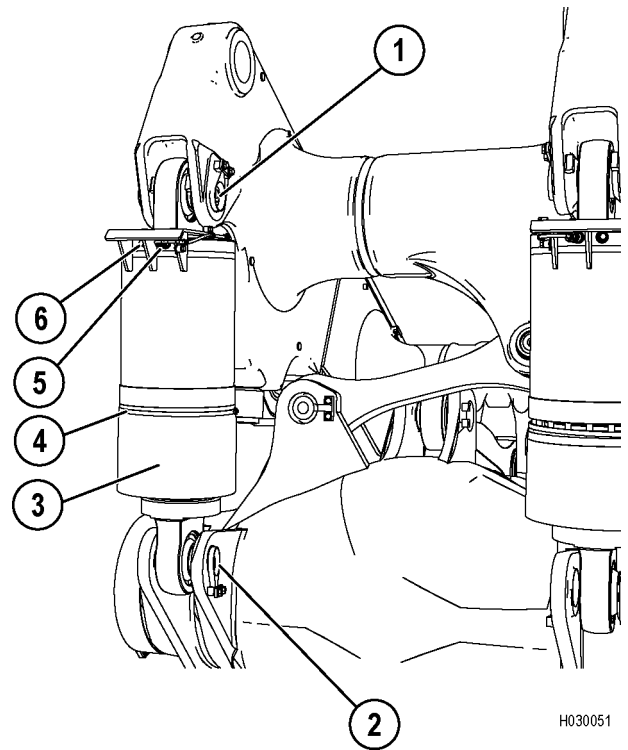


FIGURE 3-3. REAR SUSPENSION

Installation

1. Attach an appropriate lifting device to the suspension. The suspension weighs approximately 500 kg (1100 lb).
2. Lift the suspension into position on the truck. Lubricate lower pin (2, Figure 3-3) with multi-purpose grease and install the pin. Install the pin retainer and cap screws.
3. Lubricate upper pin (1) with multi-purpose grease and install the pin. Install the pin retainer and cap screws.
4. If not done already, fill the suspension with oil, and charge with nitrogen gas. Refer to Section H, Suspension Oiling and Charging Procedures, for more information.
5. Install the clamps that secure the sensor harness to the suspension.

- | | |
|--------------|--------------------|
| 1. Upper Pin | 4. Clamp |
| 2. Lower Pin | 5. Pressure Sensor |
| 3. Cover | 6. Charging Valve |

Disassembly

1. If available, mount the suspension assembly in a roll-over stand. Position the assembly upright as installed on the truck.
2. Remove clamp (4, Figure 3-3) and cover (3).
3. Remove charging valve (6) and the pressure sensor schrader valve from the suspension. Drain the oil from the cylinder.
4. Rotate the assembly to position the flange on top. Remove cap screws (1, Figure 3-4) and the washers.

Front Suspension Nitrogen Charging

WARNING

Dry nitrogen is the only gas approved for use in the suspensions. Charging the suspensions with oxygen or other gases may result in an explosion which could cause serious injuries, fatalities, and/or major property damage. Refer to Nitrogen Gas Specifications at the beginning of this chapter.

1. Remove the caps from charging valves (3, Figure 4-2).

NOTE: Before installing regulator (11, Figure 4-6), blow out the cylinder connector with nitrogen gas, 965 kPa (140 psi) or more, to clean out all dirt or dust. Dirt or dust in the system can cause suspension failures.

2. Connect the regulator to the nitrogen cylinder. Open the valve on the gas cylinder, and check the pressure on regulator gauge (1).

NOTE: The internal pressure of the gas cylinder must be substantially higher than the suspension charging pressure (refer to the chart in Figure 4-7).

3. Install the nitrogen charging kit to the suspensions, as shown in Figure 4-6.
4. Slowly turn the handle of regulator (11) clockwise. Adjust the pressure, shown on gauge (2), to the required charging pressure (refer to the chart in Figure 4-7). Then, open valves (3 & 4, Figure 4-6) to fill the suspension cylinders with nitrogen gas.
5. Fill the left and right cylinders at the same time. Verify the required charging pressure on gauge (10) by closing valve (4).

6. When the left and right cylinders reach the specified length as shown in Figure 4-7, close valve (4, Figure 4-6) to stop the flow of nitrogen gas. Turn the handle of regulator (11) counter-clockwise to close the valve.

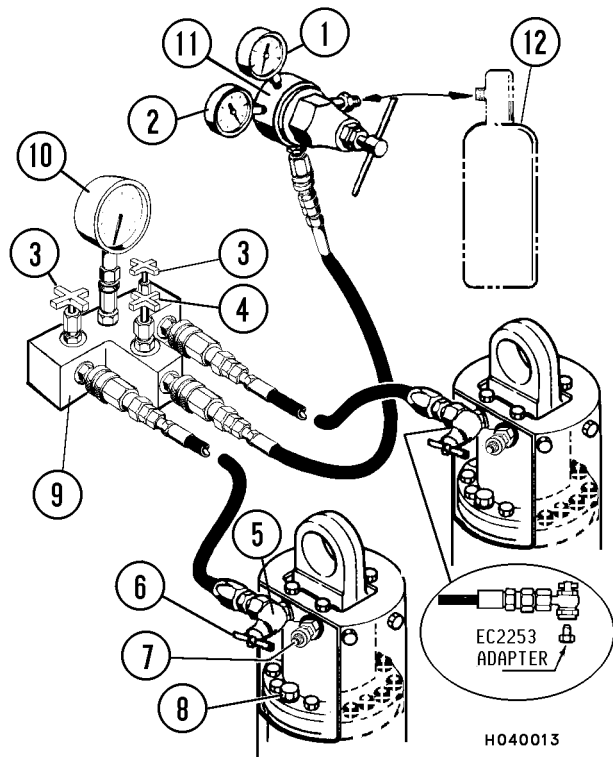


FIGURE 4-6. NITROGEN CHARGING KIT (EC3331)

1. Nitrogen Cylinder Gauge
2. Charging System Gauge
3. Manifold Outlet Valves (from gauge)
4. Inlet Valve (from regulator)
5. Connection Valve w/EC2253 Adapter Installed
6. Valve "T" Handle
7. Pressure Sensor/Schrader Valve
8. Air Bleed Valve
9. Manifold
10. Charging Pressure Gauge (Suspensions)
11. Regulator Valve (Nitrogen Pressure)
12. Dry Nitrogen Gas
(see Nitrogen Gas Specifications at the beginning of this chapter)

NOTE: Parts may vary from the illustration above depending on the charging kit part number.

BRAKE SYSTEM OPERATION

DESCRIPTION

The truck is equipped with a hydraulically actuated, wet disc service brake system. A three caliper, disc-type parking brake is located on the input side of the rear axle housing.

NOTE: The parking brake is intended to hold the truck stationary after it has completely stopped. It is not to be used as an active brake.

High pressure oil is provided by steering pump (3, Figure 2-1) and is used to charge the two brake accumulators and apply the brakes.

Front brake disc cooling oil is provided by brake cooling pump (2), a double gear pump driven by the Power Take Off (PTO). The rear brakes receive additional cooling from unused oil in the hoist circuit.

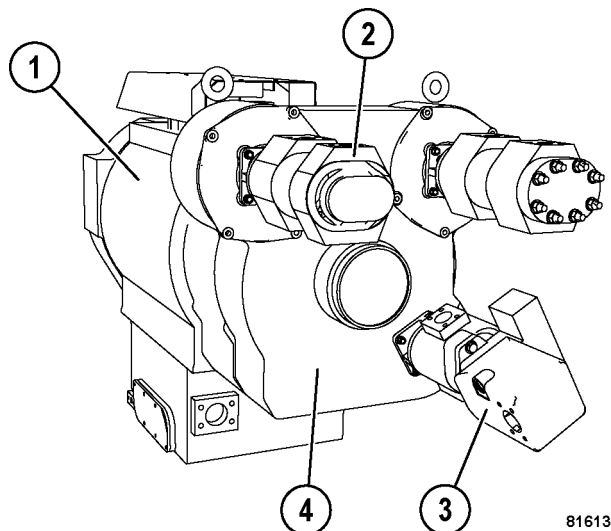


FIGURE 2-1. PUMP IDENTIFICATION

- | | |
|-----------------------|------------------|
| 1. Transmission | 3. Steering Pump |
| 2. Brake Cooling Pump | 4. PTO |

The brake system consists of several major components: the foot-operated, brake treadle valve, hydraulically operated relay valves, a brake manifold and a Retard and Control Monitor (RCM) with retard lever.

The brake treadle valve, RCM and retard lever are all located in the cab. The remainder of the control system, including the relay valves, brake manifold and accumulators is located in the weatherproof hydraulic cabinet. The cabinet is located next to the cab on the center deck, and is easily accessible for brake system diagnosis and service.

Outlined below are the functions Komatsu feels are necessary for safe truck operation and have incorporated into the brake system:

- A robust service brake system with good operator control and a short stopping distance.
- Immediate warnings for the operator giving notification of serious loss of brake pressure. This enables the operator to stop the truck before the secondary system is exhausted of power.
- Provide secondary brake circuits so that any single brake system malfunction ensures the truck has sufficient stopping power.
- Automatic-apply function to apply the service brakes when low pressure warnings are ignored and pressures continue to decrease.
- A brake lock to relieve the operator from holding the brake pedal while at the dump or shovel.
- A spring applied parking brake for holding the truck during periods other than loading or dumping. The parking brake remains effective when the engine is stopped and hydraulic system oil pressure is unavailable.
- A brake system that is easy to diagnose and service.

This brake system provides five independent means of brake actuation on the truck:

- Service brakes
- Retarding
- Brake lock
- Auxiliary brake
- Parking Brake

This chapter discusses each type of brake actuation as well as the automatic spin regulator (ASR) function.

Refer to the brake system schematic located in Section R for a diagram of the entire system.

PARKING BRAKE CIRCUIT

The parking brake is spring applied and hydraulically released. The parking brake circuit operates at 18 961 kPa (2750 psi).

If hydraulic pressure is not available, the parking brake will hold the truck stationary until hydraulic pressure is restored. Therefore, unless an alternative source is connected to the brake system, the engine must be on in order to release the parking brake.

Parking Brake Switch OFF

When parking brake switch (5, Figure 2-7) is switched to the OFF position, a signal is sent to the RCM. The RCM energizes parking brake solenoid (6). The solenoid causes the parking brake valve spool to shift against the valve spring and creates a path for hydraulic pressure to be supplied to release the parking brake springs. The release pressure acts against the parking brake springs and releases the brake pads from the brake disc.

The hydraulic pressure also causes the contacts in parking brake pressure switch (4, Figure 2-4) to open as pressure rises above 8618 kPa (1250 psi). The open contacts remove the path to ground causing the parking brake light on the EDP to turn off.

Parking Brake Switch ON

When parking brake switch (5, Figure 2-7) is switched to the ON position, a signal is sent to the RCM. The RCM de-energizes parking brake solenoid (6). The spring in the solenoid valve shifts the spool closing off the path used to supply hydraulic pressure that released the parking brake. Shifting the spool also opens a path to tank to relieve the pressure that is used to release the parking brake. Without the release pressure present, the parking brake springs cause the brake pads to grip the parking brake disc and hold the truck stationary.

The release of the hydraulic pressure also causes the contacts in parking brake pressure switch (4, Figure 2-4) to close. The closed contacts complete a path to ground and illuminates the parking brake light on the EDP.

Specifications:

SAE 10W oil @ 50°C ± 10°C
..... (122° F ± 50° F)

Solenoid Valve Off:

Cracking Pressure: 883 ± 48 kPa @ 1 - 2 l/min
..... (128 ± 7.1 psi @ 0.3 - 0.5 gpm)

Seat Pressure (Min.) 786 kPa @ 1 - 2 l/min
..... (114 psi @ 0.3 - 0.5 gpm)

Oil Leakage (Max.) 800 cc/min @ 586 kPa
..... 27 oz/min @ (85 psi)

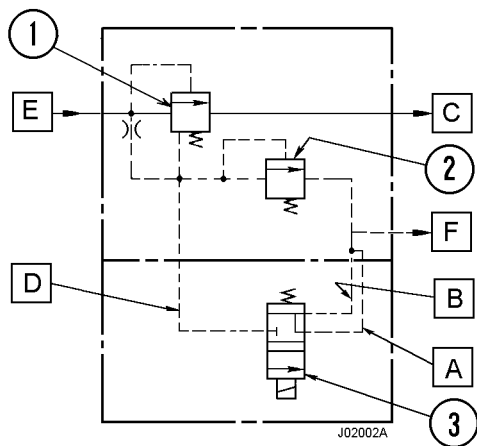


FIGURE 2-16. BCV SCHEMATIC

- | | |
|-----------------------|------------------------|
| 1. Main Spool Valve | A: Pilot Port |
| 2. Pilot Relief Valve | B: Pilot Port |
| 3. Solenoid Valve | C: Main Return to Tank |
| | D: Pilot Port |
| | E: From Pump |
| | F: To Tank |

18. Install the base plate (32) on top of the retainer plug. Tighten the four allen screws (28) evenly, alternating diagonally, to evenly seat the regulator sleeve assembly. Tighten to **16 - 17 N·m (12 - 13 lb ft)**.
19. Install the actuator base (6, Figure 3-3) on top of the valve. Make sure to position properly for correct port direction. Tighten the two socket head capscrews (5) and tighten to **20 - 22 N·m (15 - 16 lb ft)**.
20. Screw the adjustment collars (2, Figure 3-8) onto the top of the actuation plungers. Screw all the way down until they bottom on the threads.

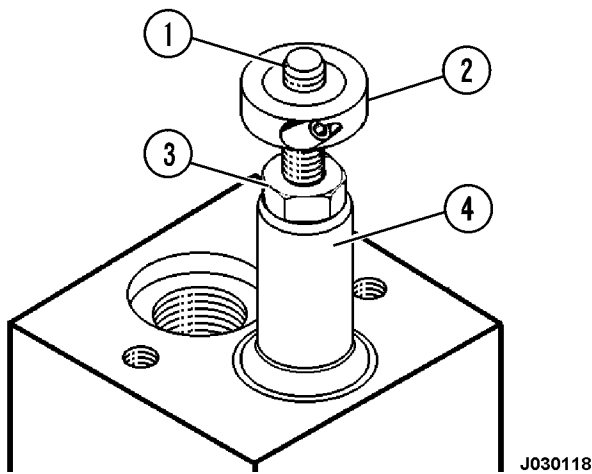


FIGURE 3-8. ADJUSTMENT COLLAR

- | | |
|----------------------|---------------------|
| 1. Stud | 3. Nut |
| 2. Adjustment Collar | 4. Actuator Plunger |

BENCH TEST AND ADJUSTMENT

The following parts and test equipment will be required to completely bench test and adjust the brake valve.

- Pressure gauges (3), 0-35 000 kPa (0-5000 psi).
- Hydraulic pressure supply, regulated to 18 960 kPa (2750 psi).
- Hydraulic test stand, Refer to Figure 3-9.
- Hose fittings for valve ports:
 Port PX: 7/16 in., # 4 SAE
 Ports P1, P2, B1 and B2: 3/4 in., #8 SAE
 Port T: 1 1/16 in., #12 SAE
- Ohmmeter or continuity tester

NOTE: It is possible to check the pressures with the brake valve installed and connected to the vehicle. Remove the brake pedal assembly and actuator cap and boot assembly to adjust individual brake circuit pressures.

Test Bench Only

Test Set Up Procedure

1. Position the valve in the fixture to allow plungers to be activated by hand using a lever (refer to Figure 3-9).
2. Attach the pilot input supply pressure to the pilot port labeled "PX" on the rear of the valve.
3. Attach the main supply input pressure to the O-ring ports on the rear of the valve labeled "P1" and "P2".
4. Attach the tank return line to the O-ring port labeled "T" on the rear of the valve.

2. Remove the valve guard from the accumulator gas valve. Remove the dyna seal.
3. Close all shutoff valves on manifold (5, Figure 3-23).
4. Connect the charging kit to the nitrogen supply tank, and open the valve on the tank.
5. Turn the "T" handle all the way out (counter-clockwise) on charging valve adapter (6).

8. Turn the "T" handle clockwise to open the accumulator gas valve. Do not turn the "T" handle all the way down, as it will damage the valve core.
9. Set the regulator for 172 kPa (25 psi), then slightly open the nitrogen bottle and slowly fill the accumulator. The proper fill rate for these accumulators is 2 minutes.

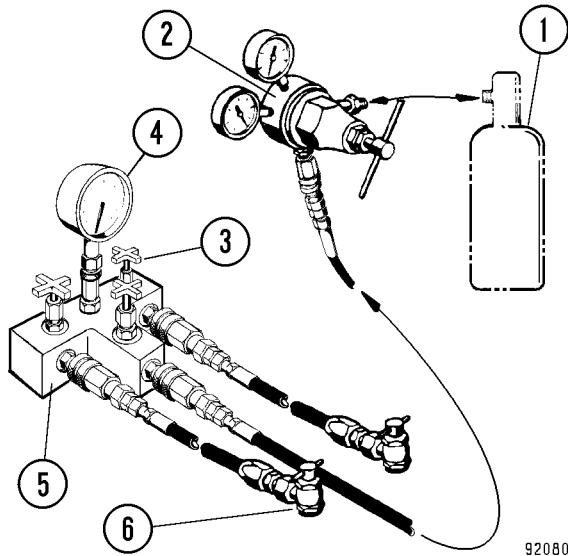


FIGURE 3-23. NITROGEN CHARGING KIT

- | | |
|--------------------|---------------------------|
| 1. Nitrogen Bottle | 4. Pressure Gauge |
| 2. Regulator | 5. Manifold |
| 3. Shut-Off Valve | 6. Charging Valve Adaptor |

6. Close any bleed valves.
7. Attach the charging valve adapter to the accumulator gas valve. DO NOT loop or twist the hose.

⚠ CAUTION

If the nitrogen is not added slowly, the bladder may suffer permanent damage. A "starburst" rupture in the lower end of the bladder is a characteristic failure caused by charging too quickly.

10. After 172 kPa (25 psi) is obtained, close the nitrogen valve. Set the regulator for the operating pressure (refer to Table 2), based on the current ambient temperature. Then, open the nitrogen bottle and fill the accumulator.

⚠ WARNING

If the accumulators are being charged for storage, only charge to 690 - 827 kPa (100 - 120 psi). Refer to Accumulator Storage later in this chapter for more information.

11. Let the accumulator set for 15 minutes. This will allow the gas temperature to stabilize. If the desired pressure is exceeded, slowly purge pressure from the accumulator.

⚠ CAUTION

Do not release pressure by depressing the valve core with a foreign object. High pressure may rupture the rubber valve seat.

10. * Quickly and completely depress the brake pedal. Check the front and rear brake pressures. The correct pressure for the front and rear is $14\,479 \pm 517$ kPa (2100 ± 75 psi) within one second. Record the front and rear brake pressures. Holding the pedal fully applied, both pressures must remain above $13\,962$ kPa (2025 psi) for a minimum of 20 seconds.
11. * Release the brake pedal. Brake pressure must return to zero within two seconds with no residual pressure trapped in the brakes. Record the pressures.

Brake Lock

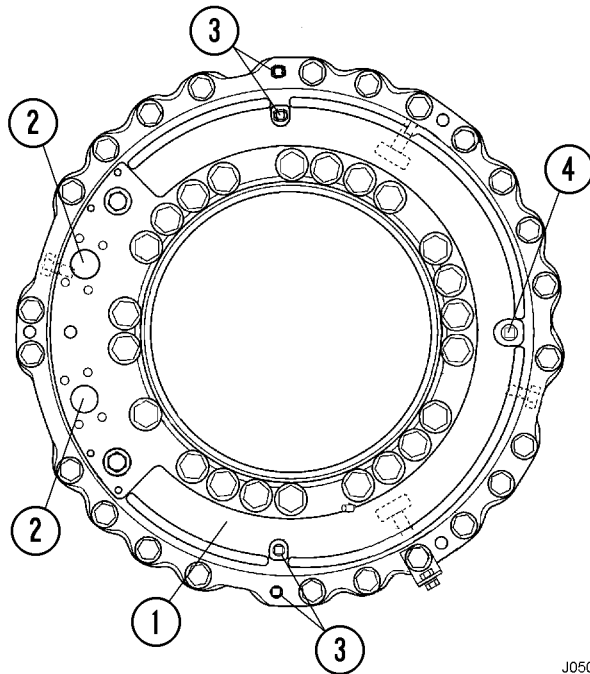
12. * Apply the brake lock. Proper rear brake pressure is $14\,479 \pm 690$ kPa (2100 ± 100 psi). Front brake pressure must be zero. Record the brake pressures.
13. Cycle the brake lock several times to ensure crisp application and release of brake pressure.

Low-Brake Pressure and Auto-Apply

14. Shut the engine off. Allow the steering accumulators to completely depressurize. Locate the steering pressure switch beneath the steering accumulators on the LH frame rail. Place a jumper wire across the pressure switch connector to disable the switch.
15. * Start the engine to fill the accumulators with oil. Allow the engine to operate until accumulator pressure stabilizes at or above $18\,616$ kPa (2700 psi). Shut the engine off. Turn the key switch back to the ON position. Slightly open the front accumulator bleddown valve to allow the pressure to dissipate. Observe the pressure at the LAP1 port while monitoring the dash panel. The low brake pressure warning lamp must illuminate at $12\,755 \pm 517$ kPa (1850 ± 75 psi).

NOTE: The warning buzzer will not sound when the engine is off.

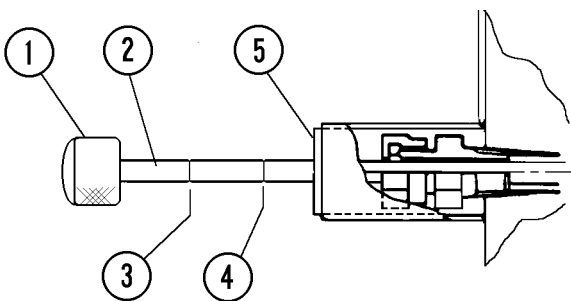
16. * Brake pressures should begin to rise (auto apply) when LAP1 reaches 9653 ± 586 kPa (1400 ± 85 psi). Record the front and rear brake pressures when auto apply is actuated.
17. * Continue to allow the front accumulator to depressurize. When discharged, the brake lights and the retard lights should illuminate. The illumination of the lights confirms operation of the normally closed pressure switch that actuates at 6722 ± 172 kPa (975 ± 25 psi). Close the bleddown valve for the front brake accumulator.
18. * Start the engine to recharge the hydraulic system. Verify that the low brake pressure warning lamp and the warning buzzer turn off at the same time. Record the LAP pressure when the warning indicators turn off. Allow the engine to operate until the brake accumulator pressure stabilizes at or above $18\,616$ kPa (2700 psi).
19. * Shut the engine off. Allow the steering accumulator to completely depressurize. Turn the key switch to the ON position. Slightly open the rear brake accumulator bleddown valve and observe the LAP1 pressure. Verify that the low brake pressure warning lamp illuminates within 690 kPa (100 psi) of the pressure recorded in Step 15.
20. * Verify that the brake pressures begin to rise (auto apply) when LAP1 is within 690 kPa (100 psi) of the pressure recorded in Step 16. Record the front and rear brake pressures when auto apply is actuated.
21. Close the rear brake accumulator bleddown valve. Remove the jumper from the steering pressure switch connector. Connect the harness connector to the pressure switch.



J050042

FIGURE 5-2. TOOL INSTALLATION LOCATION

- | | |
|-------------------------|--------------------|
| 1. Front Brake Assembly | 3. Bleeder Plugs |
| 2. Cooling Oil Ports | 4. Wear Gauge Plug |



J050038

FIGURE 5-3. BRAKE WEAR TOOL

- | | |
|-----------------------|----------------------|
| 1. Handle | 4. Rear Brake Marker |
| 2. Rod | 5. Face of the Case |
| 3. Front Brake Marker | |

6. While fully applying the service brake pedal, check brake wear as follows:

- a. Push the wear gauge in until it contacts the brake piston. Check the position of front brake marker (3, Figure 5-3). If the marker goes in beyond the face of the case (5), the disc pack is worn beyond maximum wear limits. The brakes must be repaired.
- b. If the marker does not go beyond the face of the case, brake disc wear is still within allowable limits.

NOTE: If the mark is close to the face, perform more frequent inspections.

7. Release the brakes. Shut off the engine, and allow the steering accumulators to depressurize. Open the brake accumulator bleeddown valves to relieve pressure from the brake system. Close the valves after all pressure is relieved.

8. Remove the wear indicator tool and install wear gauge plug (4, Figure 5-2).

9. Repeat this procedure for the remaining front brake. Refer to Section J, Rear Wet Disc Brakes for instructions on checking rear brake wear.

NOTE: Checking disc wear in all four brake assemblies is recommended. Disc wear in one brake assembly may be different from the other due to dissimilar operation of parts and/or haul profiles.

10. Refill the hydraulic tank, as required.

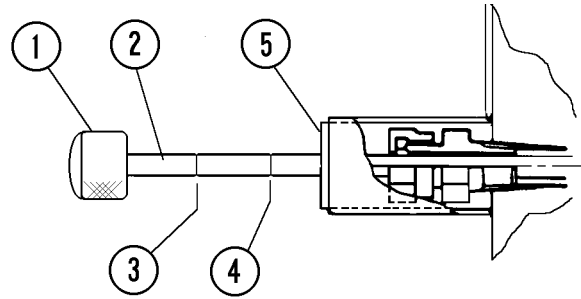
11. If brake repairs are necessary, refer to the rebuild instructions in this section and in section J6 for the rear brakes.



Brake assemblies on the same axle must be rebuilt at the same time. DO NOT rebuild brake assemblies individually.

MAINTENANCE

Brake disc wear must be checked every 1000 hours using the brake disc wear tool (refer to Section M, Special Tools). The brake disc wear tool is inserted in the wear gauge port on the brake assembly cylinder. Figure 6-3 shows the rear brake wear tool port location. Refer to Front Wet Disc Brakes, earlier in this section, for the port location on front wheel brakes.



J050038

FIGURE 6-2. BRAKE DISC WEAR TOOL

- | | |
|-----------------------|----------------------|
| 1. Handle | 4. Rear Brake Marker |
| 2. Indicator Rod | 5. Face |
| 3. Front Brake Marker | |

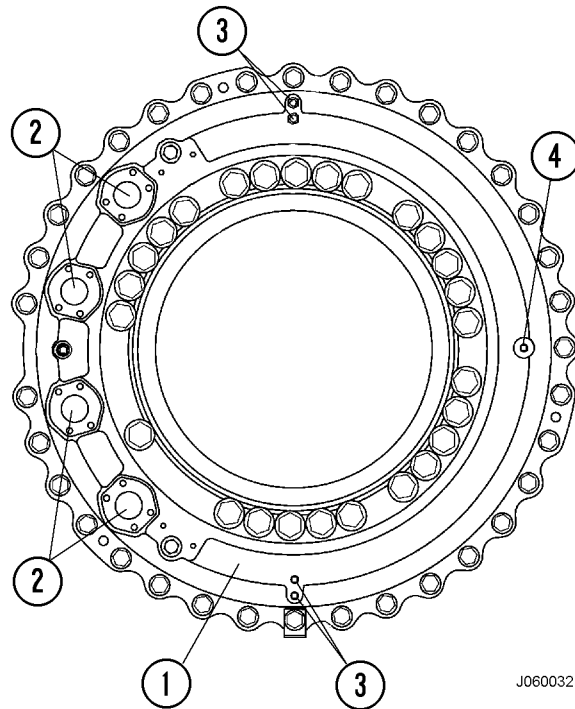
WARNING

Before removing plugs or hydraulic connections, depressurize the steering and brake accumulators. The steering accumulators can be depressurized by turning the key switch OFF and waiting 90 seconds. Confirm the steering pressure is released by turning the steering wheel. No front wheel movement should occur.

Open the bleed down valves located on the brake manifold in the brake cabinet. This will allow both accumulators for the rear brakes and front brakes to depressurize.

Before disabling the brake circuit, chock the wheels of the truck to prevent possible movement.

1. Place the range selector in NEUTRAL, apply the parking brake, and turn the key switch OFF. Wait 90 seconds to allow the steering accumulators to bleed down completely. Place wheel chocks around the wheels of the truck.
2. Open the bleed-down valves on the brake manifold in the brake cabinet and bleed all pressure from the brake accumulators. Close the valves after pressure is released.
3. Thoroughly clean the brake assemblies, especially the area surrounding the wear tool ports.
4. Remove wear tool plug (4, Figure 6-3) and install the wear tool shown in Figure 6-2.
5. Start the engine and allow the steering system to stabilize and the brake accumulators to fill.



J060032

FIGURE 6-3. TOOL INSTALLATION LOCATION

- | | |
|------------------------|------------------------|
| 1. Rear Brake Assembly | 3. Bleeder Ports |
| 2. Cooling Oil Ports | 4. Wear Tool Port/Plug |

PARKING BRAKE

Description

The disc type parking brake, mounted on the final drive input, utilizes three brake heads with spring cans (hydraulic cylinders) containing internal springs which apply the parking brake when hydraulic pressure is released.

When the engine is running and the park brake switch is in the OFF position, hydraulic oil is routed to the spring cans to extend the pistons and mechanically retract the disc brake pads to release the park brake.

A slack adjuster, mounted between each brake head and spring can, automatically maintains the correct disc pad adjustment. Automatic adjustment occurs when the parking brake is applied.

Parking Brake Service Criteria

The following specifications should be used to determine the state of parking pads and the disc. Replace if any of the limits have been exceeded.

Parking Brake Wear Limits		
Item	New	Limit
Disc Face Runout	0.4 mm (0.016 in.)	0.8 mm (0.032 in.)
Disc Thickness	25 mm (0.99 in.)	20 mm (0.79 in.)
Pads (Includes plate thickness)	20.0 mm (0.787 in.)	12.2 mm (0.48 in.)



Before removing any brake lines or brake circuit components, be certain the steering system and brake system accumulators are bled down. To bleed down accumulators:

- ***Block truck wheels***
- ***Turn the key switch OFF and wait approximately 90 seconds for the steering accumulators to bleed down. Rotate the steering wheel; no wheel movement should occur.***
- ***Bleed the brake accumulators (located in the hydraulic components cabinet) by opening (turning counterclockwise) the bleeddown valves (NV1, NV2) located on the brake manifold. Wait approximately 90 seconds to let accumulators bleed down. When brake accumulators are completely bled down, close the bleeddown valves completely by turning clockwise.***

BRAKE COOLING PUMP

Tandem gear pump (5, Figure 2-2), mounted on the right side of the transmission PTO, directs oil flow to the front and rear brake cooling circuits. The front (drive shaft end) section provides oil for the front brake circuit while the other section provides oil for the rear brake circuit.

BRAKE CONTROL VALVE (BCV)

Each circuit has its own BCV. If the brakes are not applied, 50% of the cooling oil is bypassed around the brakes and heat exchanger to be returned directly to the tank. This reduces power loss caused by excessive oil flowing through the brake housing. Also built into the BCV's is a relief valve which will activate at 883 kPa (128 psi). When actuated, the pilot relief valve will cause the main relief valves to open allowing the excess oil to return to tank.

HIGH PRESSURE FILTERS

The truck is equipped with one high pressure filter with a Beta 12 = 200 rating, for the steering and brake system. The filter assembly has a built-in bypass system which activates a message on the character display in the Electronic Display Panel (EDP) when the differential pressure across the filter exceeds 241 kPa (35 psi).

The filter must be changed as soon as possible after the indication on the EDP, before actual by-pass occurs. For the regular filter service interval, refer to Lubrication and Service, Section P, or sooner if the indicator light turns on.

LOW PRESSURE FILTERS

The truck is also equipped with three low pressure filters, for the hoist and brake cooling circuits. All three filters have a built in bypass system which also activates a display message on the EDP when the differential pressure indicates by-pass for any of the filters.

The filter elements must be changed as soon as possible after the indicator alert, before actual by-pass occurs. For the regular filter service interval, refer to Lubrication and Service, Section P, or replace when the indicator light turns on.

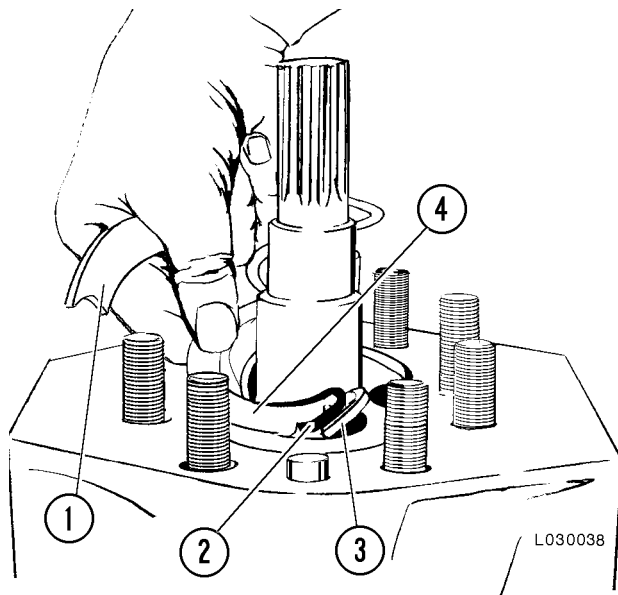


FIGURE 3-10. ISOLATION PLATE REMOVAL

- | | |
|--------------------|------------------|
| 1. Isolation Plate | 3. Backup Ring |
| 2. O-Ring | 4. Ring Retainer |

5. Remove ring retainer (4, Figure 3-10), O-ring (2), back-up ring (3), and isolation plate (1).

6. Grasp the drive gear shaft extension (1, Figure 3-11) and lift it upward to dislodge pressure plate (2). Grasp the plate between thumb and forefinger and lift it straight off the shafts.

NOTE: As parts are removed from each pump section, lay out in separate groups and in the same order in which removed.

7. Lift the drive gear and the idler gear straight out of the bore of the body.

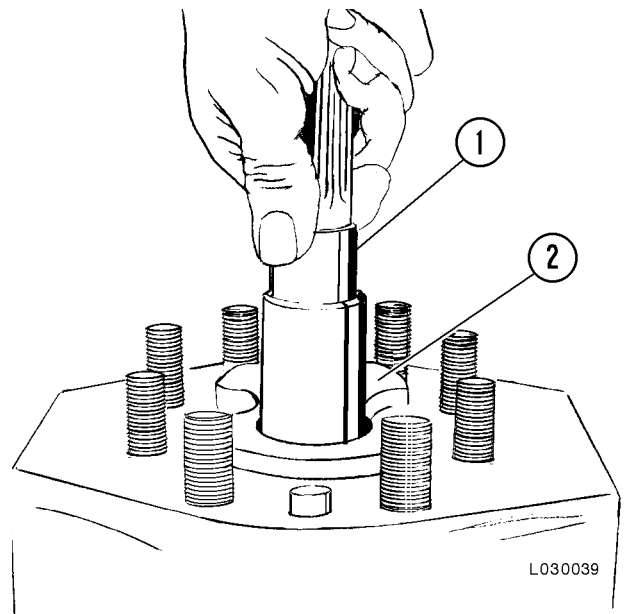


FIGURE 3-11. DRIVE GEAR REMOVAL

- | | |
|---------------|-------------------|
| 1. Drive Gear | 2. Pressure Plate |
|---------------|-------------------|

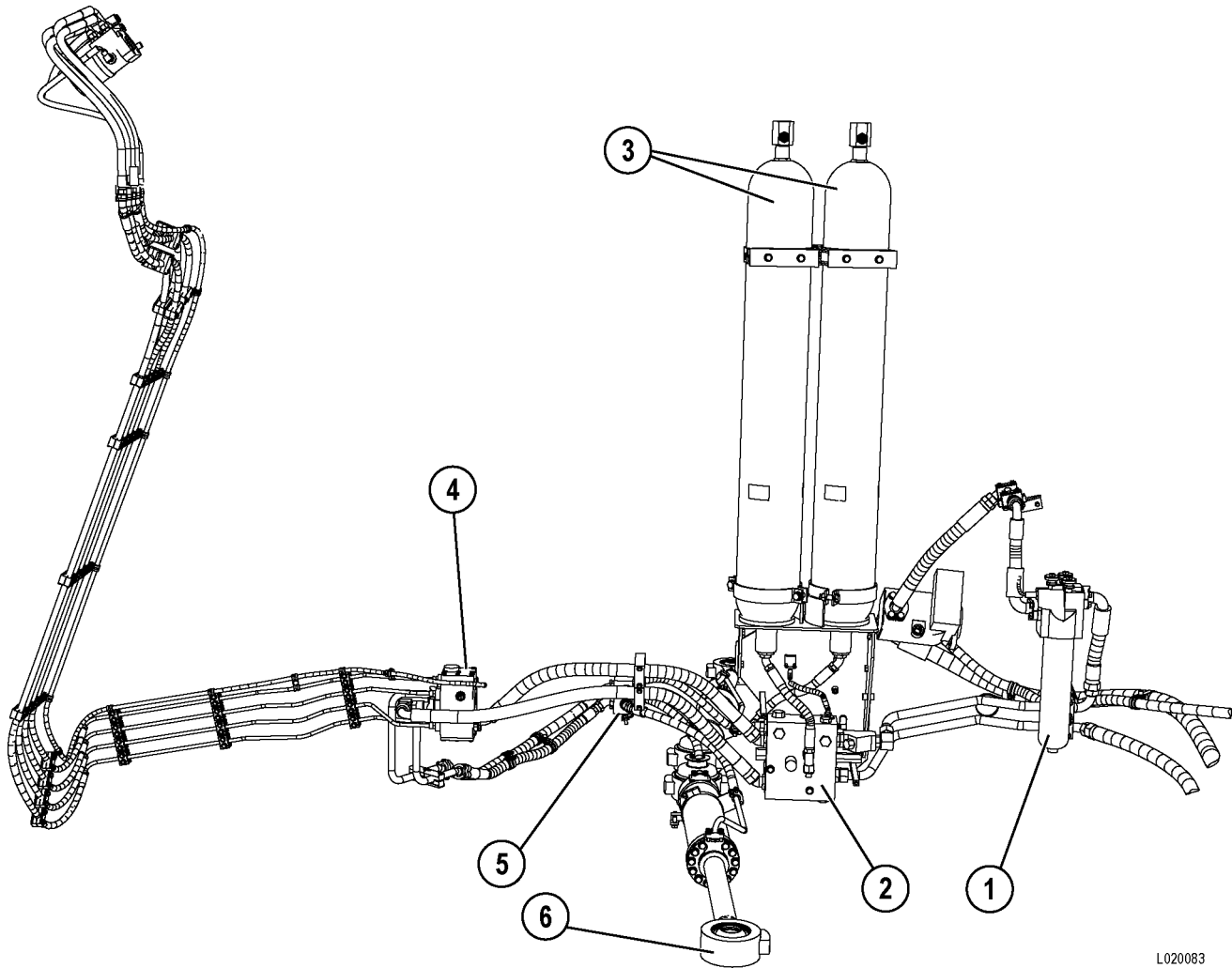
8. Examine the gear bores in body (1, Figure 3-12):

During the initial break-in at the factory the gears cut into body. The nominal depth of this cut is 0.20 mm (.008 in.) and should not exceed 0.38 mm (.015 in.). As the gear teeth cut into the housing, metal is rolled against the pressure plates.

Using a knife or sharp pointed scraper, remove the metal that was rolled against the top pressure plate. Remove the metal that is rolled against the pressure plate in the bottom of the body. Blow out the metal chips that were broken loose. This will help to keep the pressure plate from hanging as it is lifted from the bottom of the gear bores.



When removing the rolled up metal, do not attempt to remove gear track-in grooves.



L020083

FIGURE 4-1. STEERING CIRCUIT COMPONENTS

- | | | |
|-------------------------|-------------------------|----------------------|
| 1. High Pressure Filter | 3. Accumulators | 5. Manifold |
| 2. Bleed-down Manifold | 4. Flow Amplifier Valve | 6. Steering Cylinder |

Bleed-down Solenoid

Each time the key switch is turned OFF, it activates a timer that energizes the bleed-down solenoid. When the bleed-down solenoid is energized, all hydraulic steering pressure, including the accumulators, is purged back to the hydraulic tank.

After approximately 90 seconds, the timer will de-energize to close the return port to tank. By this time all the oil in the accumulators should have returned to tank.

OPERATION

Full Pump Volume (Figure 4-8):

Rotating the drive shaft turns the splined cylinder, which contains the pistons. When the cylinder is rotated, the pistons move in and out of their bores as the shoes ride against the angled swashblock.

As the cylinder rotates, the individual piston bores are connected, alternately, to Port A (upper) and Port B (lower). While connected to the upper side (suction) Port A, each piston moves outward, drawing fluid from Port A into the piston bore until it's outermost stroke is reached. At that point, the piston bore passes from the upper crescent port to the lower crescent port.

While rotating across the lower crescent, each piston moves across the angled swashblock face. Thus, each piston is forced inward. Each piston displaces fluid through the lower crescent to Port B until it's innermost stroke is reached. At that point, the piston bore passes from the lower to the upper crescent again, and the operating cycle is repeated.

Half Pump Volume (Figure 4-9):

Swashblock angle determines the length of piston stroke thereby determining the amount of delivery from the pump. In this illustration, the stroke angle is one-half of the stroke angle shown in Figure 4-8. Therefore, the piston stroke and pump delivery is one half the delivery in Figure 4-8.

Neutral Position (Figure 4-10):

Neutral position results when the control centers the swashblock. The swashblock angle is now zero and the swashblock face is now parallel to the cylinder face. Therefore, no inward or outward motion of the pump pistons exist as the piston shoes rotate around the swashblock face. The lack of inward and outward motion results in no fluid being displaced from the piston bores. Consequently, there is no delivery from pump ports.

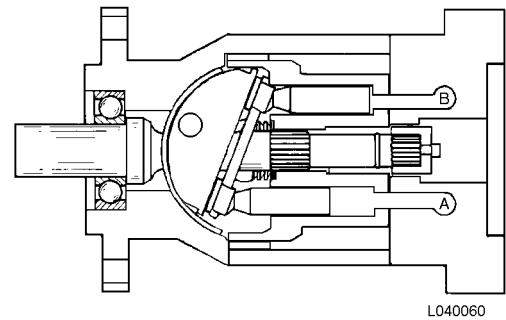


FIGURE 4-8. PUMP AT FULL VOLUME

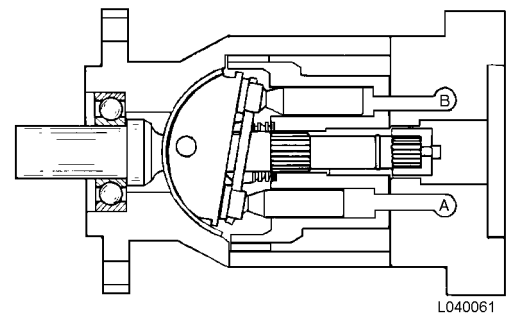


FIGURE 4-9. PUMP AT HALF VOLUME

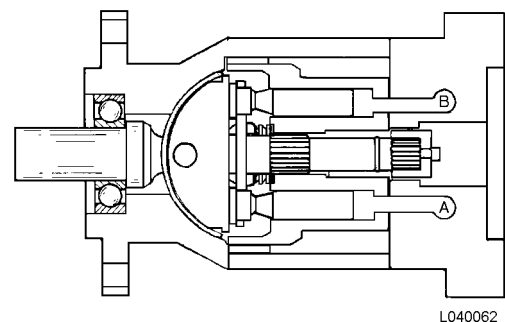


FIGURE 4-10. PUMP IN NEUTRAL POSITION

NOTES

1. Attach the appropriate lifting apparatus to the accumulator. The weight of the accumulator is approximately 140 kg (310 lb). Lift the accumulator into the holding fixture and secure. Attach the lifting apparatus to the holding fixture and lift it into the test tank.
2. Cover hydraulic port assembly (2, Figure 6-5) with a plastic cap to prevent water entry. DO NOT install a threaded plug in the hydraulic port assembly. Install bleed plug (12).
3. Charge the accumulator to 9653 kPa (1400 psi). Refer to Steering Accumulator Charging in this chapter.
4. Fill the test tank so the accumulator is completely submerged and observe for 20 minutes. No leakage (bubbling) is permitted. If leakage is present, go to Step 7. If no leakage is present, continue to the next step.
5. Drain the test tank. Remove the plastic plug from hydraulic port assembly (2). Ensure no moisture is present in the hydraulic port assembly.
6. Connect a hydraulic power supply. Pressurize the accumulator with oil to 24 132 kPa (3500 psi). Refill the test tank with water and observe for 20 minutes. No oil or nitrogen leakage is permitted.
7. Slowly release the oil pressure. Drain the test tank and remove the hydraulic power supply connection. Ensure no moisture is present in hydraulic port assembly (2) and install a plastic cap to prevent contamination. DO NOT install a threaded plug in the hydraulic port assembly.
8. If any nitrogen gas or oil leakage was present, discharge all the nitrogen gas using the charging equipment, and repair as necessary.
9. If there are no leaks, charge the accumulator to 690-827 kPa (100-120 psi). Disconnect the charging manifold. Use a wrench to tighten charging nut (5, Figure 6-5) to **7-11 N·m (5-8 lb ft)**.
10. Remove the accumulator from the test tank fixture.
11. Verify all labels are attached and legible. Refer to the parts book if replacements are required.



When storing an accumulator, pressurize the accumulator to 690-827 kPa (100-120 psi). DO NOT exceed 827 kPa (120 psi). Sudden loss of the accumulator pressure can result in a projectile hazard that can cause serious injury or death.

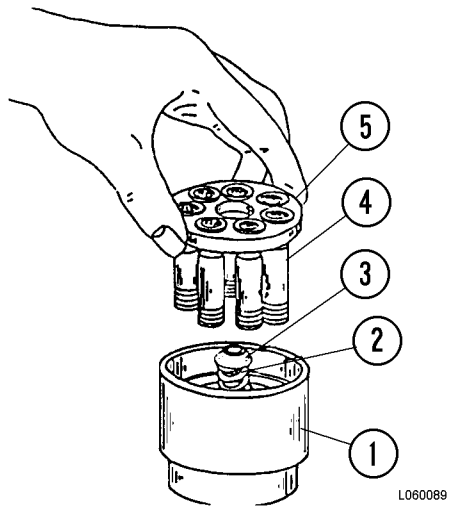


FIGURE 6-17. PISTON/SHOE REMOVAL

- | | |
|--------------------|-------------------------|
| 1. Cylinder Barrel | 4. Piston/Shoe Assembly |
| 2. Spring | 5. Shoe Retainer |
| 3. Fulcrum Ball | |

14. Place the cylinder barrel on a clean, protective surface with the piston shoes facing upward.
15. Mark each piston, its cylinder bore and location in the shoe retainer for ease of inspection and assembly.
16. Piston/shoe assemblies (4, Figure 6-17) can be removed individually or as a group by pulling upward on the shoe retainer (5).
17. Remove the fulcrum ball (3) and shoe retainer spring (2).
18. Remove the retaining ring (6, Figure 6-18) and pull the cylinder bearing (7) from the housing.
19. If necessary, remove roll pins (8) from the housing. Note the position of the roll pins in the case.

Drive Shaft Group

20. Remove the bearing retainer ring (1, Figure 6-16).
21. Grasp the outboard end of the drive shaft and pull shaft and bearing out from the pump housing.
22. Remove the shaft retaining ring (2) and bearing (3).
23. Remove the shaft seal retainer (4) and the shaft seal (5) from the housing only if necessary.

Swashblock Group

24. Remove the flat head screws (7, Figure 6-16) and guide plate (8).
25. Reach inside the case and remove the swashblock (14) and the saddle bearings (13).

Inspection



Always wear safety goggles when using solvents or compressed air. Failure to wear safety goggles could result in serious personal injury.

1. Clean all parts thoroughly.
2. Replace all seals and O-rings with new parts.
3. Check all locating pins for damage and all springs for cracking or signs of fatigue.

Control Group

4. Carefully check control piston pin (10, Figure 6-15) for cracks and/or signs of fatigue. Check the fit of the pin in the swashblock. The pin should be a slip fit without any radial free-play.
5. Verify all orifices and passages are free of obstructions.
6. Check main control piston (5), bias control piston (7), and housing (1) for excessive wear or scoring.

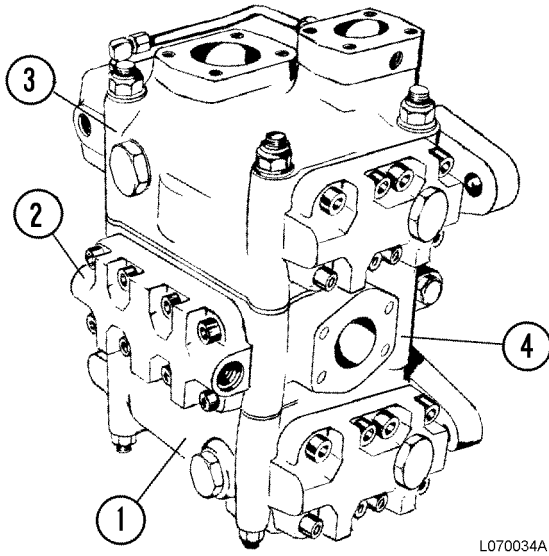


FIGURE 7-2. HOIST VALVE

- | | |
|----------------------------|------------------|
| 1. Inlet Section | 3. Inlet Section |
| 2. Top Spool Section Cover | 4. Spool Section |

The spool section of the hoist valve consists of the following components:

- Two pilot ports
- Two main spools
- Two work ports
- Check poppets

The pilot ports are located in the top spool section cover (2, Figure 7-3). These ports provide connections for pilot lines from the hoist pilot valve. Each pilot port has a corresponding work port.

The work ports provide for line connections between spool section (4) and the hoist cylinders. One main spool for each work port is spring centered at both ends to close the work port from the high and low pressure cores when there is no flow to the pilot ports.

When there is flow through a pilot port to a spool, a positive differential pressure at the top of the spool will overcome the bottom spring bias causing the spool to shift to connect the high pressure core to the work port. When there is flow from the main valve work port to the pilot port through the cross-holes, a positive differential pressure at the bottom of the spool will overcome the top spring bias and the spool will shift to connect the work port to the low pressure core.

The check poppets located in the main spools permit free flow from the work port to the pilot port and restrict flow from the pilot port to the work port. These check poppets control spool response and spool movements.

Hoist Pilot Valve

The hoist pilot valve is located in the hydraulic cabinet. (Refer to Figure 7-3.) The hoist pilot valve spool is spring centered to the HOLD position. The hoist pilot valve is controlled directly by the operator through a lever and cable arrangement. The control lever is located between the operator and center console. When the operator moves the lever, the pilot valve spool moves and directs pilot flow to the appropriate pilot port on the hoist valve causing the main spools to direct working pump flow to the hoist cylinders.

The hoist pilot valve is equipped with a one way load check valve which allows free flow from the center passage to bridge core and prevents reverse flow. The hoist pilot valve is also equipped with a power down relief valve (1, Figure 7-3). The power down relief valve is located between the power down control port and return galley. The power down relief valve limits power down pressure at 10 342 kPa (1500 psi).

NOTES

Installation

1. Install a retaining strap or chain to prevent the cylinder from extending during handling. The hoist cylinder weighs approximately 330 kg (730 lb). Attach a suitable lifting device that can handle the load safely.
2. Raise the cylinder into position over the pivot point on the frame. The air bleed vent at the top of the cylinder must be toward the front of the truck. Align the bearing eye with the pivot pin and push the cylinder into place.
3. Install retainer (2, Figure 8-17), lock plate (4), and the capscrews. Tighten the capscrews to standard torque, and bend the lock plate tabs over the capscrew flats.
4. Align the top hoist cylinder bearing eye with the bore of the upper mounting bracket.
5. Install pin (3, Figure 8-16) and retaining plate (1). Secure in place with capscrews and lockwashers (2). Tighten the capscrews to standard torque.
6. Install new O-rings in the grooves on the hose flange connections and lubricate with clean hydraulic oil. Position the flanges over the hoist cylinder ports and install the flange clamps and the mounting capscrews and lockwashers. Tighten the capscrews to standard torque.
7. Reconnect the lubrication lines for the upper and lower hoist cylinder bearings.
8. Start the engine, raise and lower the body several times to bleed air from the cylinders. Check for proper operation and inspect for leaks.
9. Service the hydraulic tank if necessary.

Disassembly

1. If removal of the hoist cylinder eye bearings is necessary, remove retainer ring (5, Figure 8-17) and press out bearing (6).
 2. Mount the hoist cylinder in a fixture which will allow it to be rotated 180°.
 3. Position cylinder head (10, Figure 8-18) at the top. Remove capscrews (11) and the lockwashers.
 4. Lift the cylinder head straight up until quill assembly (22) is clear. Remove O-ring (12) and backup ring (23).
 5. Remove snap ring (9). Remove capscrews (7) and flatwashers (5) that secure rod bearing retainer (6) to rod (1). Remove seal (8).
 6. Fabricate a retainer bar using a 6 x 25 x 460 mm (1/4" x 1" x 18") steel flat. Drill holes in the bar to align with a pair of tapped holes spaced 180° apart in the housing. Attach the bar to the housing using capscrews (11).
- NOTE: A retainer bar is required to prevent the first and second stage cylinders from dropping out when the housing is inverted.*
7. Rotate the cylinder assembly 180° to position the lower mounting eye at the top. Attach a lifting device to the eye on rod (1) and lift the rod and third stage cylinder assembly out of the cylinder housing.



As internal parts are exposed during disassembly, protect machined surfaces from scratches or nicks.

8. Rotate the cylinder housing 180°. Remove the retainer installed in step 6.
9. Fabricate a round disc with a hole in the center. Align the disc over second stage cylinder (2) and first stage cylinder (3) at the bottom of the cylinder housing.
10. Insert a 13 mm (.50 in.) dia. x 1350 mm (53 in.) threaded rod through the top and through the hole in the disc. Thread a nut on the bottom end of the threaded rod below the disc.
11. Screw a lifting eye on the top end of the rod. Attach it to a lifting device and lift the second and first stage cylinders out of the housing.

NOTE

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HOT START SYSTEM
INDEX**

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 SYSTEM OPERATION M7-3
 HEATER INFORMATION M7-4
 TROUBLESHOOTING GUIDELINES M7-6

NOTES

DOOR SEALS

Removal

1. The three-sided door seal seals the two sides and the top of the door. The seal is glued onto the door and can be replaced by peeling the seal away from the door frame. Use a suitable cleaner to remove the remaining seal and glue material.

Installation

1. Clean the mounting surface for the door seal. The surface must be free of dirt and oil. Apply weatherstrip adhesive onto the area where the seal is to be installed.
2. Install seal (3, Figure 22) so that the corners of the seal fit up into the corners of the door frame.

NOTE: Repeat the previous steps for replacement of door hinge seal (2, Figure 23).

4. Position both ends so that they are square. Then, while holding the ends together, push them firmly into the center of the opening.

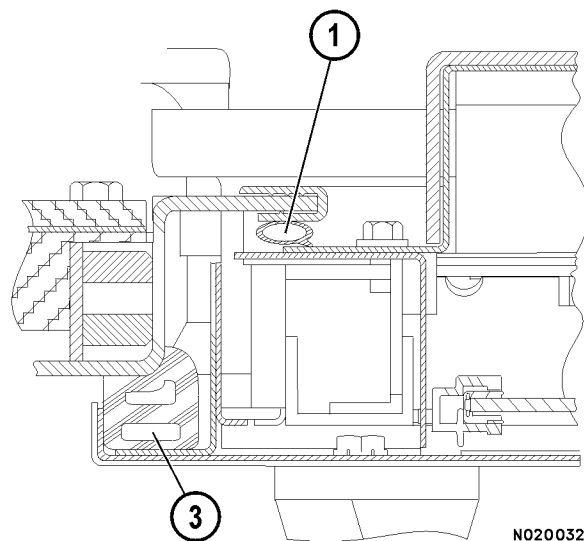


FIGURE 2-22.

1. Door Opening Seal 3. Door Assembly Seal

DOOR OPENING SEAL

Removal

1. Starting at the lower center of the door opening, pull up on one end of the seal. Remove the seal from the opening.

Installation

1. Inspect the cab opening lip for damage, dirt, or oil. Clean and repair the cab opening as necessary. Remove any dirt and adhesive. Verify the opening is clean and free of burrs.
2. Install the seal around the door opening in the cab. Start at the bottom center of the cab opening and work the seal lip over the edge of the opening. Verify the seal fits tightly in the corners. A soft face tool may be used to work the seal up into the corners.
3. Continue working all the around the opening. When the ends of the seal meet at the starting bottom center of the cab opening, it may be necessary to trim off some of the seal.

NOTE: The ends of the seal must be square-cut to ensure a proper fit.

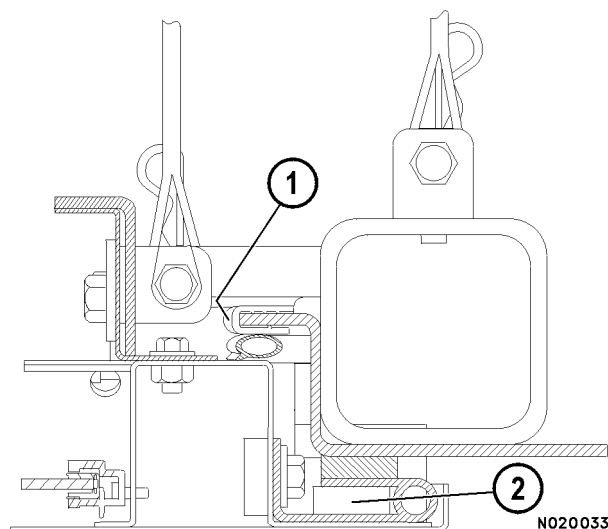


FIGURE 2-23.

1. Door Opening Seal 2. Door Hinge Seal

SYSTEM PERFORMANCE TEST	N4-20
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Handling and Reusing PAG Oil	N4-21
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Checking System Oil	N4-21
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⚠️ WARNING

Federal regulations prohibit venting R-12 and R-134a refrigerant into the atmosphere. An SAE and UL approved recovery/recycle station must be used to recover refrigerant from the A/C system. Refrigerant is stored in a container on the unit for recycling, reclaiming, or transporting. In addition, technicians servicing A/C systems must be certified they have been properly trained to service the system.

Although accidental release of refrigerant is a remote possibility when proper procedures are followed, the following warnings must be observed when servicing A/C systems:

- **Provide appropriate protection for your eyes (goggles or face shield) when working around refrigerant.**
- **A drop of the liquid refrigerant on your skin will produce frostbite. Wear gloves and use extreme caution when handling refrigerant.**
- **If even the slightest trace of refrigerant enters your eye, flood the eye immediately with cool water and seek medical attention as soon as possible.**
- **Ensure that there is sufficient ventilation whenever refrigerant is being discharged from a system. Keep in mind that refrigerant is heavier than air and will fall to low-lying areas.**
- **When exposed to flames or sparks, the components of refrigerant change and become deadly phosgene gas. This poison gas will damage the respiratory system if inhaled. Never smoke in an area where refrigerant is used or stored.**
- **Never direct a steam cleaning hose or torch in direct contact with components in the air conditioning system. Localized heat can raise the pressure to a dangerous level.**
- **Do not heat or store refrigerant containers above 49° C (120° F).**
- **Do not flush or pressure test the A/C system using shop air or another compressed air source. Certain mixtures of air and R-134a refrigerant are combustible when slightly pressurized. Shop air supplies also contain moisture and other contaminants that could damage system components.**

SERVICE TOOLS AND EQUIPMENT

Recovery/Recycle Station

Whenever refrigerant must be removed from the system, a dual purpose station as shown in Figure 4-6, performs both recovery and recycle procedures which follows the new guidelines for handling used refrigerant. The recovered refrigerant is recycled to reduce contaminants, and can then be reused in the same machine or fleet.

To accomplish this, the recovery/recycle station separates the oil from the refrigerant and filters the refrigerant multiple times to reduce moisture, acidity, and particulate matter found in a used refrigerant.

NOTE: To be re-sold, the gas must be "reclaimed" which leaves it as pure as new, but requires equipment normally too expensive for all but the largest refrigeration shops.

Equipment is also available to just remove or extract the refrigerant. Extraction equipment does not clean the refrigerant - it is used to recover the refrigerant from an A/C system prior to servicing.

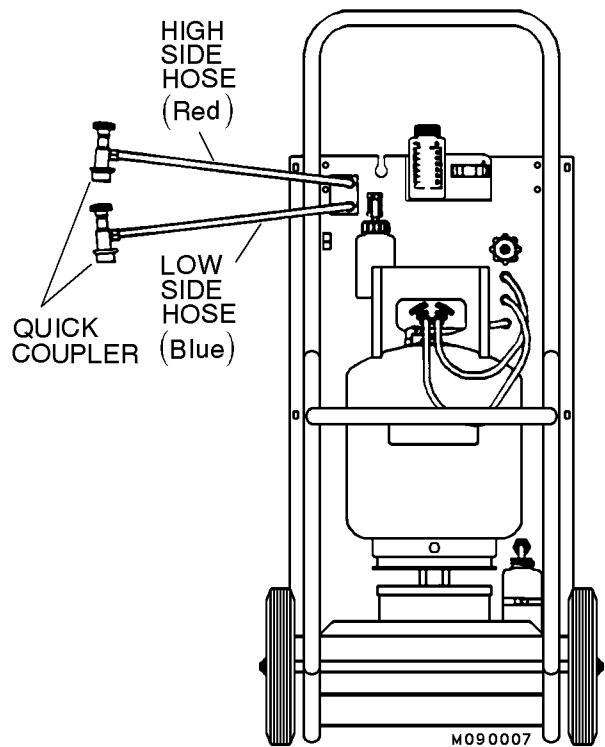
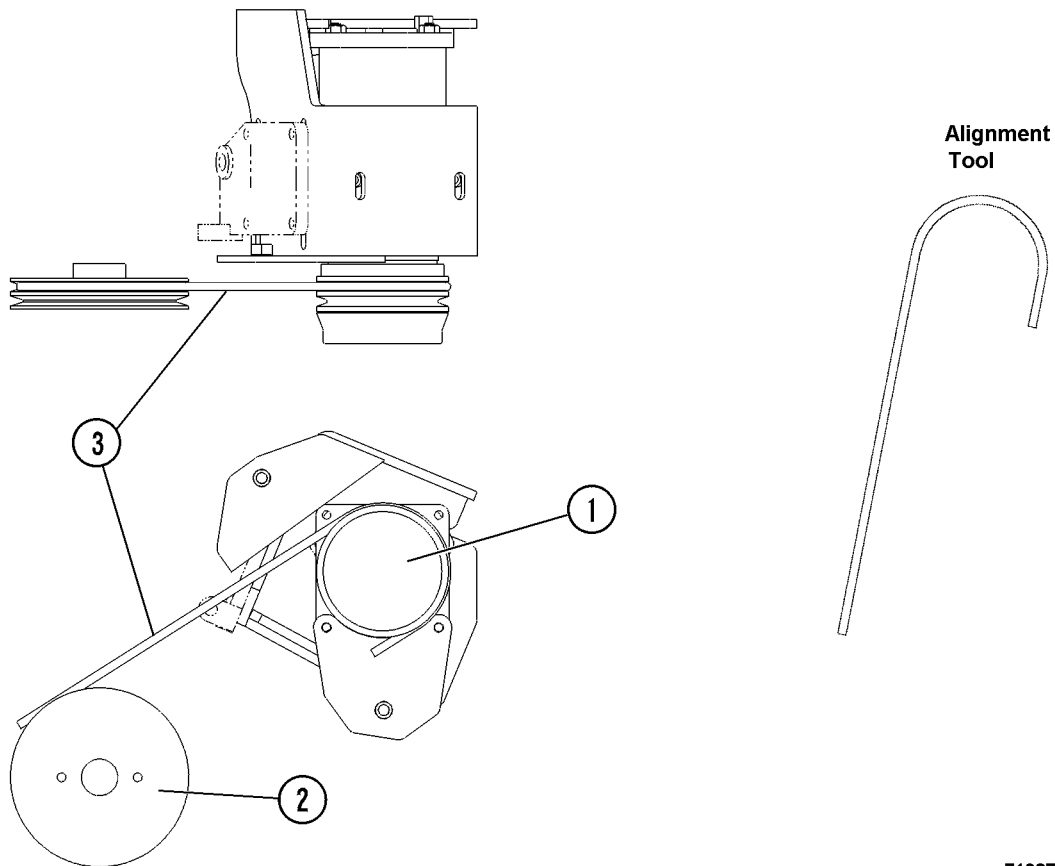


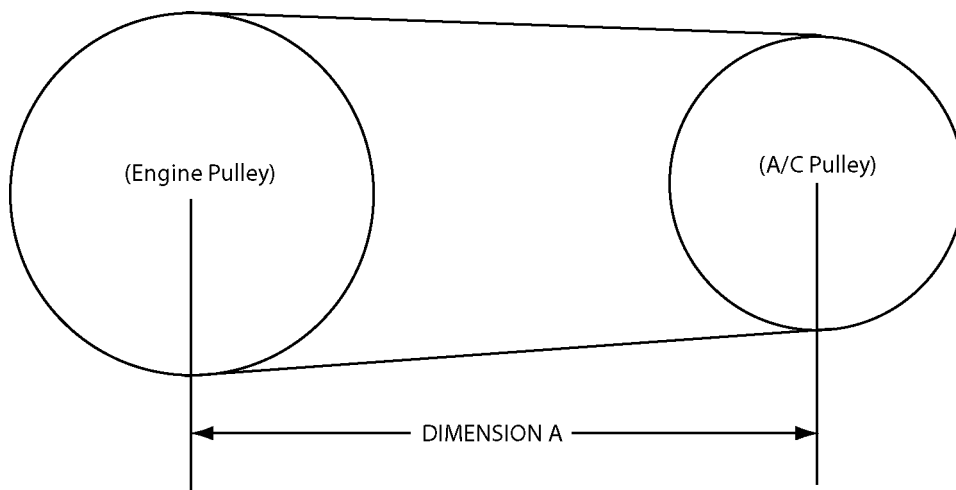
FIGURE 4-6. RECOVERY/RECYCLE STATION



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FIGURE 4-15. BELT ALIGNMENT TOOL

1. AC Compressor Pulley 2. Drive Pulley 3. Alignment Tool



N040074

FIGURE 4-16. BELT TENSION DIMENSIONS

PROBLEM: Air and/or Moisture in the System

Indications:

Low side pressure - HIGH
High side pressure - HIGH
Discharge air is only slightly cool.

Possible Causes

- Leaks in system.

Suggested Corrective Actions

Test for leaks, especially around the compressor shaft seal area. After leaks are found, recover refrigerant from the system and repair leaks. Replace the receiver-drier. Check the compressor and replace any oil lost due to leakage. Evacuate and recharge the system using a scale to ensure proper quantity. Check A/C operation and performance.

PROBLEM: Expansion Valve Stuck or Plugged

Indications:

Low side pressure - VERY LOW or in a Vacuum
High side pressure - HIGH
Discharge air only slightly cool.
Expansion valve body is frosted or sweaty.

Possible Causes

An expansion valve malfunction could mean the valve is stuck in the closed position, the filter screen is clogged (block expansion valves do not have filter screens), moisture in the system has frozen at the expansion valve orifice, or the sensing bulb is not operating. If the sensing bulb is accessible, perform the following test. If not, proceed to the Repair Procedure.

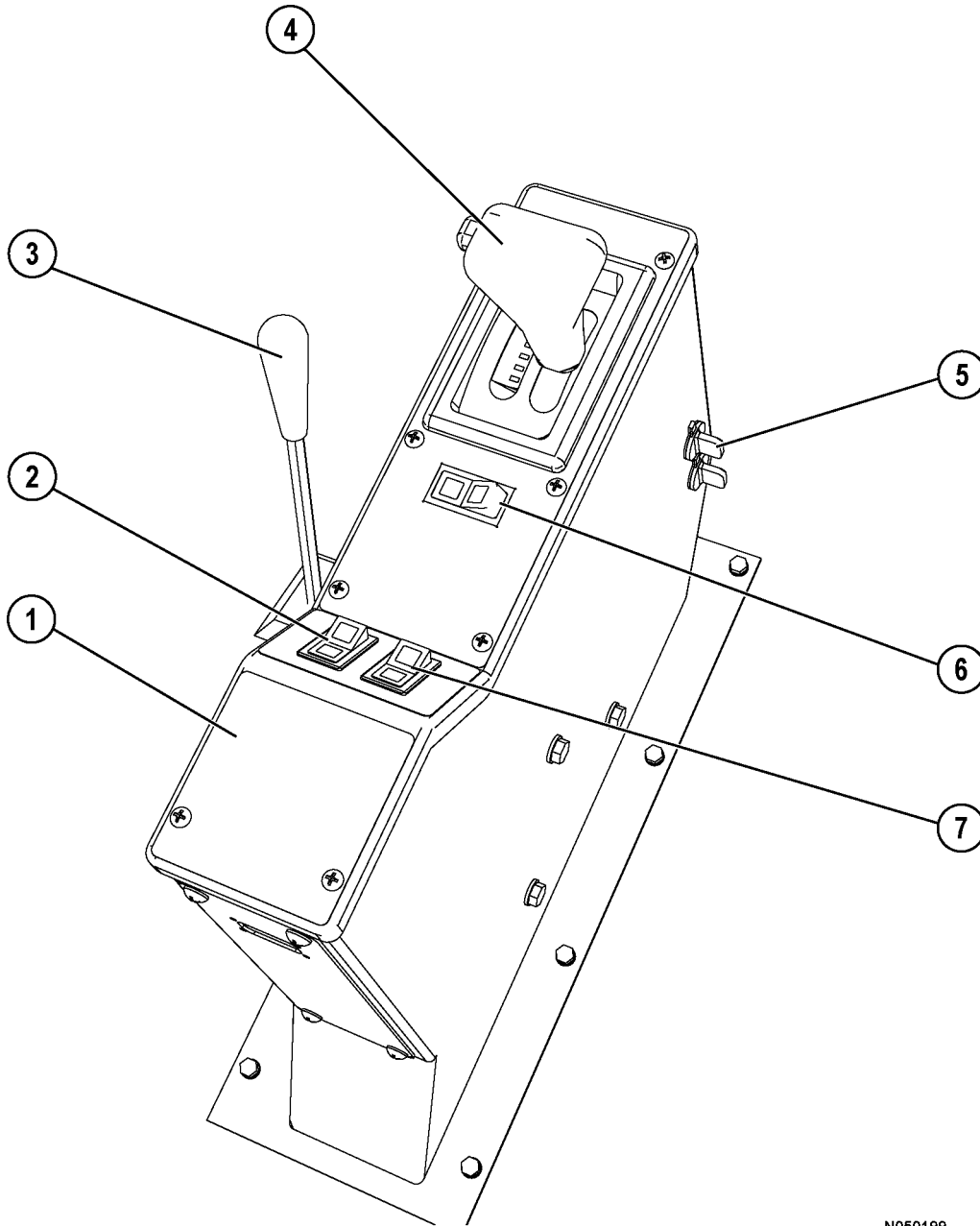
Suggested Corrective Actions

Test: Warm diaphragm and valve body with your hand, or very carefully with a heat gun. Activate the system and watch to see if the low pressure gauge rises. Next, carefully spray a little nitrogen, or any substance below 32° F, on the capillary coil (bulb) or valve diaphragm. The low side gauge needle should drop and read at a lower (suction) pressure on the gauge. This indicates the valve was partially open and that your action closed it. Repeat the test, but first warm the valve diaphragm or capillary with your hand. If the low side gauge drops again, the valve is not stuck.

Repair Procedure: Inspect the expansion valve screen (except block type valves). To do this, remove all refrigerant from the system. Disconnect the inlet hose fitting from the expansion valve. Remove, clean, and replace the screen. Reconnect the hose and replace the receiver-drier. Evacuate and recharge the system with refrigerant using a scale. Check AC operation and performance. If the expansion valve tests did not cause the low pressure gauge needle to rise and drop, and if the other procedure described did not correct the problem, the expansion valve is defective. Replace the valve.

CENTER CONSOLE

Center console (1, Figure 5-4) located to the right of the operator seat, is a housing which provides a mounting surface for certain operator controls. The passenger seat is located directly to the right of the console.

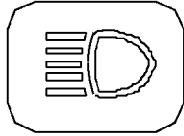


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FIGURE 5-4. CENTER CONSOLE

- | | |
|-----------------------------|-----------------------------|
| 1. Center Console | 5. Auxiliary Power Outlets |
| 2. LH Window Control Switch | 6. Parking Brake Switch |
| 3. Hoist Control Lever | 7. RH Window Control Switch |
| 4. Transmission Shift Lever | |

Head Lamp High Beam Pilot Lamp



The high beam pilot lamp will illuminate when the head lamps are set to high beam using the multi-function turn signal lever.

ASR Actuation Lamp

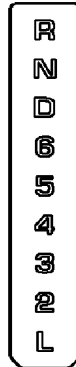
When the ASR system is active, this lamp will illuminate when slipping from the rear wheels is detected. The lamp indicates that the ASR system has actuated the brakes to prevent the slippage.



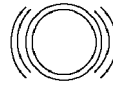
Shift Lever Pilot Lamp

The shift lever pilot lamp displays the position of the shift lever.

The letter or number for the selected speed range will be illuminated.



Retarder Pilot Lamp



The retarder pilot lamp will illuminate when the retarder control lever is actuated and the retarding system is active.

ARSC Pilot Lamp

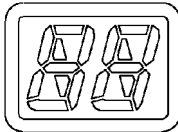
The ARSC pilot lamp indicates that the automatic retard system is active. The system will maintain the truck at the set speed.



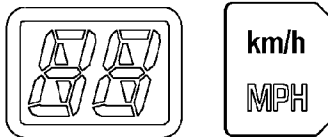
The lamp will turn off when the ARSC system is turned off.

Shift Indicator

The shift indicator displays the transmission shift range (speed range).

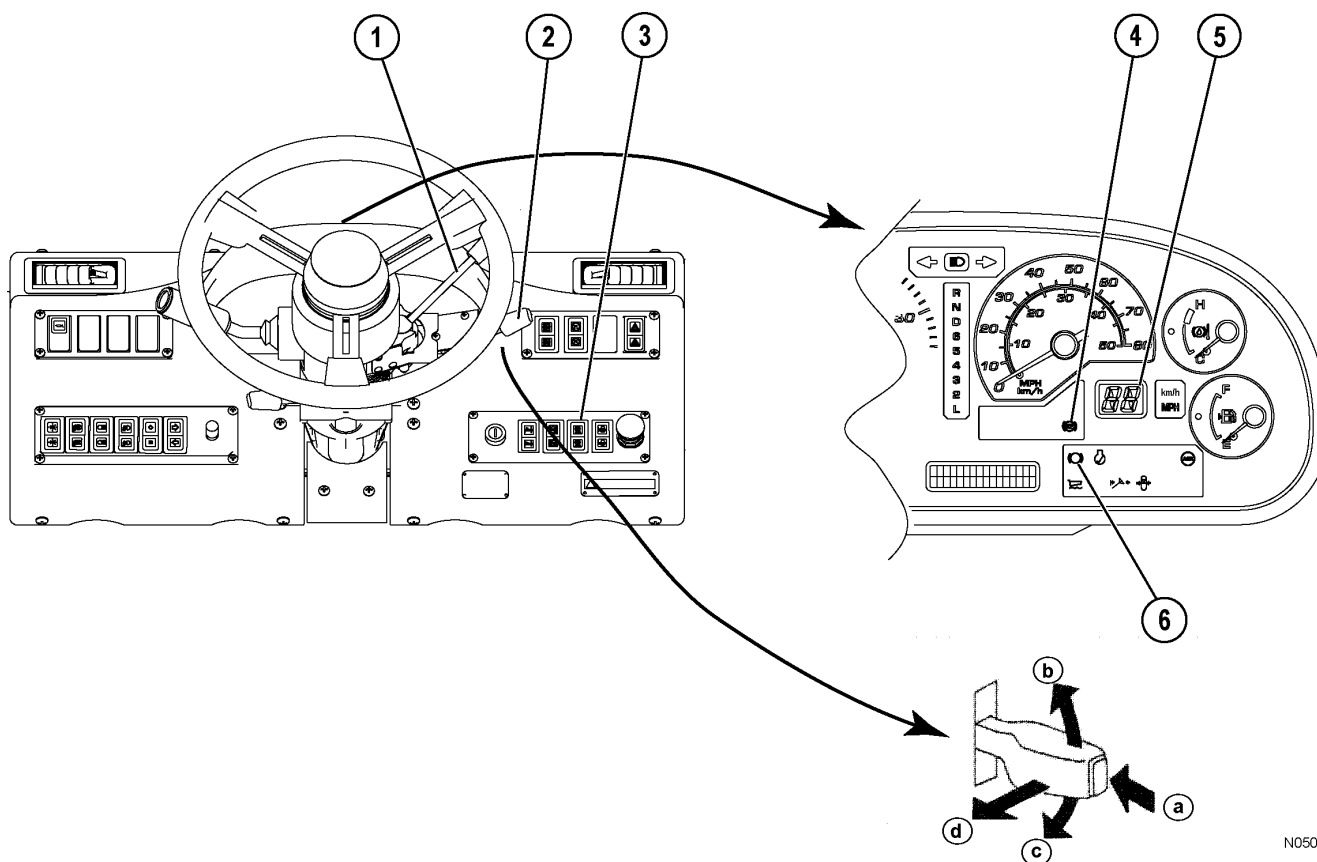


ARSC Set Speed Indicator



The ARSC set speed indicator displays the set travel speed for the auto retarder speed control.

When the ARSC switch is off, the monitor turns off. If the set travel speed has been canceled, 0 is displayed.



N050297

FIGURE 5-19. ARSC CONTROLS

- | | |
|-----------------------------|-------------------|
| 1. Retard Lever | a. Set |
| 2. ARSC Lever | b. Increase Speed |
| 3. ARSC Switch | c. Decrease Speed |
| 4. ARSC Pilot Lamp | d. Cancel |
| 5. ARSC Set Speed Indicator | |
| 6. Retarder Pilot Lamp | |

If it is desired to decrease the set speed, operate the retarder control lever to reduce speed, and when the desired set travel speed is reached, press the set switch on the auto retarder (ARSC) set lever. The set travel speed will be changed to the new speed.

To change the speed without using the accelerator or braking system, tap up (b, Figure 5-19) on the lever to increase the speed. The speed will increase by 1 km/h (0.6 mph). To decrease the speed, tap down (c, Figure 5-19) on the lever. The speed will decrease by 1 km/h (0.6 mph). The maximum speed change that can occur using the tap up - tap down functions is ± 5 km/h (3.1 mph).

If the set switch and cancel are operated at the same time, cancel is given priority.

If the set switch and tap up are operated at the same time, tap up is given priority.

If the set switch and tap down are operated at the same time, tap down is given priority.

10 HOUR (DAILY) INSPECTION

Perform a "walk around" inspection prior to each work shift. Check the general condition of the truck. Look for evidence of hydraulic leaks. Check all lights and mirrors for dirt and damage. Check the operator's cab for dirty or damaged accessories or controls. Inspect the frame, sheet metal and body for cracks. Notify the proper maintenance authority if any discrepancies are found.

Truck Serial Number _____ Site Unit Number _____ Date _____				
Hourmeter _____ Name of Service Technician _____				
TASK		COMMENTS	CHECKED	INITIALS
1.	Check all fluid levels a. Engine Oil- <i>NOTE: Refer to engine manufacturer service manual for oil recommendations.</i>			
	b. Radiator - Check coolant level and fill with proper mixture as shown in Anti-Freeze Recommendations at the beginning of this chapter.			
	c. Batteries - Check electrolyte level and add water if necessary.			
	d. Hydraulic Tank - Check oil level in tank, add if necessary. Lube key C. Refer to Hydraulic Tank Service, in this chapter. <i>NOTE: Check the oil level with the truck on a level surface, engine stopped, body down, and oil warm. Oil must be visible in sight glass. Do not overfill.</i>			
	e. Transmission - Check oil level. Add oil if necessary. Lube key C. Refer to Transmission Oil Level Check in this chapter.			
	f. Fuel Tank - Fill as required.			
	g. Differential - On a level surface, the oil level must be even with the plug hole. Refill with oil, as necessary. Lube key B.			

During the down stroke, the pump cylinder is extended into the grease. Through the combination of shovel action and vacuum generated in the pump cylinder, the grease is forced into the pump cylinder. Simultaneously, grease is discharged through the outlet of the pump. The volume of grease during intake is twice the amount of grease output during one cycle. During the upstroke, the inlet check valve closes, and one half the grease taken in during the previous stroke is transferred through the outlet check and discharged to the outlet port.

WARNING

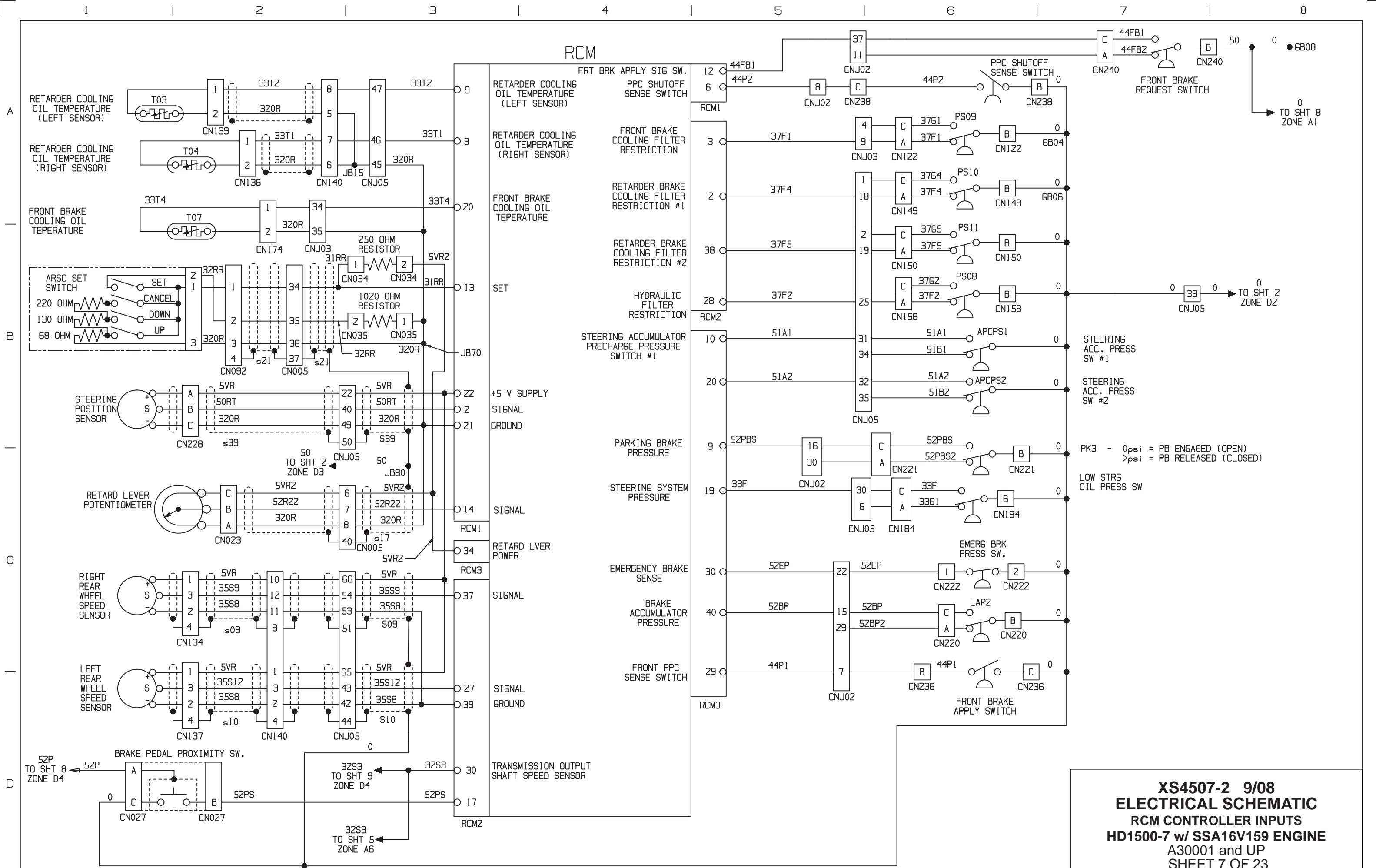
Over-pressurizing of the system, modifying parts, using incompatible chemicals and fluids, or using worn or damaged parts, may result in equipment damage and/or serious personal injury.

- ***DO NOT exceed maximum working pressure for any component in the system.***
- ***DO NOT alter or modify any part of this system unless factory authorization.***
- ***DO NOT attempt to repair or disassemble the equipment while the system is pressurized.***
- ***Ensure all fluid connections are securely tightened before using this equipment.***
- ***Read and follow the fluid manufacturer's recommendations regarding fluid compatibility.***
- ***Check all equipment regularly and repair. Replace worn or damaged parts immediately.***

This equipment generates very high grease pressure. Use extreme caution when operating this equipment. Pressurized grease can pierce the skin causing serious bodily injury. Adequate protection such as safety goggles and protective clothing is recommended.

If fluid penetrates the skin, get medical care immediately! Do not treat as a simple cut. Tell the attending physician exactly what fluid was injected.

Symptom	Possible Causes	Corrective Action
Pump Pressure Builds Very Slowly Or Not At All	No signal at solenoid.	Check timer.
Controller Does Not Operate	No electric power to controller.	Turn on electric power to pump. "POWER" LED should light, "PUMP ON" LED should light when "MANUAL LUBE" is pressed.
"PUMP ON" LED is lit, But Load Connected To Terminals 3 & 4 Will Not Energize	Printed circuit board failure.	Remove and replace.
Load Connected To Terminals 3 & 4 Energized, But "PUMP ON" LED Does Not Light	Printed circuit board failure or keypad failure.	Remove and replace.
Bearing Points Excessively Lubricated	Controller memory mode is off.	Switch controller memory mode to ON.
	Injector output adjustment setting too high.	Readjust to lower setting.
Bearing Points Are Not Sufficiently Lubricated	Timer/controller cycle time setting too low.	Set to longer cycle time or reevaluate lube requirements.
	Injector output adjustment setting too low.	Readjust injector output setting.
	Timer/controller cycle time setting does not deliver lubricant often enough.	Set to shorter cycle time or reevaluate lube requirements.
	System too large for pump output.	Calculate system requirements per planning manual.



XS4507-2 9/08
ELECTRICAL SCHEMATIC
RCM CONTROLLER INPUTS
HD1500-7 w/ SSA16V159 ENGINE
 A30001 and UP
 SHEET 7 OF 23

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