

**TRUCK, FLATBED, HEAVY, MC3, GUN TRACTOR/AMMO TRANSPORTER,
W/CRANE, W/WINCH, 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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GENERAL

INTRODUCTION

1. This EMEI supplement contains instructions for removing, repairing/replacing and installing major components of the crane fitted to the Truck, Flatbed, Heavy, MC3, Gun Tractor/Ammo Transporter, W/Crane, W/Winch, Mack. For further information on the basic truck, refer to the relevant EMEI. For warranty provisions, refer to the User Handbook.

ASSOCIATED PUBLICATIONS

2. Reference may be necessary to the latest version of the following documents:
- a. Defence Road Transport Instruction.
 - b. Australian Army Books: Record Book for Service Equipment GM 120.
 - c. Complete Equipment Schedule (CES):
 - (1) SCES 11848 – Truck, Flatbed, Heavy, MC3, Gun Tractor/Ammo Transporter, W/Crane, W/Winch, Mack.
 - (2) SCES 12104 – Truck, Flatbed, Heavy, MC3, Gun Tractor/Ammo Transporter, W/Crane, W/Winch, Mack.
 - d. Repair Parts Scale 02164.
 - e. Provisional Block Scale 2406/29.
 - f. [EMEI Vehicle A029](#) – Servicing of B Vehicles.
 - g. [EMEI Vehicle A119-21](#) – Repair of Vehicles Under Warranty Agreement.
 - h. [EMEI Vehicle G 720](#) – Data Summary (Gun/ Ammo).
 - i. [EMEI Vehicle G 702](#) – Technical Description (Cargo).
 - j. [EMEI Vehicle G 722](#) – Technical Description (Gun/Ammo).
 - k. [EMEI Vehicle G 703](#) – Light Grade Repair (Cargo).
 - l. [EMEI Vehicle G 704](#) – Medium Grade Repair (Cargo).
 - m. [EMEI Vehicle G 704-1](#) – Heavy Grade Repair (Cargo).
 - n. [EMEI Vehicle G 724](#) – Medium and Heavy Grade Repair (Gun/Ammo).
 - o. [EMEI Vehicle G 709](#) – Servicing (All Variants).
 - p. [EMEI Vehicle G 729](#) – Servicing (Gun/Ammo – Crane).

ROTABLE ITEM IDENTIFICATION

3. Table 1 lists the identification locations for rotatable items:

Table 1 Rotable Item Identification

Item	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.

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Table 1 Rotable Item Identification (Continued)

Item	Location
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.
Power Take-Off (Winch)	Below the selector housing.
Hydraulic pump	Rear face of the pump.
Winch	Upper face left-hand side.
Cab upper section	Rear inner left-hand upper panel.
Cab lower section	Left-hand door opening gusset.

SAFETY

4. The following warnings are to be adhered to when carrying out repairs to the crane.

WARNING

All industrial safety, work practices and equipment operating and maintenance instructions pertaining to this EMEI are to be adhered to.

WARNING

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

WARNING

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

WARNING

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

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.

5. It is vitally important that dirt and other foreign matter is 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.

6. Protect the equipment from dust and inclement weather when performing any of the tasks contained in this manual. If practical, perform these tasks in a sheltered or enclosed area.

- 7.** When disconnecting electrical connectors, hoses and fittings remove clamps as required to gain slack and avoid damage to connectors and fittings.
- 8.** Discard all used gaskets, seals, split pins, tab washers, lock-pins, nyloc nuts and lock-washers. Discard all contaminated lubricants drained from the equipment.
- 9.** Use only those lubricants specified in the Servicing Instruction (EMEI Vehicle G 729) and the User Handbook when replenishing lubricants.
- 10.** 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.

CAB CHASSIS

FUEL TANKS

NOTE

Isolation valves must be shut off to prevent fuel transfer prior to draining either fuel tank.

- 11.** The fuel tanks are to be removed and replaced in accordance with EMEI Vehicle G 703. Ensure that prior to draining either tank the isolation valves are shut off to prevent fuel transfer or leakage. Figure 1 illustrates the fuel system schematic.

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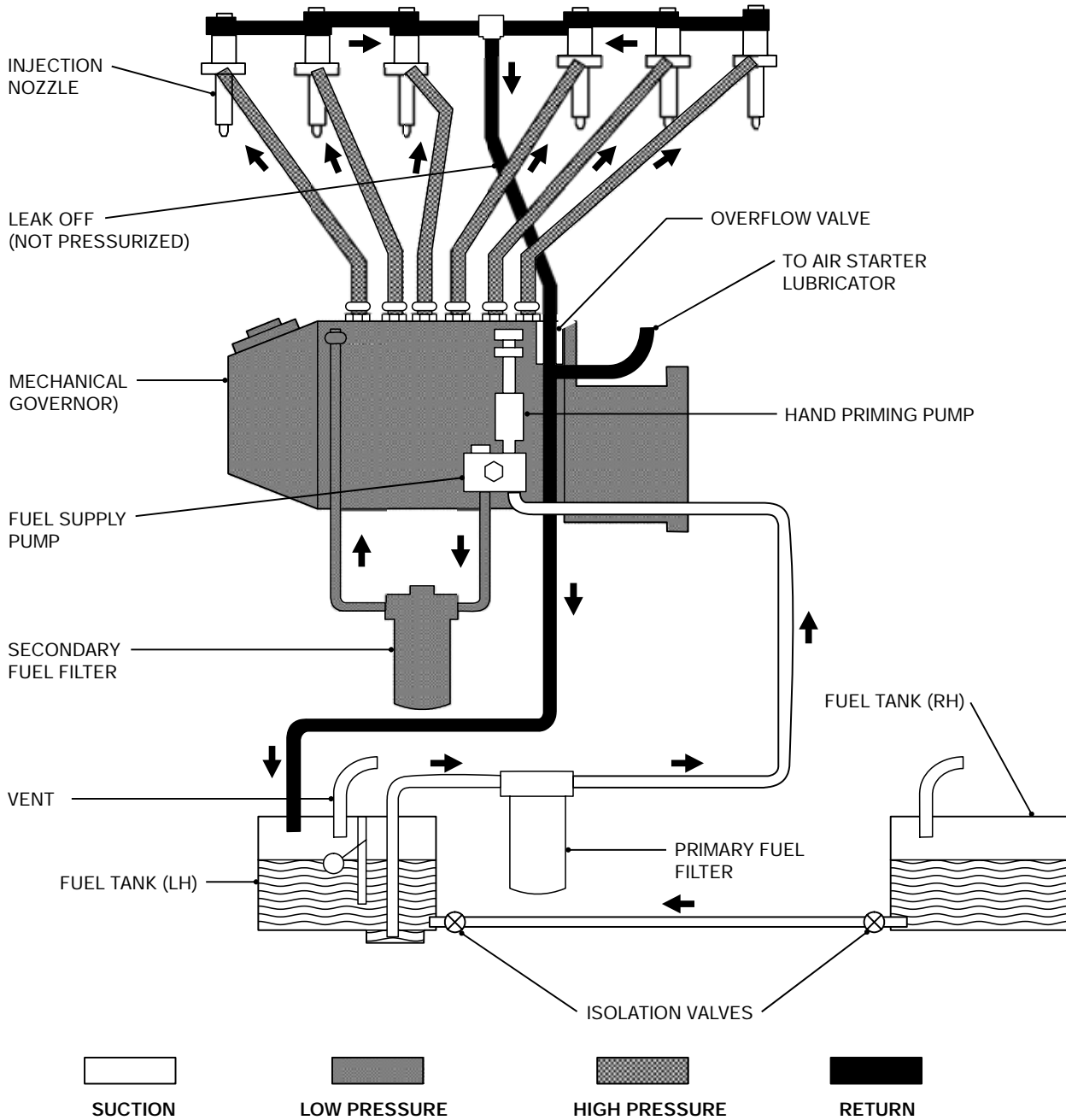


Figure 1 Fuel System Schematic

CRANE

HYDRAULIC OIL FILTERS

Return Oil Filter

12. **Removal.** To remove the return oil filter, proceed as follows (see Figure 2):

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 (1) to free it while pressing on it.
- c. Pull the return filter out of the tank and place in an appropriate drip tray.
- d. Unscrew the wing nut (6).
- e. Remove and discard the filter insert (5) and seal rings (2, 3 and 4).

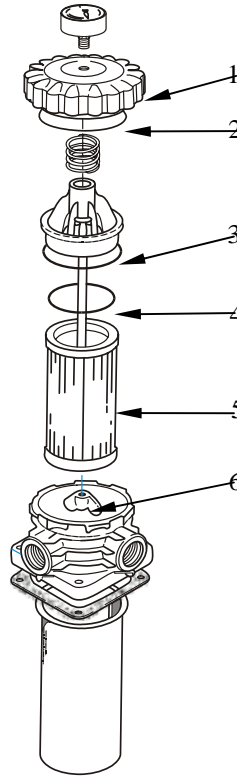


Figure 2 Return Oil Filter

- 13. **Installation.** To install the return oil filter, proceed as follows (see Figure 2):
 - a. Insert a new seal ring (4) and filter insert (5).
 - b. Tighten the wing nut (6).
 - c. Fit new seal rings (2 and 3).
 - d. Replace the oil filter in the reservoir.
 - e. Attach the cover on the return oil filter.
 - f. Check the level of fluid in the oil reservoir and if necessary top up with ISO Grade 68.

Pressure Reduction Filter

- 14. **Removal.** To remove the pressure reduction filter element, proceed as follows (see Figure 3):

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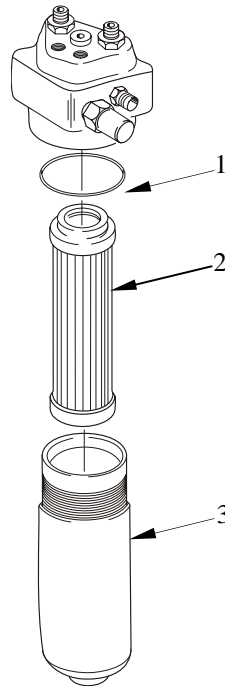


Figure 3 Pressure Reduction Oil Filter

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 (3).
- d. Remove the filter insert (2).

15. Installation. To install the pressure reduction filter element, proceed as follows (see Figure 3):

- a. Clean the filter housing (3).
- b. Fit a new insert (2).
- c. Fit a new seal ring (1).
- d. Reassemble the filter housing.

16. Flushing Lines. Before running oil through the pressure reduction system after performing maintenance tasks (not filter element changes), flush the system as follows:

- a. Disconnect both 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 re-install to the correct ports on the valve positioners.

HYDRAULIC PIPES AND HOSES

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 the loss of fluid (pressure). 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.

WARNING

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 components of the pressure reduction filter circuit, the lines must be flushed as described at Paragraph 15. This does not apply to filter element changes.

17. **Removal.** To remove hydraulic pipes and hoses, proceed as follows:
- Disengage the PTO and shut down the engine. Place a suitable container under the pipe or hose to be replaced to catch any spillage.
 - Crack loose the pipe/hose connection to allow any residual fluid (which may be under pressure) to drain off.
 - Disconnect the pipe/hose connections, remove any zip clamps or other restraining devices and remove the pipe/hose. Plug the openings to prevent dirt or other foreign material from entering the hydraulic system.
18. **Replacement (Hose).** To replace a hose, proceed as follows:
- Clamp the ferrule in a vice and screw the insert from the hose in a counter-clockwise direction (see Figure 4).

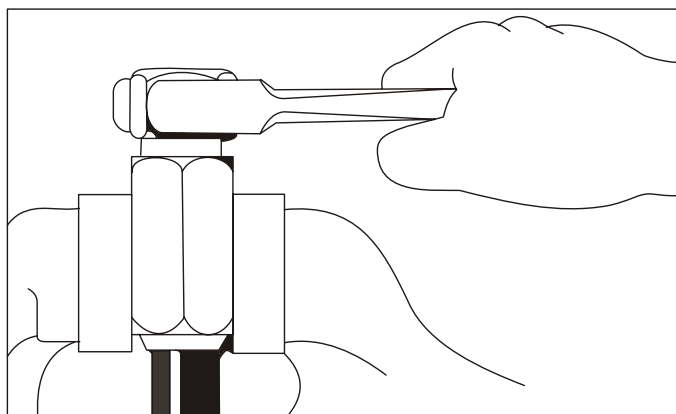


Figure 4 Removing Coupling Insert

- With the ferrule clamped in the vice, remove the hose by turning it in a clockwise direction (see Figure 5).

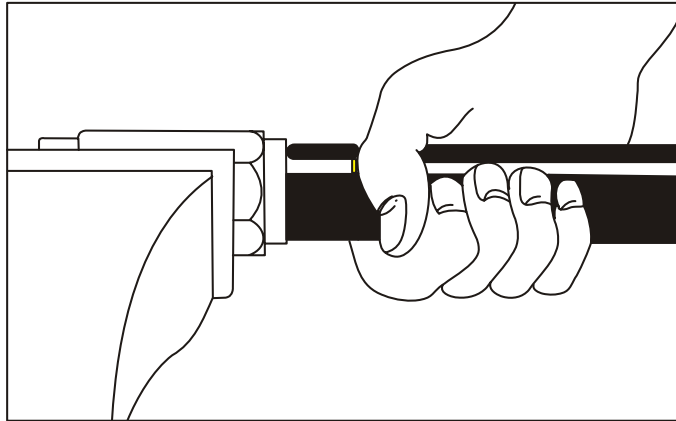


Figure 5 Removing Ferrule

- c. Repeat Paragraphs 18 a and b for the other end of the hose.
- d. Measure the length of the hose for replacement purposes, then discard the hose.
- e. Refer to the Repair Parts Scale 02164 for the correct replacement hose. Cut a length of hose to the measurement determined at Paragraph 18 d.

NOTE

A cutting disc will be required to obtain a clean cut through the hose without damaging the wire braid reinforcing.

- f. Make a knife cut around the circumference of the hose to the depth of the braid, at a distance from the end of the hose equal to the inside length of the ferrule.
- g. Make one lengthwise cut to the depth of the braid, from the circular cut to the end of the hose (see Figure 6).

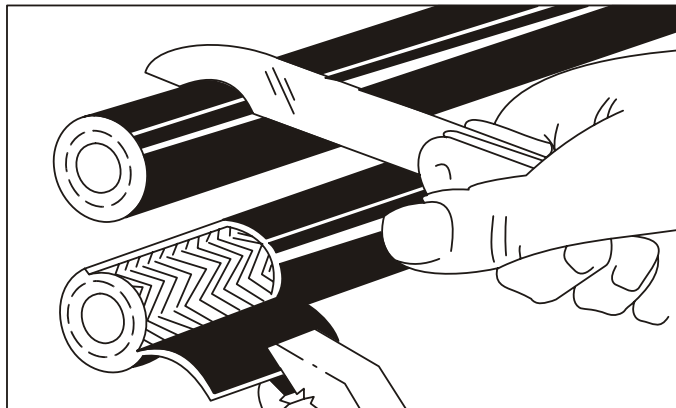


Figure 6 Cutting Hose Outer Cover

- h. Cleanly strip the cover down to the braid.
- i. Push the hose into the ferrule using semi-rotational movements in both clockwise and counter-clockwise directions. The hose is fully home when the end of the hose is 0.8 to 1.2 mm (1/32 to 1/16 inch) from the inside shoulder.
- j. Liberally oil the insert and the inside of the hose with hydraulic fluid (ISO Grade 68), then screw the insert all the way into the ferrule. Do not allow the hose to turn during this operation.
- k. Repeat Paragraphs 18 f to j for the other end of the hose.
- l. Remove the protective plugs and install the hose. Ensure that it is not twisted, and any bends are smooth and gradual. Fit zip clamps or any other restraining device which may have been removed, then operate the hydraulics to ensure that the hose is correctly fitted and free of leaks and to bleed the system (refer to Paragraph 20).
- m. Check the fluid level in the oil reservoir. If necessary, top-up with ISO Grade 68.

- 19. Replacement (Pipe).** To replace a pipe, proceed as follows:
- a. Refer to the Repair Parts Scale 02164 for the correct replacement pipe. Cut the pipe to the required length, then if necessary bend the pipe to the same shape as the pipe removed. Ensure that all burrs are removed from the ends of the pipe.
 - b. Position the union nuts on the pipe with the threads of the nuts facing the ends of the pipe.
 - c. Using a flaring tool, double flare the ends of the pipe.
 - d. Remove the plugs and install the pipe, fit zip clamps or any other restraining device which may have been removed, then operate the hydraulics to ensure that the pipe is correctly fitted and free of leaks and to bleed the system (refer to Paragraph 20).
 - e. Check the fluid level in the reservoir. If necessary, top up with ISO Grade 68.

BLEEDING AIR FROM THE SYSTEM

20. After repairs to any hydraulic component, the crane’s hydraulic system must be bled to evacuate all air. If air is left to accumulate in the system, damage to hydraulic components can occur.

21. Damages that can occur include:

- a. Cavitation damage to the pump.
- b. Slow, jerky crane actions.
- c. Auto-ignition (dieseling) resulting in burnt and damaged seals.

22. To bleed air from the hydraulic system after repairs, proceed as follows (refer to Figure 7):

- a. Check the level of fluid in the oil reservoir. If necessary, top up with ISO Grade 68.
- b. Start the engine and engage the crane PTO.
- c. Before unfolding the crane, operate the hydraulic cylinders against their stops.

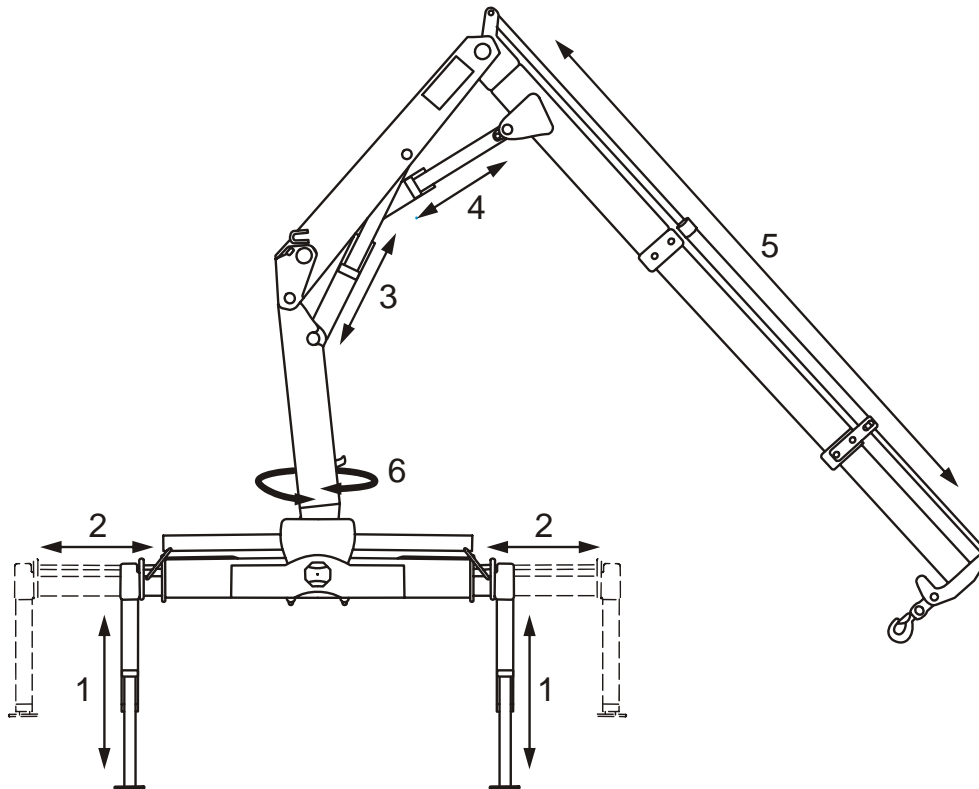


Figure 7 Bleeding Sequence

- d. Operate the crane and run each hydraulic cylinder out to its end position at least twice. Refer to Figure 7 for the recommended sequence.

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- e. Ensure that both pistons in the boom extension cylinder reach their end positions.
- f. Check for leaks and rectify as necessary.
- g. When the crane and outriggers have been returned to the transport position, re-check the level of fluid in the oil reservoir. If necessary, top up with ISO Grade 68.

HYDRAULIC CYLINDERS

WARNING

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

WARNING

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 pipework from hydraulic cylinders, always plug the pipes and fittings to prevent the ingress of dirt into the hydraulic system.

NOTE

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

Inner Boom Cylinder

- 23. Removal.** To remove the inner boom cylinder, proceed as follows (see Figure 8, Item 3):
- a. This operation is best 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 the loss of fluid (pressure).
 - 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. Tag the hoses to ensure correct connection during installation.
 - c. Disconnect and free the overload protection wiring from the load holding valve.
 - d. Suitably support the cylinder in a sling prior to the removal of the pivot pins.
 - e. Remove the retaining bolt and pivot pin securing the cylinder to the crane body.
 - f. Remove the retaining bolt and pivot pin securing the cylinder to the inner boom.
 - g. Lift the inner boom cylinder complete with load holding valve and pipework clear of the crane.
- 24. Installation.** To install the inner boom cylinder, proceed as follows:
- a. Position the inner boom cylinder in place and secure using the pivot pins and retaining bolts.
 - b. Remove the plastic plugs and connect the three flexible hoses to the appropriate load holding valve pipework. Tighten securely.
 - c. Reconnect and secure the overload protection wiring to the load holding valve.
 - d. Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder and to bleed the air from the system (see Paragraph 20). Check for leaks and rectify as necessary.

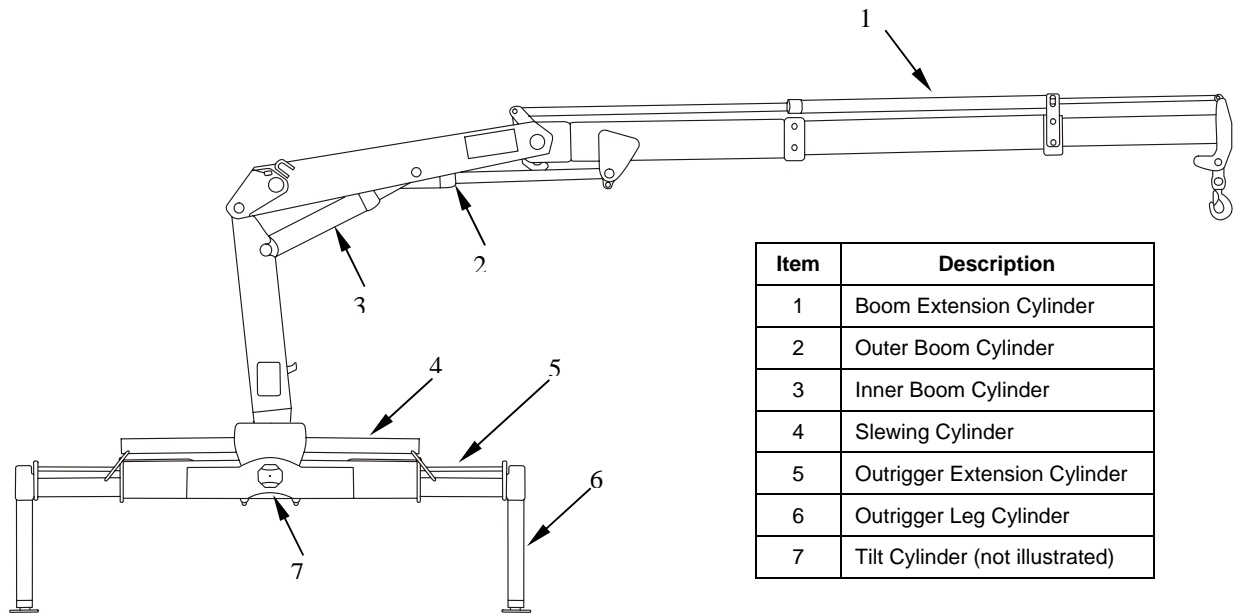


Figure 8 Major Crane Components

Outer Boom Cylinder

- 25. Removal.** To remove the outer boom cylinder, proceed as follows (see Figure 8, Item 2):
- This operation is best 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 the loss of fluid (pressure).
 - Crack loose the three flexible hose connections on the pipework leading to the load holding valve and disconnect the fittings. Use a suitable container to contain the oil spillage. Tag the hoses to ensure correct connection during installation.
 - Disconnect and free the overload protection wiring from the load holding valve.
 - Suitably support the cylinder in a sling prior to the removal of the pivot pins.
 - Remove the retaining circlip and pivot pin securing the cylinder to the inner boom.
 - Remove the retaining bolt and pivot pin securing the cylinder to the outer boom.
 - Lift the outer boom cylinder complete with load holding valve and pipework clear of the crane.
- 26. Installation.** To install the outer boom cylinder, proceed as follows:
- Position the outer boom cylinder in place and secure using the pivot pins, circlips and retaining bolts.
 - Remove the plastic plugs and connect the three flexible hoses to the appropriate load holding valve pipework. Tighten securely.
 - Reconnect and secure the overload protection wiring to the load holding valve.
 - Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder and to bleed the air from the system (see Paragraph 20). Check for leaks and rectify as necessary.

Boom Extension Cylinder

- 27. Removal.** To remove the boom extension cylinder, proceed as follows (see Figure 8, Item 1):
- This operation is best carried out with the crane in the stowed position. If this is not possible, suitably restrain the boom extensions from moving when the cylinder is removed.
 - Crack loose the two flexible hose connections on the pipework leading to the sequencing valve and disconnect the fittings. Use a suitable container to contain the oil spillage. Tag the hoses to ensure correct connection during installation.
 - Suitably support the cylinder in a sling prior to the removal of the mounting pins.
 - Remove the retaining circlip and pin securing the cylinder to the outer boom.

- e. 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.
- f. 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.
- g. Lift the boom extension cylinder complete with sequencing valve and pipework clear of the crane.

28. Installation. To install the boom extension cylinder, proceed 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 and connect the two flexible hoses to the appropriate sequencing valve pipework. Tighten securely.
- d. Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder and to bleed the air from the system (see Paragraph 20). Check for leaks and rectify as necessary.

Outrigger Leg Cylinder

29. Removal. To remove the outrigger leg cylinder, proceed as follows (see Figure 8, Item 6):

WARNING

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, alternate arrangements are to be made to stabilise the vehicle.

- a. This operation is best carried out with the crane in the stowed position and the outrigger leg lightly resting on the ground.
- 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. Tag the hoses to ensure correct connection during installation.
- c. Suitably support the cylinder prior to the removal of the mounting bolts.
- d. Remove the four nuts from the tilt mounting bracket securing bolts and carefully remove the cylinder and tilt mechanism clear of the crane.

30. Installation. To install the outrigger leg cylinder, proceed as follows:

- a. Position the outrigger cylinder in place and secure the cylinder using the mounting bolts and nuts.
- b. Remove the plastic plugs and connect the two flexible hoses to the cylinder connectors. Tighten securely.
- c. Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder and to bleed the air from the system (see Paragraph 20). Check for leaks and rectify as necessary.

Outrigger Extension Cylinder

31. Removal. To remove the outrigger extension cylinder, proceed as follows (see Figure 8, Item 5):

- a. This operation is best carried out with the crane in the reduced height (tilted) position.
- 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. Tag the hoses to ensure correct connection during installation.
- c. Remove the retaining nut on the push rod end of the cylinder.
- d. Remove the retaining mechanism securing the cylinder to the outrigger beam.

- e. Lift the outrigger extension cylinder clear of the crane. This may entail manually sliding the extension beam out of the outrigger beam to free the push rod end of the cylinder.

32. **Installation.** To install the outrigger extension cylinder, proceed as follows:

- a. Position the outrigger extension cylinder in place and secure the piston rod end using the retaining nut.
- b. Secure the cylinder barrel to the outrigger beam using its mounting hardware.
- c. Remove the plastic plugs and connect the two flexible hoses to the cylinder connectors. Tighten securely.
- d. Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder and to bleed the air from the system (see Paragraph 20). Check for leaks and rectify as necessary.

Tilt Cylinder

33. **Removal.** To remove the tilt cylinder, proceed as follows (see Figure 8, Item 7):

- a. This operation is best carried out with the crane in the reduced height (tilted) position.
- 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. Tag the hoses to ensure correct connection during installation.
- c. Suitably support the cylinder prior to the removal of the pivot pins.
- d. Remove the retaining bolts, plate and pivot pin securing the cylinder to the tilt rocker shaft.
- e. Remove the retaining bolt and pivot pin securing the cylinder to the front mounting.
- f. Lift the tilt cylinder clear of the crane.

34. **Installation.** To install the tilt cylinder, proceed 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 and connect the two flexible hoses to the cylinder connectors. Tighten securely.
- c. Start the engine, engage the crane PTO and operate the crane to check the operation of the cylinder and to bleed the air from the system (see Paragraph 20). Check for leaks and rectify as necessary.

HYDRAULIC PUMP

35. **Removal.** To remove the hydraulic pump, proceed as follows:

WARNING

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

WARNING

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

- a. Remove the hydraulic pump/PTO protective guard.
- b. Clean the pump and the hose connections, then blow dry with compressed air.
- c. Slacken the screw clamp on the supply hose. Remove and plug the hose and pump housing with suitable plastic plugs.
- d. Remove the delivery hose and plug both the hose and the pump housing with suitable plastic plugs.
- e. Match mark the pump adaptor flange to the PTO then remove the four nuts and washers and remove the pump and adaptor flange as one assembly.

- 36. Installation.** To install the hydraulic pump, proceed as follows:
- Clean the mounting faces on the pump and PTO. Apply a suitable water repellent grease to the input gear spline.
 - Position a new gasket on the PTO, align the match marks and install the pump and adaptor flange assembly. Apply Loctite 271 to the studs then install the lock washers and nuts. Torque the nuts to 34 to 38 N.m (25 to 28 lbf.ft).
 - Remove the plastic plugs and install the hoses. Securely tighten the delivery hose connection and the supply hose screw clamp.
 - Start the engine, engage the crane PTO and operate the crane to check the operation of the pump and to bleed the air from the system (see Paragraph 20). Check for leaks and rectify as necessary.
 - Replace the hydraulic pump/PTO protective guard.

CRANE POWER TAKE-OFF (PTO)

- 37. Removal.** To remove the crane PTO, proceed as follows:

WARNING

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

WARNING

Before commencing removal of hydraulic components, 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.

- Remove the hydraulic pump/PTO protective guard.
 - Wash the area around the PTO and hydraulic pump and blow dry with compressed air.
 - Remove the suction and pressure hydraulic hoses from the pump, then seal the hoses and the ports in the hydraulic pump with plastic plugs.
 - Remove the air line from the PTO selector housing.
 - Remove the six nuts and washers securing the PTO and adaptor to the transmission.
 - Remove the PTO and pump assembly and the PTO adaptor housing from the transmission.
 - Remove all traces of gasket residue from the mounting surfaces.
- 38. Determine Gasket Thickness – Adaptor to Transmission.** To determine the gasket thickness required between the adaptor plate and the transmission to obtain the correct backlash, proceed as follows:
- Insert a wooden wedge between the transmission PTO drive gear and the transmission housing (see Figure 9).
 - Install new gaskets and the adaptor housing onto the transmission housing and secure in place with the top and bottom nuts only.
 - Install a dial indicator onto the adaptor housing with the dial indicator plunger resting squarely on the adaptor gear (see Figure 10).

- d. Rock the adaptor gear back and forth by hand and check the backlash reading. Add or subtract gaskets between the adaptor and transmission to obtain a backlash figure of 0.250 to 0.375 mm (0.010 to 0.015 inch).

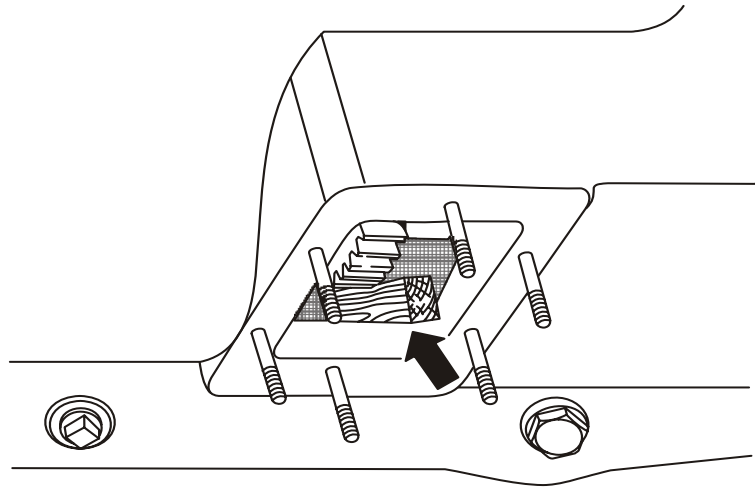


Figure 9 Wedge Location

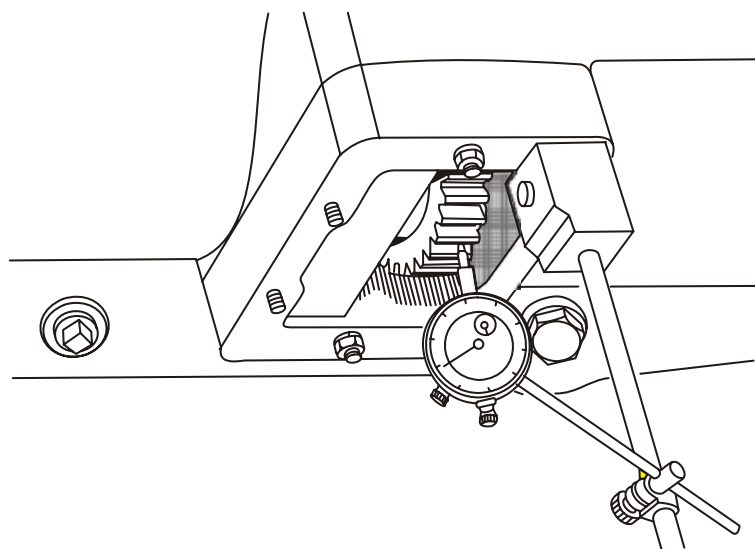


Figure 10 Checking PTO Adaptor to Transmission Backlash

- e. Remove the nuts from the adaptor and remove the adaptor from the transmission. Retain the gaskets as a set.
 - f. Remove the wooden wedge from the transmission.
- 39. Determine Gasket Thickness – Adaptor to PTO.** To determine the gasket thickness required between the adaptor plate and the PTO to obtain the correct backlash, proceed as follows:
- a. Position new gaskets and the adaptor on the PTO and secure the adaptor to the PTO with two suitably sized bolts and nuts.
 - b. Install a dial indicator on the adaptor housing with the dial indicator plunger resting squarely on the adaptor gear (see Figure 11).
 - c. 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 figure of 0.250 to 0.375 mm (0.010 to 0.015 inch).
 - d. Remove the nuts and bolts and separate the adaptor housing and PTO. Retain the gaskets as a set.

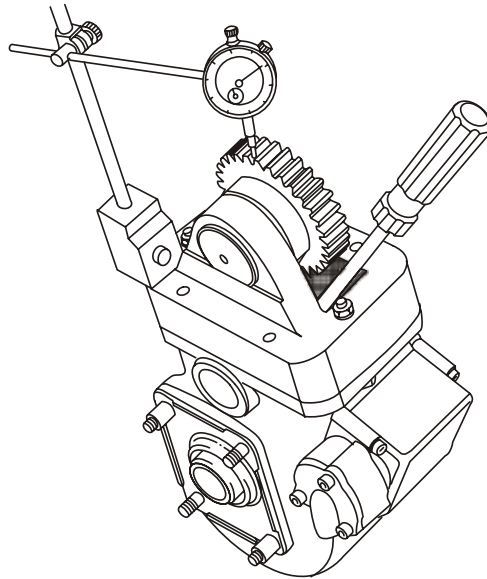


Figure 11 Checking Adaptor to PTO Backlash

40. **Installation.** To install the crane PTO, proceed as follows:



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

- a. Position the gaskets (previously determined when setting the adaptor-to-transmission backlash at Paragraph 38) and the adaptor onto the transmission.
- b. Position the gaskets (previously determined when setting the adaptor-to-PTO backlash at Paragraph 39) onto the adaptor, then install the PTO.
- c. Apply Loctite 271 to the studs then install the spring washers and nuts. Torque the nuts to 34 to 38 N.m (25 to 28 lbf.ft).
- d. Fit the hydraulic pump and gasket to the PTO. Apply Loctite 271 to the studs then install the lock washers and nuts. Torque the nuts to 34 to 38 N.m (25 to 28 lbf.ft).
- e. Remove the plastic plugs from the pump and hoses, fit the hoses and tighten the screw clamp and the connector securely.
- f. Reconnect the air line to the selector housing and tighten securely.
- g. Start the truck engine and engage the PTO. Check for leaks at the gaskets, the hydraulic hoses and the air hose, rectify if necessary.
- h. 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 (refer to Paragraphs 38 and 39).
- i. Disengage the PTO and shut down the engine.
- j. Check the oil level in the transmission. If necessary top up with OEP 220.
- k. Check the fluid level in the oil reservoir. If necessary, top up with ISO Grade 68.
- l. Replace the hydraulic pump/PTO protective guard.

CRANE PTO CONTROL VALVE

41. **Removal.** To remove the crane PTO control valve, proceed 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.

42. Installation. To install the crane PTO control valve, proceed as follows:

- a. Position the valve in the console then install the instruction plate and retaining screws. Tighten the screws securely.
- b. Reconnect the air lines and tighten the connections securely.
- c. Start the engine and allow the air pressure in the brake system to build up then check for air leaks at the valve. Rectify as necessary.
- d. Shut down the engine.

CRANE PTO ENGAGEMENT SELECTOR

43. Removal. To remove the crane PTO engagement selector, proceed as follows:

- a. Remove the hydraulic pump/PTO protective guard.
- b. Clean the selector housing and the area around the housing.
- c. Disconnect the air line from the elbow on the selector housing.
- d. Remove the four socket head bolts retaining the selector housing to the PTO and remove the selector housing and gasket from the PTO.
- e. Clean any gasket residue from the mounting surfaces of the PTO and the selector housing.

44. Installation. To install the crane PTO engagement selector, proceed as follows:

- a. 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. Torque the bolts to 34 to 38 N.m (25 to 28 lbf.ft).
- b. Reconnect the air line and tighten the connection securely.
- c. Start the engine and engage the PTO.
- d. Check for air leaks at the air line connection. Rectify as necessary.
- e. Disengage the PTO and shut down the engine.
- f. Replace the hydraulic pump/PTO protective guard.

BOOM EXTENSION SLIDE PADS

45. Pad Adjustment. To adjust the boom extension slide pad clearance, proceed as follows:

- a. This adjustment should be carried out with the boom level and no load on the boom.
- b. Straighten and remove the cotter pin from both the slide pad adjusting screws.
- c. 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's housing.
- d. 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.
- e. Secure the adjusting screws with the cotter pins. Replace the cotter pins if they are damaged in any way. Splay the cotter pins.

WINCH

WINCH POWER TAKE-OFF (PTO)

46. Removal. To remove the winch PTO, proceed as follows:

- a. With the main transmission in neutral, run the engine for a few minutes to warm up the oil in the gearbox. Stop the engine and remove the drain plug allowing all oil to drain from the gearbox into a suitable receptacle.
- b. Clean the PTO and surrounding area.

- c. Disconnect the PTO cable from the control lever on the PTO and remove the cable from the mounting bracket (refer to Figure 12). Disconnect the propeller shaft from the PTO and move the shaft to one side.
- d. Remove the bolts securing the PTO to the gearbox, then remove the PTO from the truck.
- e. Remove all gasket residue from the mating surface on the gearbox where the PTO is fitted.

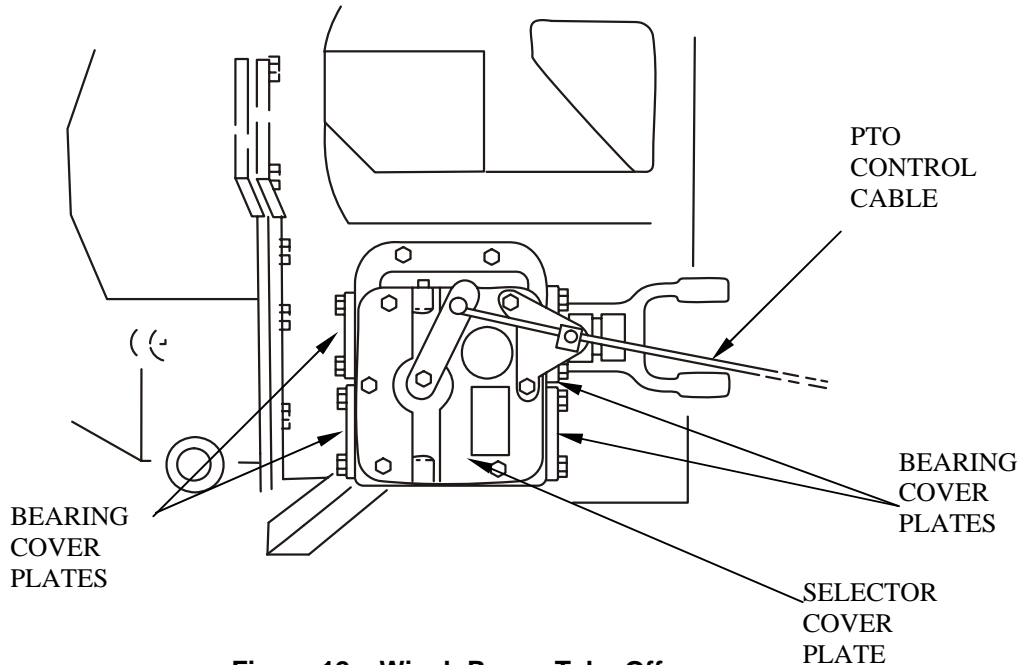


Figure 12 Winch Power Take-Off

47. **Installation.** To install the winch PTO, proceed as follows:

NOTE

The backlash for the PTO gears must be no less than 0.15 mm (0.006 inch) when the PTO gaskets are fully compressed.

- a. Using your hand, rock the transmission PTO drive gear to establish the amount of backlash built into the transmission Likewise rock the PTO meshing gear whilst holding the output shaft of the unit.
- b. Place the unit onto the gearbox and rock the PTO output shaft. Compare this backlash with the previous backlash then gauge the thickness of gasket required to bring the backlash within limits.
- c. Ensure that the PTO is in the disengaged position. With oil proof gaskets against each metal surface, attach the PTO to the gearbox again. Install and evenly torque the retaining bolts to 27 N.m (20 lbf.ft).
- d. Check the action of the PTO by moving the control lever to the engaged then disengaged position, several times. The movement must be accomplished easily and smoothly, without having to use excessive force.
- e. Install and tighten the gearbox drain plugs, and fill the gearbox to correct level with OEP 220 oil.
- f. Start the engine, disengage the clutch and shift the PTO into gear. Slowly engage the clutch and note if the PTO whines or rattles. If the PTO whines or rattles, repeat the backlash adjustment detailed at Paragraphs 47 a and b.
- g. Attach the propeller shaft to the PTO. Install and tighten the locking bolt and secure it with locking wire. Attach the PTO cable to the mounting bracket on the PTO and fit the clevis claw to the PTO control lever. Install and secure the clevis pin.
- h. Test the operation of the PTO.

BODY

CAB ROOF – SEALING STRIPS

48. **Removal.** To remove the cab roof sealing strips, proceed as follows:
- Disconnect the windscreen washer hose, the clearance light and windscreen washer motor wiring at the connectors located inside the cowl, forward of the driver's door.
 - Disconnect the clearance light wiring for the left-hand door at the connector located inside the cowl, forward of the left-hand door.
 - Support each door in turn and remove the hinge-to-door retaining bolts, illustrated in Figure 13 then lift the door from the cab.

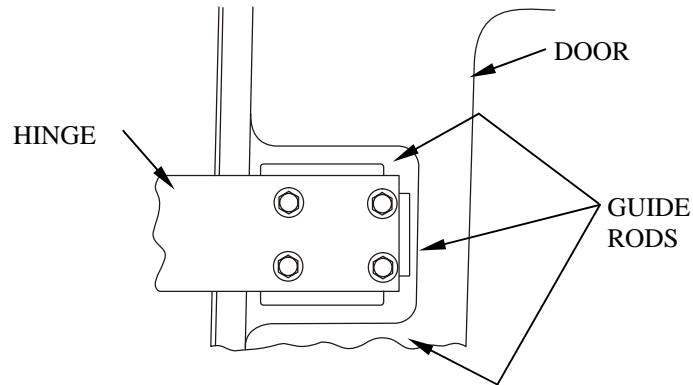


Figure 13 Door Hinge Bolts

- Disconnect the dome light wiring at the bayonet connector located on the inside of the right-hand side windscreen pillar.
- Remove the top bolt and slacken the lower bolt on the external grab handles located on both sides of the cab, then lower the handles down.
- Remove the bolts, nuts and washers mounted externally on the right and left-hand windscreen pillars (see Figure 14).

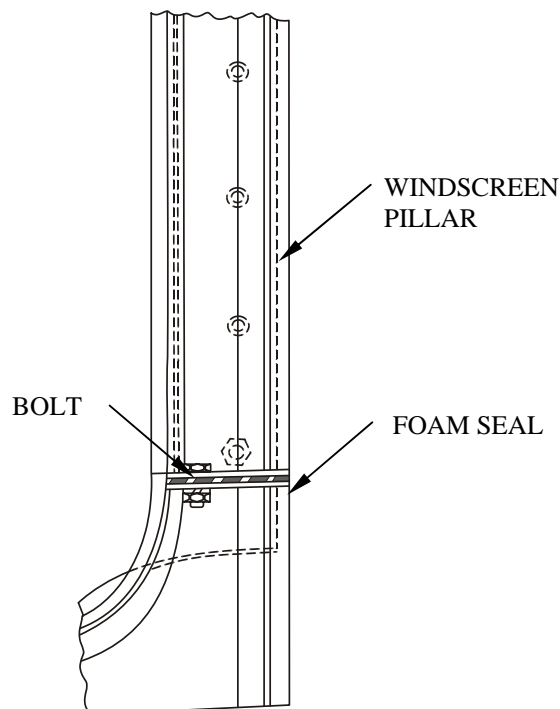


Figure 14 Windscreen Pillar Bolt Location

- g. Remove the nuts and washers (both internal and external) from the cab/cab roof flange at the rear of the cab.
- h. The cab roof is heavy and awkward. If suitable lifting equipment is not available, additional personnel will be required to facilitate the removal of the cab roof.

NOTE

Remove the cab roof taking care not to break the glass in the front and rear windcreens.

- i. Remove the rubber sealing strip from the cab flange and the top cowl (forward of the dashboard). If necessary scrape off any residue to obtain clean surfaces.

49. Installation. To install the cab roof sealing strips, proceed as follows:

- a. Position a new rubber sealing strip on the rear flange and on the top cowl.

NOTE

Do not cut the ends off the rubber strips until after the roof has been installed. The cab roof is heavy and awkward. If suitable lifting equipment is not available, additional personnel will be required to facilitate the installation of the cab roof.

- b. Position the cab roof on the lower section of the cab. Install the bolts, nuts and washers on the windscreen pillars and tighten securely.
- c. Install the nuts and washers on the studs on the cab rear flange and tighten securely.
- d. Swing the external grab handles up into position, install the top bolt, then tighten both the top and bottom bolts on each grab handle.
- e. Reconnect the dome light wiring at the connector on the inside of the driver's side windscreen pillar.
- f. Cut the excess of the ends of the rubber strips using a sharp blade.
- g. Position the doors on the cab and place the hinges between the guide rods. Install the hinge retaining bolts and tighten securely.
- h. Reconnect the windscreen washer hose, the clearance light and the windscreen washer motor wiring at the connectors located inside the cowl, forward of the driver's door.
- i. Reconnect the clearance light wiring for the left-hand door at the connector located inside the cowl, forward of the left-hand door.
- j. Check the operation of the clearance lights and the windscreen washer motor to ensure the correct reconnection of the wiring.

OBSERVER HATCH

50. Removal. To remove the observer hatch, proceed as follows:

- a. Unscrew the three screws securing the hatch cover hinge mounting bracket to the roof, then lift off the hatch cover assembly.
- b. Unscrew the Phillips head screws from the side of the turret and remove the inner turret from inside the cab.
- c. Unscrew the Phillips head screws around the turret flange and lift the turret from the cab roof.
- d. Clean all surfaces and replace parts as necessary.

51. Installation. To install the observer hatch, proceed as follows:

- a. Apply a silicone sealer to the bottom of the turret flange, then position the turret on the cab roof.
- b. Install the Phillips head screws in the turret flange and tighten them securely.
- c. Position the inner turret up inside the turret, then install the Phillips head screws in the side of the turret and tighten securely.
- d. Place the hatch cover over the turret and align the holes in the hinge mounting bracket with those in the cab roof, then install and tighten the screws securely.

FAULT FINDING

SPACE SYSTEM FAULT FINDING

52. Table 2 details the likely symptoms, the probable causes and the remedial actions required when fault finding general problems with the SPACE functions of the crane.

Table 2 SPACE System Fault Finding

Symptom		Probable Cause	Action
1	Space does not work; or the Off/On indicator lamp will not light.	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 (9828711).
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 blinks when operation is attempted, the safety system has intervened. If it does not flash, check the cables between the DA modules.
5	Fault light on the PSBI box blinks; or the crane does not work; or 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

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

Table 3 Hydraulic System Fault Finding

Symptom		Probable Cause	Action
1	No fluid flow – no pressure.	a. Fluid level in reservoir too low.	a. Top-up with ISO Grade 68.
		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.

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Table 3 Hydraulic System Fault Finding (Continued)

Symptom		Probable Cause	Action
		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.
		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.
		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.
3	Excessive flow or movement.	Fluid viscosity too low.	Change fluid. Use only ISO Grade 68.
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.
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.
		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.
6	Excessive fluid pressure.	Incorrect oil viscosity.	Change fluid. Use only ISO Grade 68.
7	No movement.	a. Mechanical binding.	Report.
		b. Refer to 'No fluid flow – No pressure'.	—
		c. Pilot operated valves or flow control valves inoperative or incorrectly adjusted.	Report.

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Table 3 Hydraulic System Fault Finding (Continued)

Symptom		Probable Cause	Action
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.
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.
		c. Lack of lubrication of mechanical components.	Lubricate.
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.
		b. Fluid viscosity too high.	Warm fluid up to operating temperature. If viscosity is still too high, change fluid. Use only ISO Grade 68.
		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.
		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.
		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.
		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.
		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.

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END

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