

**TRUCK, CARGO, MEDIUM, CRANE, MC2 – UNIMOG
LIGHT GRADE REPAIR**

This instruction is authorised for use by command of the Chief of Army. It provides direction, mandatory controls and procedures for the operation, maintenance and support of equipment. Personnel are to carry out any action required by this instruction in accordance with EMEI General A 001.

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GENERAL

Introduction

1. This EMEI details all Light Grade Repair procedures for the crane system of the Truck, Cargo, Medium, Crane, MC2 – Unimog.
2. Before starting repairs, observe the crane data contained in EMEI Workshop H 108-1.

NOTE

At the time of publishing EMEI Vehicle G 623, EMEI Workshop H 108-1 has still to be published.

Associated Publications

3. Reference may be necessary to the latest version of the following documents:
 - a. [Defence Road Transport Instructions](#);
 - b. Australian Army Books – Record Book for Service Equipment GM 120;
 - c. EMEI Vehicle G 600 Decade;
 - d. [EMEI Workshop H 108-1](#);
 - e. EMEI Vehicle G 620 Decade; and
 - f. User Handbook – Truck Medium MC2 Unimog – All Types – 7610-66-156-2407.

Authorised Personnel

4. All tasks are to be carried out by a Vehicle Mechanic (ECN 229), or civilian equivalent who is qualified in accordance with the requirements of the TRAMM.

Safety Precautions

5. The following warnings and cautions shall be adhered to when carrying out repairs to the crane:

WARNING

Before working on the hydraulic system, ensure that the hydraulic fluid is sufficiently cool to avoid burns.

Before working on components of the hydraulic system, ensure that there is no residual pressure in the system by operating the relevant control levers.

CAUTION

Do not start the engine whilst replacement procedures are being carried out on the crane system components.

Do not use adhesive tape to seal hydraulic hose or pipe openings. The adhesive on most tapes is soluble in oil and can cause contamination. Use protective caps, plugs or covers, and remove them before installation.

- a. It is vitally important that dirt and other foreign matter are not allowed to enter the hydraulic system during repairs. Dirt or fluid other than clean hydraulic fluid in the system will cause almost immediate failure. Plug or protect openings to prevent dirt entering the system. Use plastic plugs or covers only for this purpose. Do not use cloth or paper as plugs or covers.
- b. Discard all used seals, O rings, cotter pins, and washers. Discard all hydraulic oil drained from the equipment.

- c. When replenishing lubricants, use only those lubricants specified in EMEI Vehicle G 609, G 629 and the User Handbook.
- d. Any fastening or fittings being tightened to prescribed torques are to have dry, clean threads, unless thread sealants are specified. Thread sealants are to be applied to dry, clean, oil-free threads.

Replacement

6. Light Grade Repair includes replacement of the following components:

- a. oil hoses and pipes;
- b. the oil filter assembly;
- c. oil pump drive belts;
- d. the hydraulic oil pump;
- e. the diverter valve;
- f. the directional control valve bank;
- g. the sensing valve;
- h. the reset valve;
- i. the stabiliser shut-off valve;
- j. the pump relay control microswitch;
- k. the cabin switch panel components; and
- l. the spotlight fused cut-out.

Inspection after Repair

7. All procedures for checking and testing the replaced components and the associated systems are integrated into the replacement procedures.

COMPONENT REPLACEMENTS

Oil Hoses and Pipes

8. The crane system components are interconnected by oil hoses or metal pipes as necessary. These items are connected by reduction bushes, elbow joints or adjustable hose clamps to the parent component. Before removing any connection ensure that the oil is drained below the connector level. Also ensure that the oil level is checked and replenished as necessary following any repair/replacement process.

Oil Filter Element

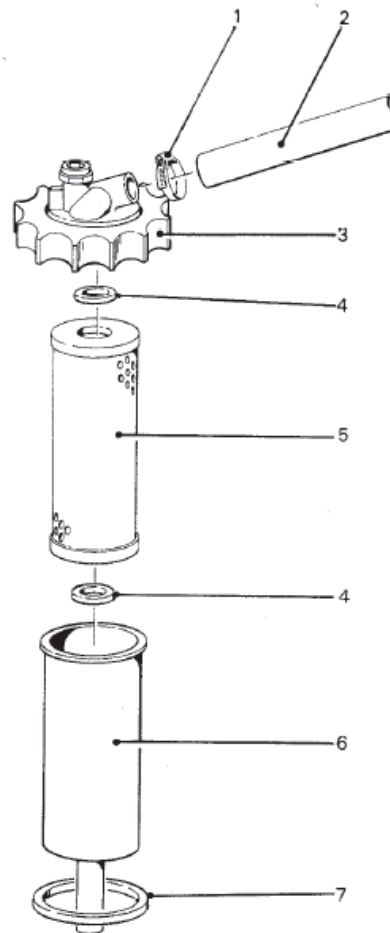
9. **Removal.** Remove the filter element as follows (Figure 1):

- a. Raise the engine bonnet.
- b. Remove the hose clamp (Item 1) from the return hose (Item 2) and detach the hose from the filler cap assembly (Item 3).
- c. Unscrew and remove the filler cap assembly.
- d. Lift the filter element (Item 5) from the filter bowl (Item 6). Allow the oil to drip back into the bowl.
- e. Remove and discard all seals and gaskets.
- f. Clean and inspect the bowl.

10. **Installation.** Install the filter element as follows (Figure 1):

- a. Lightly lubricate the new seals and gaskets with hydraulic oil OM-33. Fit the new seals, gaskets and filter element into the bowl.
- b. Fit the filler cap assembly and tighten the retaining ring.

- c. Attach the return hose to the oil inlet on the filler cap assembly with the clamp.
- d. Start the engine. Allow the oil pressure to build and check for oil leaks at the filler cap and the return hose.
- e. Stop the engine.
- f. Lower the engine bonnet.



- | | | | |
|---|---------------------|---|--------------------|
| 1 | Hose Clamp | 5 | Filter element |
| 2 | Oil return hose | 6 | Filter bowl |
| 3 | Filler cap assembly | 7 | Filter bowl gasket |
| 4 | Seal | | |

Figure 1 Oil Filter Element Replacement

Oil Pump Drive Belts

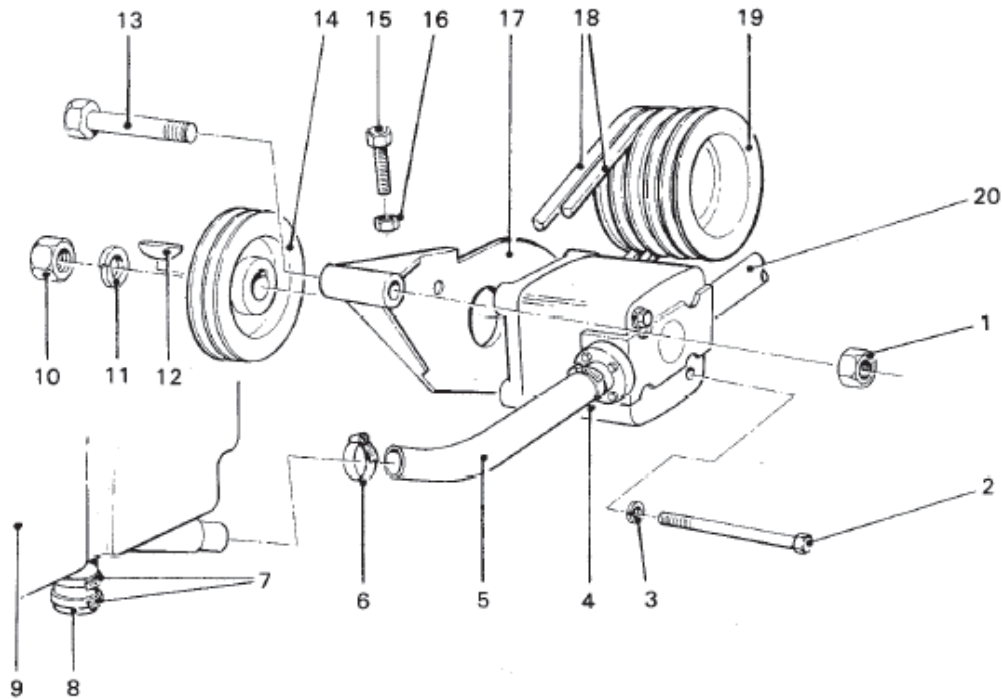
11. **Adjustment.** Adjust the drive belts as follows (Figure 2):

WARNING

To prevent the guard from dropping, support the sump guard with a jack prior to removing the sump guard mounting bolts.

- a. Lower the sump guard to gain access to the drive belts.
- b. Loosen the nut (Item 1) securing the pump mounting bracket (Item 17).

- c. Adjust the tension screw (Item 15) and nut (Item 16) to attain the correct tension deflection (between 5 mm and 10 mm) on the drive belts (Item 18).
- d. Tighten the pump mounting bracket nut (Item 1) to 60 N.m.
- e. Raise and secure the sump guard.



1	Oil pump mounting bracket nut	8	Expansion plug	15	Tension screw
2	Oil pump securing bolt	9	Oil reservoir	16	Tension nut
3	Oil pump securing washer	10	Drive pulley securing nut	17	Oil pump mounting bracket
4	Hydraulic oil pump	11	Drive pulley securing washer	18	Oil pump drive belts
5	Supply hose	12	Woodruff key	19	Crankshaft drive pulley
6	Hose clamp	13	Oil pump mounting bracket bolt	20	Pressure hose
7	Expansion plug cover clamps	14	Oil pump drive pulley		

Figure 2 Hydraulic Oil Pump and Drive Arrangement

12. **Replacement.** Replace the drive belts as follows (Figure 2):

WARNING

To prevent the guard from dropping, support the sump guard with a jack prior to removing the sump guard mounting bolts.

- a. Lower the sump guard to gain access to the drive belts.
- b. Drain the oil from the oil reservoir (Item 9) into a suitable receptacle (35 litres) by removing the two clamps (Item 7) securing the expansion plug cover (Item 8). Replace the expansion plug cover and secure it with the clamps.
- c. Detach the supply hose (Item 5) and pressure hose (Item 20) from the hydraulic oil pump (Item 4). Cap the hoses to prevent entry of dirt.
- d. Remove the fan drive belt, air compressor drive belt and the steering pump drive belt (Ref EMEI Vehicle G 603).

- e. Loosen the oil pump mounting bracket nut (Item 1).
- f. Loosen the tension nut (Item 16) and screw (Item 15).
- g. Remove the oil pump drive belts (Item 18) and fit new belts.
- h. Adjust the tension nut and screw to attain correct tension (5 mm to 10 mm deflection).
- i. Tighten the oil pump mounting bracket nut (Item 1).
- j. Fit and tension the steering pump drive belt, air compressor drive belt and the fan drive belt in order (Ref EMEI Vehicle G 603).
- k. Remove the caps from the hoses. Attach the supply hose (Item 5) and pressure hose (Item 20) to the hydraulic oil pump (Item 4).
- l. Refill the oil reservoir with grade OM-33 hydraulic oil to the oil level arrow markings.
- m. Start and run the engine. Check the crane system for oil leaks at the hose connections.
- n. Stop the engine.
- o. Raise and secure the sump guard.

Hydraulic Oil Pump

- 13. The oil pump, drive pulley and mounting bracket must be removed as a complete unit.
- 14. **Removal.** Remove the hydraulic oil pump as follows (Figure 2):

WARNING

To prevent the guard from dropping, support the sump guard with a jack prior to removing the sump guard mounting bolts.

- a. Lower the sump guard to gain access to the oil pump.
 - b. Drain the oil reservoir (Item 9) by removing the two clamps (Item 7) and the expansion plug cover (Item 8).
 - c. Remove the supply hose clamps (Item 6) and detach the supply hose (Item 5) from the oil reservoir (Item 9) and oil pump (Item 4).
 - d. Detach the pressure hose (Item 20) from the pump (Item 4). Cap the hoses to prevent entry of dirt.
 - e. Loosen the oil pump mounting bracket (Item 17). Loosen the tension nut (Item 16) and bolt (Item 15).
 - f. Remove the drive belts (Item 18) from the oil pump drive pulley (Item 14). The belts may remain in-situ.
 - g. Support the hydraulic oil pump (Item 4). Remove the nut (Item 1) and bolt (Item 13) securing the pump mounting bracket to the front engine support.
 - h. Remove the oil pump (Item 4), mounting bracket (Item 17) and drive pulley (Item 14) as a complete unit.
 - i. Clamp the unit in a suitable vice; remove the locknut (Item 10) and lock washer (Item 11) securing the drive pulley (Item 14) to oil pump shaft; use a puller to remove the drive pulley and remove the Woodruff key (Item 12) from the shaft.
 - j. Remove the bolts (Item 2) and washers (Item 3) securing the oil pump flange to the mounting bracket (Item 17).
 - k. Clean the engine support and inspect all parts.
- 15. **Installation.** Install the hydraulic oil pump as follows (Figure 2):
 - a. Fit the oil pump flange to the mounting bracket (Item 17). Install and tighten the washers (Item 3) and bolts (Item 4).
 - b. Clamp the drive pulley (Item 14) in a vice to enable the oil pump to be fitted to the pulley. Fit the Woodruff key (Item 12) into the oil pump shaft and fit the drive pulley to the shaft.

- c. Fit a new washer (Item 11) and locknut (Item 10) to secure the drive pulley. Tighten the locknut to 60 N.m.
- d. Align the pump mounting bracket (Item 17) to the front engine support. Install and hand-tighten the oil pump bolt (Item 13) and nut (Item 1).
- e. Fit and adjust the oil pump drive belts (Para 12).
- f. Uncap and attach the supply hose (Item 5) and the pressure hose (Item 20) to the oil pump (Item 4).
- g. Refill the reservoir with hydraulic oil grade OM-33 to the level marks on the reservoir.
- h. Raise and secure the sump guard.
- i. Start the engine and operate the crane (Ref User Handbook). Check the crane movements for correct control lever responses.

Hydraulic Oil Reservoir

- 16. Removal.** Remove the hydraulic oil reservoir as follows (Figure 3):
- a. Drain the oil from the reservoir (Item 7) into a suitable receptacle by removing the two clamps (Item 9) and the expansion plug cover (Item 10). Install the expansion plug cover and clamps.
 - b. Raise the bonnet and remove the grille (Ref EMEI Vehicle G 603).
 - c. Detach the oil return hose (Item 5), the vent tube (Item 6) and the supply hose (Item 8) from the reservoir. Cap the hoses to prevent entry of dirt.
 - d. Remove the clamp nut (Item 4), lock washer (Item 3), cone washer (Item 2), screw (Item 1) and nuts (Item 11) securing the clamp strap (Item 12) to the chassis bracket and mud apron respectively.
 - e. Remove the clamp strap (Item 12) and pad (Item 13).
 - f. Lift the reservoir clear of the engine compartment.
 - g. Remove the oil filter assembly (Para 9).
- 17. Installation.** Install the hydraulic oil reservoir as follows (Figure 3):
- a. Fit the reservoir in position on the right-hand side of the engine compartment.
 - b. Align the pad (Item 13) and clamp strap (Item 12) to the reservoir. Secure the clamp strap to the mud apron with screw (Item 1), cone washer (Item 2), lock washer (Item 3) and clamp nut (Item 4), and to the chassis bracket with the clamp nuts (Item 11).
 - c. Remove the caps and attach the supply hose (Item 8), the return hose (Item 5) and the vent tube (Item 6).
 - d. Install the oil filter assembly (Para 10).
 - e. Refill the reservoir with hydraulic oil grade OM-33 to the level marks on the reservoir.
 - f. Start the engine and check that no leaks exist at the hose connections.
 - g. Stop the engine.
 - h. Fit the grille and close the bonnet (Ref EMEI Vehicle G 603).

Diverter Valve

- 18. Removal.** Remove the diverter valve as follows (Figure 4):
- a. Disconnect the battery leads (Ref EMEI Vehicle G 603).
 - b. Gain access to the valve from beneath the front end of the truck.
 - c. Disconnect the electrical leads (Item 3) ensuring to take note of the orientation of the colour of the leads.

NOTE

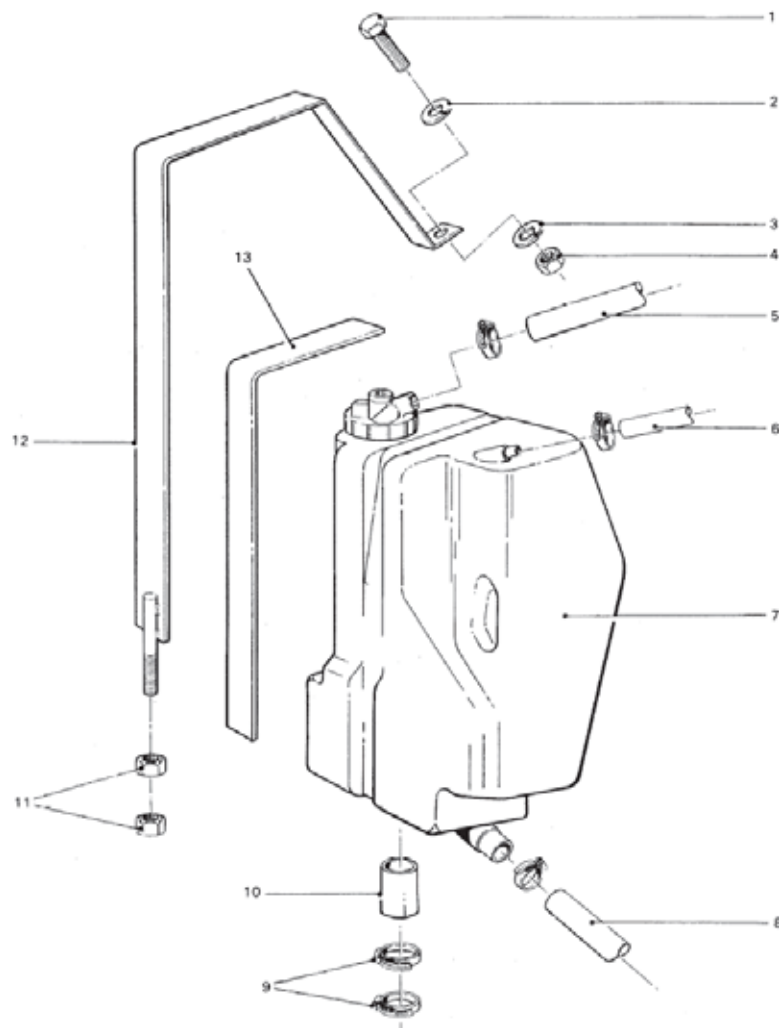
Use a large drip tray to prevent oil spillage on the ground.

- d. Note the oil line connections for correct installation. Disconnect the three oil hoses (Item 10) from the adapter (Item 7).

- e. Support the diverter valve (Item 4); remove the four Allen head screws (Item 2) securing the valve to the adapter. Remove the valve, complete with solenoid.
- f. Remove the four nuts (Item 5), washers (Item 6) and bolts (Item 9) securing the adapter to the mounting bracket (Item 1). Remove the adapter.

19. Installation. Install the diverter valve as follows (Figure 4):

- a. Align the adapter (Item 7) to the mounting bracket (Item 1) and secure it with the four bolts, washers and nuts.
- b. Align the diverter valve to the adapter and secure it with the four Allen head screws (Item 2).
- c. Connect the three oil hoses (Item 10) to the adapter.
- d. Connect the electrical leads (Item 3) according to the orientation noted in removal.

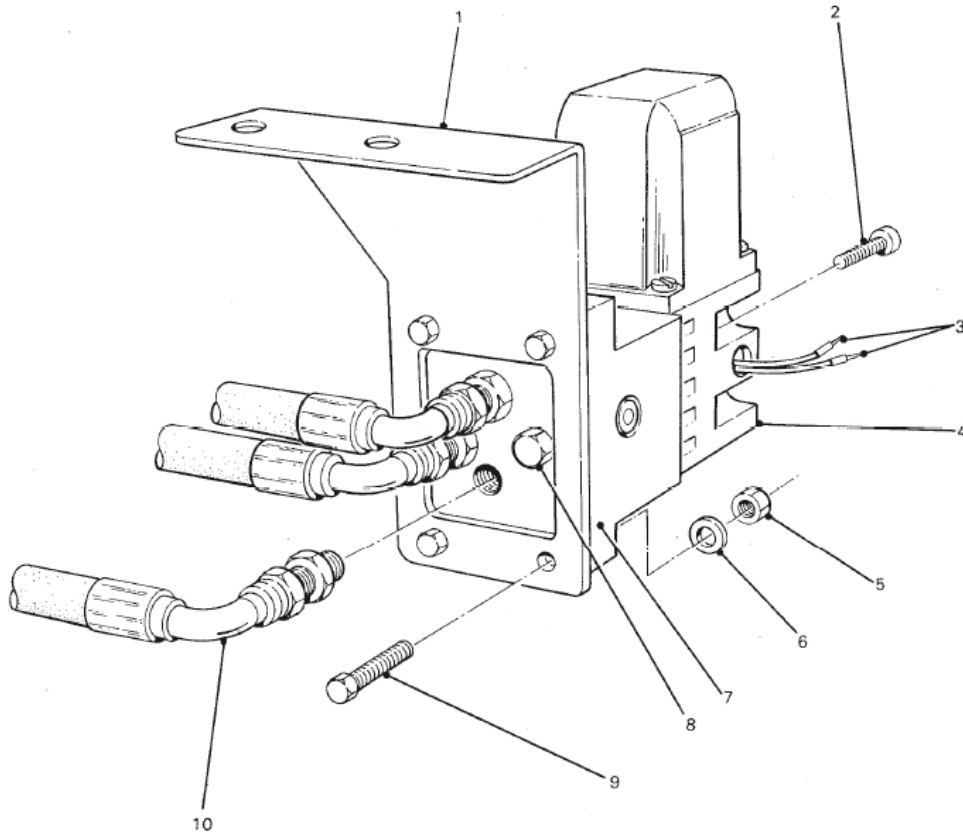


1	Screw	6	Vent tube	11	Clamp nuts
2	Cone washer	7	Hydraulic oil reservoir	12	Clamp strap
3	Lock washer	8	Oil supply hose	13	Pad
4	Clamp nut	9	Hose clamps		
5	Oil return hose	10	Expansion plug		

Figure 3 Hydraulic Oil Reservoir

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- e. Connect the battery leads.
- f. Start the engine. Check that no oil leaks exist at the diverter valve connections.
- g. Operate the crane (Ref User Handbook). Check the crane's movements for correct control lever response.



1	Mounting bracket	5	Nut	9	Adapter bolt
2	Allen head screw	6	Washer	10	Oil hoses
3	Electrical leads	7	Adapter		
4	Diverter valve	8	Stud		

Figure 4 Diverter Valve

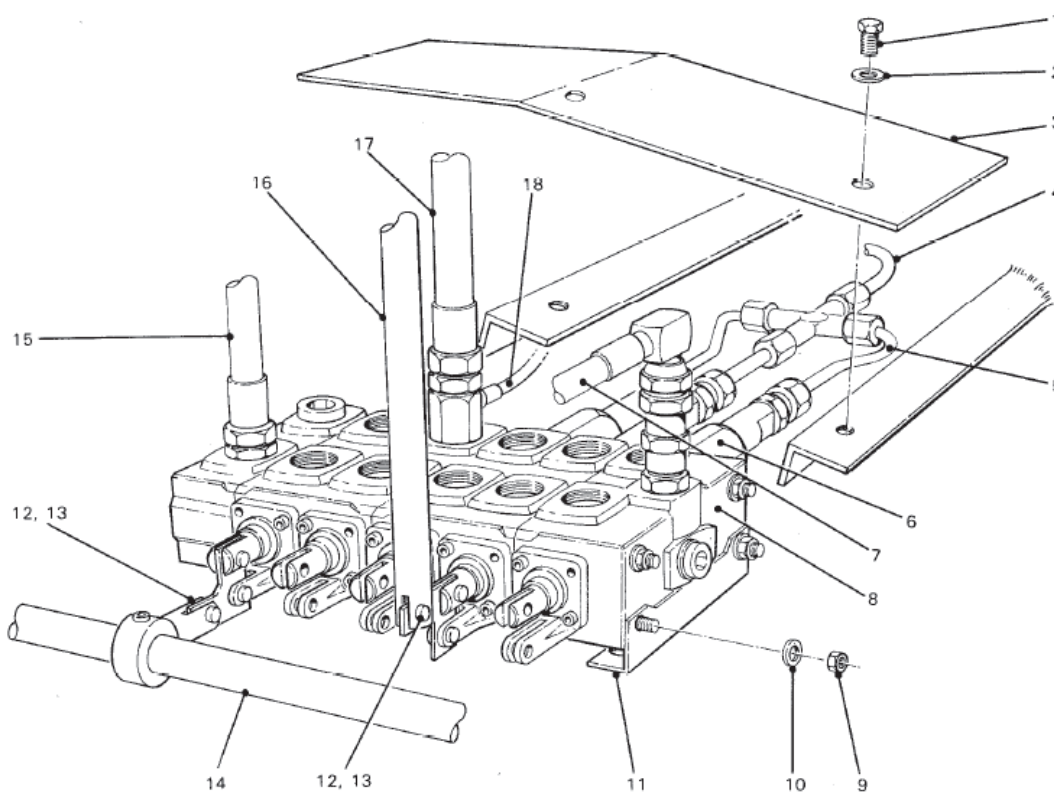
Directional Control Valve Bank

20. Removal. Remove the directional control valve bank as follows (Figure 5):

- a. Stabilise and unstow the crane (Ref User Handbook).
- b. Slew the crane until it is centralised on the driver's side between the cabin and the tray.
- c. Fully extend the outer boom and the boom extensions and lower the inner boom until the end of the crane rests on a firm prepared platform.
- d. Disengage the oil pump and switch off the engine.
- e. Remove the two screws (Item 1), washers (Item 2) and the hose protection plate (Item 3).
- f. Mark all oil hoses prior to, or immediately after removal, to ensure they are replaced in the correct position on the valve bank.
- g. Disconnect the oil pressure gauge hose (Item 18).
- h. Disconnect and lay clear of the mounting the return oil hose (Item 7), and supply oil hose (Item 15).

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- i. Disconnect and lay back the ten cylinder oil hoses (Item 17).
- j. Disconnect the overload oil pipe (Item 4) and the three blocking cylinder oil pipes (Item 5) at the rear of the valve bank (Item 8).



1	Screw	7	Return oil hose	13	Pin
2	Washer.	8	Directional control valve bank	14	Stabiliser control rod
3	Hose protection plate	9	Nut	15	Supply oil hose
4	Overload oil pipe.	10	Washer	16	Control lever tube
5	Blocking cylinder oil pipe	11	Mounting bracket	17	Cylinder oil hose
6	Blocking cylinder	12	Circlip	18	Pressure gauge oil hose

Figure 5 Directional Control Valve Bank

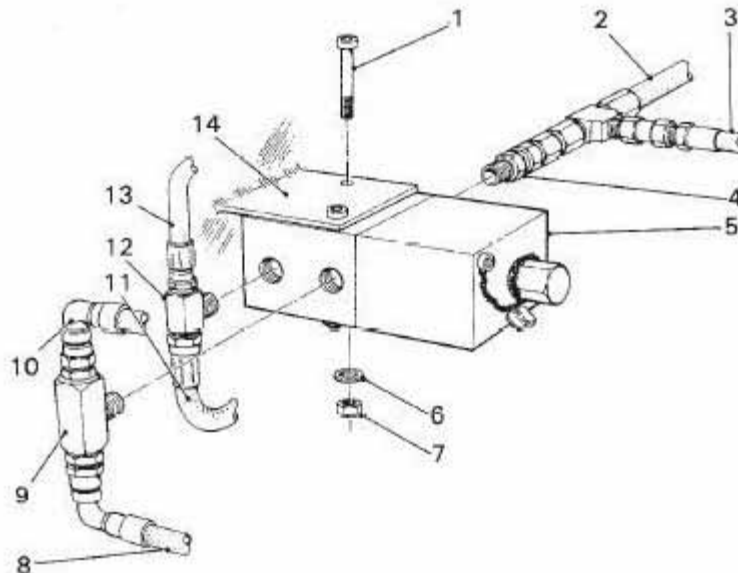
- k. Remove the circlip (Item 12) and pin (Item 13) from each of the four control valve stems. Release the four control lever tubes (Item 16).
 - l. Remove the circlip (Item 12) and pin (Item 13) attaching the stabiliser control rod (Item 14) to the stabiliser valve stem. Release the control rod.
 - m. Support the valve bank (Item 8). Remove the four nuts (Item 9) and washers (Item 10) securing the valve bank to the mounting bracket (Item 11).
 - n. Carefully lift the valve bank and the attached blocking cylinders from its location.
 - o. Remove the two bolts and washers attaching each blocking cylinder (Item 6) to the valve bank (Item 8). Remove the blocking cylinders.
- 21. Installation.** Install the directional control valve bank as follows (Figure 5):
- a. Align each blocking cylinder (Item 6) to its associated valve on the valve bank (Item 8) and secure it with two bolts and washers.
 - b. Align the valve bank to the mounting bracket (Item 11) and secure it with four washers (Item 10) and nuts (Item 9).

- c. Connect the blocking cylinders' oil pipes (Item 5) and the overload oil pipe (Item 4) to the blocking cylinders.
- d. Connect the supply oil hose (Item 15) and the return oil hose (Item 7) to the valve bank.
- e. Connect the ten cylinder hoses (Item 17) ensuring they are in the correct position in relation to the markings and the oil pressure gauge hose (Item 18).
- f. Attach the four control lever tubes (Item 16) and the stabiliser control rod (Item 14) to their associated control valve stems with the pin (Item 13) and circlip (Item 12).
- g. Align and attach the hose protection plate (Item 3) with the two washers (Item 2) and screws (Item 1).
- h. Start the engine. Operate the crane (Ref User Handbook). Check the crane movements for correct control lever response.
- i. Check that no oil leaks exist at the hose connections. Stow the crane and stabilisers (Ref User Handbook).
- j. Stop the engine

Sensing Valve

22. **Removal.** Remove the sensing valve as follows (Figure 6):

- a. Remove the hose protection plate (Para 20.e).
- b. Remove the restrictor (Item 4) and hoses (Item 2 and Item 3) from the sensing valve (Item 5).
- c. Disconnect the pipes and hoses (Item 8, Item 10, Item 11 and Item 13) from the tee-pieces (Item 9 and Item 12).
- d. Support the sensing valve (Item 5) and remove the two screws (Item 1) and washers (Item 6) and nuts (Item 7). Remove the valve from the mounting bracket (Item 14).
- e. Remove the two tee-pieces from the solenoid valve.



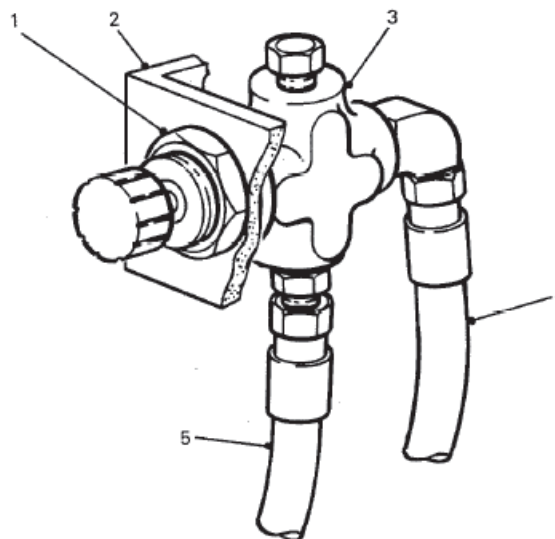
1	Allen head screw	6	Washer	11	Inner boom supply hose
2	Blocking cylinder pipe	7	Nut	12	Tee-piece
3	Reset valve hose	8	Reset valve hose	13	Oil pressure gauge hose
4	Restrictor	9	Tee-piece	14	Mounting bracket
5	Sensing valve	10	Return hose tapping		

Figure 6 Sensing Valve

- 23. Installation.** Install the sensing valve as follows (Figure 6):
- Align the sensing valve (Item 5) to the mounting bracket (Item 14) and secure with the two screws (Item 1), washers (Item 6) and nuts (Item 7).
 - Insert the restrictor (Item 4) and tee-pieces (Item 9 and Item 12).
 - Connect the pipes and hoses (Item 2, Item 3, Item 8, Item 10, Item 11 and Item 13).
 - Replace the hose protection plate.
 - Start the engine. Operate the crane (Ref User Handbook). Check that no oil leaks exist at the hose and pipe connections.
 - Stop the engine.

Reset Valve

- 24. Removal.** Remove the reset valve as follows (Figure 7):
- Disconnect the oil hoses (Item 4) and (Item 5) from the reset valve (Item 3).
 - Unscrew the valve retaining nut (Item 1) attaching the reset valve to the mounting bracket (Item 2). Remove the valve.
- 25. Installation.** Install the reset valve as follows (Figure 7):
- Align the reset valve (Item 3) to the mounting bracket (Item 2) and secure with the valve retaining nut (Item 1).
 - Connect the oil hoses (Item 4) and (Item 5) to the reset valve.
 - Start the engine. Operate the crane (Ref User Handbook). Check that no leaks exist at the reset valve connections.
 - Stop the engine.



- | | | | |
|---|---------------------|---|-----------------|
| 1 | Valve retaining nut | 4 | Inlet oil hose |
| 2 | Mounting bracket | 5 | Outlet oil hose |
| 3 | Reset valve | | |

Figure 7 Reset Valve

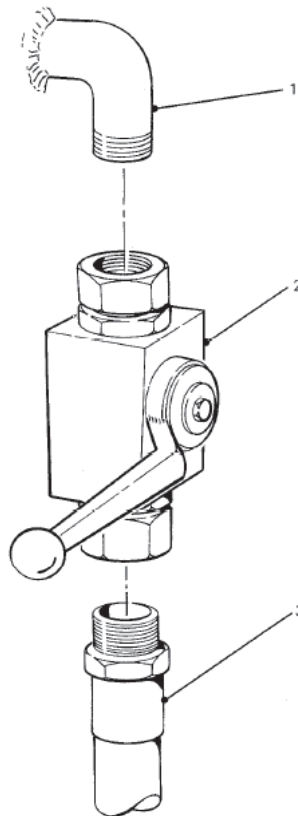
Stabiliser Shut-off Valve

- 26. Removal.** Remove the stabiliser shut-off valve as follows (Figure 8):

- a. Ensure that the shut-off valve is CLOSED.
- b. Disconnect the oil pipe (Item 1) from the valve (Item 2).
- c. Support the valve. Disconnect the hose (Item 3) from the valve.

27. **Installation.** Remove the stabiliser shut-off valve as follows (Figure 8):

- a. Align the shut-off valve (Item 2) to the stabiliser cylinder.
- b. Connect the oil pipe (Item 1) and hose (Item 3) to the valve.
- c. Start the engine. Operate the stabiliser (Ref User Handbook). Check that no oil leaks exist at the connections.
- d. Stop the engine.



- 1 Oil pipe
- 2 Shut-off valve
- 3 Oil hose

Figure 8 Stabiliser Shut-off Valve

Electrical System Components

28. Component replacements include:
- a. the pump relay control microswitch (Para 29); and
 - b. the cabin switch panel components (Para 31).

WARNING

Before replacing any electrical component, ensure that the battery leads are disconnected.

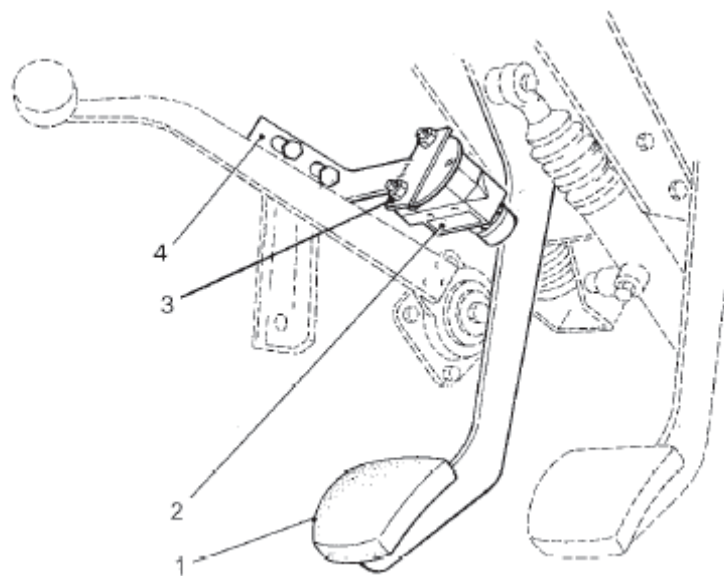
Pump Relay Control Microswitch

29. Removal. Remove the microswitch as follows (Figure 9):

- a. Remove the two nuts (Item 3), washers and screws securing the microswitch (Item 2) to the mounting bracket (Item 4).
- b. Remove the two screws attaching the connector block to the microswitch. Disconnect the electrical leads.

30. Installation. Install the microswitch as follows (Figure 9):

- a. Connect the electrical leads to the connector block and secure it to the microswitch with two screws.
- b. Align the microswitch to the mounting bracket (Item 4). Secure it with two screws, washers and nuts (Item 3).
- c. Ensure the microswitch operates when the clutch pedal is fully released then fix it into position by tightening the mounting bracket (Item 4).



- | | |
|----------------|--------------------|
| 1 Clutch pedal | 3 Nut |
| 2 Microswitch | 4 Mounting bracket |

Figure 9 Pump Relay Control Microswitch

Cabin Switch Panel Components

31. The cabin switch panel is mounted on the right-hand side of the passenger's seat. It contains the following electrical components (Figure 10):

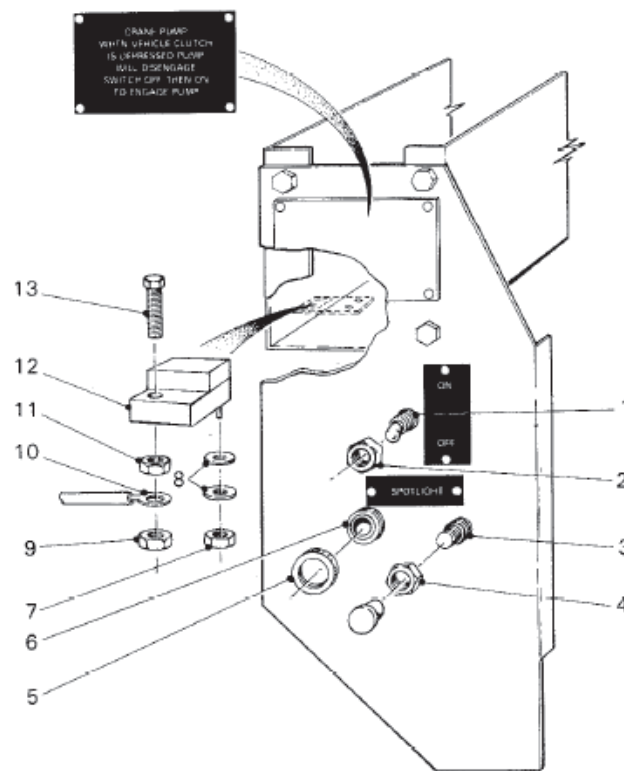
- a. the spotlight switch,
- b. the spotlight socket, and
- c. the pump engage switch.

32. The components are removed by unscrewing the keep rings (Item 2), (Item 4) and (Item 5) from the switches (Item 1) and (Item 3), and the socket (Item 6).

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Spotlight Fused Cut-out.

33. The fused cut-out for the spotlight is mounted behind the passenger's seat.
34. **Removal.** Remove the cut-out as follows (Figure 10):
 - a. Unlatch and fold down the backrest of the passenger seat.
 - b. Remove the nut (Item 7), washers (Item 8) and electrical leads to the cut-out (Item 12).
 - c. Remove the nut (Item 9), earth lead (Item 10), locknut (Item 11) and bolt (Item 13). Remove the fused cut-out (Item 12).
35. **Installation.** Install the cut-out as follows (Figure 10):
 - a. Align the cut-out to the angle bracket and secure it with the bolt (Item 13) and locknut (Item 11). Connect the earth lead (Item 10) using the nut (Item 9).
 - b. Connect the electrical leads to the cut-out with the washers (Item 8) and locknut (Item 7).



1	Pump engage switch	6	Spotlight-socket	11	Nut
2	Keep ring	7	Nut	12	Fused cut-out
3	Spotlight switch	8	Washers	13	Bolt
4	Keep ring	9	Nut		
5	Keep ring	10	Earth lead		

Figure 10 Cabin Switch Panel – Components

END

Distribution List: **VEH G 32.0 – Code 4** (Maint Level)
(Sponsor: LV SPO, Mdm/Hvy B Vehicles)
(Authority ECO LV SPO 030/08)

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