TRUCK, CARGO, MEDIUM, CRANE, MC2 - UNIMOG

TECHNICAL DESCRIPTION

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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INTRODUCTION

1. This EMEI provides a technical description of the Truck Cargo Medium Crane, MC2 - Unimog.

Associated Publications

2. Reference may be necessary to the latest issue of the following documents:
   a. EMEI Vehicle G 62 Decade, Truck, Cargo, Medium, Crane, MC2 – Unimog;
   b. SCES 11756; and
   c. Repair Parts Scale 02157.

3. The crane is mounted on a frame assembly which is bolted to the chassis between the cabin and the truck body. The crane may be operated by one person to lift or lower the inner and outer boom, to extend and retract the extension booms, and to slew clockwise or anticlockwise through an arc of 210°. It is designed to lift a maximum load of 2010 kg at 2.5 metres outreach with the inner boom angle raised to 10°. A Safe Working Load Label (Figure 1) is attached to the support column.

Figure 1    Safe Working Load Label

4. The hydraulic components are protected by an overload system which detects the overload and neutralises further crane control lever operation until the operator reduces the load operation radius.

5. The crane is stabilised by two hydraulically operated legs with attached circular footplates. The legs extend horizontally, one from each side of the crane mounting base, and are controlled independently of the crane by a lever mounted on the frame assembly. The lever enables both stabilisers to be raised or lowered simultaneously or independently from either side of the truck.

6. Hydraulic pressure required to operate the crane and stabilisers is supplied by an internally geared pump which is bracket-mounted to the front engine support. The pump is belt-driven by the engine crankshaft pulley. Hydraulic oil is gravity fed from a reservoir and pumped under pressure to the hydraulic system.

7. Control levers provided for the crane are connected by tube and clevis to a directional control valve bank. Access to the controls is gained through the observation hatch.
8. The Palfinger crane consists of an inner and outer boom arrangement and two extension booms connected inline and mounted on a vertical support column. The column is attached to a base and slewing mechanism assembly which is supported on a frame secured to the chassis. The booms are operated individually or simultaneously by double-acting hydraulic cylinders mounted between each boom. The crane assembly is shown in Figure 2.

![Figure 2  Crane Assembly](image-url)
Stabilisers

**CAUTION**

The Shut-off valve handle, Figure 3 item 9 must always be in the CLOSED position when the stabiliser is stowed.

9. The left-hand and right-hand stabilisers (Figure 3) are identical in construction and operation. Each cylinder is a double-acting unit which extends or retracts under oil pressure. A manually operated shut-off valve, labelled CLOSED-OPEN, is incorporated on each stabiliser to isolate it from the crane's hydraulic system.

**Figure 3 Stabilisers**
10. A steel rod with a control lever secured at each end is bracket-welded to the mounting frame and extends the full width of the truck. The levers, JACK-RAISE-LOWER, enable the simultaneous operation of both stabilisers from either side of the truck. The rod connects by clevis and bolt to the stabiliser control valve on the directional control valve bank (Para 21). When operated, fluid is directed to raise or lower the stabiliser ram and its attached footplate.

11. A flow regulator in the valve bank governs the speed of operation and a non-return valve ensures that in either the retraction or extension mode the fluid is returned to the oil reservoir via the return hose.

12. A U-shaped handle is welded to the stabiliser to enable the operator to manually extend or retract the horizontal shaft from its extension housing. Two cam-operated spring-loaded locking bolts are fitted; one to lock the stabiliser cylinder in the vertical operational position and the 45° stowed position; the other to retain the horizontal shaft in its extension housing. The levers are drilled to receive a retaining pin and chain. A retention bracket is also welded to prevent any oil hose entanglement when the stabiliser is stowed.

HYDRAULIC SYSTEM

13. The crane's hydraulic system (Figure 10) consists of the following components;
   a. a hydraulic oil reservoir, oil pump and drive belt arrangement;
   b. a solenoid operated diverter valve for hydraulic fluid control to the system;
   c. a directional control valve bank for slewing extension booms and stabilisers;
   d. an overload protection system to safeguard the hydraulic components;
   e. control levers; and
   f. a system pressure gauge.

Hydraulic Oil Reservoir

14. The hydraulic oil reservoir (Figure 4) is retained in position by a metal strap and rubber insert on the right-hand side of the engine compartment. The strap is secured at the lower section to a bracket welded to the chassis cross member and at the top to the right-hand side mud apron. The reservoir has a capacity of 35 litres of OM-33 hydraulic oil with arrows to indicate the oil level. It incorporates an outlet hose to the hydraulic oil pump, a vent tube connected between the crankcase breather and the steering pump oil reservoir via a tee-piece, and a return hose from the directional control valve bank via a tee-piece. The return hose connects to a screw type filler cap assembly and filter element and bowl which are housed within the reservoir. An expansion type drain plug at the reservoir base is secured by two adjustable circular clips.

Hydraulic Oil Pump

15. The hydraulic oil pump (Figure 5) is an internal gear type which delivers oil at constant pressure to the diverter valve (Para 18) when the engine is running. The pump shaft is keyed to a dual pulley and the complete assembly is bracket-mounted to the front engine support. The pulley is driven by two V-section belts aligned to the engine crankshaft pulley. An adjustable screw and nut assembly is attached to the pump mounting bracket for V-belt tensioning.

16. The pump driveshaft pinion drives the internal ring gear in the eccentric mode. A crescent-shaped spring-loaded sealing segment fills the space located at the extremes of the crescent between the pinion gear and ring gear. The spaces between the high points of the gears change in volume and thus create an oil pumping action to discharge oil through the holes in the ring gear and to the outlet port. The pressurised oil is piped to the diverter valve.

17. The pump's driveshaft rotates in self-lubricating copper bushes located in the pump body and the assembly is sealed by a gasket and circlip at the drive-end and by a metal expansion disc at the non-drive end. The internal ring gear and shaft pinion are enclosed by thrust plates held by a flat-sided positioning pin and seal and seal springs. A steel rod is located through the thrust plates to prevent backward movement of the sealing segment should the pump's rotation be reversed. The oil pump, drive pulley and mounting bracket must be removed as a complete assembly from the engine mounting bracket.
1. Oil reservoir
2. Filler cap and filter assembly
3. Oil return hose
4. Vent tube
5. Front engine support
6. Oil pressure (supply) hose
7. Pump drive belts
8. Pump mounting bracket
9. Oil pump
10. Oil inlet hose
11. Clamp strap

Note: Sump guard removed for clarity

Figure 4  Oil Reservoir, Pump and Drive Belt Arrangement
18. The diverter valve (Figure 6) is a unidirectional hydraulic valve controlled by a 24 V dc solenoid. The valve provides oil pressure to the hydraulic system when the crane is operational, and circulates the oil from the pump to the oil reservoir when the truck is driven normally.

19. The diverter valve is mounted vertically by four hex socket head screws to an aluminium alloy adapter. The adapter, which is drilled and threaded to receive the oil connections, is secured to a mounting plate which is fixed to the brush-guard mounting angle.
20. The electrically controlled solenoid is attached by four screws to the valve and is mounted uppermost. Electrical connections are taken through an aperture in the valve body. The valve contains a spool which is mechanically operated by a push-pin centred in a guide tube. The spool covers/uncovers four pressure ports engraved A, P, B and T on the valve body (port A is plugged). When the solenoid is de-energised the spring held spool is centred to allow oil pressure to port B through port T. When energised the spool is moved by the push-pin to uncover port P, close port B, and pressurise the directional control valve bank (Para 21).

![Figure 6 Diverter Valve](image)

**Figure 6 Diverter Valve**

**Directional Control Valve Bank**

21. The directional control valve bank (Figure 7) is secured by two mounting brackets to a metal plate welded to the crane base. The valve bank contains an inlet and outlet valve connected by flexible oil hoses to the diverter valve (Para 18) and five control valves connected by hoses or pipes to the stabilisers, slewing and boom cylinders. The control valves comprise a hydraulic check valve, relief valve and outlet valve, with various components designed to suit the operating pressure required by the valve function. Operating pressures for the valves are shown in Figure 10.

22. The valve components are operated through ports in the valve bank by pressure exerted from a control tube attached via a pivot plate and clevis rod. Should excess pressure be exerted on the valve the associated relief valve operates to divert oil back to the reservoir (Para 14) via a tee-piece on the return hose.
23. The overload protection system (Figure 8) ensures that the operator cannot overload the crane's hydraulic system. The overload protection system contains the following:
   a. three blocking cylinders;
   b. a sensing pressure valve; and
   c. an overload reset valve.

24. The crane's hydraulic system is protected against overload by a hydraulic pressure sensing valve and blocking cylinders located in the control lever circuits. If an overload condition is reached, the sensing valve bypasses oil to the blocking cylinders which neutralises any further operation by forcing the control lever to the centre position against the operator's hand pressure. The operator must then reduce the load radius by either lifting the inner boom, lowering the outer boom or retracting the boom extensions. When the overload condition has triggered, the operator can bypass the overload by the hand operation of a reset valve located near the control levers (Figure 9).

25. A functional diagram of the overload system is shown in Figure 10.
Figure 8  Overload Protection System

Blocking Cylinder

The reset knob is only to be used to enable movement of the crane to allow reduction of the load after an overload condition.

26. A blocking cylinder is secured to the outlet port of the inner boom, outer boom and extension boom control valves on the directional control valve bank (Para 21). Should an overload occur, the blocking cylinder receives oil from the sensing valve which operates the cylinder piston to force the control lever from the operator's hand and into the neutral (centre) position. The operator must then reduce the load radius by either lifting the inner boom, lowering the outer boom or retracting the extension booms but must first press the reset valve knob (Para 28).

Sensing Valve

27. The sensing valve contains a pressure sensitive spring-loaded diaphragm which allows oil flow under normal operating pressures to the crane's cylinders. The spring, which is preset to 21.5 MPa, acts to control a plunger assembly which retains an internal port open to the system. Should the oil pressure exceed the spring setting the plunger moves to change the internal port position and allows oil to flow to the blocking cylinders.
Reset Valve

28. A reset valve is bracket-mounted near the crane's control levers (Figure 9). It permits the operator to manually override an overload condition. When the reset valve knob is pressed, the overload pressure on the sensing valve spring is relieved, which returns the sensing valve to normal operation and allows oil flow to the system.

Crane Control Levers

29. The four crane control levers are mounted by bushes to an axle assembly and supported by a frame welded to the main bearer of the crane base. Each lever is linked to a vertical steel tube which is attached by a circlip and pin to the stem of its associated valve on the directional control valve bank (Para 21).

30. The lever's control movements are engraved on a label riveted to the cabin roof. An overload reset valve (Para 28) and the hydraulic system's pressure gauge (Para 31) are mounted near the levers.

Pressure Gauge

31. The hydraulic system's pressure gauge is bracket mounted to the left of the control levers (Figure 9). It is calibrated from 0 - 250 bar (0 - 3625 psi) to monitor the normal working pressure of the system's components. With the crane operating, the gauge should indicate the following pressures:
   a. slew control - 160 bar (2320 psi);
   b. inner boom - 210 bar (3045 psi);
   c. outer boom - 190 bar (2755 psi);
   d. extension booms - 215 bar (3118 psi);
   e. stabilisers (extended) - 80 bar (1160 psi); and
   f. stabilisers (retracted) - 215 bar (3118 psi).

32. If necessary the gauge can be unscrewed from its mounting nut which is welded to the bracket.

ELECTRICAL SYSTEM

33. The crane's electrical system is supplied from an 8 amp cut-out in Block B at the top of the dashboard. A wiring diagram of the crane electrical system is shown in Figure 12. The system consists of:
   a. a diverter valve solenoid control circuit;
   b. a cabin switch panel; and
   c. a portable spotlight with its associated accessories.

Diverter Valve Solenoid

34. The solenoid of the diverter valve, detailed in Para 18, is normally de-energised until oil pressure is required at the control valve bank for the crane's operation. The solenoid is isolated during normal truck operation by a double-pole pump engage toggle switch mounted on a panel in the cabin (Figure 11). When the switch is set to ON then OFF, power is applied and retained to the solenoid via a relay and a microswitch actuated by the clutch pedal. When the diverter valve has operated and the oil has reached its operating pressure, contacts will illuminate a red lamp on the instrument panel engraved RED LIGHT ON PUMP ENGAGED. To safeguard the system if the clutch pedal is depressed and the clutch engaged during crane operation, the microswitch's contacts open to override the pump engage switch and to de-energise the pump engage relay and the diverter valve solenoid. Oil pressure is thus cut off to the system and the crane stops.

Cabin Switch Panel

35. The cabin switch panel (Figure 11) is welded to the cabin structure on the right hand side of the passenger's seat and also secures the extension lead stowage. The panel contains the double-pole pump engage toggle switch and the spotlight socket and push-pull switch.

Spotlight

36. A 24 V 70 W quartz halogen spotlight is normally stowed beneath the passenger's seat. When required it is secured to an extendable post mounted on the left-hand side of the cabin exterior. It is plugged into a socket located on
the cabin switch panel and controlled by an adjacent push-pull switch (Figure 11). Should the mounting post be fully extended the extra cable length may be obtained by using the reel-type extension lead. A fused cut-out is attached to the cabin structure below the extension lead stowage to prevent circuit damage due to overload.

Figure 9  Crane Control Levers

1. System pressure gauge
2. Axle assembly
3. Control levers
4. Bush
5. Overload reset valve
6. Tube
7. Bearer
8. Directional control valve bank
Figure 10    Hydraulic System, Functional Diagram
1. Extension lead Stowage  
2. Cabin switch panel  
3. Spotlight puch-pull switch  
4. Spotlight socket  
5. Pump engage switch  
6. Fused cut-out
Figure 12  Electrical Diagram

1. Instrument panel
2. Cut-out block B (EMEI Vehicle G602)
3. Clutch pedal
4. Pump relay control microswitch
5. Pump engage relay
6. Pump engage indicator
7. Divertor valve solenoid (Figure 6)
8. Cabin switch panel
9. Pump engage switch
10. Fused cut-out
11. Floodlight switch
12. Floodlight socket

Wire Colours
bl – black
b – blue
br – brown
r – red
w – white