

**TRUCK, CARGO, WITH CRANE, HEAVY, MC3, MACK
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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INTRODUCTION

1. This EMEI details all Light Grade Repair procedures for the crane fitted to the Truck, Cargo, With Crane, Heavy, MC3 (Mack). Where applicable, instructions for the adjustment, lubrication and minor servicing of these items are included. This EMEI should be read in conjunction with EMEI Vehicle G 703 for Truck, Cargo, Heavy, MC3 (Mack) for those items common to the Truck, Cargo, Heavy, MC3 (Mack).

Associated Publications

2. Reference may be necessary to the latest version of the following documents:
- a. Defence Road Transport Instructions ([DRTI](#));
 - b. Defence Safety Manual ([SAFETYMAN](#));
 - c. Defence Supply Chain Manual ([DSCM](#));
 - d. Complete Equipment Schedule (CES):
 - (1) CCES 19236 – Truck, Cargo, With Crane, Heavy, MC3 (Mack);
 - (2) SCES 11653 – Truck, Cargo, With Crane, Heavy, MC3 (Mack); and
 - (3) SCES (AMK) 11654 – Truck, Cargo, With Crane, Heavy, MC3 (Mack);
 - e. Repair Parts Scale 02162;
 - f. Provisional Block Scale 2406/29;
 - g. [EMEI Vehicle G 702](#) – Technical Description (Cargo);
 - h. [EMEI Vehicle G 703](#) – Light Repair (Cargo);
 - i. [EMEI Vehicle G 704](#) – Medium Repair (Cargo);
 - j. [EMEI Vehicle G 704-1](#) – Heavy Repair (Cargo);
 - k. [EMEI Vehicle G 709](#) – Servicing (All Variants);
 - l. [EMEI Vehicle G 710](#) – Data Summary (Cargo Crane);
 - m. [EMEI Vehicle G 712](#) – Technical Description (Cargo Crane);
 - n. [EMEI Vehicle G 714](#) – Medium and Heavy Repair (Cargo Crane); and
 - o. [EMEI Vehicle G 719](#) – Servicing (Cargo Crane).

Safety Precautions

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

WARNING

Practices and equipment operating and maintenance instructions pertaining to this EMEI shall be adhered to.

WARNING

Before working on the hydraulic system ensure the power take off pump has been disengaged and the engine is shut down.

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.

WARNING

Chemical substances are to be stored, used and handled in accordance with SAFETYMAN, MSDS and EMEI Workshop E series.

General Precautions

CAUTION

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.

4. 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, paper or adhesive tape as plugs or covers.
5. Protect the equipment from dust and inclement weather when performing any of the tasks contained in this manual. If practical, perform the tasks in a sheltered or enclosed area.
6. When disconnecting electrical connectors, hoses and fittings remove clamps as required gaining slack and avoiding damage to connectors and fittings.
7. Discard all used gaskets, seals, split pins, tab washers, lock-pins, Nyloc nuts and lock-washers. Discard all contaminated lubricants drained from the equipment.
8. When replenishing lubricants, use only those lubricants specified in this instruction, EMEI Vehicle G 709 and the User Handbook
9. 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.

Maintenance Supply Items

10. Table 1 identifies the location of identification numbers for maintenance supply items (MSI).

Table 1 Location of Identification Numbers on MSIs

Identification	Location
Chassis No.	Right-hand rear frame, above intermediate axle.
Chassis nameplate.	Left-hand door inside cab
Engine No.	Right-hand top of timing gear housing
Front axle No.	Left rear of axle housing.
Transmission No.	Left-hand side.
Transfer case	Right-hand rear.
Intermediate axle No.	Right-hand front of carrier housing.
Rear axle No.	Right-hand front of carrier housing.
Injection pump identification	Side of the pump.
Crane	Located on the crane body.
Power Take-Off (Hydraulic Pump)	Right-hand side.
Hydraulic pump	Rear face of the pump
Cab upper section	Rear inner left-hand upper panel.
Cab lower section	Left-hand door opening gusset.

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ADJUSTMENTS

Boom Extension Slide Pad Clearance

11. Adjust the boom extension slide pad clearance as follows:

NOTE

This adjustment should be carried out with the boom level and no load on the boom.

- a. Remove and discard the cotter pin from both the slide pad adjusting screws.
- b. Using a broad tipped screwdriver, screw the adjusting screws in evenly until the slide pads contact the boom extension and the boom extension is centralised in the boom housing.
- c. Slacken off each adjusting screw approximately half a turn to provide clearance between the slide pads and the boom extension, until the cotter pins can be reinserted.
- d. Secure the adjusting screws with new cotter pins.

FLUSHING HYDRAULIC LINES

12. Before running oil through the pressure reduction system after performing maintenance tasks, except filter element changes, flush the system as follows:

- a. Disconnect both pressure reduction filter hoses from their connections at the valve positioners at the main control valve.
- b. Using a suitable male/male adapter, connect the two hoses together.
- c. Start the engine, engage the crane PTO and allow oil to circulate through the filter for approximately 30 seconds.
- d. Disengage the crane PTO and stop the engine.
- e. Disconnect the hoses from the adapter and reinstall them to the correct ports on the valve positioners.

COMPONENT REPLACEMENT

HYDRAULIC OIL FILTERS

Return Oil Filter

13. **Removal.** Remove the return oil filter as follows (Fig 1):

WARNING

Before removing the return oil filter, ensure that the hydraulic fluid is sufficiently cool to avoid burns.

- a. Clean the immediate surroundings of the return oil filter housing.
- b. Turn the cover (Fig 1, Item 1) to free it while pressing on it.
- c. Pull the return filter out of the tank and place it in an appropriate drip tray.
- d. Unscrew the wing nut (Fig 1, Item 6)
- e. Remove and discard the filter insert (Fig 1, Item 5) and seal rings (Fig 1, Items 2, 3 and 4).

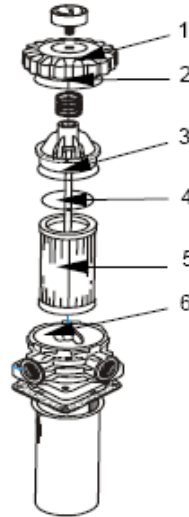


Figure 1 Return Oil Filter

- 14. Installation.** Install the return oil filter as follows (Fig 1):
- a. Insert a new seal ring and filter insert (Fig 1, Items 4 and 5).
 - b. Tighten the wing nut (Fig 1, Item 6).
 - c. Fit new seal rings (Fig 1, Items 2 and 3).
 - d. Replace the oil filter in the reservoir.
 - e. Attach the cover on the return oil filter (Fig 1, Item 1)
 - f. Check the level of fluid in the oil reservoir and if necessary top up with ISO Grade 68 hydraulic fluid.
 - g. Bleed air from the hydraulic system in accordance with Para 40.

Pressure Reduction Filter

- 15. Removal.** Remove the pressure reduction filter element as follows (Fig 2):

WARNING

Before removing the pressure reduction oil filter, ensure that the hydraulic fluid is sufficiently cool to avoid burns.

- a. Clean the immediate surroundings of the pressure reduction oil filter housing.
- b. Place a suitable receptacle beneath the filter to catch any spillage during removal.
- c. Dismantle the filter housing (Fig 2, Item3)
- d. Remove and discard the sealing ring and the filter insert (Fig 2, Items 1 and 2).

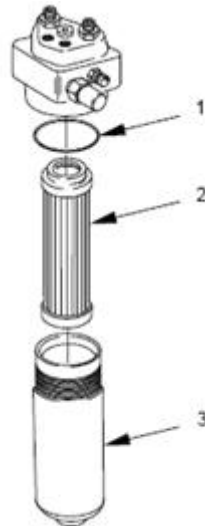


Figure 2 Pressure Reduction Oil Filter

- 16. Installation.** Install the pressure reduction filter element as follows (Fig 2):
- a. Clean the filter housing (Fig 2, Item 3).
 - b. Fit a new insert (Fig 2, Item 2).
 - c. Fit a new seal ring (Fig 2, Item 1).
 - d. Reassemble the filter housing (Fig 2, Item 3).
 - e. Bleed air from the hydraulic system in accordance with Para 40.

HYDRAULIC PIPES AND HOSES

WARNING

Maintenance operations on hydraulic pipes and hoses are to be carried out with the crane in the stowed position. If this is not possible, suitably support the crane with chocks to prevent the booms moving due to loss of fluid pressure when fittings are loosened. Ensure that the control or operating lever is in the neutral position and a warning not to operate the crane is placed on or near the vehicle controls.

Before removing any hydraulic pipes or hoses, ensure that the hydraulic fluid is sufficiently cool to avoid burns.

CAUTION

After any maintenance work is carried out on hydraulic pipes and/or hoses of the pressure reduction filter circuit, the lines must be flushed as described as paragraph 12. This does not apply to filter element changes.

Removal

- 17.** Remove hydraulic pipes and hoses as follows:
- a. Place a suitable container under the pipe or hose to be replaced to catch any spillage.
 - b. Crack loose the pipe/hose connection to allow any residual fluid (that may be under pressure) to drain off.

- c. Disconnect the pipe/hose connections, remove any zip clamps or other restraining devices and remove the pipe/hose.
- d. Plug the openings left on the truck mounted equipment to prevent dirt or other foreign material from entering the hydraulic system.

NOTE

If replacement hydraulic pipes and/or hoses cannot be supplied by the OEM, or Defence Supply Chain the vehicle is to be sent to trade repair via the units supporting Logistic Unit. The practice of maintainers manufacturing replacement parts from bulk stocks of pipe and hose is not endorsed.

Replacement

18. Replace hydraulic pipes and hoses as follows:
- a. Remove the plugs from the end fittings of the replacement pipe/hose.
 - b. Remove the plugs that were previously inserted on the truck mounted equipment.
 - c. Install the pipe/hose and tighten the connection fittings ensuring that the pipe/hose is not twisted or deformed during tightening.
 - d. Fit zip clamps or any other restraining device that may have been removed.
 - e. Operate the hydraulics to ensure that the pipe is correctly fitted and free of leaks.
 - f. Bleed air from the hydraulic system in accordance with Para 40.
 - g. Check the fluid level in the reservoir and if necessary top up with ISO Grade 68 hydraulic fluid.

HYDRAULIC CYLINDERS

WARNING

Before removing any hydraulic cylinder, ensure that the hydraulic fluid is sufficiently cool to avoid burns.

Before commencing removal of hydraulic components, place a warning sign not to operate the crane on or near the vehicle controls.

NOTE

Before commencing the removal procedure of any hydraulic cylinder, clean the area around the cylinder, paying particular attention to the area around the pipe connections.

After removing pipes/hoses from hydraulic cylinders, always plug the openings to prevent ingress of foreign material into the hydraulic system.

After installation, bleeding and testing of hydraulic cylinders, always check the level of fluid in the reservoir, and if necessary, top up with ISO Grade 68 hydraulic fluid.

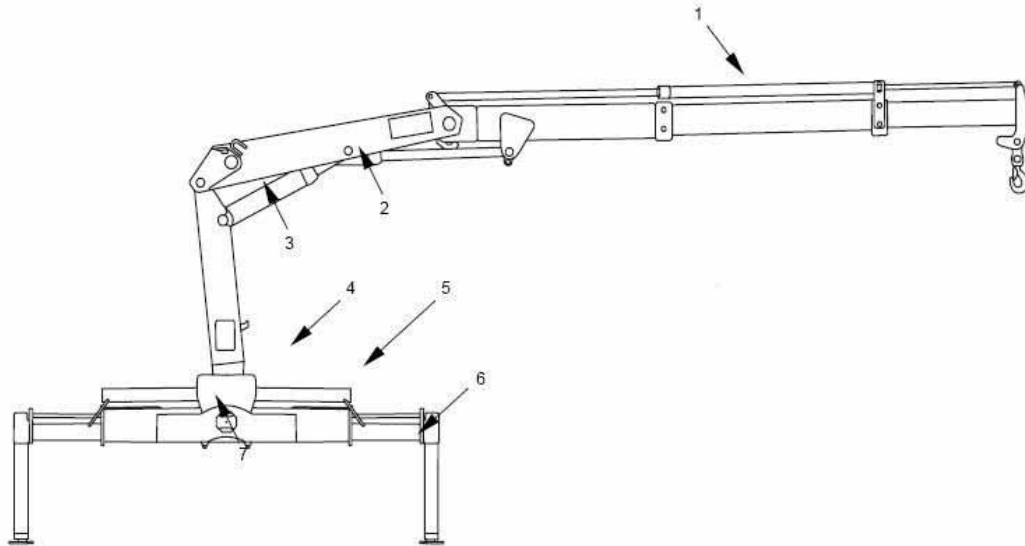
Inner Boom Cylinder

19. **Removal.** Remove the inner boom cylinder as follows (Fig 3, Item 3):

WARNING

This operation is to be carried out with the crane in the stowed position. If this is not possible, suitably support the crane with chocks to prevent the booms moving due to loss of fluid pressure when fittings are loosened.

- a. Tag the hoses to ensure correct connection during installation.



- | | | | |
|---|-------------------------|---|---------------------------------|
| 1 | Boom Extension Cylinder | 5 | Outrigger Extension Cylinder |
| 2 | Outer Boom Cylinder | 6 | Outrigger Leg Cylinder |
| 3 | Inner Boom Cylinder | 7 | Tilt Cylinder (not illustrated) |
| 4 | Slewing Cylinder | | |

Figure 3 Major Crane Components

- b. Crack loose the three flexible hose connections on the pipes leading to the load holding valve and disconnect the fittings. Use a suitable container to contain the oil spillage.
- c. Plug the hose openings and cylinder port openings.
- d. Disconnect and free the overload protection wiring from the load holding valve.
- e. Suitably support the cylinder in a sling prior to the removal of the pivot pins.
- f. Remove the retaining bolt and pivot pin securing the cylinder to the crane body.
- g. Remove the retaining bolt and pivot pin securing the cylinder to the inner boom.
- h. Lift the inner boom cylinder complete with load holding valve and pipe work clear of the crane.

20. Installation. Install the inner boom cylinder as follows:

- a. Position the inner boom cylinder in place and secure it using the pivot pins and retaining bolts.
- b. Remove the plugs from the cylinder ports and the hose ends.
- c. Connect the three flexible hoses to the appropriate load holding valve pipe work and tighten them securely.
- d. Remove the previously attached identification tags from the hoses.
- e. Reconnect and secure the overload protection wiring to the load holding valve.

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- f. Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder.
- g. Bleed air from the hydraulic system in accordance with Para 40.
- h. Check for leaks and rectify as necessary.

Outer Boom Cylinder

21. **Removal.** Remove the outer boom cylinder as follows (Fig 3, Item 2):

WARNING

This operation is to be carried out with the crane in the stowed position. If this is not possible, suitably support the crane with chocks to prevent the booms moving due to loss of fluid pressure when fittings are loosened.

- a. Tag the hoses to ensure correct connection during installation.
- b. Crack loose the three flexible hose connections on the pipe work leading to the load holding valve and disconnect the fittings. Use a suitable container to contain the oil spillage.
- c. Plug the hose openings and cylinder port openings.
- d. Disconnect and free the overload protection wiring from the load holding valve.
- e. Suitably support the cylinder in a sling prior to the removal of the pivot pins.
- f. Remove the retaining circlip and pivot pin securing the cylinder to the inner boom.
- g. Remove the retaining bolt and pivot pin securing the cylinder to the outer boom.
- h. Lift the outer boom cylinder complete with load holding valve and pipe work clear of the crane.

22. **Installation.** Install the outer boom cylinder as follows:

- a. Position the outer boom cylinder in place and secure it using the pivot pins, circlips and retaining bolts.
- b. Remove the plugs from the cylinder ports and the hose ends.
- c. Connect the three flexible hoses to the appropriate load holding valve pipe work and tighten them securely.
- d. Remove the previously attached identification tags from the hoses.
- e. Reconnect and secure the overload protection wiring to the load holding valve.
- f. Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder.
- g. Bleed air from the hydraulic system in accordance with Para 40.
- h. Check for leaks and rectify as necessary.

Boom Extension Cylinder

23. **Removal.** Remove the boom extension cylinder as follows (Fig 3, Item 1):

WARNING

This operation is to be carried out with the crane in the stowed position. If this is not possible, suitably support the crane with chocks to prevent the booms moving due to loss of fluid pressure when fittings are loosened.

- a. Tag the hoses to ensure correct connection during installation.
- b. Crack loose the two flexible hose connections on the pipe work leading to the sequencing valve and disconnect the fittings. Use a suitable container to contain the oil spillage.
- c. Plug the hose openings and cylinder port openings.

- d. Suitably support the cylinder in a sling prior to the removal of the mounting pins.
- e. Remove the retaining circlip and pin securing the cylinder to the outer boom.
- f. Ensure that the second boom extension is restrained from moving then remove the retaining bolt and pin securing the cylinder to the leading end of the second boom extension.
- g. Ensure that the first boom extension is restrained from moving then remove the retaining bolts, washers, spacers and mounting pin securing the cylinder to the leading end of the first boom extension.
- h. Lift the boom extension cylinder complete with sequencing valve and pipe work clear of the crane.

24. Installation. Install the boom extension cylinder as follows:

- a. Position the boom extension cylinder in place and secure the piston rod ends using the mounting pins, circlips and retaining bolts.
- b. Secure the cylinder barrel at the leading end of the first boom extension using the retaining bolts, washers, spacers and mounting pin. Ensure correct alignment of the cylinder.
- c. Remove the plastic plugs from the cylinder ports and hose ends.
- d. Connect the two flexible hoses to the appropriate sequencing valve pipe work and tighten securely.
- e. Remove the previously attached identification tags from the hoses.
- f. Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder.
- g. Bleed air from the hydraulic system in accordance with Para 40.
- h. Check for leaks and rectify as necessary.

Outrigger Leg Cylinder

25. Removal. Remove the outrigger leg cylinder as follows (Fig 3, Item 6):

WARNING

This operation is to be carried out with the crane in the stowed position and the outrigger leg resting lightly on the ground.

At no time is the outrigger leg to be removed when it is being used to stabilise the vehicle. Either stow the crane or, if that is not possible, make alternative arrangements to stabilise the vehicle.

- a. Tag the hoses to ensure correct connection during installation.
- b. Crack loose the two flexible hose connections at the valve block at the base of the cylinder and disconnect the fittings. Use a suitable container to contain the oil spillage.
- c. Plug the hose openings and cylinder port openings.
- d. Suitably support the cylinder prior to the removal of the mounting bolts.
- e. Remove the four nuts from the tilt mounting bracket securing bolts and carefully remove the cylinder and tilt mechanism clear of the crane.

26. Installation. Install the outrigger leg cylinder as follows:

- a. Position the outrigger cylinder in place and secure the cylinder using the mounting bolts and nuts.
- b. Remove the plastic plugs from the cylinder ports and hose ends.
- c. Connect the two flexible hoses to the cylinder connectors and tighten them securely.
- d. Remove the previously attached identification tags from the hoses.
- e. Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder.
- f. Bleed air from the hydraulic system in accordance with Para 40.

- g. Check for leaks and rectify as necessary.

Tilt Cylinder

27. **Removal.** Remove the tilt cylinder as follows (Fig 3, Item 7):

NOTE

Removal and installation of the tilt cylinder is best carried out with the crane in the reduced height (tilted) position.

- a. Tag the hoses to ensure correct connection during installation.
 - b. Crack loose the two flexible hose connections, one at each end of the cylinder and disconnect the fittings. Use a suitable container to contain the oil spillage.
 - c. Plug the hose openings and cylinder port openings.
 - d. Suitably support the cylinder prior to the removal of the pivot pins.
 - e. Remove the retaining bolts, plate and pivot pin securing the cylinder to the tilt rocker shaft.
 - f. Remove the retaining bolt and pivot pin securing the cylinder to the front mounting.
 - g. Lift the tilt cylinder clear of the crane.
28. **Installation.** Install the tilt cylinder as follows:
- a. Position the tilt cylinder in place and secure the cylinder using the mounting pins, plates and bolts.
 - b. Remove the plastic plugs from the cylinder ports and hose openings.
 - c. Connect the two flexible hoses to the cylinder connectors and tighten securely.
 - d. Remove the previously attached identification tags from the hoses.
 - e. Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder.
 - f. Bleed air from the hydraulic system in accordance with Para 40.
 - g. Check for leaks and rectify as necessary.

HYDRAULIC PUMP

29. **Removal.** Remove the hydraulic pump as follows:

WARNING

Before removing the hydraulic pump, ensure that the hydraulic fluid is sufficiently cool to avoid burns.

Before removing hydraulic components, place a warning sign not to operate the crane on or near the vehicle controls.

- a. Remove the hydraulic pump/power take off (PTO) protective guard.
 - b. Clean the pump and the hose connections, then blow them dry with compressed air.
 - c. Slacken the screw clamp on the supply hose. Remove the hose and plug both the hose and pump housing openings with suitable plastic plugs.
 - d. Remove the delivery hose and plug both the hose and the pump housing openings with suitable plastic plugs.
 - e. Match mark the pump adaptor flange to the PTO, remove the four nuts and washers and remove the pump and adaptor flange as one assembly from the PTO.
 - f. Remove and discard the pump adaptor flange to PTO gasket.
30. **Installation.** Install the hydraulic pump as follows:

- a. Clean the mounting faces on the pump adaptor flange and PTO ensuring that all gasket residue is removed.
- b. Apply suitable water repellent grease to the input gear spline.
- c. Position a new gasket on the PTO and apply Loctite 271 to the studs.
- d. Align the match marks and install the pump and adaptor flange assembly onto the PTO.
- e. Assemble the lock washers and nuts and tighten the nuts to 34 to 38 N.m.
- f. Remove the plastic plugs from the pump and hose openings, install the hoses and securely tighten the delivery hose connection and the supply hose screw clamp.
- g. Start the engine, engage the crane PTO and operate the crane to check the operation of the pump.
- h. Bleed air from the hydraulic system in accordance with Para 40.
- i. Check for leaks and rectify as necessary.
- j. Replace the hydraulic pump/PTO protective guard.

POWER TAKE OFF UNIT

31. **Removal.** Remove the PTO unit as follows:



WARNING

Before removing the PTO unit, place a warning sign not to operate the crane on or near the vehicle controls.



CAUTION

Both the PTO and adaptor housings are quite brittle and easily damaged unless handled carefully.

- a. Remove the hydraulic pump in accordance with Para 29.
 - b. Remove the air line from the PTO selector housing.
 - c. Remove the six nuts and washers securing the PTO and adaptor housings to the transmission.
 - d. Remove the PTO and adaptor housings from the transmission as one unit and remove and discard the gasket.
 - e. Separate the PTO housing from the adaptor housing and remove and discard the gasket.
32. **Determine Gasket Thickness – Adaptor-to-Transmission.** Determine the gasket thickness required between the adaptor housing and transmission to obtain the correct backlash as follows:
- a. Clean all traces of gasket material from the mounting faces of the transmission and adaptor housings.
 - b. Insert a wooden wedge between the transmission PTO drive gear and the transmission housing (Fig 4).

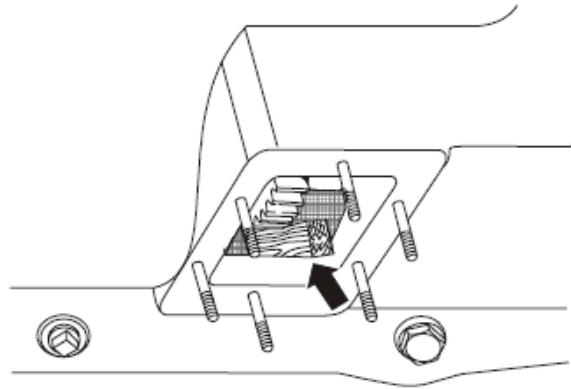


Figure 4 Wedge Location

- c. Install new gaskets and the adaptor housing onto the transmission housing and secure them in place with the top and bottom nuts only.
- d. Install a dial indicator onto the adaptor housing with the dial indicator plunger resting squarely on the adaptor gear (Fig 5).
- e. Rock the adaptor gear back and forth by hand and check the backlash reading. Add or subtract gaskets between the adaptor housing and transmission housing to obtain a backlash of 0.250-0.375 mm.
- f. Remove the dial indicator from the adaptor housing.
- g. Remove the nuts and remove the adaptor housing from the transmission.
- h. Retain the gaskets as a set.
- i. Remove the wooden wedge from the transmission.

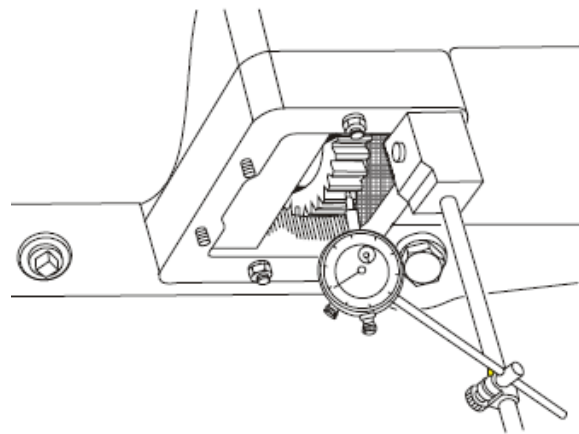


Figure 5 Checking PTO Adaptor-to-Transmission Backlash

33. Determine Gasket Thickness – Adaptor-to-PTO. Determine the gasket thickness between the adaptor housing and the PTO to obtain the correct backlash as follows:

- a. Clean all traces of gasket material from the mounting faces of the adaptor and the PTO.
- b. Position new gaskets and the adaptor housing on the PTO housing and secure the adaptor to the PTO with two suitably sized bolts and nuts (Fig 6)
- c. Install a dial indicator on the adaptor housing with the dial indicator plunger resting squarely on the adaptor gear (Fig 6).
- d. Slide the idler gear against the spring pressure to mesh the idler gear with the adaptor gear. Hold the gear in this position and lock it to prevent it from turning, then rock the adaptor gear back and forth by hand and check the backlash reading. Add or subtract gaskets between the adaptor and PTO to obtain a backlash of 0.250-0.375 mm.

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- e. Remove the dial indicator from the adaptor housing.
- f. Remove the nuts and bolts and separate the adaptor housing and PTO.
- g. Retain the gaskets as a set.

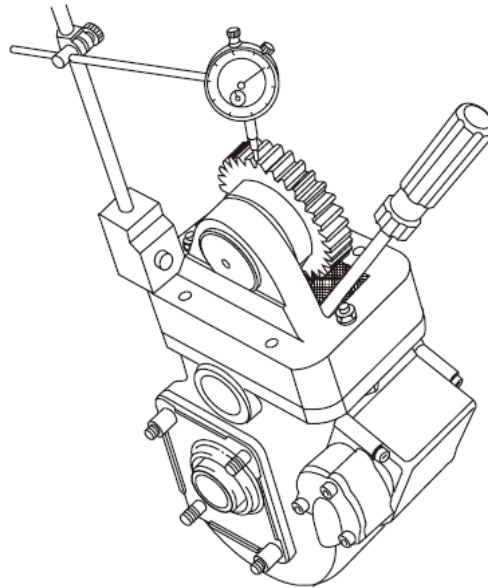


Figure 6 Checking Adaptor-to-PTO Backlash

34. **Installation.** Install the PTO unit as follows:



Both the PTO and adaptor housings are quite brittle and easily damaged unless handled carefully.

- a. Apply Loctite 271 to the studs on the transmission housing.
- b. Position the gasket set (previously determined when setting the adaptor-to-transmission backlash in Para 32) onto the transmission.
- c. Assemble the adaptor housing to the transmission.
- d. Position the gasket set (previously determined when setting the adaptor-to-PTO backlash in Para 33) onto the adaptor housing.
- e. Assemble the PTO housing to the adaptor housing.
- f. Install the nuts and washers to the studs and tighten them to 34 to 38 N.m.
- g. Re-connect the air line to the PTO selector housing.
- h. Install the hydraulic pump in accordance with Para 30.
- i. Check that the PTO is operating correctly and not making any whining or rattling noise. If the PTO whines or rattles repeat the backlash adjustment in accordance with Paras 32. and 33.

CRANE PTO CONTROL VALVE

35. **Removal.** Remove the crane PTO control valve as follows:

- a. Drain the air from the air brake reservoirs.
- b. From under the centre console, disconnect the air lines from the control valve.
- c. Remove the two retaining screws and the instruction plate from the fascia side of the console and remove the valve.

- 36. Installation.** Install the crane PTO control valve as follows:
- Position the valve in the console then install the instruction plate and retaining screws. Tighten the screws securely.
 - Reconnect the air lines and tighten the connections securely.
 - Start the engine, allow the air pressure in the brake system to build up, check for air leaks at the valve and rectify as necessary.
 - Shut down the engine.

CRANE PTO ENGAGEMENT SELECTOR

- 37. Removal.** Remove the crane PTO engagement selector as follows:
- Remove the hydraulic pump/PTO protective guard.
 - Clean the selector housing and the area around the housing.
 - Disconnect the air line from the elbow on the selector housing.
 - Remove the four socket head bolts retaining the selector housing to the PTO, remove the selector housing, remove gasket from the PTO and discard it.
 - Clean any gasket residue from the mounting surfaces of the PTO and the selector housing.
- 38. Installation.** Install the crane PTO engagement selector as follows:
- Position a new gasket and the selector housing on the PTO ensuring that the selector fork is aligned with the gear.
 - Install the retaining bolts and tighten them to 34 to 38 N.m.
 - Reconnect the air line and tighten the connection securely.
 - Start the engine and engage the PTO.
 - Check for air leaks at the air line connection. Rectify as necessary.
 - Disengage the PTO and shut down the engine.
 - Replace the hydraulic pump/PTO protective guard.

BLEEDING AIR FROM THE HYDRAULIC SYSTEM

- 39.** After repairs to any hydraulic component, the crane's hydraulic system must be bled to expel all air. If air is left to accumulate in the system, damage to hydraulic components can occur. Damage that can occur includes:
- cavitation damage to the pump;
 - slow, jerky crane actions; and
 - auto-ignition (dieseling) resulting in burnt and damaged seals.
- 40.** To bleed air from the hydraulic system after repairs, proceed as follows:
- Check the level of fluid in the oil reservoir and if necessary, top up with ISO Grade 68 hydraulic fluid.
 - Start the engine and engage the crane PTO.
 - Before unfolding the crane, operate the hydraulic cylinders against their stops.
 - Operate the crane and run each hydraulic cylinder out to its end position at least twice. Refer to Fig 7 for the recommended sequence.
 - Ensure that both pistons in the boom extension cylinder reach their end positions.
 - Check for leaks and rectify as necessary.
 - When the crane and outriggers have been returned to the transport position, re-check the level of fluid in the oil reservoir and, if necessary, top up with ISO Grade 68 hydraulic fluid.

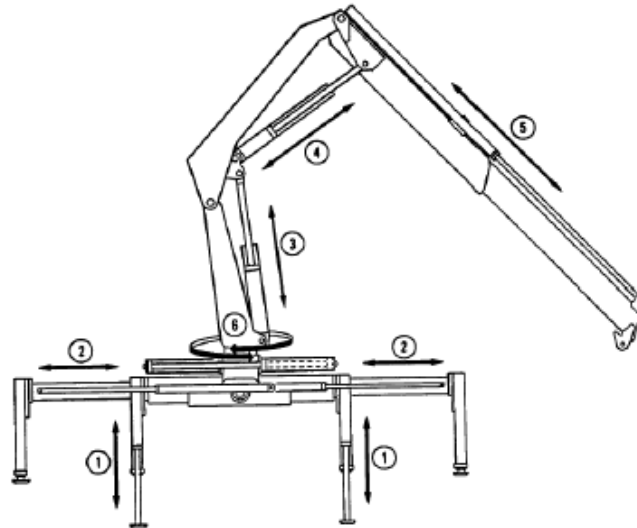


Figure 7 Bleeding Sequence

FAULT FINDING

SPACE System Fault Finding

41. Table 2 details the likely symptoms, the probable causes and the remedial actions required when fault finding general problems with the SPACE (speed, payload, accessories, certificate and electronics) functions of the crane.

Table 2 SPACE – System Fault Finding

Serial	Symptom	Probable Cause	Action
1	SPACE does not work; or The Off/On indicator lamp will not work	a. Fuse(s) defective in the MPCB box.	Remove the cover of the MPCB box and replace the defective 15 A fuse(s). Replace the cover.
		b. Fuse defective in the PSBI box.	Remove the cover of the PSBI box and replace the defective 7.5 A fuse. Replace the cover.
2	The efficiency of the remote control gradually deteriorates	Blocked filter element in the pressure reduction filter	Replace the filter insert.
3	The remote control does not work	a. If the indicator light on the controller does not flash, the controller is not connected properly.	Check and correct the remote controller connections
		b. If the On/Off lamp is lit but the lamp situated on the left below the warning triangle is not, the Stop buttons are pressed in.	Pull out the Stop buttons.
4	One remote controller function inoperative	The remote control lever was not in the neutral position at start up.	a. Push in the Stop button.
			b. Ensure that all levers are in the neutral position.
			c. Pull out the Stop Button.
			NOTE: If one function is still inoperative, check the centre indicator on the DA module. If it <i>flashes</i> when operation is attempted, the safety system has intervened. If it does <i>not flash</i> , check the cables between the DA modules

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Table 2 SPACE – System Fault Finding (Continued)

Serial	Symptom	Probable Cause	Action
5	Fault light on the PSBI box blinks; or the crane does not work; or the crane operates with low capacity or speed	The SPACE system has detected a fault.	a. Check that the Stop buttons are pulled out and that the levers are in the neutral position.
			b. Check the fault codes displayed in the SPACE box.
			c. Refer to the fault list and carry out the appropriate rectification action.

Hydraulic System Fault Finding

42. Table 3 details the likely symptoms, the probable causes and the remedial actions required when fault finding general problems with the hydraulic functions of the crane.

Table 3 Hydraulic System Fault Finding

Serial	Symptom	Probable Cause	Action
1	No fluid flow – no pressure.	a. Fluid level in reservoir too low.	Top up with ISO Grade 68 hydraulic fluid.
		b. Pump not receiving fluid.	a. Replace filter.
			b. Check for a blocked pump supply hose, clean or replace as necessary.
			c. Clean the reservoir breather vent then check the fluid level in the reservoir. Top up if necessary with ISO Grade 68 hydraulic fluid.
		c. Power take off-to-pump splined connection damaged.	a. If the pump only is damaged, replace.
			b. If the PTO is damaged, report.
		d. Air leaks in pump supply line.	a. Check hose connections. Tighten as necessary.
			b. Replace hose if necessary.
		e. Cavitation or aeration in pump.	a. Check for air leaks in the pump supply line and rectify.
			b. Clean or replace blocked pump supply line.
c. Clean reservoir breather vent and if necessary change the system fluid.			
2	Low fluid flow rate.	a. Fluid level in reservoir is incorrect.	Top up with ISO Grade 68 hydraulic fluid.
		b. Leaking pipe or hose connections.	Tighten connections.
		c. Damaged or leaking pipes or hoses.	Replace
		d. Fluid viscosity too high.	Warm fluid up to operating temperature. If viscosity is still too high, change fluid. Use only ISO Grade 68 hydraulic fluid.
		e. Pump not operating at optimum capacity.	Replace the pump.
		f. Air leaks in pump supply line	a. Check hose connections, tighten as necessary.
			b. Replace hose if necessary.
		g. Cavitation or aeration in pump.	a. Check for air leaks in the pump supply line and rectify.
			b. If the supply line is blocked, clean or replace as necessary.
			c. Ensure that the reservoir breather vent is clear and if necessary change the system fluid.

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Table 3 Hydraulic System Fault Finding (Continued)

Serial	Symptom	Probable Cause	Action
3	Excessive flow or movement.	Fluid viscosity too low.	Change fluid. Use only ISO Grade 68 hydraulic fluid.
4	Low fluid pressure	a. Inadequate flow rate.	Refer to 'No fluid flow – No pressure', or 'Low fluid flow'.
		b. Excessive external leakage	Rectify leaks and fill reservoir to correct level with ISO Grade 68 hydraulic fluid.
5	Erratic fluid pressure.	a. Air in fluid.	a. Repair or replace damaged hoses or pipes.
			b. Tighten leaking connections then fill the reservoir to correct level with ISO Grade 68 hydraulic fluid.
			c. Bleed system in accordance with Para 40.
		b. Hydraulic fluid contaminated.	a. Replace filter
b. Check for a blocked pump supply hose, clean or replace as necessary.			
		c. Ensure that the breather vent is clear and if necessary change the system fluid. Use only ISO Grade 68 hydraulic fluid.	
6	Excessive fluid pressure	Incorrect oil viscosity.	Change fluid. Use only ISO Grade 68 hydraulic fluid.
7	No movement.	a. Mechanical binding.	Report
		b. Refer to 'No fluid flow – No pressure'.	---
		c. Pilot operated valves or flow control valves	Report
8	Slow movement.	a. Refer to 'Low fluid flow rate'.	---
		b. Insufficient control pressure for valves. Refer to 'Low fluid pressure'.	---
		c. Lack of lubrication of mechanical components.	Lubricate
		d. Fluid viscosity too high.	Warm fluid up to operating temperature. If viscosity is still too high, change fluid. Use only ISO Grade 68 hydraulic fluid.
9	Erratic movement.	a. Refer to 'Erratic fluid pressure'.	---
		b. Air in fluid.	a. Replace damaged hoses or pipes and tighten leaking connections.
			b. Fill reservoir to correct level with ISO Grade 68 hydraulic fluid.
			c. Bleed system in accordance with Para 40.
	c. Lack of lubrication of mechanical components	Lubricate	

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Table 3 Hydraulic System Fault Finding (Continued)

Serial	Symptom	Probable Cause	Action
10	Noisy pump.	a. Air in fluid.	a. Replace damaged hoses or pipes and tighten leaking connections.
			b. Fill reservoir to correct level with ISO Grade 68 hydraulic fluid.
			c. Bleed system in accordance with Para 40.
		b. Fluid viscosity too high.	Warm fluid up to operating temperature. If viscosity is still too high, change fluid. Use only ISO Grade 68 hydraulic fluid.
		c. Pump operating too fast.	Set truck engine speed to 1100 rev/min.
		d. Cavitation in pump.	a. Replace filter.
			b. Check for a blocked pump supply hose, clean or replace as necessary.
c. Ensure that the breather vent is clear and if necessary change the system fluid. Use only ISO Grade 68 hydraulic fluid.			
e. Worn or damaged pump.	Replace pump		
11	Relief valve noise.	Worn poppet and seat.	Report
12	Fluid overheated	a. Fluid dirty or reservoir level low or incorrect fluid viscosity.	Replace fluid filter, if necessary change system fluid, ensure reservoir is filled to correct level with ISO Grade 68 hydraulic fluid.
		b. System pressure too high.	Report
13	Pump overheated.	a. Refer to 'Fluid overheated'.	---
		b. Air in fluid.	a. Replace damaged hoses or pipes and tighten leaking connections.
			b. Fill reservoir to correct level with ISO Grade 68 hydraulic fluid.
			c. Bleed system in accordance with Para 40.
		c. Excessive load.	Ensure that crane is not overloaded then locate and correct any mechanical binding.
		d. Cavitation in pump.	a. Replace filter.
			b. Check for a blocked pump supply hose, clean or replace as necessary.
c. Ensure that the breather vent is clear and if necessary change the system fluid. Use only ISO Grade 68 hydraulic fluid.			
e. Worn or damaged pump.	Replace		
f. Relief valve set too high.	Report		
14	Relief valve overheated	a. Refer to 'Fluid overheated'.	---
		b. Valve setting incorrect.	Report
		c. Worn or damaged valve.	Report

END

Distribution List: **VEH G 52.0 – Code 2** (Maint Level)
(Sponsor: LV SPO Mdm/Hvy Vehicles)
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