129. **Removal**

The removal procedure for intermediate axle and rear axle park brake actuating cylinder is identical.

a. Chock the wheels at the front, intermediate and rear axles, excluding the wheels to be raised.

**NOTE**

DO NOT WORK ON THE VEHICLE WITHOUT SAFETY STANDS BENEATH THE CHASSIS OR BENEATH THE AXLE. PLACE THE AXLE STAND AS CLOSE TO THE RAISED WHEEL AS POSSIBLE. FAILURE TO USE SAFETY STANDS MAY RESULT IN SEVERE INJURY OR DEATH IF THE JACK SLIPS OR COLLAPSES.

b. Jack up the wheel that is to be removed until it is clear of the ground. Support the vehicle on axle stands as close to the raised wheel as is possible.

c. Remove the road wheel (refer to the Operator Handbook).

d. Remove the four bolts and lock nuts securing the brake protection rings to the wheel hub and slide the rings from the hubs.

**NOTE**

The park brake must be released and the park brake lever (Fig 327(6)) at the wheel station must rest against its stop (Fig 327(13)).

e. Ensure that the vehicle brake air pressure is more than 6 bar (600 kPa) and release the park brake.

f. Remove the split pin and clevis pin (Fig 327(7)) from the clevis on the pull rod (Fig 327(8)).

g. Apply the park brake and drain the air from the compressed air accumulator circuit 1 (bottom tank), compressed air accumulator circuit 2 (top tank) and the trailer brake circuit compressed air accumulator.

h. Disconnect the air supply line and breather line from the park brake actuating cylinder (Fig 327).

i. Remove the four mounting bolts and flat washers and remove the park brake actuating cylinder (Fig 328).
130. **Installation**

**NOTE**

The installation procedure for intermediate axle and rear axle park brake actuating cylinder is identical.

- a. Fit the park brake actuating cylinder, and secure with the four mounting bolts fitted with flat washers. Do not tighten the bolts at this stage.

- b. Connect the air supply line and breather line.

- c. Pull the park brake lever (Fig 329(1)) to the stop (Fig 329(2)) against the wheel.

**NOTE**

Do not actuate the emergency park brake release. When carrying out the adjustment the park brake actuating cylinder must be in the applied position.

- d. Measure the dimension “A” (Fig 329). With the park brake lever resting against the stop the dimension should be 78.5 ± 0.2 mm.

![Figure 328 - Park Brake Actuating Cylinder - Removal](image)

![Figure 329 - Park Brake Actuating Cylinder - Adjustment](image)

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**WARNING**

**A SUDDEN INCREASE IN AIR PRESSURE MAY CAUSE INJURY TO HANDS OR DAMAGE TO COMPONENTS.**

- f. Release the park brake, run the engine at idle and slowly pressurise the compressed air accumulators, while guiding the clevis on the pull rod (Fig 327(8)) over the park brake lever (Fig 327(6)).

- g. Align the mounting holes for the clevis pin on the pull rod and the park brake lever.

- h. Lubricate the clevis pin with a molybdenum disulphide based grease (XG-276) and install the clevis pin. Secure the pin with a split pin.

- i. Install the brake protection rings on the wheel hubs and secure with the four bolts and nuts.

- j. Install the road wheel (refer to the Operator Handbook).

**NOTE**

Check the torque (400 Nm) of the wheel nuts after 50 km of vehicle operation.

- k. Remove the axle stands, lower the wheel to the ground and torque the wheel nuts to 400 Nm.

- l. Remove the chocks from the wheels at the front, intermediate and rear axles.

- m. Test the operation of the park brake and the service brakes.

### Service Brake Valve

131. **Removal**

- a. Chock the road wheels front and rear.

- b. Drain the air from the compressed air accumulator circuit 1 (bottom tank), compressed air accumulator circuit 2 (top tank) and the trailer brake circuit compressed air accumulator.

- c. Remove the two Phillips head screws and flat washers securing the right hand footwell cover and remove the cover.

- d. Identify each air line and port position on the service brake valve and tag each connection for ease of assembly.
NOTE
On disconnection of air line fittings blank off all openings to prevent the ingress of dirt and moisture.

- Disconnect all the air lines from the service brake valve.
- Disconnect the brake light switch electrical connector (Fig 330(3)) from the brake light switch.
- Remove the four brake valve bracket mounting bolts (Fig 330(4)), nuts and spring washers securing the brake valve mounting bracket to the cab frame, then remove the bracket with brake valve.
- Disconnect the brake light switch electrical connector (Fig 330(3)) from the brake light switch.
- Remove the two brake valve front mounting bolts (Fig 330(1), the two brake valve and stop light switch mounting bolts (Fig 330(2)), nuts, and spring washers, securing the brake valve and the stop light switch to the brake valve mounting bracket and remove the brake valve.

1. Brake valve front mounting bolt
2. Brake valve and stop light switch mounting bolt
3. Brake light switch electrical connector
4. Brake valve bracket mounting bolt

Figure 330 - Service Brake Valve

132. Cleaning and Inspection

WARNING
ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

- Clean all parts with an appropriate cleaning agent and blow dry with compressed air.
- Visually inspect the brake valve; pay particular attention to the threads in the connecting ports.

NOTE
Refer to EMEI Veh D 393 Group 8 - Brake System, for the inspection and repair of polyamide pipe fittings.

- Inspect the seals, O-rings and clips on the polyamide pipe fittings, replace as required.
- Inspect the brake valve mounting bracket, pivot, pedal assembly, pedal return spring, push rod and clevis for wear or damage. Replace as required.

133. Installation

NOTE
Refer to EMEI Veh D 393 Group 8 - Brake System, for the installation of polyamide pipe fittings.

- Remove the blanking plugs and install the pipe fittings in the new brake valve (refer to EMEI Veh D 393 Group 8 - Brake System).
- Install the brake valve into the brake valve mounting bracket and fit the two brake valve front mounting bolts (Fig 330(1), the two brake valve and stop light switch mounting bolts (Fig 330(2)) and spring washers and nuts. Tighten the two front mounting bolts (Fig 330(1)) securely. Do not tighten the two rear mounting bolts (Fig 330(2)) at this stage.
- Position the brake valve mounting bracket with brake valve on the cab frame and secure with the four brake valve bracket mounting bolts (Fig 330(4)).
- Adjust the stop light switch (refer to EMEI Veh D 393 Group 10 - Electrical).
- Adjust the brake valve push rod free travel. The free travel “A” (Fig 331) is not to exceed 0.5 mm. To adjust, release the lock nut on the push rod and turn the rod as required. Check the adjustment after tightening the lock nut to ensure it has not altered, rectify if required.
**Figure 331 - Service Brake Valve Push Rod - Free Travel**

- **f.** Connect all air lines to the service brake valve fittings noting the positions tagged during removal.
- **g.** Connect the electrical connector (Fig 330(3)) to the brake light switch.
- **h.** Run the engine until the pressure in the compressed air accumulators is at operating pressure.
- **i.** Test the pipe fittings for leaks with a soap and water mixture.
- **j.** Install the right hand footwell cover and secure with the two Phillips head screws, fitted with flat washers.
- **k.** Road test the vehicle and check the operation of the service brakes and the vehicle stoplights.

**Park Brake Valve**

**134. Removal**

- **a.** Chock the road wheels front and rear.
- **b.** Drain the air from the compressed air accumulator circuit 1 (bottom tank), compressed air accumulator circuit 2 (top tank) and the trailer brake circuit compressed air accumulator
- **c.** Raise the cab (refer to EMEI Veh D 393 Group 01 - Access for Repair).
- **d.** Identify each air line and port position on the park brake valve and tag each pipe connection for ease of assembly.
- **e.** Remove the two bolts (Fig 332(1)) securing the park brake valve to the control panel.

**Figure 332 - Park Brake Valve - Connections**

- 1. Mounting bolt
- 2. Park brake valve
- 3. Trailer brake signal line
- 4. Air line
- 5. Vent line

**NOTE**

On disconnection of hose fittings blank off all openings to prevent the ingress of dirt and moisture.

- **g.** Unclamp and remove the air lines (Fig 332(4) and the trailer brake signal line (Fig 332(3)) from the park brake valve.
- **h.** Remove the vent line (Fig 332(5)) from the park brake valve.

**135. Cleaning and Inspection**

**WARNING**

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

- **a.** Clean all metal parts with an appropriate cleaning agent and blow dry with compressed air. Ensure that all parts are in perfect condition.
- **b.** Inspect the pipe threads and O-rings on the polyamide pipe fittings, replace as required (refer to EMEI Veh D 393 Group 8 - Brake System).
136. **Installation**

   a. Remove the blanking plugs and install all air line connector fittings to the park brake valve noting the positions tagged during removal (refer to EMEI Veh D 393 Group 8 - Brake System).

   b. Connect the trailer brake signal line (Fig 332(3) and air lines (Fig 332(4)).

   c. Connect the vent line (Fig 332(5)) to the park brake valve.

   d. Position the park brake valve in the control panel and secure with the two mounting bolts (Fig 332(1)).

   e. Lower and secure the cab (refer to EMEI Veh D 393 Group 01 - Access for Repair).

   f. Run the engine until the compressed air accumulators are at operating pressure.

   g. Test the operation of the park brake valve and check for air leaks.

**Brake ALB Valve**

137. **Removal**

   a. Chock the road wheels at the front and at the rear axles.

   b. Drain the air from the compressed air accumulator circuit 1 (bottom tank) compressed air accumulator circuit 2 (top tank), and the trailer brake circuit compressed air accumulator.

   **NOTE**

   On disconnection of air line fittings blank off all openings to prevent the ingress of dirt and moisture.

   c. Tag and disconnect the air lines (Fig 333(1)) from the ALB valve.

   d. Remove the nut securing the operating rod ball joint to the ALB valve actuating lever.

   e. Remove the two mounting bolts (Fig 333(3)) securing the ALB valve to the chassis then remove the ALB valve and spacers.

138. **Cleaning and Inspection**

   **WARNING**

   ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

   a. Clean all metal parts with an appropriate cleaning agent and blow dry with compressed air. Ensure that all parts are in perfect condition.

   b. Inspect the pipe threads and O-rings on the polyamide pipe fittings (refer to EMEI Veh D 393 Group 8 - Brake System), replace as required.

139. **Installation**

   a. Secure the ALB valve and spacers to the chassis with the two mounting bolts (Fig 333(3)).

   b. Connect the air lines (Fig 333(1)) (previously tagged on removal) to the ALB valve.
c. Connect the operating rod ball joint to the ALB valve actuating lever and secure with the nut.

d. Run the engine until the compressed air accumulators are at operating pressure.

e. Remove the chocks from the wheels at the front and rear axles.

f. Adjust the ALB valve operating linkage, see para 140.

140. Adjustment

NOTE

Two personnel are required to carry out the adjustment check. One person to operate the brake pedal and the other to read the pressure gauges.

CAUTION

DO NOT ALTER THE CONTROL LINKAGE (FIG 334(1)) LENGTH “a” DURING THE ADJUSTMENT OF THE ALB VALVE. ADJUSTMENT IS TO BE CARRIED OUT ONLY BY TURNING THE OPERATING SHAFT ON THE ALB VALVE.

1. Control linkage
   a = 190 mm
   b = 200 mm

Figure 334 - ALB Linkage - Adjustment

   a. Determine the rear axle load (standard load, both rear axles) of the vehicle (including CES) on a weighbridge.

   b. Chock the road wheels at the front and at the rear axles.

   c. Connect a pressure gauge to test connection 1 (Fig 335(1)), upstream of the ALB valve (to check that the air pressure available at the ALB valve is 7.3 bar when the brake pedal is fully depressed).

   1. Test connection 1 (brake pressure unregulated upstream of ALB valve)
   2. Test connection 2 (FA (front axle)) (regulated brake pressure, downstream of the pressure control valve)
   3. Test connection 3 RA (rear axle)) (regulated brake pressure, downstream of the ALB valve)

Figure 335 - ALB Valve Adjustment - Test Connections

d. Connect a pressure gauge to the test connection 3 (Fig 335(3)), downstream of the ALB valve (to measure the rear axle circuit brake pressure).

e. Connect a pressure gauge to the test connection 2 (Fig 335(2)), downstream of the pressure control valve (to measure the front axle circuit brake pressure).

f. Carry out the ALB valve adjustment check as follows:

   NOTE

    During the check, ensure the compressed air system for the brakes is charged to cut-out pressure before each application of the brake pedal. When the brake pedal is depressed during the check, 7.3 ± 0.2 bar must be available.

    (1) Fully depress the brake pedal. The gauge at test connection 1 must indicate 7.3 bar.

    (2) At the same time, whilst the brake pedal is depressed, note the readings on the pressures gauges at test connections 2 and 3.

    (3) Compare the readings with the specified pressure ranges recommended by the manufacturer (Fig 336). The specified pressure ranges are also depicted on the manufacturers data decal on the inside of the driver's door.
NOTE
Line 1 on the graph (Fig 336) relates to the pressure read on the pressure gauge connected to test connection 2 at the specific weight of the front axles. Line 2 on the graph (Fig 336) relates to the pressure read on the pressure gauge connected to test connection 3, at the specific weight of the rear axles.

DO NOT ALTER THE LINKAGE LENGTH “a” (FIG 334(1)) DURING THE ADJUSTMENT OF THE ALB VALVE.

h. With the brakes released turn the operating shaft and adjust as follows:
(1) Pressure too low - turn shaft in clockwise direction.
(2) Pressure too high - turn shaft in anti-clockwise direction (not more than 90 degrees).

i. Repeat the procedure until the brake pressures are within specifications.

j. Torque the clamping bolt (Fig 333(2)) on the ALB valve actuating lever to 12 Nm.

k. Recheck the ALB valve adjustment and detach the pressure gauges.

l. Remove the chocks from the wheels at the front and rear axles.

NOTE
After every adjustment tighten the clamping bolt on the ALB linkage and repeat the braking procedure. Ensure the compressed air system for the brakes is charged to cut-out pressure before each application of the brake pedal. When the brake pedal is depressed during the check 7.3 ± 0.2 bar must be available.
GROUP 9 — STEERING

NOTE

A strict standard must be applied when cleaning, inspecting and repairing steering components. In cases of doubt, the components in question must always be replaced.

Pitman Shaft

141. Adjustment

a. Jack up the vehicle at the front axle until the front wheels are just clear of the ground and support on safety stands.

NOTE

There are two types of nuts in service that are used to fasten the drag link to the pitman arm, a castellated nut (with split pin) or a self locking nut. When fitting a self locking nut use the old nut to carry out the adjustment procedure and then always fit a new self locking nut on completion of the adjustment.

b. Remove the split pin and the castellated nut (Fig 337(18)), and detach the drag link (Fig 337(15)) from the pitman arm (Fig 337(13)) using the ball joint remover (Table 2, Item 47). Retain the old nut to carry out the adjustment.

c. Centralise the steering box as follows:

1. Turn the steering wheel to full left hand lock.
2. Mark 12 o’clock on the steering wheel and turn the wheel to full right hand lock. Count the number of turns.
3. Turn the steering wheel back halfway.

d. Undo the pitman shaft adjusting screw lock nut (Fig 338(1)). Torque the adjusting screw (Fig 338(2)) to 20 to 25 Nm and then back off the screw two turns.

(1) Turn the steering wheel to full left hand lock.
(2) Mark 12 o’clock on the steering wheel and turn the wheel to full right hand lock. Count the number of turns.
(3) Turn the steering wheel back halfway.

d. Undo the pitman shaft adjusting screw lock nut (Fig 338(1)). Torque the adjusting screw (Fig 338(2)) to 20 to 25 Nm and then back off the screw two turns.

1. Lock nut
2. Pitman shaft adjusting screw

Figure 338 - Pitman Shaft - Adjustment

e. Torque the pitman shaft adjusting screw (Fig 338(2)) to 2.5 Nm with the torque wrench (Table 2, Item 35).

f. Draw an alignment mark on the end of the pitman shaft adjusting screw and the steering box housing.

IT IS CRITICAL TO THE SMOOTH OPERATION OF THE STEERING BOX THAT THE PITMAN SHAFT ADJUSTING SCREW DOES NOT MOVE WHEN TENSIONING THE LOCK NUT.

g. Hold the pitman shaft adjusting screw in position and torque the lock nut (Fig 338(1)) to 153 to 187Nm. Ensure the alignment marks on the end of the pitman shaft adjusting screw and the steering box housing remain aligned.

h. Turn the steering from lock to lock and check the steering box for smooth operation, readjust if any stiffness is felt.
NOTE

There are two types of nuts in service that are used to fasten the drag link to the pitman arm, a castellated nut (with split pin) or a self locking nut. When fitting a self locking nut always use a new nut, coat the threads of the nut with a thread locking agent (Loctite 243) and torque the new self locking nut to 220 Nm.

i. Attach the drag link (Fig 337(15)) to the pitman arm (Fig 337(13)), install the castellated nut (Fig 337(14)) and tighten securely. If fitting a new self locking nut coat the threads of the nut with a thread locking agent (Loctite 243) and torque the nut to 220 Nm.

NOTE

If the nut castellations are not aligned with the split pin mounting holes in the drag link after initial torquing, tighten the drag link castellated nut slightly further to align the split pin mounting holes. Do not loosen the nut to align the split pin mounting holes.

j. Torque the drag link castellated nut (Fig 337(14)) to 190 Nm and lock the nut with a split pin.

k. Lower the vehicle to the ground.

l. Road test the vehicle and check the steering is free from stiffness, has no free play and the steering wheel centralises on turns.

Steering Limiter Valves

142. Removal

WARNING

THE STEERING LIMITER VALVES ARE NOT TO BE REMOVED WHEN THE ENGINE IS RUNNING. THE VALVES ARE UNDER PRESSURE WHEN THE ENGINE IS RUNNING AND COULD BECOME A PROJECTILE IF UNSCREWED TOO FAR, CAUSING SERIOUS INJURY TO PERSONNEL. IN ADDITION HOT OIL WILL BE SPRAYED FROM THE STEERING BOX CAUSING SERIOUS BURNS TO PERSONNEL.

NOTE

Oil drained from the steering system is not to be re-used.

a. Operate the battery isolation switch to disconnect the batteries from the vehicle electrical system.
NOTE

Place a receptacle under the steering box to capture draining oil.

d. Remove the left steering limiter valve (Fig 339(7)) with seal (Fig 339(6)) and the O-ring (Fig 339(5)).
e. Remove the right steering limiter valve (Fig 339(3)) with seal (Fig 339(6)) and O-ring (Fig 339(5)).
f. Remove and discard the seals and O-rings from the steering limiter valves.

143. Inspection

a. Using hand pressure press the piston (Fig 340(2)) of each valve inwards (direction of arrow) and check that spring tension is felt and the piston operates smoothly. If the piston cannot be actuated by hand, replace the steering limiter valve.

![Steering Limiter - Inspection](1)

1. Steering limiter valve
2. Piston
3. Retaining plate
4. Spring washer
5. Retaining plate securing bolt

Figure 340 - Steering Limiter - Inspection

144. Installation


a. Fit new seals and O-rings to the steering limiter valves. Lubricate the seals and O-rings with oil (OX-47) prior to assembly.

b. Screw in the steering limiter valves until they just bottom in the housing. Do not exceed a tightening torque of 5 Nm.
c. Check the steering stop adjustment, see para 153.
d. Operate the battery isolation switch to connect the batteries to the vehicle electrical system.
e. Bleed the steering system (refer to EMEI Veh D 393 Group 9 - Steering).
f. Adjust the steering limiter valves, see para 146.

145. Testing

a. Check the adjustment of the steering stops, adjust if required, see para 153.

NOTE

The temperature of the oil in the steering gear should be about 50°C.

c. Let the engine run at about 1000 RPM and turn the steering from lock to lock, holding the steering on full lock for no longer than 10 seconds at a time, to raise the power steering oil to operating temperature.

d. Clean the steering box around the test connection area.
e. Connect the pressure gauge and fitting (Table 2, Items 36 and 37) to the test connection (Fig 341(1)).
1. Test connection

**Figure 341 - Steering Box - Pressure Test Connection**

f. Run the engine at idle (700 RPM) and turn the steering to the left and right locks **against the steering stops**. A pressure drop to 50 to 60 bar should occur as the wheel rests against each stop. Adjust if required, see para 153.

**NOTE**

When replacing the steering box, or adjusting the steering stops, the steering limiter valves have to be checked and adjusted.

**NOTE**

The adjustment procedure requires the cooperation of two persons.

a. Check the steering centre position, adjust if required (refer to EMEI Veh D 393 Group 9 - Steering).

b. Check the adjustment of the steering stops and adjust if required, see para 153.

c. Check the oil level in the hydraulic steering pump reservoir (refer to the Operator Handbook).

d. Check the condition and tension of the power steering drive belt (refer to EMEI Veh D 393 Group 1 - Engine).

**WARNING**

DO NOT WORK ON THE VEHICLE WITHOUT A SAFETY STAND BENEATH THE CHASSIS OR BENEATH THE AXLE. PLACE THE AXLE STAND AS CLOSE TO THE RAISED WHEEL AS POSSIBLE.

**NOTE**

The temperature of the oil in the steering gear should be about 50°C.

h. Let the engine run at about 1000 RPM and turn the steering from lock to lock, holding the steering on full lock for no longer than 10 seconds at a time, to raise the power steering oil to operating temperature.

**DURING ADJUSTMENT, THE STEERING LIMITER VALVES ARE NEVER TO BE UNSCREWED OUT OF THE STEERING BOX BY MORE THAN 2 1/2 TURNS. WHEN THE ENGINE IS RUNNING THE STEERING LIMITER VALVES ARE UNDER PRESSURE AND COULD BECOME A PROJECTILE IF UNSCREWED TOO FAR, CAUSING SERIOUS INJURY TO PERSONNEL. IN ADDITION HOT OIL WILL BE SPRAYED FROM THE STEERING BOX CAUSING SERIOUS BURNS TO PERSONNEL.**

i. Remove the M6 bolt and spring washer securing the retaining plate (Fig 342(1)) to the steering box and remove the plate.

**Figure 342 - Retaining Plate - Removal**

1. Retaining plate
2. Left hand steering limiter valve
3. Right hand steering limiter valve

NOTE

Adjustment of one limiter valve may affect the setting of the other one. It may be necessary to adjust the left and right hand limiter valves several times to achieve the desired pressure.

NOTE

If a reading of 50 to 60 bar cannot be achieved when adjusting the right or left hand steering limiter valves, inspect the valve and check for binding (see para 143), replace if required. Then repeat the adjustment procedure.

j. Screw both limiter valves in until they just bottom in the housing. Do not exceed a tightening torque of 5 Nm.

k. Shut down the engine.

l. Adjustment - Left Hand Side

(1) Screw the left hand limiter valve (Fig 342(2)) out 2 1/2 turns.

NOTE

To obtain an accurate reading the steering limiter valve must be adjusted with the wheel against the steering stop.

NOTE

If a reading cannot be obtained check the pressure limiting valve in the steering box, see para 149.

(2) Run the engine.

(3) Turn the steering to the left until the wheel contacts the stop. Then have a second person exert approximately 25 Nm (normal hand force) at the periphery of the steering wheel. Maintain the pressure for no more than 10 seconds each time during the adjustment procedure, otherwise damage to the steering box seals may result.

(4) Maintain the steering on full left lock and slowly screw in the left steering limiter valve until the pressure gauge indicates a pressure of 50 to 60 bar.

(5) Shut down the engine.

m. Adjustment - Right Hand Side

(1) Screw the right hand limiter valve (Fig 342(3)) out 2 1/2 turns.

NOTE

To obtain an accurate reading the steering limiter valve must be adjusted with the wheel against the steering stop.

NOTE

If a reading cannot be obtained check the pressure limiting valve in the steering box, see para 149.

(2) Run the engine.

(3) Turn the steering to the right until the wheel contacts the stop. Then have a second person exert approximately 25 Nm (normal hand force) at the periphery of the steering wheel. Maintain the pressure for no more than 10 seconds each time during the adjustment procedure, otherwise damage to the steering box seals may result.

(4) Maintain the steering on full right lock and slowly screw in the right steering limiter valve until the pressure gauge indicates a pressure of 50 to 60 bar.

(5) Recheck the adjustment for the left steering limiter. The pressure of 50 to 60 bar must be maintained. Adjust if required.

(6) Shut down the engine.

n. Continue the adjustments detailed in sub-paras l(3) to l(4) and sub-paras m(3) to m(4) until the pressures are within specifications.

NOTE

It may be necessary to rotate one of the pressure limiting valves very slightly to align the pressure limiting valve retaining plate (Fig 342(1)).

o. Install the pressure limiting valve retaining plate (Fig 339(8)) and secure with the bolt (Fig 339(1)) fitted with a spring washer (Fig 339(2)). Tighten the bolt securely.
p. Recheck the adjustment for the right and left steering limiters, readjust if required.

**WARNING**

CARE SHOULD BE TAKEN WHEN DISCONNECTING OIL LINES. HOT POWER STEERING OIL CAN CAUSE SERIOUS BURNS.

q. Disconnect the pressure gauge and hose from the steering box and refit the threaded cap to test connection point.

r. Check the oil level in the hydraulic steering pump reservoir. Refer to the Operator Handbook.

s. Lower the vehicle to the ground.

t. Road test the vehicle and check the steering response under all conditions.

Pressure Limiting Valve (Steering Box)

147. **Removal**

a. Operate the battery isolation switch to disconnect the batteries from the vehicle electrical system.

**WARNING**

CARE SHOULD BE TAKEN WHEN DRAINING OIL, DISCONNECTING OIL LINES, OR REMOVING THE PRESSURE LIMITING VALVE. HOT POWER STEERING OIL CAN CAUSE SERIOUS BURNS.

NOTE

Oil drained from the steering system is not to be re-used.

b. Place a suitable container underneath the steering box.

c. Clean the steering box around the pressure limiting valve area.

d. Remove the pressure limiting valve (Fig 343(1)) with O-ring and the copper sealing washer. Discard the washer.

b. Operate the battery isolation switch to connect the batteries to the vehicle electrical system.

c. Bleed the power steering system (refer to EMEI Veh D 393 Group 9 - Steering).

d. Test the pressure limiting valve operating pressure, see para 149.

e. Road test the vehicle and check the steering response under all conditions.

149. **Testing**

**WARNING**

DO NOT WORK ON THE VEHICLE WITHOUT A SAFETY STAND BENEATH THE CHASSIS OR BENEATH THE AXLE. PLACE THE AXLE STAND AS CLOSE TO THE RAISED WHEEL AS POSSIBLE. FAILURE TO USE A STAND MAY RESULT IN SEVERE INJURY OR DEATH IF THE JACK SLIPS OR COLLAPSES.

a. Jack up vehicle at the front axle until the front wheels are just clear of the ground and support on safety stands.

b. Clean the steering box around the test connection area.
NOTE

The testing procedure requires the cooperation of two persons.

c. Connect the pressure gauge and fitting (Table 2, Items 36 and 37) to the test connection (Fig 341(1)).

NOTE

The temperature of the oil in the steering gear should be about 50°C.

d. Let the engine run at about 1000 RPM and turn the steering from lock to lock, holding the steering on full lock for no longer than 10 seconds at a time, to raise the power steering oil to operating temperature.

THE STEERING LIMITER VALVES ARE NOT TO BE REMOVED WHEN THE ENGINE IS RUNNING. THE STEERING LIMITER VALVES ARE UNDER PRESSURE WHEN THE ENGINE IS RUNNING AND COULD BECOME A PROJECTILE IF UNSCREWED TOO FAR, CAUSING SERIOUS INJURY TO PERSONNEL. IN ADDITION HOT OIL WILL BE SPRAYED FROM THE STEERING BOX CAUSING SERIOUS BURNS TO PERSONNEL.

DURING ADJUSTMENT, THE STEERING LIMITER VALVES ARE NEVER TO BE UNSCREWED OUT OF THE STEERING BOX BY MORE THAN 2 1/2 TURNS. WHEN THE ENGINE IS RUNNING THE STEERING LIMITER VALVES ARE UNDER PRESSURE AND COULD BECOME A PROJECTILE IF UNSCREWED TOO FAR, CAUSING SERIOUS INJURY TO PERSONNEL. IN ADDITION HOT OIL WILL BE SPRAYED FROM THE STEERING BOX CAUSING SERIOUS BURNS TO PERSONNEL.

e. Remove the steering limiter valve retaining plate securing bolt with spring washer then remove the retaining plate (Fig 339(8)).


f. Screw both steering limiter valves in until they just bottom in the housing. Do not exceed a tightening torque of 5 Nm.

g. Unscrew the left or right steering stop bolt on the axle at the wheel hub out about 3 turns.

h. Run the engine at idle (700 RPM) and have a second person turn the steering to the left or right until the wheel contacts a steering stop. Then have the person exert a force of about 25 Nm (normal hand force) briefly (maximum of 5 seconds) at the periphery of the steering wheel.

i. Read off the test pressure at the pressure gauge. The rated pressure is 150 bar.

j. If the rated pressure (150 bar) is not attained during the tests on either the right or the left lock, replace the pressure limiting valve (Fig 343(1)) and repeat the test.

k. Adjust the steering stop bolts, see para 153.

l. Adjust the steering limiter valves, see para 146.

m. Lower the vehicle to the ground.

n. Road test the vehicle and check the steering response under all conditions.

Hydraulic Steering Pump Reservoir

150. Removal

a. Remove the bonnet from the vehicle (refer to EMEI Veh 393 Group 01 - Access for Repair).

CARE SHOULD BE TAKEN WHEN DRAINING OIL OR DISCONNECTING OIL LINES. HOT POWER STEERING HYDRAULIC OIL CAN CAUSE SERIOUS BURNS.
NOTE

Oil drained from the steering system is not to be re-used.

b. Operate the battery isolation switch so that the batteries are isolated from the vehicle.
c. Clean the hydraulic steering pump reservoir and connections.
d. Place a suitable container underneath the hydraulic steering pump reservoir.
e. Identify and tag the oil feed and return lines hoses to the hydraulic steering pump reservoir.

NOTE

Blank off all openings to prevent the ingress of dirt and moisture on disconnection of oil line fittings.

f. Loosen the oil feed and return lines hose clamps (Fig 344(3)) and disconnect the hoses from the hydraulic steering pump reservoir. Allow all oil to drain from the reservoir and blank off the pipes to prevent dirt entering.

g. Disconnect the vent line (Fig 344(1)) from the lid of the hydraulic steering pump reservoir.
h. Loosen the clamp bolt and lock nut (Fig 344(2)) and remove the hydraulic steering pump reservoir from the circular mounting bracket.

151. Cleaning and Inspection

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Wash the parts in an appropriate cleaning agent and blow dry with compressed air. Inspect all parts for wear or damage, replace as required.
b. Clean the mounting bracket and the front inner fender.

152. Installation

a. Fit a new oil filter in the hydraulic steering pump reservoir, a new gasket under the reservoir lid and a new O-ring under the wing nut securing the lid.
b. Fit the hydraulic steering pump reservoir into the mounting bracket and secure with the clamp bolt (Fig 344(2)) and lock nut.
c. Uncap connections and connect the vent line (Fig 344(1)) to the lid of the hydraulic steering pump reservoir.
d. Uncap connections and connect the oil feed and return hoses, previously tagged, to the hydraulic steering pump reservoir and secure with the hose clamps (Fig 344(3)).
e. Fill the power steering system with new, clean oil (OX-47 Lubricating Oil, Gear (SAE Grade 10W)) (steering system capacity 3.2 litres).
f. Operate the battery isolation switch so that the batteries are connected to the vehicle.

g. Bleed the power steering system (refer EMEI Veh D 393 Group 9 - Steering).
h. Check the hydraulic steering pump reservoir oil level, top-up if required.
i. Install and secure the bonnet on the vehicle (refer to EMEI Veh D 393 Group 01 - Access for Repair).
j. Road test the vehicle, inspect for leaks and check the performance of the steering system.
Steering Stops

153. **Adjustment**

a. Position the vehicle on a flat even surface.
b. Position the front wheels on the turntables (Fig 345).
c. Set the front wheels to the straight ahead position and the turntable scales to zero.
d. Turn the steering to the left lock and note the angle of the left wheel on the turntable scale (Fig 346).
e. If the specified maximum angle (35°) is not attained loosen the lock nut on the steering stop bolt and adjust the bolt in or out (Fig 347).

**Figure 345 - Turntable - Installation**

f. Tighten the steering stop bolt lock nut and recheck the steering angle.

g. Repeat the same procedure (sub-paras c. to e.) on the right wheel.
h. Remove the turntables from under the front wheels.
i. Adjust the steering limiter valves, see para 146.
j. Road test the vehicle and check the performance of the steering.

**Figure 346 - Left Lock - Steering Angle**
### Table 12 - Steering Data

<table>
<thead>
<tr>
<th>Vehicle</th>
<th>Type</th>
<th>Rim</th>
<th>Track Width</th>
<th>Disk wheel</th>
<th>Rim offset</th>
<th>Vehicle width*</th>
<th>max. pitman arm deflection</th>
<th>Steering wheel Outside diameter</th>
<th>Steering offset on the ground</th>
<th>Steering angle</th>
<th>Steering angle</th>
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<tr>
<td>437.156</td>
<td>365/85R20</td>
<td>11-20 SDC</td>
<td>1875</td>
<td>184</td>
<td>2343</td>
<td>93</td>
<td>475</td>
<td>83</td>
<td>35 max</td>
<td>32.6</td>
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</tr>
</tbody>
</table>

**Theoretical wheel base**

<table>
<thead>
<tr>
<th>A (mm)</th>
<th>Wheelbase</th>
<th>Wheelbase 1st rear axle</th>
<th>1st rear axle to 2nd rear axle</th>
<th>2nd rear axle</th>
<th>Outer turning circle</th>
<th>Track arc</th>
<th>Inner turning circle</th>
<th>Top rim circle</th>
<th>Toe</th>
<th>Camber</th>
<th>King Pin Inclination</th>
<th>Caster</th>
</tr>
</thead>
<tbody>
<tr>
<td>4600</td>
<td>3900</td>
<td>1400</td>
<td>19500</td>
<td>17230</td>
<td>10530</td>
<td>4280</td>
<td>0 to -3</td>
<td>1.75</td>
<td>10</td>
<td>7</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

* Vehicle width measured at cab
** Steering angle limited by stop
*** Estimated (with 365/85 R20 tyres fitted)

---

**Figure 348 - Steering Diagram**
**GROUP 10 — ELECTRICAL GROUP**

**Splitter Transmission Shift Cylinder Solenoid**

154. **Removal**

   a. Operate the battery isolation switch so that the batteries are isolated from the vehicle.

   b. Disconnect the electrical lead connector (Fig 349(5)) from the shift cylinder solenoid (Fig 349(6)).

   c. Tag the splitter transmission shift cylinder solenoid to splitter transmission valve block air line (Fig 349(4)) and remove the banjo bolt (Fig 349(2)) and sealing washers (Fig 349(3)) securing the air line to the splitter transmission shift cylinder solenoid. Discard the sealing washers.

   d. Tag and disconnect the air supply line (Fig 349(1)) to the splitter transmission shift cylinder solenoid.

   e. Tag the gear change lever switch air supply line (Fig 349(8)) and remove the banjo bolt and sealing washers securing the air supply line to the splitter transmission shift cylinder solenoid. Discard the banjo bolt sealing washers.

   f. Tag and remove the vent line from the splitter transmission shift cylinder solenoid exhaust port barbed fitting at the rear of the solenoid.

   g. Remove the two M6 bolts (Fig 349(7)) and spacers (Fig 349(15)) securing the splitter transmission shift cylinder solenoid to the splitter transmission housing, and remove the solenoid.

---

**Figure 349 - Splitter Transmission Shift Cylinder Solenoid - Removal**

1. Air supply line  
2. Banjo bolt  
3. Sealing washer  
4. Solenoid to valve block air line  
5. Electrical connector  
6. Shift cylinder solenoid  
7. Bolt  
8. Change lever switch air supply line  
9. Splitter transmission valve block  
10. Bolt  
11. Spacer  
12. Change lever switch signal air line  
13. Air line - valve block to shift cylinder  
14. Air line - valve block to shift cylinder  
15. Spacer
155. **Cleaning and Inspection**

**WARNING**

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Clean all parts in an appropriate cleaning agent and blow dry with compressed air. Inspect all parts for serviceability.

156. **Installation**

a. Mount the spacers (Fig 349(15)) and the splitter transmission shift cylinder solenoid on the splitter transmission housing and secure with the two M6 bolts (Fig 349(7)).

b. Connect the splitter transmission shift cylinder solenoid to splitter transmission valve block air line (Fig 349(4)) (tagged on removal) to the splitter transmission shift cylinder solenoid (Fig 349(6)) with the banjo bolt (Fig 349(2)), fitted with new sealing washers (Fig 349(3)).

c. Connect the gear change lever switch air supply line (Fig 349(8)) (tagged on removal) to the splitter transmission shift cylinder solenoid with the banjo bolt (Fig 349(2)), fitted with new sealing washers (Fig 349(3)).

d. Connect the vent line (tagged on removal) to the exhaust port barbed fitting on the rear of the splitter transmission shift cylinder solenoid.

e. Connect the air supply line (Fig 349(1)) (tagged on removal) to the splitter transmission shift cylinder solenoid.

f. Connect the electrical lead connector (Fig 349(5)) to the splitter transmission shift cylinder solenoid and tighten the connector.

g. Operate the battery isolation switch so that the batteries are connected to the vehicle.

h. Road test the vehicle and check the operation of the splitter transmission.

**Splitter Transmission Shift Cylinder Sender Unit**

157. **Removal**

a. Operate the battery isolation switch so that the batteries are isolated from the vehicle.

b. Disconnect the electrical lead from the shift cylinder sender unit (Fig 350(1)) on the splitter transmission shift cylinder (Fig 350(2)).

c. Remove the shift cylinder sender unit (Fig 350(1)) and sealing washer from the shift cylinder. Discard the washer.

**WARNING**

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

d. Clean all parts in an appropriate cleaning agent and blow dry with compressed air. Inspect all parts for serviceability.

158. **Installation**

a. Fit a new sealing washer to the shift cylinder sender unit (Fig 350(1)) and install the sender unit on the splitter transmission shift cylinder (Fig 350(2)). Tighten the sender unit securely.

b. Connect the electrical lead to the sender unit and tighten the connector.

c. Operate the battery isolation switch so that the batteries are connected to the vehicle.

d. Operate the splitter transmission switch and ensure that the splitter gear engaged indicator light illuminates and extinguishes.
ELECTRICAL AND MECHANICAL ENGINEERING INSTRUCTIONS

GROUP 11 — HYDRAULIC SYSTEM

WARNING

BEFORE COMMENCING REPAIRS ENSURE THE HYDRAULIC SYSTEM IS SHUT DOWN AND THE SYSTEM IS DEPRESSURISED. REMOVAL OF HYDRAULIC CONNECTIONS UNDER PRESSURE WILL RESULT IN AN EXPLOSIVE RELEASE OF HYDRAULIC OIL AND COMPONENTS MAY BECOME PROJECTILES. DEATH OR SERIOUS INJURY COULD OCCUR IF A COMPONENT IS DISCONNECTED OR REMOVED WITHOUT FIRST RELIEVING THE HYDRAULIC PRESSURE. EXERCISE EXTREME CAUTION WHEN ‘CRACKING’ HYDRAULIC CONNECTIONS.

Hydraulic System

159. General

a. To depressurise the hydraulic system proceed as follows:

(1) Disengage the PTO (i.e. stop the hydraulic triple pump).

(2) Stop the engine.

(3) Remove the filler/breather cap located on top of the hydraulic reservoir to relieve the pressure in the reservoir.

(4) Replace the filler/breather cap and tighten securely.

NOTE Before commencement of repairs, observe the data contained in EMEI Miscellaneous O-018 Cranes, Hoists and Winches - Inspection Data.

NOTE To prevent dirt, dust and foreign matter from entering or adhering to any component maintain a high standard of cleanliness. Before disconnecting hydraulic lines, clean the connections thoroughly. Cap or plug all disconnected hoses and lines with plastic caps or plugs.

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

NOTE Discard all used seals, O-rings, cotter pins, washers and lockpins. Discard any hydraulic oil drained from components.

Hydraulic Reservoir

160. Removal

a. Lower the main boom position and insert the boom locking pins in the lowest holes in the quadrant.

b. Ensure the PTO is disengaged.

c. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.

d. Depressurise the hydraulic system, see para 159.

e. Ensure the hydraulic control levers are in a neutral position.

f. Remove the eight M8 bolts, spring and flat washers securing the two camouflage net storage platform panels and remove the panels.
g. Remove the left hand front cabinet (refer to Group 19 - Frame/Chassis Group, para 340).

h. Remove the screw securing the float level switch wiring loom to the top of the switch in the hydraulic reservoir (Fig 351(2)).

i. Cut the cable tie securing the float level switch wiring loom to the top of switch in the hydraulic reservoir and secure away from the reservoir.

j. Unscrew the float level switch from the hydraulic reservoir and discard the sealing washer. Cover the opening for the float level switch in the hydraulic reservoir to prevent the ingress of dirt.

k. Disconnect the electrical connections to the cooler fan (Fig 351(13)).

l. Close the ball valve at the base of the hydraulic reservoir.

NOTE

The hydraulic reservoir may be removed with the oil remaining in the reservoir.

m. Tag and disconnect the hose to the end port on the hydraulic reservoir suction manifold (Fig 352(6)). Attach a drain hose to the end port, open the ball valve and drain the hydraulic oil from the hydraulic reservoir (Fig 351(2)) (approx 94 litres). Close the ball valve and cap the open connections.

n. Remove the four bolts (Fig 352(8)), nuts (Fig 352(11)), spring washers (Fig 352(10)) and clamp (Fig 352(5)) securing the hydraulic reservoir suction manifold (Fig 352(6)) to the ball valve (Fig 352(4)). Discard the O-ring (Fig 352(9)) and cap the open connections.

o. Tag and disconnect the crane return hoses to the cooler manifold (top) (Fig 351(16)) Cap all exposed connections.

p. Tag and disconnect the directional control valve hose (Fig 351(11)) and crane inlet hose (Fig 351(10)) at the cooler manifold (bottom) (Fig 351(9)). Cap all exposed connections.
NOTE

The hydraulic reservoir, cooler and fan will be removed as one unit.

q. Attach a suitable lifting sling to the four lugs (Fig 351(21)) on top of hydraulic reservoir (Fig 351(2)).

r. Remove the three M16 nuts and bolts fitted with spring washers, spacers and flat washers securing the hydraulic reservoir to the sub-frame.

s. Lift the hydraulic reservoir/cooler assembly clear of the vehicle with a crane taking care to provide suitable packing to lower the assembly onto, so as not to damage the ball valve.

161. Disassembly (Oil Cooler)

a. Disconnect the return hose (Fig 351(18)) complete with cooler manifold (top) (Fig 351(16)) from the oil cooler (Fig 351(15)) and from the hydraulic reservoir diffuser/filter cap housing (Fig 351(1)).

b. Remove the two M10 bolts, nuts and washers securing the oil cooler (Fig 351(15)) to the side of the hydraulic reservoir (Fig 351(2)).

c. Remove the two M8 bolts, nuts and washers securing the strut (top) (Fig 351(3)) and the strut (bottom) (Fig 351(12)) to the hydraulic reservoir (Fig 351(2)) then detach the oil cooler (Fig 351(15)) with cooler fan (Fig 351(13)) from the reservoir.

162. Cleaning and Inspection

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTENT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Wash all parts in an appropriate cleaning agent and blow dry with compressed air.

b. Inspect all parts for wear or damage. Check the security of all hydraulic tank lid and suction pipe nut inserts. Tighten or replace as required. Crack test the hydraulic reservoir using the dye penetrant method if required.

163. Reassembly (Oil Cooler)

a. Attach the oil cooler (Fig 351(15)) with cooler fan (Fig 351(13)) to the side of the hydraulic reservoir (Fig 351(2)) with the two M10 bolts, nuts and washers. Only hand tighten the bolts at this stage.

b. Fit the two M8 bolts, nuts and washers securing the strut (top) (Fig 351(3)) and strut (bottom) (Fig 351(12)) to the hydraulic reservoir. Only hand tighten the bolts at this stage.
NOTE

Ensure that the oil cooler and mountings are not stressed when connecting the hose.

c. Connect the return hose (Fig 351(18)) with cooler manifold (top) (Fig 351(16)) to the top of the oil cooler (Fig 351(15)) and to the hydraulic reservoir diffuser/filter housing (Fig 351(1)).
d. Torque the M10 bolts to 44 Nm and the M8 bolts to 22 Nm.

164. Installation

a. Attach a suitable lifting sling to the four lugs (Fig 351(21)) on top of hydraulic reservoir and with the aid of a crane lift the hydraulic reservoir/cooler assembly onto the vehicle and align the mounting bolt holes.
b. Secure the hydraulic reservoir/cooler assembly with the three M16 mounting bolts fitted with a flat washer and a spacer. Fit the spring washer and nut and torque the bolt to 190 Nm.
c. Fit a new O-ring (Fig 352(9)) to the hydraulic reservoir suction manifold (Fig 352(6)) and connect the suction manifold to the ball valve (Fig 352(4)) with the clamp (Fig 352(5)). Secure the clamp with the four bolts (Fig 352(8)), spring washers (Fig 352(10)) and nuts (Fig 352(11)).
d. Connect the hose (tagged on removal) to the end port on the hydraulic reservoir suction manifold (Fig 352(6)) and tighten.
e. Connect the crane return hoses (tagged on removal) to the cooler manifold (top) (Fig 351(16)).
f. Connect the directional control valve hose (Fig 351(11)) (tagged on removal) and the crane inlet hose (Fig 351(10)) (tagged on removal) to the cooler manifold (bottom) (Fig 351(9)).
g. Connect the electrical connections to the cooler fan (Fig 351(13)).
h. Install the float level switch in the hydraulic reservoir with a new sealing washer and tighten.
i. Secure the float level switch wiring loom to the switch in the top of the hydraulic reservoir with the screw.
j. Secure the float level switch wiring loom to the hydraulic reservoir with a cable tie.
k. Refill the hydraulic reservoir with about 94 litres of oil.

Hydraulic Triple Pump

165. Removal

a. Lower the main boom and engage the boom locking pins in the lowest holes in the quadrant.
b. Disengage the PTO and shut down the engine.
c. Depressurise the hydraulic system, see para 159.
d. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.
e. Ensure the hydraulic control levers are in a neutral position.
f. Close the ball valve at the base of hydraulic reservoir.
g. Place a suitable container under the hydraulic oil pump to catch draining oil.
h. Clean the area around the mounting flanges of the six hydraulic hoses at the hydraulic triple pump.
i. Identify and tag the hydraulic hoses to facilitate identification on assembly.
j. Remove the eight 7/16 x 1½ in UNC, the twelve 3/8 x 1½ in UNC and the four 3/8 x 1¼ in UNC mounting flange bolts (Fig 353(3)) with washers securing the three inlet and three outlet hydraulic hoses to the hydraulic triple pump.
k. Disconnect the six hydraulic hoses and remove the flange O-rings. Discard the O-rings.
l. Cap the hoses and ports (all SAE ports) immediately to prevent the ingress of dirt.
m. Position a support strap under the hydraulic triple pump.
1. Spline adaptor
2. M12 socket head screw
3. Flange mounting bolt

Figure 353 - Hydraulic Triple Pump

**NOTE**

Note the location of the spline adaptor relative to the PTO and pump splines so that it can be reassembled in the same orientation.

**n.** Remove the two M12 socket head screws (Fig 353(2)) securing the hydraulic triple pump to the PTO output flange and then carefully withdraw the pump.

**o.** Remove the spline adaptor.

166. **Cleaning and Inspection**

**a.** Clean and inspect the splines of the spline adaptor (Fig 353(1)). Lubricate the splines liberally with an extreme pressure, molybdenum disulphide based grease (XG-276).

**b.** Inspect the splines on the pump input shaft and PTO output drive for wear, replace as required.

**c.** Check the relief hole and blowout seal for serviceability.

167. **Installation**

**a.** Lubricate the hydraulic triple pump input shaft splines liberally with an extreme pressure, molybdenum disulphide based grease (XG-276).

**NOTE**

Install the spline adaptor in the same orientation (relative to the PTO and pump splines) to what it was in prior to removal.

**b.** Install the spline adaptor.

**c.** Install the hydraulic triple pump on the PTO output flange and secure with the two M12 socket head screws (Fig 353(2)). Torque the screws to 77 Nm.

**d.** Install the six hose flange O-rings on the inlet and outlet ports. Lubricate the O-rings with clean hydraulic oil prior to fitting.

**e.** Connect the six hydraulic hoses, previously tagged, with the split flange clamps and secure each clamp with the mounting bolts (Fig 353(3)), fitted with spring washers.

**f.** Torque the 3/8 UNC clamp bolts to 45 Nm and the 7/16 UNC clamp bolts to 70 Nm.

**g.** Open the ball valve at the base of the hydraulic reservoir.

**h.** Operate the winch, lifting boom and crane and check the pump connections for leaks.

**i.** Position all hydraulic components in their stowed position (as for travel) and check the oil level in the hydraulic reservoir.
GROUP 12 — RECOVERY SYSTEM

**WARNING**

BEFORE COMMENCING REPAIRS ENSURE THE HYDRAULIC SYSTEM IS SHUT DOWN AND THE SYSTEM IS DEPRESSURISED. REMOVAL OF HYDRAULIC CONNECTIONS UNDER PRESSURE WILL RESULT IN AN EXPLOSIVE RELEASE OF HYDRAULIC OIL AND COMPONENTS MAY BECOME PROJECTILES. DEATH OR SERIOUS INJURY COULD OCCUR IF A COMPONENT IS DISCONNECTED OR REMOVED WITHOUT FIRST RELIEVING THE HYDRAULIC PRESSURE. EXERCISE EXTREME CAUTION WHEN ‘CRACKING’ HYDRAULIC CONNECTIONS.

**Recovery System 168. General**

a. To depressurise the hydraulic system proceed as follows:

1. Disengage the PTO (i.e. stop the hydraulic pump).
2. Stop the engine.
3. Remove the filler/breather cap located on top of the hydraulic reservoir to relieve the pressure in the reservoir.
4. Replace the filler/breather cap and tighten securely.

**NOTE**

Before commencement of repairs, observe the data contained in EMEI Miscellaneous O-018 Cranes, Hoists and Winches - Inspection Data.

**NOTE**

To prevent dirt, dust and foreign matter from entering or adhering to any component maintain a high standard of cleanliness. Before disconnecting hydraulic lines, clean the connections thoroughly. Cap or plug all disconnected hoses and lines with plastic caps or plugs.

**NOTE**

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

**NOTE**

Discard all used seals, O-rings, cotter pins, washers and lockpins. Discard any hydraulic oil drained from components.

**Directional Control Valve**

**169. Removal**

a. Raise the main boom and engage the locking pins in the top hole in the quadrant.

b. Disengage the PTO and shut down the engine.

c. Depressurise the hydraulic system, see para 168.

d. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.

e. Ensure the hydraulic control levers are in a neutral position.

f. Close the ball valve at the base of the hydraulic reservoir.
g. Apply the park brake and drain the air from the compressed air accumulator circuit 1 (bottom tank), compressed air accumulator circuit 2 (top tank) and the trailer brake circuit compressed air accumulator.

h. Place a suitable container under the directional control valve to catch draining oil.

i. Clean the area around lines, hoses and control cable connections at the directional control valve (Fig 355(1)).

j. Identify and tag the control cable connections (Fig 354), air lines (Fig 356) and hydraulic hoses at the directional control valve to facilitate assembly. Disconnect the air lines from the directional control valve.

k. Disconnect the hydraulic hoses from the directional control valve.

l. Cap the hoses and ports immediately to prevent the ingress of dirt.

m. Remove the four M8 directional control valve mounting bolts (Fig 355(4)), fitted with spring washers, securing the directional control valve to the vehicle sub-frame.

n. Remove the seven M10 connection bracket socket head screws (Fig 355(3)) and self locking nuts connecting the control cable connection brackets (Fig 355(2)) to the valve spool operating rods.

o. Slide the directional control valve towards the front of the vehicle then lift to clear the cable connectors.

170. **Cleaning and Inspection**

**WARNING**

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Wash the parts in an appropriate cleaning agent and blow dry with compressed air. Do not wipe valve components with cloth or paper towel because lint or other matter could enter the hydraulic system and cause a malfunction.

b. Inspect each control valve spool for leaks, wear or damage. Replace the directional control valve (complete) if leaks, wear or damage is apparent on any of the spools.
171. Installation

NOTE

The cables from the left hand cabinet must be connected to the top hole of the connection bracket (Fig 355(2)) at each valve spool operating rod.

NOTE

Do not tighten the screws and self locking nuts securing the control cable connection brackets to the valve spool operating rods to the extent of causing the spool rod to seize in the connection bracket.

a. Position the directional control valve (Fig 355(1)) on the vehicle sub-frame and fit the seven M10 connection bracket socket head screws (Fig 355(3)) and self locking nuts connecting the control cable connection brackets to the valve spool operating rods. Tighten the nuts until there is no axial movement of the mounting bolts. Do not overtighten the nuts.

b. Secure the directional control valve to the vehicle sub-frame with the four M8 directional control valve mounting bolts (Fig 355(4)), fitted with spring washers. Torque the bolts to 22 Nm.

c. Connect the air lines (previously tagged on removal) to the directional control valve. Refer to Figure 356.

d. Connect the hydraulic hoses (previously tagged on removal) to the directional control valve.

e. Open the ball valve at the base of the hydraulic reservoir.

f. Run the engine to build up air pressure and check for air leaks.

Check all operating cables lie smoothly in position, with no kinks, pinching or rubbing. Check the cables do not foul or chafe the main boom lifting cylinders when the main boom is raised/lowered.

g. Operate all the recovery system controls at both control panels and check the function of all components (refer to EMEI Veh D 393 Group 13 - Boom).

h. Check for oil leaks at the directional control valve, rectify as required.

i. Position all hydraulic components in their stowed position (as for travel) and check the oil level in the hydraulic reservoir.

Fairleads and Rollers (Front Winching)

172. Removal/Installation

a. Refer to the Group 15 – Winches for the following repair tasks pertaining to the front winching fairleads, guides and rollers:

(1) Upper Winch Sheave (Front Winching) Removal/Installation.

(2) Lower Winch Sheave (Front Winching) Removal/Installation.


NOTE:
1. NYLON TUBE SHALL BE BLACK UV STABILIZED TUBE MANUFACTURED TO DIN 73378 AND DIN 74324, BS 5409.1-1976 OR EQUIVALENT.
   WORKING PRESSURE AT 20°C SHALL BE 3.2 MPa OR GREATER.
   USE OF LOCTITE 545 ON TAPER THREADED CONNECTIONS IS PERMISSIBLE.

Figure 356 - Recovery System Pneumatic
ENSURE THE HYDRAULIC SYSTEM IS SHUT DOWN AND THE SYSTEM IS DEPRESSURISED BEFORE COMMENCING REPAIRS. REMOVAL OF HYDRAULIC CONNECTIONS UNDER PRESSURE WILL RESULT IN AN EXPLOSIVE RELEASE OF HYDRAULIC OIL AND COMPONENTS MAY BECOME PROJECTILES. DEATH OR SERIOUS INJURY COULD OCCUR IF A COMPONENT IS DISCONNECTED OR REMOVED WITHOUT FIRST RELIEVING THE HYDRAULIC PRESSURE. EXERCISE EXTREME CAUTION WHEN ‘CRACKING’ HYDRAULIC CONNECTIONS.

Boom

173. General

a. To depressurise the hydraulic system proceed as follows:

(1) Disengage the PTO (i.e. stop the hydraulic pump).

(2) Stop the engine.

(3) Remove the filler/breather cap located on top of the hydraulic reservoir to relieve the pressure in the reservoir.

(4) Replace the filler/breather cap and tighten securely.

BEFORE DISCONNECTING ANY HOSE/PIPE OR REMOVING THE FILTER BOWLS ENSURE THE HYDRAULIC OIL HAS SUFFICIENTLY COOLED TO AVOID BURNS.

REMOVAL OF A HYDRAULIC HOSE MAY ALLOW THE HYDRAULIC RESERVOIR TO DRAIN THROUGH THE OPENED CONNECTIONS. ENSURE SEALING CAPS ARE AVAILABLE PRIOR TO REMOVAL OF A HYDRAULIC HOSE OR PART, OR THAT THE REPLACEMENT HOSE OR PART CAN BE FITTED IMMEDIATELY.

NOTE

Before commencement of repairs, observe the data contained in EMEI Miscellaneous O-018 Cranes, Hoists and Winches - Inspection Data.

NOTE

To prevent dirt, dust and foreign matter from entering or adhering to any component maintain a high standard of cleanliness. Before disconnecting hydraulic lines, clean the connections thoroughly. Cap or plug all disconnected hoses and lines with plastic caps or plugs.

NOTE

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

NOTE

Discard all used seals, O-rings, cotter pins, washers and lockpins. Discard any hydraulic oil drained from components.

Main Boom Cylinder

174. Removal

a. Raise the main boom and engage the locking pins in the top hole in the quadrant. Ensure the weight of the boom is on the locking pins.

b. Disengage the PTO and shut down the engine.

c. Depressurise the hydraulic system, see para 173.

d. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.

e. Ensure the hydraulic control levers are in a neutral position.

ENSURE THE MAIN BOOM LOCKING PINS ARE ENGAGED BEFORE GETTING UNDER THE BOOM.

f. Close the ball valve at the base of the hydraulic reservoir.

g. Place a suitable container under the main boom cylinder to catch draining oil.

h. Attach a sling to the main boom cylinder (Fig 357(5)) and position the sling above midway and towards the top of the cylinder outer housing, so that when the cylinder is raised from its installed position it lifts vertically.
NOTE
Ensure the main boom cylinder hoses are identified and tagged prior to removal of the hoses.

i. Clean the area around the hose connections. Tag and disconnect the hydraulic hoses (Fig 357(8)) from the main boom cylinder to be removed. Cap all open connections.

ENSURE THE MAIN BOOM CYLINDER IS IN THE “NO LOAD” CONDITION BEFORE ATTEMPTING TO REMOVE THE PIVOT PINS.

j. Remove the M8 locating bolt, fitted with a spring washer (Fig 357(4) and (3)) securing the main boom cylinder rod pivot pin (Fig 357(2)) to the main boom.

k. Take the weight of the main boom cylinder with the crane and using the locating bolt as a jacking screw in the jacking screw hole (Fig 357(1)) remove the main boom cylinder rod pivot pin.

l. Remove one circlip (Fig 357(7)) securing the main boom cylinder lower pivot pin (Fig 357(6)) and knock out the pin using a hammer and drift.

m. Remove the main boom cylinder from the vehicle.

Figure 357 - Main Boom Cylinder - Removal
175. **Cleaning and Inspection**

**WARNING**

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTENT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Wash the parts in an appropriate cleaning agent and blow dry with compressed air.

b. Inspect the main boom cylinder rod and rod wipers for leaks, wear or damage, replace as required.

c. Inspect the main boom cylinder pivot pins and pin bushes for wear or damage, replace as required.

d. Inspect the main boom cylinder hydraulic pipes, hoses and fittings for cracks, leaks, wear or damage, replace as required.

176. **Installation**

a. Attach a sling to the main boom cylinder (Fig 357(5)). Position the sling, above midway and towards the top of the cylinder outer housing, so that when the cylinder is lifted into its installed position it lifts vertically.

b. With the aid of a crane, position the cylinder on the vehicle.

c. Lubricate the pivot pins, liberally with an extreme pressure, molybdenum disulphide based grease (XG-276).

d. Align the boom cylinder housing pivot points with the recovery platform bearing mounts and insert the lower pivot pin (Fig 357(6)). Secure the pin in position with a circlip (Fig 357(7)).

e. Align the main boom cylinder rod with the pivot pin mounts and install the main boom cylinder rod pivot pin (Fig 357(2)).

f. Lock the pin to the main boom with the M8 locating bolt fitted with a spring washer (Fig 357(4) and (3)). Torque the bolt to 22 Nm.

g. Connect all the previously tagged hydraulic hoses (Fig 357(8)) to the main boom cylinder.

h. Open the ball valve at the base of the hydraulic reservoir.

i. Bleed the boom hydraulics (refer to EMEI Vehicle D 393 Group 13 - Boom).

j. Test the operation of the lifting boom and check for leaks.

k. Position all hydraulic components in their stowed position (as for travel) and check the oil level in the hydraulic reservoir. Top up if required.

**Fairlead Wear Inserts (Main Boom)**

177. **Removal**

a. Lower the main boom to the travel position.

b. Release the tension on the winch rope slightly and unstow the rope.

c. Remove the 3/8 UNC bolt (Fig 358(9)) and self locking nut (Fig 358(4)) securing the fairlead wear inserts in the nose of the fairlead and remove the wear inserts (Fig 358(10)).

178. **Installation**

a. Fit the fairlead wear inserts over the winch rope and slide them into position. When fitted the insert mating faces are to be parallel to the ground (Fig 358(10)).

b. Install the 3/8 UNC bolt (Fig 358(9)) and self locking nut (Fig 358(4)) and tighten securely.

c. Stow and tension the winch rope for travelling.

**Fairlead Sheave (Main Boom)**

**NOTE**

The sheave weighs about 10 kg. It must be suitably supported while the axle pin is removed/installed.

179. **Removal**

a. Lower the main boom to the travel position.

b. Release the tension on the winch rope slightly and unstow the rope.

c. Remove the hook and D shackle from the end of the winch rope.

d. Remove the roll pin (Fig 358(15)) from the sheave axle pin (Fig 358(14)). Rotate the fairlead body to allow the axle pin to be driven out.

e. Drive out the sheave axle pin and remove the sheave (Fig 358(13)) and the rope guide (Fig 358(12)) from the fairlead.
180. Installation

**CAUTION**

MOLYBDENUM DISULPHIDE BASED GREASE MUST NOT BE USED ON THE SHEAVE COMPONENTS. LUBRICATE THE PIVOT PIN LIBERALLY WITH A MINERAL OIL BASED GREASE (XG-274) PRIOR TO INSTALLATION.

a. Position the sheave (Fig 358(13)) and rope guide (Fig 358(12)) in the fairlead and insert the sheave axle pin (Fig 358(14)).

b. Rotate the sheave axle pin to locate the pin locking flange in the retaining groove in the fairlead body.

c. Insert the roll pin (Fig 358(15)) in the sheave axle pin.

d. Fit the D shackle and hook to the end of the winch rope and stow and tension the winch rope for travelling.

c. Slide the rope tensioning device out of the fairlead, along the winch rope towards the winch and temporarily secure to the boom.

d. Remove the fairlead wear inserts, see para 177.

e. Remove the D-shackle and hook from the winch rope.

f. Remove the fairlead sheave and rope guide, see para 179.

g. Remove the circlip (Fig 358(1)) with spacer (Fig 358(2)) securing the fairlead hollow axle (Fig 358(11)) in the transverse bracket (Fig 358(3)).

h. With the aid of a soft faced hammer remove the fairlead assembly and slide clear of the winch rope.

182. Cleaning and Inspection

**WARNING**

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Wash the parts in an appropriate cleaning agent and blow dry with compressed air.
b. Inspect all components for wear, pitting and corrosion, rectify as required. Ensure all pitting and corrosion is removed from the fairlead and main boom transverse bracket mating surfaces.

183. Installation

**CAUTION**

MOLYBDENUM DISULPHIDE BASED GREASE MUST NOT BE USED ON THE FAIRLEAD COMPONENTS. LUBRICATE THE HOLLOW AXLE WITH A MINERAL OIL BASED GREASE (XG-274).

a. Insert the fairlead hollow axle (Fig 358(11)) into the transverse bracket (Fig 358(3)) then install the spacer (Fig 358(2)) and secure the hollow axle to the fairlead with the circlip (Fig 358(1)).

b. Insert the winch rope through the fairlead hollow axle (Fig 358(11)).

c. Install the fairlead sheave and rope guide, see para 180.

d. Install the fairlead wear inserts, see para 178.

e. Fit the D-shackle and hook to the winch rope.

f. Slide the rope tensioning device (rope brake) along the winch rope and locate it in the fairlead.

g. Secure the rope tensioning device (rope brake) with the two mounting bolts and sleeves, using an 8 mm Allen head key. Lubricate the threads of the mounting bolts sparingly with a thread locking agent (Loctite 242). Ensure the thread locking agent does not bond the sleeve to the bolt.

h. Stow and tension the winch rope for travel.

**Folding Boom Cylinder**

184. Removal

a. Position the folding boom in the stowed (locked) position.

b. Place a suitable container under the extension boom cylinder to catch draining oil.

c. Disengage the PTO and shut down the engine.

d. Depressurise the hydraulic system, see para 173.

e. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF. Ensure the hydraulic control levers are in a neutral position. Close the ball valve at the base of the hydraulic reservoir.

f. Clean the area around the hose connections. Disconnect the hydraulic hose from the folding boom cylinder. Cap all open connections.

g. Remove the split pin (Fig 359(13)) from the cylinder rod pivot pin (Fig 359(12)) securing the folding boom cylinder (Fig 359(3)) and the two link plates (Fig 359(9)) to the pivot lever arm (Fig 359(8)). Withdraw the pivot pin through the access hole on the left hand side of the main boom.

h. Remove the split pin (Fig 359(2)) and washer (Fig 359(1)) from the upper pivot pin (Fig 359(18)) securing the folding boom cylinder (Fig 359(3)) housing to the main boom support plate.

i. Support the folding boom cylinder at the ram end and withdraw the pivot pin through the access hole on the left hand side of the main boom.

j. Lower the folding boom cylinder through the main boom between the crosshead and folding boom pivot and remove.

185. Cleaning and Inspection

**WARNING**

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Wash the parts in an appropriate cleaning agent and blow dry with compressed air.

b. Inspect the folding boom cylinder rod and rod wipers for leaks, wear or damage, replace as required.

c. Inspect the folding boom cylinder pipes, hoses and fittings for cracks, leaks, wear or damage, replace as required.

d. Inspect the folding boom pivot pins, pin bushes and seals for wear or damage, replace as required.
186. Installation

NOTE

Lubricate the folding boom cylinder pivot pins liberally with an extreme pressure, molybdenum disulphide based grease (XG-276) prior to installation.

a. Slide the folding boom cylinder into the main boom housing. Align the upper pivot pin mounting holes in the main boom plate and the cylinder housing and install the upper pivot pin (Fig 359(18)). Secure the pivot pin with the washer (Fig 359(1)) and split pin (Fig 359(2)).

b. Align the pivot pin mounting holes of the folding boom cylinder rod, the two link plates (Fig 359(9)) and the pivot lever arm (Fig 359(8)).

c. Install the cylinder rod pivot pin (Fig 359(12)) through the access hole on the left hand side of the main boom. Secure the pin with the split pin (Fig 359(13)).

d. Connect the hydraulic hose to the folding boom cylinder.

e. Open the ball valve at the base of the hydraulic reservoir.

f. Bleed the boom hydraulics (refer to EMEI Vehicle D 393 Group 13 - Boom).

g. Test the operation of the folding boom, check for leaks.

h. Position all hydraulic components in their stowed position (as for travel) and check the oil level in the hydraulic reservoir. Top up if required.
Extension Boom Cylinder

187. Removal

a. Lock the main boom in the 3rd or 4th hole from the lowest position on the quadrant.
b. Lower the folding boom (Fig 360(17)) to its stops and extend the extension boom (Fig 360(4)) (to facilitate inspection of the extension boom cylinder rod upon removal).
c. Disengage the PTO and shut down the engine.
d. Depressurise the hydraulic system, see para 173.
e. Close the ball valve at the base of the hydraulic reservoir.
f. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.
g. Ensure the hydraulic control levers are in a neutral position.
h. Place a suitable container under the extension boom cylinder (Fig 360(12)) to catch draining oil.
i. Clean the area around the hose connections at the extension boom cylinder.
j. Tag and disconnect the hydraulic hoses (Fig 360(16)) to the extension boom cylinder.
k. Remove the two right angle unions (Fig 360(15)) from the extension boom cylinder.

NOTE

The extension boom may bind on the wear inserts in the folding boom and may require the use of manual force to initially separate the extension boom from the folding boom. If difficulty removing the extension boom is experienced, remove the T-bar and yoke assembly prior to removing the extension boom.

l. Attach a lifting sling to the extension boom (Fig 360(4)) and support the boom with a crane. Remove one external circlip (Fig 360(14)) from the pivot pin (Fig 360(13)) securing the extension boom cylinder to the folding boom (Fig 360(17)) and remove the pin.

Figure 360 - Extension Boom Cylinder - Connections

17. Folding boom
m. Release the extension boom locking pin with the extension boom locking handle (Fig 360(5)) and with the aid of the crane, slide the extension boom and cylinder out of the folding boom (Fig 360(17)).

n. Remove the lynch pin (Fig 360(10)) from the pivot pin (Fig 360(11)) securing the extension boom ram to the extension boom and knock out the pin.

o. Withdraw the cylinder from the extension boom housing.

188. Cleaning and Inspection

**WARNING**

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Wash the parts in an appropriate cleaning agent and blow dry with compressed air.

b. Inspect the extension boom cylinder rod and rod wipers for leaks, wear or damage, replace as required.

c. Inspect the extension boom cylinder, hydraulic pipes, hoses and fittings for cracks, leaks, wear or damage, replace as required.

d. Inspect the extension boom pivot pins, pin bushes and wear plates for wear or damage, replace as required.

189. Installation

**NOTE**

Lubricate the extension boom cylinder pivot pins liberally with an extreme pressure, molybdenum disulphide based grease (XG-276) prior to installation.

a. Slide the extension boom cylinder (Fig 360(12)) into the extension boom (Fig 360(4)).

b. Align the pivot pin mounting holes in the extension boom and the extension cylinder ram and install the pivot pin (Fig 360(11)). Secure the pivot pin with the lynch pin (Fig 360(10)).

c. Install the extension boom with cylinder in the folding boom housing (Fig 360(17)) with the aid of a crane.

d. Align the pivot pin mounting holes of the folding boom housing and the extension boom cylinder and then install the pivot pin (Fig 360(13)). Secure the pin with the circlip (Fig 360(14)).

e. Install the right angle unions (Fig 360(15)) on the extension boom cylinder.

f. Connect the hydraulic hoses (Fig 360(16)) (tagged on removal) to the right angle unions on the extension boom cylinder.

g. Open the ball valve at the base of the hydraulic reservoir.

h. Bleed the boom hydraulics (refer to EMEI Vehicle D 393 Group 13 - Boom).

i. Test the operation of the extension boom and check for leaks.

j. Engage the boom locking pin with the extension boom locking handle (Fig 360(5)).

k. Position all hydraulic components in their stowed position (as for travel) and check the oil level in the hydraulic reservoir. Top up if required.

**T-Bar Yoke and T-Bar Bushes**

190. Removal

**NOTE**

The lateral play in the T-bar cross bar bushes (Fig 361(12) and (13)) or the T-bar yoke bush (Fig 361(5)) is not to exceed 1.5 mm.

a. Lock the main boom to a suitable working height, with the folding boom fully lowered against the crosshead stops and the extension boom fully retracted.

b. Remove the transport lock (Fig 361(11)).

c. Remove the roll pin (Fig 361(16)) securing the T-bar yoke pivot pin (Fig 361(2)).

d. Remove the nut (Fig 361(15)) and spacer washer (Fig 361(14)).

e. Position a lifting sling and crane and take the weight of the T-bar (Fig 361(1)).

f. Knock out the pivot pin (Fig 361(2)) using a soft faced hammer and remove the T-bar from the vehicle.

g. Press the three T-bar bushes out of the T-bar, noting the position of the narrow bush (Fig 361(13)) between the two bushes (Fig 361(12)).

h. Raise the main boom to a suitable working height (for removing the T-bar yoke) and lock the main boom.
1. Unlock the tabs on the lock washer (Fig 361(8)) and undo the lock nut (Fig 361(9)) with a C-spanner (Table 2 Item 38). Remove the lock nut and lock washer.

j. Remove the two back-up rings (Fig 361(7)) and the O-ring (Fig 361(6)). If difficulty is experienced removing the back-up rings and O-ring attempt to raise the T-bar yoke to dislodge them. Discard the O-ring.

k. Remove the T-bar yoke (Fig 361(3)) and the bronze bearing (Fig 361(4)). Note the orientation of the bearing i.e. the inner chamfered diameter must face upwards towards the T-bar yoke.

l. Remove the extension boom and cylinder from the folding boom. Do not disconnect the extension boom cylinder from the extension boom, see para 187.

m. Remove the grease nipple and press out the T-bar yoke bush (Fig 361(5)) from the extension boom.

Figure 361 - T-Bar Bushes - Exploded View

i. Unlock the tabs on the lock washer (Fig 361(8)) and undo the lock nut (Fig 361(9)) with a C-spanner (Table 2 Item 38). Remove the lock nut and lock washer.

j. Remove the two back-up rings (Fig 361(7)) and the O-ring (Fig 361(6)). If difficulty is experienced removing the back-up rings and O-ring attempt to raise the T-bar yoke to dislodge them. Discard the O-ring.

k. Remove the T-bar yoke (Fig 361(3)) and the bronze bearing (Fig 361(4)). Note the orientation of the bearing i.e. the inner chamfered diameter must face upwards towards the T-bar yoke.

l. Remove the extension boom and cylinder from the folding boom. Do not disconnect the extension boom cylinder from the extension boom, see para 187.

m. Remove the grease nipple and press out the T-bar yoke bush (Fig 361(5)) from the extension boom.

Cleaning and Inspection

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Wash the parts in an appropriate cleaning agent and blow dry with compressed air.

b. Inspect the T-bar bushes and pin for wear, pitting or corrosion. Lateral movement must not exceed 1.5 mm.

c. Inspect the nylon back-up rings (Fig 361(7)) for wear and replace the O-ring (Fig 361(6)).
d. Inspect the T-bar yoke and bush for wear. Lateral movement must not exceed 1.5 mm.

e. Check the end float (along the pin) in the yoke does not exceed 2 mm (when assembled).

192. Installation

MOLYBDENUM DISULPHIDE BASED GREASE MUST NOT BE USED ON THE T-BAR YOKE AND T-BAR BUSHES. LUBRICATE THE YOKE AND PIVOT PIN LIBERALLY WITH A MINERAL OIL BASED GREASE (XG-274) PRIOR TO INSTALLATION.

NOTE

When replacing the T-bar yoke bush ensure a hole is drilled at the grease nipple mounting hole to provide a lubricant path to the bush and yoke.

a. Press a new T-bar yoke bush (Fig 361(5)) into the extension boom (Fig 361(10)).

b. Carefully drill a 5 mm hole in the T-bar yoke bush at the grease nipple mounting hole to provide a lubricant path to the bush and yoke. Clean the hole and the bush of all swarf.

c. Install the grease nipple in the extension boom.

d. Install the extension boom (Fig 361(10)) with cylinder in the folding boom housing with the aid of a crane, see para 189.

e. Lock the main boom to a suitable working height (with the folding boom fully lowered against the crosshead stops and the extension boom fully retracted).

f. Fit the bronze bearing (Fig 361(4)) on the T-bar yoke (Fig 361(3)). The inner chamfered diameter of the bronze bearing must face upwards i.e. towards the T-bar yoke.

g. Insert the T-bar yoke with bronze bearing into the extension boom. Coat all mating surfaces liberally with a mineral oil based grease (XG-274) prior to installation.

h. Install the O-ring (Fig 361(6)) and the two nylon back-up rings (Fig 361(7)).

i. Install the lock washer (Fig 361(8)) and the lock nut (Fig 361(9)).

j. Tighten the lock nut with the C-spanner (Table 2, Item 38). The T-bar should pivot freely and have 0.05 to 0.10 mm end float. Lock the lock nut with the lock washer tabs.

k. Press the bushes (Fig 361(12) and (13)) into the T-bar (Fig 361(1)) ensuring the narrow bush (Fig 361(13)) is fitted in the centre.

l. Lower and lock the main boom to a suitable working height

m. With the aid of a crane, position the T-bar in the T-bar yoke (Fig 361(3)).

n. Install the T-bar yoke pivot pin (Fig 361(2)), ensuring the pin is fully home and the flat of the pivot pin head is secured by the locking strip on the T-bar yoke.

o. Install the spacer washer (Fig 361(14)) and the castellated nut (Fig 361(15)). Tighten the nut and secure the castellated nut with the roll pin (Fig 361(16)).

p. Install the transport lock (Fig 361(11)).

q. Open the ball valve at the base of the hydraulic reservoir.

r. Bleed the boom hydraulics (refer to EMEI Vehicle D 393 Group 13 - Boom).

s. Test the operation of the extension boom, and check for leaks.

t. Engage the boom locking pin with the extension boom locking handle (Fig 360(5)).

u. Position all hydraulic components in their stowed position (as for travel) and check the oil level in the hydraulic reservoir. Top up if required.
BEFORE COMMENCING REPAIRS ENSURE THE HYDRAULIC SYSTEM IS SHUT DOWN AND THE SYSTEM IS DEPRESSURISED. REMOVAL OF HYDRAULIC CONNECTIONS UNDER PRESSURE WILL RESULT IN AN EXPLOSIVE RELEASE OF HYDRAULIC OIL AND COMPONENTS MAY BECOME PROJECTILES. DEATH OR SERIOUS INJURY COULD OCCUR IF A COMPONENT IS DISCONNECTED OR REMOVED WITHOUT FIRST RELIEVING THE HYDRAULIC PRESSURE. EXERCISE EXTREME CAUTION WHEN ‘CRACKING’ HYDRAULIC CONNECTIONS.

Earth Anchors

193. General

a. To depressurise the hydraulic system proceed as follows:
   (1) Disengage the PTO (i.e. stop the hydraulic pump).
   (2) Stop the engine.
   (3) Remove the filler/breather cap located on top of the hydraulic reservoir to relieve the pressure in the reservoir.
   (4) Replace the filler/breather cap and tighten securely.

BEFORE DISCONNECTING ANY HOSE/PIPE OR REMOVING THE FILTER BOWLS ENSURE THE HYDRAULIC OIL HAS SUFFICIENTLY COOLED TO AVOID BURNS.

REMOVAL OF A HYDRAULIC HOSE MAY ALLOW THE HYDRAULIC RESERVOIR TO DRAIN THROUGH THE OPENED CONNECTIONS, ENSURE SEALING CAPS ARE AVAILABLE PRIOR TO REMOVAL OF THE HOSE OR THE REPLACEMENT HOSE OR PART CAN BE FITTED IMMEDIATELY.

Earth Anchor Hydraulic Cylinder

194. Removal

a. Lower the main boom to the fully down position.

b. Place packing under the earth anchor to keep the cylinder in the fully retracted position.

c. Disengage the PTO and shut down the engine.

d. Depressurise the hydraulic system, see para 193.

e. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.

f. Ensure the hydraulic control levers are in a neutral position.

g. Close the ball valve at the base of the hydraulic reservoir.

h. Remove the four M8 bolts (Fig 362(11)), fitted with spring and flat washers (Fig 362(10) and (9)), then remove the cover plate (Fig 362(8)).

i. Disconnect the hydraulic pipes (Fig 362(1)) from the earth anchor leg cylinder. Note the orientation of the pipe connections on the earth anchor leg cylinder.

j. Remove one external circlip (Fig 362(5)) from the upper pivot pin (Fig 362(6)) and remove the pin and spacer washers (Fig 362(4)).

k. Secure a lifting sling to the earth anchor leg cylinder and support the cylinder with a crane. Secure the sling around the barrel of the cylinder, below the valve block.
1. Remove one external circlip (Fig 362(5)) from the lower pivot pin (cylinder rod) (Fig 362(6)) and knock out the pin.

2. Elbow  6. Pivot pin  10. Spring washer
4. Spacer  8. Cover plate

Figure 362 - Earth Anchor Cylinder - Connections

m. Lift the earth anchor cylinder out of the earth anchor leg housing.

195. Cleaning and Inspection

**WARNING**

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTENT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Wash the parts in an appropriate cleaning agent and blow dry with compressed air.

b. Inspect the earth anchor cylinder pivot pins and bushes for wear or damage, replace as required.

c. Inspect the earth anchor cylinder rod and rod wipers for leaks, wear or damage, replace as required.

d. Inspect the earth anchor cylinder hydraulic pipes, hoses and fittings for cracks, leaks, wear or damage, replace as required.

196. Installation

a. Secure a lifting sling around the earth anchor leg cylinder, below the valve block.

b. With the aid of a crane, lift the earth anchor leg cylinder into earth anchor leg housing and install the lower pivot pin (Fig 362(6)) securing the cylinder rod to the housing. Ensure the pipe connections on the earth anchor leg cylinder are in the orientation noted on removal.

c. Secure the pin with the external circlip (Fig 362(5)).

d. Remove the lifting sling and install the spacer washers (Fig 362(4)) and upper pivot pin (Fig 362(6)) securing the earth anchor leg cylinder to the housing. Secure the pin with the external circlip (Fig 362(5)).

e. Connect the hydraulic pipes (Fig 362(1)) to the connections on the earth anchor leg cylinder.

f. Close the ball valve at the base of the hydraulic reservoir.

g. Bleed the boom hydraulics (refer to EMEI Veh D 393 Group 13 - Boom).

h. Remove the packing from underneath the earth anchor leg.

i. Test the operation of the earth anchor and check for leaks.

j. Install the cover plate (Fig 362(8)) to the top of the earth anchor leg housing and secure with the four M8 bolts (Fig 362(11)), fitted with flat and spring washers (Fig 362(9) and (10)). Torque the bolts to 22 Nm.

k. Position all hydraulic components in their stowed position (as for travel) and check the oil level in the hydraulic reservoir. Top up if required.

Earth Anchor Leg

197. Removal

a. Position the vehicle over a pit so that a clearance of about one metre exists below the anchor leg.

b. Extend the anchor leg down as far as it will go.

c. Attach the vehicle winch rope, or a workshop crane and sling, to the hook on the spade to hold the anchor leg in place.
d. Remove the circlips (Fig 362(5)) from the lower anchor pivot pin (Fig 362(6)) and knock out the pin.

e. Retract the hydraulic ram as far as it will go.

NOTE

At least two personnel are required to guide the anchor leg as it is lowered via the vehicle winch or with the workshop crane.

f. Lower the anchor leg using the vehicle winch or a workshop crane and sling.

198. Cleaning and Inspection

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTENT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Wash the parts in an appropriate cleaning agent and blow dry with compressed air.

b. Inspect the anchor leg wear plates (Fig 363(1)) for wear or damage, replace as required.

199. Installation

NOTE

In addition to the winch operator, two personnel are required for the installation of the anchor leg.

a. Position the vehicle over a pit so that a clearance of about one metre exists below the anchor leg.

NOTE

When installing new wear plates (Fig 363(1)), secure the plates with temporary holding bolts (M10 x 26) (Fig 363(2)) during the installation of the earth anchor leg (Fig 363(3)). After the anchor leg is installed, remove the temporary holding bolts.

b. Position the new wear plates (if required) in the recesses provided in the anchor leg housing and secure with the temporary holding bolts (Fig 363(2)).

c. Lubricate retaining pins and sliding surfaces with an extreme pressure, molybdenum based grease (XG-276).

d. Extend the hydraulic ram as far as it will go.

e. Attach the vehicle winch rope, or the workshop crane and sling, to the hook on the spade and raise the leg with the assistance of at least two personnel to guide the leg into position.

f. When the lower anchor housing mounting holes are aligned with the cylinder rod mounting hole insert the lower anchor pivot pin (Fig 362(6)) and lock in position with the circlips (Fig 362(5)).

g. Retract the hydraulic ram as far as it will go.

h. Remove the temporary holding bolts (Fig 363(2)) if new wear plates have been fitted.

i. Test the operation of the anchor leg.
GROUP 15 — WINCHES

WARNING

BEFORE COMMENCING REPAIRS ENSURE THE HYDRAULIC SYSTEM IS SHUT DOWN AND THE SYSTEM IS DEPRESSURISED. REMOVAL OF HYDRAULIC CONNECTIONS UNDER PRESSURE WILL RESULT IN AN EXPLOSIVE RELEASE OF HYDRAULIC OIL AND COMPONENTS MAY BECOME PROJECTILES. DEATH OR SERIOUS INJURY COULD OCCUR IF A COMPONENT IS DISCONNECTED OR REMOVED WITHOUT FIRST RELIEVING THE HYDRAULIC PRESSURE. EXERCISE EXTREME CAUTION WHEN ‘CRACKING’ HYDRAULIC CONNECTIONS.

Winches

200. General

a. To depressurise the hydraulic system proceed as follows:

(1) Disengage the PTO (i.e. stop the hydraulic pump).
(2) Stop the engine.
(3) Remove the filler/breather cap located on top of the hydraulic reservoir to relieve the pressure in the reservoir.
(4) Replace the filler/breather cap and tighten securely.

NOTE

Before commencement of repairs, observe the data contained in EMEI Miscellaneous O-018 Cranes, Hoists and Winches - Inspection Data.

NOTE

To prevent dirt, dust and foreign matter from entering or adhering to any component maintain a high standard of cleanliness. Before disconnecting hydraulic lines, clean the connections thoroughly. Cap or plug all disconnected hoses and lines with plastic caps or plugs.

NOTE

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

NOTE

Discard all used seals, O-rings, cotter pins, washers and lockpins. Discard any hydraulic oil drained from components.

LEATHER GLOVES MUST ALWAYS BE WORN WHEN HANDLING STEEL WIRE ROPE AND SLINGS.

Winch

201. Removal

NOTE

When removing the left hand winch the left hand front cabinet must be removed first to access the winch mounting bolts.

a. Remove the left hand front cabinet (only if left hand winch is to be removed. Refer to Group 19 - Frame/Chassis Group, para 340.)

b. Remove the winch rope from the winch drum (refer to EMEI Veh D 393 Group 15 - Winches).

c. Disengage the PTO and shut down the engine.

d. Depressurise the hydraulic system, see para 200.

e. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.

f. Ensure the hydraulic control levers are in a neutral position.

g. Close the ball valve at the base of the hydraulic reservoir.
h. Remove the eight M8 bolts, spring and flat washers securing the two camouflage net storage platform panels and remove the panels.

**NOTE**

Clean the area around the winch drive unit and flat rate mechanism.

i. Tag and disconnect the hydraulic hoses from the winch drive unit and flat rate mechanism. Cap the hoses and open connections immediately to prevent the ingress of dirt and moisture.

j. Tag and disconnect the air line to the winch free spool cylinder. Remove any hose clamps that secure pipes and hoses to the winch drum housing.

k. Remove the six M12 X 60 socket head bolts (Fig 364(4)) and the six M12 X 40 socket head bolts (Fig 364(2)) securing the winch housing to the mounting cradle.

**NOTE**

The winch assembly weighs approx. 350 kg.

l. Attach a lifting sling to the winch assembly and with the aid of a crane remove the assembly.

202. **Cleaning and Inspection**

**WARNING**

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Plug all open connections and wash the parts in an appropriate cleaning agent then blow dry with compressed air. Ensure that dirt and cleaning agents are not forced past the drum lip seal.

b. Inspect all parts for wear or damage, replace as required.

203. **Installation**

**NOTE**

The winch assembly weighs approx. 350 kg.

a. Attach a lifting sling to the winch assembly and with the aid of a crane, position the winch in the cradle mounts on the main boom.

---

![Figure 364 - Winch - Mountings](image)

1. Winch assembly 3. Mounting cradle
2. M12 X 40 socket head bolt 4. M12 X 60 socket head bolt
b. Locate and align the winch housing in position with the six M12 X 60 socket head bolts (Fig 364(4)) and six M12 X 40 socket head bolts (Fig 364(2)). Only hand tighten the bolts until the winch is correctly aligned.

NOTE
Where zinc plated socket head bolts are fitted, torque the bolts to 120 Nm. If black, oxide coated socket head bolts are fitted torque the bolts to 135 Nm. Ensure the winch assembly is sitting correctly in the cradle before tightening the bolts.

c. Torque the zinc plated, winch housing socket head mounting bolts to 120 Nm and the black, oxide coated winch housing socket head mounting bolts to 135 Nm. Torque the bolts in stages, in a criss-cross fashion.

d. Connect the air lines (previously tagged) to the winch free spool cylinder (refer to Figure 356). Connect any hose clamps securing pipes and hoses to the winch drum housing.

e. Connect the hydraulic hoses (previously tagged) to the winch drive unit and the flat rate mechanism.

f. Open the ball valve at the base of the hydraulic reservoir.

g. Connect the winch rope to the drum with the wedge and lay on the winch rope (refer to EMEI Veh D 393 Group 15 - Winches).

h. Calibrate the winch. Contact the Mobility Systems Program Office (MOB SPO) for details of the calibration procedure.

i. Check the operation of the winch and inspect for oil and air leaks whilst laying on the winch rope.

j. Install the two camouflage net storage platform panels and secure with the eight M8 bolts fitted with spring and flat washers.

Winch Drive Unit

Removal

a. Disengage the PTO and shut down the engine.

b. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.

c. Ensure the hydraulic control levers are in a neutral position.

d. Close the ball valve at the base of the hydraulic reservoir.

e. Remove the eight M8 bolts, spring and flat washers securing the two camouflage net storage platform panels and remove the panels.

f. Clean around the hydraulic connections on the winch drive unit and place a suitable container underneath to catch draining oil.

g. Tag and disconnect the hydraulic pipes and hoses (Fig 365(7)) from the winch drive unit. Cap the hoses immediately to prevent the ingress of dirt.

h. Remove the three Allen head lower end plate screws (Fig 365(3)).

Figure 365 - Winch Drive Unit - Removal

i. Remove the four Allen head winch drive unit mounting bolts (Fig 365(4)) and remove the winch drive unit.

Installation

a. Position the winch drive unit with the drive gear engaged with the winch gear wheel and secure the drive unit with the four Allen head winch drive unit mounting bolts (Fig 365(4)).

b. Install the three Allen head lower end plate screws (Fig 365(3)) and tighten securely.

NOTE
The ports marked V1 and V2 on the hydraulic valve block are for the hydraulic connections from the control valve on the control panel. V2 is the supply (incoming) connection. V1 is the return connection.
c. Connect the hydraulic pipes and hoses (Fig 365(7)) (previously tagged) to the winch - drive unit hydraulic valve block.

d. Open the ball valve at the base of the hydraulic reservoir.

e. Operate the winch, inspect for oil leaks.

f. Calibrate the winch. Contact the Mobility Systems Program Office (MOB SPO) for details of the calibration procedure.

g. Position all hydraulic components in their stowed position (as for travel) and check the oil level in the hydraulic reservoir. Top up if required.

h. Install the two camouflage net storage platform panels and secure with the eight M8 bolts fitted with spring and flat washers.

Hydraulic Valve Block

206. Removal

a. Disengage the PTO and shut down the engine.

b. Depressurise the hydraulic system, see para 200.

c. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.

d. Ensure the hydraulic control levers are in a neutral position.

e. Close the ball valve at the base of the hydraulic reservoir.

f. Remove the eight M8 bolts, spring and flat washers securing the two camouflage net storage platform panels and remove the panels.

g. Clean around the hydraulic oil connections on the hydraulic valve block and place a suitable container underneath to catch draining oil.

h. Tag and disconnect the hydraulic pipes and hoses (Fig 365(7)) from the hydraulic valve block (Fig 365(6)). Cap the hoses immediately to prevent the ingress of dirt.

i. Remove the two Allen head plugs covering the hydraulic valve block hollow mounting screws (Fig 365(5)).

j. Remove the two Allen head mounting screws securing the hydraulic valve block to the winch drive unit and remove the block.

k. Remove the two seal rings from the base of the hydraulic valve block and discard the rings. Cap all openings immediately to prevent the ingress of dirt.

207. Cleaning and Inspection

WARNING

ENSURE THE SAFETY REQUIREMENTS FOR USE OF COMPRESSED AIR ARE STRICTLY ADHERED TO. INADVERTANT USE OF COMPRESSED AIR EQUIPMENT MAY RESULT IN INJURY TO PERSONNEL.

a. Seal all openings and clean the hydraulic valve block with an appropriate cleaning agent. Blow dry with compressed air.

b. Inspect the sealing surfaces of the hydraulic valve block and winch drive unit for damage, repair/replace as required.

208. Installation

a. Install the two seal rings in the grooves in the base of the hydraulic valve block. Lubricate the seal rings with hydraulic oil prior to installation.

b. Mount the hydraulic valve block on the winch drive unit and align the mounting screw holes. Install the two mounting screws (Fig 365(5)) and tighten securely.

c. Install the two Allen head plugs covering the mounting screw access holes and tighten securely.

NOTE

The ports marked V1 and V2 on the hydraulic valve block are for the hydraulic connections from the control valve on the control panel. V2 is the supply (incoming) connection. V1 is the return connection.

d. Connect the hydraulic pipes and hoses (Fig 365(7)) (previously tagged) to the hydraulic valve block (Fig 365(6)).

e. Open the ball valve at the base of the hydraulic reservoir.

f. Operate the winch, inspect for oil leaks.

g. Adjust the overcentre and sequence valves, see para 211.

h. Position all hydraulic components in their stowed position (as for travel) and check the oil level in the hydraulic reservoir. Top up if required.

i. Calibrate the winch. Contact the Mobility Systems Program Office (MOB SPO) for details of the calibration procedure.
j. Install the two camouflage net storage platform panels and secure with the eight M8 bolts fitted with spring and flat washers.

Overcentre and Sequence Valves

209. General

CAUTION

TO ENSURE SATISFACTORY OPERATION AND TO PREVENT DAMAGE TO THE WINCH, THE OVERCENTRE AND SEQUENCE VALVES MUST BE ADJUSTED IN CONJUNCTION WITH EACH OTHER.

NOTE

If it is suspected the overcentre and sequence valves in a hydraulic valve block are defective or require adjustment, PRECHECKS must be carried out before adjustment/replacement.

a. Prior to adjusting/replacing the overcentre and sequence valves carry out the following checks:

(1) Check the oil level in the hydraulic reservoir, top up if required.
(2) Ensure the engine is operating at 1500 RPM when PTO high idle is selected.
(3) Inspect the hydraulic system filters for serviceability.
(4) Ensure the directional control valves are operating correctly with full travel.

NOTE

Refer to the Operator Handbook for winch in/out speeds.

NOTE

If the winch in/out speeds are not satisfactory, after adjustment/replacement of the overcentre and sequence valves, test the hydraulic pumps for serviceability (refer to MOB SPO for test procedure and special tools). If the pumps are serviceable, replace the winch drive hydraulic motors as required.

210. Removal/Replacement

WARNING

DEATH OR SERIOUS INJURY COULD OCCUR IF AN ATTEMPT IS MADE TO REMOVE A VALVE FROM THE WINCH HYDRAULIC VALVE BLOCK WHILST THE WINCH IS UNDER LOAD OR THE HYDRAULIC PUMP IS OPERATING. REMOVAL OF A VALVE UNDER PRESSURE WILL RESULT IN THE VALVE BECOMING A PROJECTILE AND WILL CAUSE AN EXPLOSIVE RELEASE OF HYDRAULIC OIL.

a. Disengage the PTO and shut down the engine.
b. Depressurise the hydraulic system, see para 200.
c. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.
d. Ensure the hydraulic control levers are in a neutral position.
e. Close the ball valve at the base of the hydraulic reservoir.
f. Remove the eight M8 bolts, spring and flat washers securing the two camouflage net storage platform panels and remove the panels.
g. Unscrew the defective valve (Fig 366), fit the replacement and tighten.
h. Open the ball valve at the base of the hydraulic reservoir.
i. Adjust the overcentre and sequence valves, see para 211. When operating the winch, inspect for oil leaks and rectify as required.
j. Calibrate the winch. Contact the Mobility Systems Program Office (MOB SPO) for details of the calibration procedure.
k. Install the two camouflage net storage platform panels and secure with the eight M8 bolts fitted with spring and flat washers.
211. Adjustment

**WARNING**

DEATH OR SERIOUS INJURY COULD OCCUR IF AN ATTEMPT IS MADE TO REMOVE A VALVE FROM THE WINCH HYDRAULIC VALVE BLOCK WHilst THE WINCH IS UNDER LOAD OR THE HYDRAULIC PUMP IS OPERATING. REMOVAL OF A VALVE UNDER PRESSURE WILL RESULT IN THE VALVE BECOMING A PROJECTILE AND WILL CAUSE AN EXPLOSIVE RELEASE OF HYDRAULIC OIL.

**NOTE**

The overcentre and sequence valve adjustment procedure is identical for both winches.

a. Depressurise the hydraulic system, see para 200.

b. Set the winch remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.

c. Ensure the hydraulic control levers are in a neutral position.

d. Remove the eight M8 bolts, spring and flat washers securing the two camouflage net storage platform panels and remove the panels.

e. Clean around the overcentre valve “OUT” (Fig 367(2)), the overcentre valve “IN” (Fig 367(4)), the sequence valve (Fig 367(1)) and test connection (Fig 367(3)) on the hydraulic valve block.
1. Sequence valve
2. Overcentre valve “OUT”
3. Test connection
4. Overcentre valve “IN”

**Figure 367 - Overcentre and Sequence Valves**

f. Loosen the T-pieces (Fig 368(1)) connecting the in/out flexible hydraulic hoses (Fig 369(1)) to the hydraulic valve block and reposition the hoses to enable access to the test connection (Fig 369(2)). Tighten the T-pieces after repositioning the hoses.

g. Remove the dust cap from the test connection (Fig 369(2)) and connect the pressure gauge and hose (Table 1, Item 49) to the test connection.

h. Carefully remove the protective caps from the overcentre valve “OUT” (Fig 367(2)), the overcentre valve “IN” (Fig 367(4)) and the sequence valve (Fig367(1)) by gently lifting and turning each cap, taking care not to damage the caps. Replace the protective caps if damaged.

i. Position the splitter transmission in low and the gear change lever in neutral between sixth and eighth gear in the shift gate.

j. Start the engine and engage the PTO.

k. Connect the winch remote control to the connector in the left hand side equipment bin and set the remote control selector switch to RECOVER.

l. Disengage the winch free spool cylinder and pull out approximately ten metres of winch rope.

m. Loosen the lock nut on the sequence valve (Fig 367(1)) and turn the adjusting screw anti-clockwise until it reaches its stop (approximately 2-3 turns).
NOTE

To raise the “winch-in” pressure, turn the adjusting screw anti-clockwise. To lower the pressure turn the adjusting screw clockwise.

n. Using the winch remote control, engage PTO high idle and run the winch in the direction of winching in the winch rope (with the free spool cylinder disengaged). Undo the lock nut on the overcentre valve “IN” (Fig 367(4)) adjusting screw and turn the adjusting screw clockwise until it reaches its stop (the pressure indicated on the gauge will be the minimum pressure). Turn the adjusting screw anti-clockwise until an increase in pressure of 10 bar is achieved and lock the adjusting screw. The indicated pressure must be between 50 and 80 bar. Record the exact pressure reading.

o. Cease running the winch and disengage PTO high idle.

NOTE

To raise the “winch-out” pressure, turn the adjusting screw anti-clockwise. To lower the pressure turn the adjusting screw clockwise.

p. Using the winch remote control engage PTO high idle, run the winch in the direction of winching out the winch rope (with the free spool cylinder disengaged) and observe the overcentre valve “OUT” (Fig 367(2)) operating pressure on the gauge. The pressure reading should be exactly 10 bar higher than the overcentre valve “IN” operating pressure recorded in para n.

q. To adjust the overcentre valve “OUT” (Fig 367(2)) operating pressure, run the winch in the direction of winching out, undo the lock nut and adjust the overcentre valve “OUT” adjusting screw until the pressure indicated is exactly 10 bar higher than the overcentre valve “IN” operating pressure. Tighten the adjusting screw lock nut.

r. Run the winch in the direction of winching out and check that the overcentre valve “OUT” operating pressure (Fig 367(2)) is still exactly 10 bar higher than overcentre valve “IN” operating pressure, adjust as required.

s. Cease running the winch and disengage PTO high idle.

t. Using the winch remote control engage PTO high idle, run the winch in the direction of winching in the winch rope (with the free spool cylinder disengaged) and turn the sequence valve adjusting screw clockwise until there is a noticeable increase in the speed of the winch (the pressure gauge will also indicate an increase of pressure at that point). Turn the adjusting screw a further ½ a turn clockwise and lock the screw with the lock nut.

u. Cease running the winch and disengage PTO high idle.

WHEN ENGAGING THE FREE SPOOL CYLINDER OPERATE THE WINCH DRUM SLOWLY. OPERATING THE WINCH DRUM AT EXCESSIVE SPEED WILL CAUSE ACCELERATED WEAR TO THE WINCH DRUM AND THE FREE SPOOL CYLINDER LOCKING MECHANISM.

v. Operate the winch free spool switch and slowly pull out the winch rope until the free spool cylinder lock pin engages.

w. Disconnect the PTO and shut down the engine.

x. Disconnect the pressure gauge and hose (Table 1, Item 49) from the test connection (Fig 367(3)) and refit the dust cap.

y. Coat the adjusting screws for the overcentre and sequence valves with grease (XG-274).

z. Clean the mating surfaces of the protective caps and their respective valve bodies and apply a sealing compound (Silastic) to the surfaces.

aa. Install the protective caps on the overcentre and sequence valves.

WHEN REPOSITIONING THE IN/OUT FLEXIBLE HYDRAULIC HOSES ENSURE THERE IS CLEARANCE BETWEEN THE HOSES AND THE CAMOUFLAGE NET STORAGE PLATFORM PANELS. IF THE HOSES WERE TO CONTACT THE STORAGE PLATFORM PANELS DURING VEHICLE OPERATION ACCELERATED WEAR TO THE HOSES WILL OCCUR.
ab. Loosen the T-pieces (Fig 368(1)) connecting in/out flexible hydraulic hoses to the hydraulic valve block and reposition the hoses to their initial mounted position (Fig 370). Tighten the T-pieces after repositioning the hoses.

ac. Stow the winch ropes and at the same time, check the hose connections at the hydraulic valve block for leaks, rectify as required.

ad. Stow the winch remote control.

ae. Install the two camouflage net storage platform panels and secure with the eight M8 bolts fitted with spring and flat washers.

Figure 370 - Hydraulic Hoses - Original Position
Upper Winch Sheave (Front Winching)

212. **Removal**

a. Remove the winch rope/rat tail from the upper and lower sheaves.

**NOTE**
The upper sheave weighs about 10 kg, and must be supported while the sheave axle pin is removed/installed.

b. Remove the three outer M6 socket head screws (Fig 371(10)) and spring washers (Fig 371(9)) on the upper rope guide (Fig 371(2)) to provide a clearance for the removal of the upper sheave.

c. Remove the M6 socket head screw securing the outer side of the rope guide.

d. Remove the M8 bolt (Fig 371(13)), with spring washer (Fig 371(9)), securing the upper sheave axle pin.

e. Support the upper sheave and remove the upper sheave axle pin (Fig 371(12)). Use a M6 jacking screw in the threaded hole in the axle bracket if required.

f. Lift the upper sheave (Fig 371(6)) out of the upper rope guide (Fig 371(2)).
213. Installation

**CAUTION**

MOLYBDENUM DISULPHIDE BASED GREASE MUST NOT BE USED ON THE SHEAVE COMPONENTS. LUBRICATE THE PIVOT PIN LIBERALLY PRIOR TO INSTALLATION WITH A MINERAL OIL BASED GREASE (XG-274).

**NOTE**
The upper sheave weighs about 10 kg and must be supported while the sheave axle pin is removed/installed.

a. Position the upper sheave (Fig 371(6)) in its mounted position.

b. Install the upper sheave axle pin (Fig 371(12)).

c. Install the M8 bolt (Fig 371(13)), with spring washer (Fig 371(9)), securing the upper sheave axle pin. Torque the M8 bolt to 22 Nm.

d. Install the three outer M6 socket head screws (Fig 371(10)) on the upper rope guide (Fig 371(2)). Torque the screws to 9 Nm.

e. Install the M6 socket head screw securing the outer side of the rope guide. Torque the screw to 9 Nm.

f. Reeve the winch rope/rat tail to the front over the upper and lower sheaves (refer to the Operator Handbook).

214. Removal

a. Remove the winch rope/rat tail from the upper and lower sheaves.

**NOTE**
The lower sheave weighs 10 kg. The sheave must be suitably supported while the sheave axle pin is removed/installed.

b. Remove the six M6 socket head screws (Fig 371(10)), fitted with spring washers (Fig 371(9)), securing the lower sheave rope guide (Fig 371(8)) and remove the guide.

c. Remove the nut (Fig 371(3)), flat washer (Fig 371(4)) and M8 through bolt (Fig 371(5)) securing the lower sheave axle pin (Fig 371(11)) in the axle boss.

d. Support the lower sheave (Fig 371(7)) and remove the lower sheave axle pin. Use a hammer and brass drift if required.

e. Remove the lower sheave.

215. Installation

**CAUTION**

MOLYBDENUM DISULPHIDE BASED GREASE MUST NOT BE USED ON THE SHEAVE COMPONENTS. LUBRICATE THE PIVOT PIN LIBERALLY WITH A MINERAL OIL BASED GREASE (XG-274) PRIOR TO INSTALLATION.

**NOTE**
The lower sheave weighs 10 kg. The sheave must be suitably supported while the sheave axle pin is removed/installed.

a. Position the lower sheave (Fig 371(7)) to enable installation of the sheave axle pin.

b. Install the lower sheave axle pin (Fig 371(11)).

c. Install the M8 through bolt (Fig 371(5)), flat washer (Fig 371(4)) and nut (Fig 371(3)), securing the lower sheave axle pin in the axle boss. Torque the M8 through bolt to 22 Nm.

d. Install the lower sheave rope guide (Fig 371(8)) and secure with the six M6 socket head screws (Fig 371(10)) fitted with spring washers (Fig 371(9)). Torque the screws to 9 Nm.

e. Reeve the winch rope/rat tail to the front over the upper and lower sheaves (refer to the Operator Handbook).
Front Winch Rope Guide Tube

216. **Removal**

a. Remove the vertical and upper horizontal front winch rope guide rollers. Refer to the Operator Handbook.

b. Pull the winch rope/rat-tail back through and out of the winch rope guide tube (Fig 372(1)).

c. Remove the two M6 socket head screws (Fig 372(5)), spring washers (Fig 372(8)) and nuts (Fig 372(9)) securing the mounting bracket (Fig 372(6)) to the chassis.

d. Remove the two M6 socket head screws (Fig 372(2)) and spring washers (Fig 372(3)) securing the U-clamp (Fig 372(10)) to the chassis crossmember (Fig 372(11)).

e. Remove the winch rope guide tube (Fig 372(1)) from the vehicle.

217. **Installation**

a. Position the winch rope guide tube (Fig 372(1)) on the vehicle crossmember (Fig 372(11)) and fit the U-clamp (Fig 372(10)) and two M6 socket head screws (Fig 372(2)) fitted with spring washers (Fig 372(3)). Do not tighten at this stage.

b. Install the two M6 socket head screws (Fig 372(5)), spring washers (Fig 372(8)) and nuts (Fig 372(9)).

c. Torque the two M6 socket head screws (Fig 372(5)) to 9 Nm.

d. Tighten the remaining screws securely.

e. Reeve the winch rope/rat-tail to the front through the winch rope guide tube (refer to the Operator Handbook).

f. Fit the vertical and upper horizontal front winch rope guide rollers. Refer to the Operator Handbook.

![Figure 372 - Winch Rope Guide Tube](image-url)
Front Winch Rope Guide Channel

218. **Removal**

a. Move the winch rope/rat-tail out of the winch rope guide channel (Fig 373(3)).

b. Remove the two M8 socket head screws (Fig 373(2)) and flat washers (Fig 373(5)), securing the winch rope guide channel (Fig 373(3)) to the front rope window housing (Fig 373(1)).

c. Remove the M10 hex head bolt (Fig 373(8)) and spring washer (Fig 373(7)) securing the winch rope guide channel mounting bracket (Fig 373(6)) to the front of the steering box housing.

d. Remove the winch rope guide channel from the vehicle.

e. Remove the two M8 socket head screws (Fig 373(4)) and flat washers (Fig 373(5)) and separate the winch rope guide channel mounting bracket (Fig 373(6)) from the front winch rope guide channel.

219. **Installation**

a. Connect the winch rope guide channel mounting bracket (Fig 373(6)) to the front winch rope guide channel with the two M8 socket head screws (Fig 373(4)) and flat washers (Fig 373(5)). Do not tighten the screws at this stage.

b. Position the winch rope guide channel (Fig 373(3)) in the mounted position and fit the two M8 socket head screws (Fig 373(2)) fitted with flat washers (Fig 373(5)), securing the guide channel to the front rope window housing (Fig 373(1)).

c. Install the M10 hex head bolt (Fig 373(8)) fitted with a spring washer (Fig 373(7)), securing the rear guide channel mounting bracket (Fig 373(6)) to the front of the steering box housing.

d. Torque the M8 socket head screws (Fig 373(2) and (4)) to 22 Nm and the M10 hex head bolt (Fig 373(8)) to 44 Nm.

e. Reeve the winch rope/rat-tail to the front through the winch rope guide channel (refer to the Operator Handbook).

![Figure 373 - Winch Rope Guide Channel](image-url)
Winch Pressure/Tension Gauge

220. Removal

   a. Disengage the PTO and shut down the engine.

   b. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.

   c. Ensure the control levers are in a neutral position.

   d. Operate the battery isolation switch so that the batteries are isolated from the vehicle.

   e. Remove the four control panel mounting bolts (Fig 374(1)), fitted with flat and spring washers, securing the control panel to the inside wall of the cabinet. Move the panel out far enough to access connections on the rear of the panel.

   f. Clean the area around the hydraulic connection at the winch pressure/tension gauge (Fig 375(1)).

   g. Disconnect the hydraulic hose from the winch pressure/tension gauge. Cap open connections.

   h. Remove the three Phillips head gauge mounting screws (Fig 374(2)) and Nyloc nuts, securing the winch pressure/tension gauge to the control panel and remove the gauge. Note the orientation of the gauge.

221. Installation

   a. Position the winch pressure/tension gauge (in the orientation noted on removal) in the control panel and secure with the three Phillips head gauge mounting screws (Fig 374(2)) and Nyloc nuts. Note the orientation of the gauge.

   b. Connect the hydraulic hose to the gauge.

   c. Place the control panel in the mounted position and install the four control panel mounting bolts (Fig 374(1)) fitted with spring and flat washers. Torque the bolts to 16 Nm.

   d. Operate the battery isolation switch so that the batteries are connected to the vehicle.

   e. Operate the winch and check for leaks.
Control Panel Switches

222. **Removal**

a. Operate the battery isolation switch so that the batteries are isolated from the vehicle.

b. Remove the four control panel mounting bolts (Fig 375(12)), fitted with flat (Fig 375(8)) and spring washers (Fig 375(9)), securing the control panel to the wall of the locker. Move the panel out far enough to access connections on the rear of the panel.

c. Tag and disconnect the electrical connection/s to the switch to be replaced.

d. Remove the knurled nut (Fig 375(11)) securing the switch to the control panel and remove the switch.

e. Operate the battery isolation switch so that the batteries are connected to the vehicle.

f. Test the operation of the control panel switch.

**Hydraulic Control Solenoids**

**NOTE**

The six bank solenoids are located behind the remote control panel (Fig 376(2)) and the three bank solenoids (Fig 377(1)) are located behind the rear panel of the right hand front, lower, equipment bin (No. 8) (Fig 377 (2)).

224. **Removal**

a. Drain the three compressed-air receivers.

b. Ensure the PTO is disengaged.

c. Set the remote control selector switch to OFF. Ensure the front winching control switch (in cab) is set to OFF.

d. Ensure the hydraulic control levers are in a neutral position.

e. Operate the battery isolation switch so that the batteries are isolated from the vehicle.
f. Remove the four M8 bolts fitted with flat and spring washers securing the panel (Fig 376(2)) for the six bank solenoid panel (the three bank solenoid panel is not pictured) to the wall of the cabinet. Lower the panel to expose the solenoids mounted on the inner wall (Figs 376(1) and 377(1)).

g. Clean the area around the connection at the solenoids unit.

h. Tag and disconnect the electrical connections to the solenoid bank (Figs 376(1) and 377(1)).

i. Tag and disconnect the pneumatic connections to the solenoid bank.

j. Remove the two M5 Phillips head screws, flat washers and Nyloc nuts securing the solenoid bank to the wall and remove the solenoid bank.

225. Installation

a. Connect the pneumatic connections, previously tagged on removal, to the solenoid bank.

b. Connect the electrical connections (previously tagged) to the solenoid bank. Refer to Figure 356.

c. Install the solenoid bank (Figs 376(1) and 377(1)) to the inner wall with the two M5 Phillips head screws, flat washers and Nyloc nuts. Tighten the screws securely.

d. Operate the battery isolation switch so that the batteries are connected to the vehicle.

e. Run the engine and charge the pneumatic system.

f. Test the operation of the solenoids and check for leaks.

g. Install the panel (see Fig 376(2)) for the six bank solenoid panel (the three bank solenoid panel is not pictured) on the rear locker wall and secure with the four bolts, fitted with flat and spring washers. Torque the bolts to 16 Nm.
### Table 13 - Fault Finding - Winches

<table>
<thead>
<tr>
<th>Symptom</th>
<th>Probable Cause</th>
<th>Action/Remedy</th>
</tr>
</thead>
<tbody>
<tr>
<td>Winch speed changes</td>
<td>Directional Control Valve</td>
<td>Check operation of control linkage and ensure freedom of movement and full range of travel possible.</td>
</tr>
<tr>
<td></td>
<td>PTO high idle RPM low</td>
<td>Adjust PTO high idle linkage.</td>
</tr>
<tr>
<td></td>
<td>Hydraulic Pump</td>
<td>Test hydraulic pumps (refer to MOB SPO for test procedure and special tools).</td>
</tr>
<tr>
<td>Both winches spool IN at different speeds with the same load</td>
<td>Sequence valve</td>
<td>Check and adjust the sequence valve</td>
</tr>
<tr>
<td>Winch does not pull rated load</td>
<td>Sequence valve</td>
<td>Check and adjust the sequence valve</td>
</tr>
<tr>
<td></td>
<td>Flat rating device</td>
<td>Refer to MOB SPO for test procedure and special tools.</td>
</tr>
<tr>
<td>Both winches spool OUT at different speeds with the same load</td>
<td>Overcentre valves</td>
<td>Check and adjust overcentre valves</td>
</tr>
<tr>
<td>Winch in/out speeds unsatisfactory after adjustment or replacement of overcentre or sequence valve</td>
<td>Hydraulic motors</td>
<td>Replace faulty hydraulic motor.</td>
</tr>
<tr>
<td></td>
<td>One-way clutch</td>
<td>Replace one-way clutch</td>
</tr>
<tr>
<td>Winch brake chatters</td>
<td>Overcentre valves</td>
<td>Check and adjust overcentre valves</td>
</tr>
<tr>
<td></td>
<td>Winch out of calibration</td>
<td>Calibrate winch</td>
</tr>
<tr>
<td>Winches do not operate</td>
<td>PTO</td>
<td>Check PTO is engaged</td>
</tr>
<tr>
<td></td>
<td>Winch drive unit</td>
<td>Replace winch drive unit</td>
</tr>
<tr>
<td></td>
<td>Winch gearbox</td>
<td>Replace winch.</td>
</tr>
<tr>
<td>Winch free spool does not engage/disengage</td>
<td>Free spool cylinder connection has air leak</td>
<td>Repair air leak.</td>
</tr>
<tr>
<td></td>
<td>Free spool cylinder partially/fully seized</td>
<td>Service the free spool cylinder piston. Check adjustment of free spool cylinder.</td>
</tr>
<tr>
<td></td>
<td>Free spool cylinder control circuit faulty</td>
<td>Check electrical circuit switches and solenoids.</td>
</tr>
</tbody>
</table>