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

Introduction
1. This EMEI contains procedures for removing, dismantling, repairing, assembling and installing various components of the Truck, Cargo, Medium, MC2 – Unimog including winch models. Where applicable, instructions for the adjustment, lubrication and minor servicing of these items are included.

CAUTION

Do not use adhesive tapes to seal fuel or oil openings. The adhesive tape is soluble in fuel or oil and can cause contamination. Remove temporary covers before assembling.

2. Prevent dirt and foreign objects from entering any component by placing clean temporary coverings over all exposed openings, including hoses, tubes and lines.

CAUTION

Before removing any electrical system components, disconnect the battery leads.

3. When disconnecting electrical connectors, hoses and fittings, remove clamps, as required, to gain slack and avoid damage to connectors and fittings.

WARNING

Asbestos is a hazardous material and a carcinogen. Airborne asbestos fibre poses a serious danger to personnel and can lead to acute health concerns and eventual death.

The Unimog Family of Vehicles (FOV) was originally fitted with a number of gaskets, seals and washers known to have contained asbestos.

Since 2009, all genuine OEM supplied gaskets, seals and washers are asbestos free. If it is unknown as to whether the material contains asbestos, such items are to be removed, handled and disposed of in accordance with EMEI Workshop E 410.

4. Discard all used gaskets, seals, cotter pins, tab washers, lock pins, key washers and lock washers. Discard all contaminated fuel and lubricants drained from the vehicle.

5. Use only those fuels and lubricants specified in the Servicing Instruction, EMEI Vehicle G 609, the User Handbook and this EMEI when replenishing fuel or lubricants.

6. Any fastenings or fittings being tightened to prescribed torques are to have dry, clean threads unless otherwise specified. When specified, thread sealants are to be applied to dry, clean, oil free threads.

WARNING

Precautions should be taken prior to carrying out repairs which include painting, sanding, scraping or welding. Refer to EMEI Workshop D 701 – Repair Policy for Equipment Painted in Polyurethane Paint.

7. This vehicle is painted in polyurethane paint.
8. Before removing any pneumatic components from the vehicle, exhaust the compressed air tanks.

**WARNING**

The compressed air tanks are pressure vessels. Under no circumstances are they to be heated, brazed or welded. A damaged compressed-air receiver can explode when pressurised.

**Personnel**

9. Maintenance is to be carried out by Vehicle Mechanic ECN 229, Technical Electrician ECN 418, GSEFITT or civilian equivalent.

**Associated Publications**

10. Reference may be necessary to the latest version of the following documents:

**WARNING**

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

The handling, storage and use of chemical substances are to be in accordance with SAFETYMAN, MSDS and EMEI Workshop series requirements.

a. Defence Road Traffic Instructions;
b. Defence Safety Manual (SAFETYMAN);
c. SCES 010573 – Tool Kit, General, Mechanic, Truck Maintenance (Unimog);
d. SCES 012469-01 – Tilting Kit, Cabin Vehicular, C/W CES Items;
e. SCES 010613 – Threading Set, Screw Metric, Tap and Die, Cased, Unimog;
f. SCES 010788 – Personnel, Stores and Ammunition Module Kit for Fitment to the Unimog Truck Cargo Medium with Twistlocks C/W CES Items;
g. SCES 011753 – Truck Cargo Medium, Unimog WO/Winch;
h. SCES 011755 – Truck Cargo Medium, Unimog W/Winch;
i. SCES 011756 – Truck Cargo Medium, Unimog W/ Crane;
j. SCES 012072 – Truck Cargo Medium, Unimog W/Twistlocks, WO/Winch;
k. SCES 012105 – Equipment Kit, Vehicular, Truck, Medium, MC2 – Unimog;
l. **EMEI Vehicle A 019-1** – General Information – Replacement of Vehicle Speedometers/ Hourmeters and Trailer Odometers – Miscellaneous Instruction;
m. **EMEI Vehicle A 029-2** – Vehicles – General – Road Testing of Medium and Heavy B Vehicles and Combinations – General Instruction;

n. **EMEI Vehicle A 049-1** – Towing Pintle Hooks – Medium and Heavy General Service B Vehicles – Inspection and Repair – Miscellaneous Instruction;

r. **EMEI Vehicle G 600** – Truck, Cargo, Medium, MC2 and Truck, Cargo, Medium, Winch, MC2 – Data Summary;
s. **EMEI Vehicle G 602** – Truck, Cargo, Medium, MC2 and Truck, Cargo, Medium, Winch, MC2 – Technical Description;
t. **EMEI Vehicle G 609** – Truck, Cargo, Medium, MC2, Unimog – All Types – Servicing Instruction;
u. **EMEI Workshop D 701** – Repair Policy for Equipment Painted in Polyurethane Paint;
v. **EMEI Workshop E 410** – Occupational Health and Safety – Asbestos – General Instruction;
w. RPS 02155 (Base Scale);
x. RPS 02156 (Cargo, w/winch);
y. RPS 02157 (Cargo, w/crane);
z. RPS 02158 (Dump);
aa. RPS 02202 (Cargo, w/o winch, w/twist locks);
bb. RPS 02204 (Cargo, w/winch, w/twist locks); and
c. RPS 02205 (Cargo, w/crane, w/twist locks).

**11.** A number of modifications and improvements have been made during the service life of the vehicle. Reference to the following EMEI may be required during repair activities:

a. **EMEI Vehicle G 607-1** – Brushguard;
b. **EMEI Vehicle G 607-2** – Horn Relocation;
c. **EMEI Vehicle G 607-3** – Hydraulic Jack Stowage Bracket;
d. **EMEI Vehicle G 607-4** – Tray Seating Grab Handle;
e. **EMEI Vehicle G 607-6** – Centre Seating;
f. **EMEI Vehicle G 617-2** – Coolant Header Tank;
g. **EMEI Vehicle G 617-3** – Clearance Light Wiring;
h. **EMEI Vehicle G 617-4** – Accelerator Pedal Stop Bolt;
i. **EMEI Vehicle G 617-6** – Brake Calliper Protection Shrouds;
j. **EMEI Vehicle G 617-7** – Change of Engine Shutdown Method;
k. **EMEI Vehicle G 617-9** – Fuel Tank Drain Plug;
l. **EMEI Vehicle G 617-10** – Accelerator Stop Pedal Cross Shaft;
m. **EMEI Vehicle G 617-11** – Lifting and Tie Down Attachments;
n. **EMEI Vehicle G 617-12** – Water Pump Jockey Pulley Bracket;
o. **EMEI Vehicle G 617-13** – Trays Seat Legs and Stowage Strap;
p. **EMEI Vehicle G 617-14** – Brake Airline Chaffing;
q. **EMEI Vehicle G 617-15** – Clutch Output Shaft Bearing;
r. **EMEI Vehicle G 617-16** – Clutch Master Cylinder Removal;
s. **EMEI Vehicle G 617-18** – Tray Floor Headboard Assembly;
t. **EMEI Vehicle G 617-20** – Engine Warning Device;
u. **EMEI Vehicle G 617-23** – Fitting Additional Blackout Driving Light;
v. **EMEI Vehicle G 617-24** – Transmission Oil Distribution Pipe;
w. **EMEI Vehicle G 617-25** – Fitting of Austeyr Weapon Brackets;
x. **EMEI Vehicle G 617-26** – Handbrake Lever;
y. **EMEI Vehicle G 617-29** – Transmission Shift Mechanism; and
z. **EMEI Vehicle G 617-36** – Fitting of 12.5 Tonne Trailer Safety Chain Mounts.
Special Tools

12. Many of the procedures described in this EMEI require the use of special tools, jigs or fixtures. The special tools required are listed in Table 1 and illustrated in Figure 1.
Table 1  Special Tools

<table>
<thead>
<tr>
<th>Serial</th>
<th>Part No</th>
<th>NSN</th>
<th>Item name</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>SCES 012469-01</td>
<td>2510-66-157-7384</td>
<td>Tilting Kit, Cabin, Vehicular C/W CES items (not shown)</td>
</tr>
<tr>
<td>1.1</td>
<td>435 589 01 63 02</td>
<td>4320-12-176-7451</td>
<td>Pumping Unit, Hydraulic, Hand Driven, Cabin Tilt</td>
</tr>
<tr>
<td>1.2</td>
<td>435 589 01 63 01</td>
<td>3040-12-177-0553</td>
<td>Cylinder Assembly, Actuating, Linear cabin tilt</td>
</tr>
<tr>
<td>1.3</td>
<td>YA 435 550 00 75</td>
<td>5315-66-147-6683</td>
<td>Pin, Cable, Lock, Cabin Lift Assembly</td>
</tr>
<tr>
<td>1.4</td>
<td>YA435 553 00 00</td>
<td>4030-66-156-8299</td>
<td>Shackle Bow, 6mm nom size, c/w screw pin (x2)</td>
</tr>
<tr>
<td>1.5</td>
<td>437 589 04 63 00</td>
<td>4010-66-156-7737</td>
<td>Wire Rope Assembly, Single Leg</td>
</tr>
<tr>
<td>2</td>
<td>435 589 00 63 00</td>
<td>4910-12-176-6860</td>
<td>Stay, Cabin Tilting</td>
</tr>
<tr>
<td>3</td>
<td>406 589 04 15 00</td>
<td>5120-12-176-6853</td>
<td>Peg, Installation Mandrel (for use with special tools 4, 14, 15 and 16)</td>
</tr>
<tr>
<td>4</td>
<td>355 589 00 33 00</td>
<td>5120-01-243-5333</td>
<td>Puller, Mechanical, Steel, for removal of drive gear and timing assembly</td>
</tr>
<tr>
<td>5</td>
<td>435 589 00 43 00</td>
<td>4910-12-177-0961</td>
<td>Remover/Replacement Tool, Timing Seal</td>
</tr>
<tr>
<td>6</td>
<td>352 589 07 15 00</td>
<td>5120-01-243-1255</td>
<td>Inserter, Seal</td>
</tr>
<tr>
<td>7</td>
<td>YA435 581 00 00</td>
<td>5120-66-156-3511</td>
<td>Installer, Engine Mount Sleeve</td>
</tr>
<tr>
<td>8</td>
<td>001 589 83 21 00</td>
<td>4910-12-324-4645</td>
<td>Tester, Pressurized Container, Leakage (pressure tester radiator/radiator cap)</td>
</tr>
<tr>
<td>9</td>
<td>435 589 00 25 00</td>
<td>NIC</td>
<td>Pressure Tester, Coolant Tank Adaptor</td>
</tr>
<tr>
<td>10</td>
<td>000 589 68 03 00</td>
<td>5120-12-176-4841</td>
<td>Crowfoot Attachment, Socket, Wrench, Injector Pipe Cap-Nut</td>
</tr>
<tr>
<td>11</td>
<td>425 589 03 31 00</td>
<td>5120-12-333-5943</td>
<td>Spring Compressor, Clutch Pedal</td>
</tr>
<tr>
<td>12</td>
<td>425 589 00 90 00</td>
<td>4730-12-176-7572</td>
<td>Adaptor, Connector, Cabin (bleed clutch master cylinder)</td>
</tr>
<tr>
<td>13</td>
<td>AAMCO Tools 7400</td>
<td>4910-66-092-8669</td>
<td>Pressure Bleeder, AAMCO 7400 (R2D2)</td>
</tr>
<tr>
<td>14</td>
<td>425 589 11 43 00</td>
<td>5120-12-176-6855</td>
<td>Installer, Transmission Input Shaft Seal</td>
</tr>
<tr>
<td>15</td>
<td>435 589 01 43 00</td>
<td>5120-12-176-6849</td>
<td>Tool, Installing, Steel (press tool)</td>
</tr>
<tr>
<td>16</td>
<td>435 589 02 43 00</td>
<td>5120-12-174-6850</td>
<td>Press Tool</td>
</tr>
<tr>
<td>17</td>
<td>001 589 43 33 00</td>
<td>5120-12-176-7184</td>
<td>Puller, Disk Brake Pad, With Slide Hammer</td>
</tr>
<tr>
<td>18</td>
<td>000 589 52 43 00</td>
<td>5120-12-176-7183</td>
<td>Spreader, Piston Brake Calliper</td>
</tr>
<tr>
<td>19</td>
<td>001 589 69 09 00</td>
<td>5120-12-158-5319</td>
<td>Screwdriver Attachment, Socket Wrench, Hex Key 17 mm</td>
</tr>
<tr>
<td>20</td>
<td>425 589 01 15 00</td>
<td>5120-12-369-7402</td>
<td>Drift Pin (guide, disc brake, Qty 2)</td>
</tr>
<tr>
<td>21</td>
<td>001 589 68 09 00</td>
<td>5120-12-158-5318</td>
<td>Screwdriver Attachment, Socket Wrench, Hex Key 14 mm</td>
</tr>
<tr>
<td>22</td>
<td>000 589 03 25 00</td>
<td>4910-12-170-6443</td>
<td>Adaptor, Aluminium Closure Lid NR048, for expansion tank brake fluid (Qty 2)</td>
</tr>
<tr>
<td>23</td>
<td>000 589 02 25 00</td>
<td>4720-66-112-9326</td>
<td>Hose Bleeder Kit (brake master cylinder bleed)</td>
</tr>
<tr>
<td>24</td>
<td>000 589 40 33 00</td>
<td>5120-12-146-2825</td>
<td>Adaptor, Remover</td>
</tr>
<tr>
<td>25</td>
<td>406 589 05 33 00</td>
<td>5120-12-176-6772</td>
<td>Puller, Mechanical, Drag Link Remover</td>
</tr>
<tr>
<td>26</td>
<td>387 589 02 37 00</td>
<td>5120-12-181-6233</td>
<td>Wrench, Pliers, 250 mm long</td>
</tr>
<tr>
<td>27</td>
<td>637-589-00-15-00</td>
<td>NIC</td>
<td>Tool, Mandrel, Plug And Socket</td>
</tr>
<tr>
<td>28</td>
<td>425 589 00 43 00</td>
<td>5120-12-333-5736</td>
<td>Tool, Installing Bearing And Seal Ring</td>
</tr>
<tr>
<td>29</td>
<td>425 589 04 14 00</td>
<td>5120-12-333-5740</td>
<td>Remover and Installer Tool</td>
</tr>
<tr>
<td>30</td>
<td>425 589 01 15 00</td>
<td>5315-12-333-3997</td>
<td>Guide, Disc Brake And Hub (Qty 2)</td>
</tr>
</tbody>
</table>
Figure 1  Special Tools
Figure 1  Special Tools (Continued)
Figure 1  Special Tools (Continued)
Figure 1  Special Tools Continued)
Lubricants

13. Table 2 lists the lubricants used on the Unimog, Family of Vehicles (FOV).

<table>
<thead>
<tr>
<th>Serial</th>
<th>Equipment</th>
<th>Lubricant</th>
<th>Capacity (Litres)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Engine (including filter)</td>
<td>SAE Grade 40 (OMD-115)</td>
<td>15</td>
</tr>
<tr>
<td>2</td>
<td>Transmission</td>
<td>SAE Grade 40 (OMD-115)</td>
<td>10.5</td>
</tr>
<tr>
<td>3</td>
<td>Power take-off</td>
<td>SAE Grade 40 (OMD-115)</td>
<td>5.75</td>
</tr>
<tr>
<td>4</td>
<td>Front axle</td>
<td>OEP-220</td>
<td>2.5</td>
</tr>
<tr>
<td>5</td>
<td>Rear axle</td>
<td>OEP-220</td>
<td>2.3</td>
</tr>
<tr>
<td>6</td>
<td>Front wheel hub drives</td>
<td>OEP-220</td>
<td>0.6 each</td>
</tr>
<tr>
<td>7</td>
<td>Rear wheel hub drives</td>
<td>OEP-220</td>
<td>0.6 each</td>
</tr>
<tr>
<td>8</td>
<td>Brake master cylinder</td>
<td>OX-8</td>
<td>Fill to level</td>
</tr>
<tr>
<td>9</td>
<td>Clutch master cylinder</td>
<td>OX-8</td>
<td>Fill to level</td>
</tr>
<tr>
<td>10</td>
<td>Steering system</td>
<td>OEP-220</td>
<td>2.25</td>
</tr>
<tr>
<td>11</td>
<td>Wheel bearings</td>
<td>XG-291</td>
<td>As required</td>
</tr>
<tr>
<td>12</td>
<td>Brake assembly</td>
<td>XG-276</td>
<td>As required</td>
</tr>
<tr>
<td>13</td>
<td>Winch cable</td>
<td>Rocol wire rope lube NSN 9510-99-337-1498</td>
<td>As required</td>
</tr>
<tr>
<td>14</td>
<td>Radiator inhibitor</td>
<td>TEC PG-XL</td>
<td>Premixed Product. Fill until the coolant expansion tank is two-thirds full</td>
</tr>
<tr>
<td>15</td>
<td>Winch</td>
<td>OEP-220</td>
<td>2.0</td>
</tr>
</tbody>
</table>

Access for Repair

14. To gain access to certain vehicle components, it may be necessary to remove the following:
   a. bonnet (Para 17);
   b. radiator grille (Para 19);
   c. brushguard (Para 21); and
   d. brushguard mounting bracket (Para 23).

15. It may also be necessary to raise the cabin (Para 25).

16. To access the bonnet, radiator grille and battery box a budget key socket is provided.

Bonnet

17. **Removal.** Remove the bonnet as follows:
   a. release the two forward bonnet catches,
   b. lift the bonnet to the vertical position,
   c. release the three remaining bonnet hinge catches,
   d. lower the bonnet sufficiently to clear the rear hinges, and
   e. lift off the bonnet.

18. **Installation.** Install the bonnet as follows:
   a. position the bonnet over the rear hinges,
   b. raise the bonnet sufficiently to permit the rear hinge catches to be engaged, and
   c. lower the bonnet and lock two forward bonnet catches.
Radiator Grille

NOTE
The radiator grille may be removed with the brushguard fitted.

19. Removal. Remove the radiator grille as follows:
   a. release the two grille catches using the bonnet key,
   b. pull outwards from the top of the grille to disengage catches, and
   c. pull upwards on the grille to withdraw the assembly and lift out.

20. Installation. Install the radiator grille as follows:
   a. fit the grille lower catches,
   b. tilt the grille back towards the cabin to engage the top catches,
   c. using the bonnet key, lock the two grille catches.

Brushguard

21. Removal. Remove the brushguard as follows:
   a. remove the two nuts and bolts from the support arms,
   b. loosen the locking bolts on the two pipe brackets, and
   c. lift off the brushguard.

22. Installation. Install the brushguard as follows:
   a. fit the brushguard,
   b. fit the brushguard support arms to the outside of the fixing brackets,
   c. insert and tighten the two nuts and bolts, and
   d. tighten the locking bolts on the two pipe brackets.

Brushguard Mounting Bracket

23. Removal. Remove the brushguard mounting bracket as follows:
   a. remove the radiator grille and brushguard (Paras 19 and 21);
   b. remove the three retaining bolts securing the brushguard mounting bracket to the chassis rails; and
   c. remove the brushguard mounting bracket.

24. Installation. Install the brushguard mounting bracket as follows:
   a. position the brushguard mounting bracket on the vehicle so that the bolt holes are aligned;
   b. install and tighten the three retaining bolts; and
   c. fit the radiator grille and brushguard (Paras 20 and 22).
Raising and Lowering the Cabin

WARNING

Ensure the cabin safety support bar is installed prior to carrying out any work on the vehicle with the cabin raised.

Personnel are to stay clear of the area between the cabin and the chassis whilst the cabin is in the raised position and unsupported.

Personnel are not to stand in front of the cabin whilst it is being raised.

Personnel are to stay clear of the area between the cabin and the chassis whilst the cabin is being lowered.

When using overhead lifting facilities to raise or lower the cabin, ensure that only the tilting weight of the cabin is supported by the overhead lifting facilities. Do not overload the lifting eye on the cabin roof as this may lead to failure of the eye.

Prior to raising the cabin with overhead lifting facilities, install the restraining cable in accordance with paras 25.y to 25.cc and 25.ff to 25.gg.

After raising the cabin using overhead lifting facilities, install the safety support stay in accordance with paras 25.oo to 25.rr.

NOTE

The cabin is raised and lowered using the cabin lift kit (Table 1, Item 1) or overhead lifting facilities. The preferred method is to use the cabin lift kit where possible.

Prior to using overhead lifting facilities inspect the lifting eye for cracks or deformation. If cracks or deformation are found do not use the lifting eye.

25. Raising the Cabin. Raise the cabin as follows:

CAUTION

Before raising the cabin, ensure that the park brake is applied and the front and rear wheels are chocked.

a. Apply the park brake.
b. Chock the vehicle wheels.
c. Remove all loose objects from inside the cabin.
d. Position the transmission gear lever in the neutral position, centred in the middle of the gear gate.
e. On the dump variant, disconnect the load gauge.
f. Close both doors.
g. Remove the bonnet, radiator grille and brushguard (Para 14).
h. Disconnect the generator output cable.
i. Remove the generator drive belt.
j. Remove the generator rear mounting clamp.
k. Loosen the generator front mounting clamp.
l. Rotate the generator to allow the electrical box and Canon plug on the generator to slide forward of the rear bracket.
m. Slide the generator forward.
n. Loosen the worm drive clamp and detach the air intake line from the air cleaner.
o. Loosen the worm drive clamp and detach the compressor intake hose from the air cleaner.

p. Disconnect the temperature sensor wire.

q. Remove the two cabin heater lines from their retaining brackets.

r. Remove the locking pin from the front cabin tilting hinge on both sides of the vehicle (Figure 2).

s. Rotate the hinges upwards and over the two pivot bars on either side of the cabin.

t. Reinsert the locking pins.

u. Remove the front retaining bolts in the foot-well on both sides of the cabin (Figure 3).

v. Remove the rear retaining bolts located beneath each seat base (Figure 4).
Inspect the cabin lift assembly as follows:

(1) Check that the cabin lift kit is in-date for technical inspection and is classified “FF-Fully Functional”.

(2) Check that the hydraulic reservoir has the correct oil (OM-15 or PX-26).

**CAUTION**

Ensure that the cabin tilt hydraulic cylinder is fully retracted before checking the fluid level in the hydraulic pump reservoir.

(3) Check that the hydraulic reservoir is filled to the correct level.

(4) Check that all hoses are serviceable.

(5) Check that both the quick-disconnect couplings are serviceable and seated correctly.

**CAUTION**

Ensure that the upper hose coupling points downwards.

Align the cabin tilt cylinder (Table 1, Item 1.2) with the cabin pivot yoke located on the underside of the cabin to the rear of the left-hand front wheel (Figure 5).

Secure the cabin tilt cylinder to the cabin pivot yoke by inserting the locking pin (Table 1, Item 1.3) as shown in Figure 6.
z. To secure the locking pin, insert a lynch pin through the inner hole of the locking pin (Figure 6).

aa. Fit the shackle (Table 1, Item 1.4) to a loop in the end of the restraining cable (Table 1, Item 1.5).

bb. Slide the shackle (Figure 7, Item 1) with restraining cable (Figure 7, Item 2) onto the locking pin, outboard of the locking pin handle as shown in Figure 7.

c. Fit the lynch pin through the bracket on the vehicle and through the locking pin.

dd. Attach the cabin tilt cylinder to the chassis pivot bar located at the bottom of the lower left-hand step (Figure 8).
ee. Secure the cylinder to the chassis pivot bar with the lynch pin (Figure 9).

ff. Wrap the loose end of the restraining cable around the lower left-hand step mounting bracket; through the cut-out in the heat shield and between the upper bracket and the chassis rail (Figure 10).

gg. Secure the cable on itself with a shackle (Table 1, Item 1.4) (Figure 10).
When using overhead lifting facilities in conjunction with the lifting eye at the centre rear of the cabin, the restraining cable must be secured to the left-hand step mount inboard of the heat shield (Figure 11) and to the cabin pivot yoke (Figure 10) before commencing to tilt the cabin. Failure to do so may result in the cabin tipping over-centre and causing injury to personnel and damage to the vehicle.

![Figure 11 Restraining Cable Secured to Cabin](image1)

**hh.** Attach the hydraulic pump to the lower left-hand step (Figure 12) and tighten the two wing-nuts (Figure 12, Item 2).

![Figure 12 Reservoir Mounting and Control Lever](image2)

**ii.** Remove the covers from the hose couplings and connect the hydraulic hoses to the couplings.

**WARNING**

Ensure the control lever is positioned hard against the stops in the intended direction of travel.

**jj.** Move the control lever on the pump (Figure 12, Item 1) to the Heben (raise) position.
kk. Insert the pump handle into the socket on the pump.

**WARNING**

The handle is to be operated with full and deliberate strokes.

Monitor the cabin whilst operating the handle to ensure that the cabin continues to move in the intended direction of travel with each stroke. If the cabin does not continue to move in the intended direction of travel, lower the cabin, remove the cabin lift assembly and check the cabin lift assembly for serviceability.

ll. Operate the pump handle and raise the cabin sufficiently to facilitate fitting the upper bolt, from inside the cabin.

mm. Insert a cabin retaining bolt through the right-hand rear cabin mount in the cabin (upper bolt).

nn. Raise the cabin until it is over-centre.

oo. Fit the upper end of the cabin safety support stay (Table 1, Item 2) over the upper bolt.

pp. Lower the cabin whilst guiding the lower part of the safety support stay over the cabin mounting on the right-hand side of the chassis (Figure 13).

Figure 13 Safety Support Stay Installation

qq. Secure the lower part of the stay with a cabin-retaining bolt (Figure 14, Item 2).
rr. Secure the upper part of the safety support stay using a suitable metric nut with same thread pitch as the cabin mounting bolt (Figure 15).

---

**WARNING**

If the cabin is to be left for a period longer than 3 hrs in the raised position, the cabin tilt hydraulic cylinder is to be removed and fully retracted until required for lowering the cabin. Lowering the lift cylinder when not needed prevents possible bleed down of hydraulic fluid and ensures the lift cylinder is operational when required for cabin lowering.

26. **Lowering the Cabin.** Lower the cabin as follows:

   a. Check that the transmission gear change lever is in the neutral position.

   b. Remove the safety support stay bolt on the chassis (Figure 14, Item 2) and the nut on the upper bolt (Figure 15).
Ensure the control lever is positioned hard against the stop for the intended direction of travel.

c. Insert the pump handle into the socket on the hydraulic pump.

d. Operate the pump handle and raise the cabin sufficiently to allow removal of the safety support stay.

e. Remove the safety support stay.

f. Move the hydraulic pump control lever to the Senken (lower) position.

**WARNING**

When lowering the cabin, no personnel are to be under the cabin.

The handle is to be operated with full and deliberate strokes.

The steering shaft alignment procedure must be carried out from the front of the vehicle by a second person.

**CAUTION**

When lowering the cabin, the steering shaft has a master spline, which must be aligned with the missing tooth on the spring loaded, plastic gear splined section of the shaft.

g. Operate the pumping handle and slowly lower the cabin while aligning the steering shafts.

h. Fit the splined portion of the steering shaft into the sliding joint (Figure 16).

![Figure 16 Steering Shaft Alignment](image)

i. Continue to lower the cabin ensuring smooth engagement of the steering shaft and sliding joint spline.

j. Refit the steering shaft sliding joint boot.

k. Check that the air intake and the cabin heater hoses are free from obstruction.

**NOTE**

While lowering the cabin, ensure that it sits squarely with the chassis and clears the handbrake lever and the main transmission gear shift lever as it is lowered.

Ensure the mudflaps do not become caught on the steps (guide the mudflaps clear of the steps if required).

l. Disconnect the hydraulic pump hoses via the quick-disconnect couplings at the cabin tilt cylinder and fit the protective caps and plugs to the fittings.
m. Disconnect the lynch pin and remove the restraining cable and shackle from the locking pin at the cabin pivot yoke (Figure 7).

n. Disconnect the lynch pin and remove the locking pin securing the cabin tilt cylinder to the cabin pivot yoke (Figure 6).

o. Disconnect the lynch pin securing the cabin tilt cylinder on the lower pivot bar (Figure 9).

p. Remove the cabin tilt cylinder from the vehicle.

q. Remove the restraining cable and shackle from the left-hand step mount (Figure 10).

r. Unscrew the two wing nuts and remove the hydraulic pump from the vehicle.

s. Install the front retaining bolts (short) in the foot-wells on both sides of the cabin (Figure 3).

t. Torque the bolts to 210 N.m.

u. Install the rear retaining bolts (long) beneath the seats on both sides of the cabin (Figure 4).

v. Torque the bolts to 210 N.m.

w. Remove the locking pins and lynch pins from the two front cabin tilting hinges.

x. Rotate the hinges downwards and off the pivot bars.

y. Insert the locking pins and lynch pins to secure the hinges in place.

z. Reposition the generator.

aa. Refit the generator rear clamp.

bb. Tighten the front generator clamp bracket.

cc. Reconnect the generator output cable.

dd. Re-install the generator drive belt.

ee. Re-tension the drive belt (Para 50).

ff. Attach the air intake hose to the air cleaner and tighten the worm drive clamps.

gg. Attach the compressor intake hose to the air cleaner and tighten the worm drive clamp.

hh. Reconnect the engine temperature sensor wire.

ii. Secure the heater lines in their retaining brackets.

jj. Start and run the engine for a brief period checking for any leaks (repair if necessary).

kk. Fit the radiator grille, bonnet and brushguard (Para 14).

Jacking Procedures

**WARNING**

Personnel are to stay clear of the area between the wheels and the chassis whilst the vehicle is in the raised position and unsupported by axle stands.

Do not work underneath a raised vehicle without it being supported on axle stands.

Check that the jack and axle stands have in-date useability labels indicating all items are classified ‘FF-Fully Functional’.
27. **Jacking the Vehicle.** Jack the vehicle as follows:

**CAUTION**
Before jacking the vehicle, ensure that the park brake is applied and the wheels that are not to be raised are chocked.

a. Park the vehicle on a suitable flat, level hard standing area.
b. Apply the park brake.
c. Position the transmission gear lever in the neutral position.
d. Ensure the vehicle ignition is turned off.
e. Chock the wheels that are not to be raised.
f. Select the jack to be used, either:

1. A trolley jack with a minimum of 4 tonne capacity; or

**WARNING**
Prior to using the vehicle CES jack, ensure the correct, concave fixed head is fitted and not a round swivel head. A vehicle CES jack with a round swivel head is to be classified ‘Do Not Use – XX’ and replaced.

2. The vehicle CES jack (NIIN 66-113-7917).

g. Visually inspect the jack for useability.
h. Position the jack as follows:

**WARNING**
The front axle is not to be raised by a central position unless both front wheels are fitted. If a wheel is to be removed for maintenance, the wheel nuts are to be loosened half a turn prior to raising the axle.

1. **Trolley Jack.** Position the trolley jack centrally under the vehicle and at 90 degrees to the axle assembly (Figure 17).

![Figure 17 Trolley Jack Positioned](image)

2. **Vehicle CES Jack.** Position the vehicle CES jack as follows (Figure 18):
NOTE
The front axle is raised by placing the CES jack centrally below the axle (Figure 18). The rear axle is raised one side at a time by placing the CES jack as close as possible to the wheel to be raised whilst allowing room for the axle stand to be placed next to the wheel once raised.

![Vehicle CES Jack Positioned – Front Axle](image1)

**Figure 18** Vehicle CES Jack Positioned – Front Axle

(a) Position the Support Platform, Jack Elevating Block, Base Plate, Steel NSN 4910-66-117-2503 under the vehicle at the jacking position.

(b) Position the Base Plate Jack Wood, Chamfered edges, Fitted W2 Coach Bolts NSN 5120-66-048-8539 on the steel base plate.

(c) Position the Vehicle CES jack on the wooden block.

i. Operate the jack until the jack ‘takes the weight’ of the vehicle.

j. Visually recheck the alignment of the jack (Figure 19).

![Jack Alignment](image2)

**Figure 19** Jack Alignment

k. Continue to operate the jack until the vehicle is evenly raised (Figure 20).
Use of Axle Stands

28. After raising the vehicle as described in Para 27, place the vehicle on axles stands as follows:

Personnel are to stay clear of the area between the wheels and the chassis whilst the vehicle is in the raised position and unsupported by axle stands.

Do not work underneath a raised vehicle unless it is being supported on axle stands.

a. Visually inspect the axle stands for useability.
b. Set the axle stand to the correct height.
c. Insert the locking pin, ensuring it is passed fully through the axle stand base.
d. Insert the retaining ‘R’ clip.
e. Position the axle stands under the axle as close the wheels as possible with the axle positioned centrally above the stand and with the stand at 90 degrees to the axle (Figures 22, 23 and 24).
f. Once satisfied with the position and placement of the axle stands, under control slowly release the jack pressure and lower the vehicle onto the axle stands (Figure 25).
Figure 25  Vehicle Resting on Axle Stands

g. Check that the vehicle is fully supported and seated on the stands.
h. Remove the jack (if required).
Removal of Axle Stands

29. Remove the axle stands as follows:
   a. Check that the ground is clear under the vehicle.
   b. Visually inspect the jack to ensure its useability.
   c. Position the jack as follows:
      (1) **Trolley Jack.** Position the trolley jack centrally under the vehicle and at 90 degrees to the axle assembly (Figure 17).
      (2) **Vehicle CES Jack.** Position the vehicle CES jack as follows (Figure 18):
         (a) Position the Support Platform, Jack Elevating Block, Base Plate, Steel NSN 4910-66-117-2503 under the vehicle at the jacking position.
         (b) Position the Base Plate Jack Wood, Chamfered edges, Fitted W2 Coach Bolts NSN 5120-66-048-8539 on the steel base plate.
         (c) Position the Vehicle CES jack on the wooden block.
   d. Operate the jack until the jack ‘takes the weight’ of the vehicle.
   e. Carry out another visual check of the jack for alignment.
   f. Continue to operate the jack until the vehicle is raised evenly off the axle stands.
   g. Remove the axle stands from beneath the vehicle.
   h. Under control, slowly release the jack pressure, lowering the vehicle to the ground.
   i. Re-stow the vehicle CES jack, the steel and wooden base plates (if used).

**ITEMS PREVIOUSLY KNOWN TO HAVE CONTAINED ASBESTOS**

![WARNING]

Asbestos is a hazardous material and a carcinogen. Airborne asbestos fibre poses a serious danger to personnel and can lead to acute health concerns and eventual death.

The Unimog Family of Vehicles (FOV) was originally fitted with a number of gaskets, seals and washers known to have contained asbestos.

Since 2009, all genuine OEM supplied repair parts including; gaskets, seals and washers are asbestos free. If it is unknown as to whether the material contains asbestos, such items are to be removed, handled and disposed of in accordance with EMEI Workshop E 410.

**NOTE**

Prior to the disruption, removal or replacement of the items contained within Table 3, the vehicle logbook (GM120) should be reviewed. If the item has been replaced since 2009 and notated in Part 4 of the logbook the item can safely be handled as being asbestos free.

30. The following table provides a list of all known, in-situ items including; gaskets, seals and washers which may contain asbestos. If an item in Table 3 is to be replaced, the GM120, Part 4 should be reviewed. If the item in question has been replaced after 2009 and notated at Part 4 the item can safely be considered as being asbestos free.
### Table 3  Items Previously Known to have Contained Asbestos

<table>
<thead>
<tr>
<th>Serial</th>
<th>Item</th>
<th>ACM NIIN</th>
<th>Non-ACM NIIN</th>
<th>Can remain in-situ</th>
<th>Procedure in this EMEI</th>
<th>Enter GM120 Part 4</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Gasket - Engine Drain Plug; All variants</td>
<td>12-126-0420</td>
<td>12-124-4379</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>2</td>
<td>Gasket - Fuel Tank Drain Plug Washer</td>
<td>12-156-4547</td>
<td>12-131-4119</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>3</td>
<td>Gasket - Parkbrake Pneumatic Line Washer</td>
<td>12-156-4547</td>
<td>12-131-4119</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>4</td>
<td>Gasket - Engine; Oil Cooler to Cover</td>
<td>12-124-1185</td>
<td>12-323-8272</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>5</td>
<td>Gasket - Engine; Bell Housing Drain Plug</td>
<td>12-156-4552</td>
<td>12-335-8363</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>6</td>
<td>Gasket - Engine; Turbo Drain Pipe</td>
<td>12-168-5836</td>
<td>12-331-5310</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>7</td>
<td>Packing, Engine; Preformed Seal Crankshaft</td>
<td>66-140-5249</td>
<td>12-339-1107</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>8</td>
<td>Gasket - Engine Dipstick block mounting to sump</td>
<td>12-173-3440</td>
<td>12-332-6949</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>9</td>
<td>Clutch - Disc plate</td>
<td>12-197-4851</td>
<td>12-315-1428</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>10</td>
<td>Gasket - Transmission Shift Housing</td>
<td>12-197-1785</td>
<td>66-135-2706</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>11</td>
<td>Gasket - Transmission Housing</td>
<td>12-197-3203</td>
<td>66-139-1660</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>12</td>
<td>Gasket - Transfer gear case rear output housing</td>
<td>12-300-8412</td>
<td>12-354-2839</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>13</td>
<td>Gasket - Transfer gear case front output housing</td>
<td>12-300-8414</td>
<td>12-354-2841</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>14</td>
<td>Gasket - Transmission Rear Bearing Cap</td>
<td>12-300-8435</td>
<td>66-120-6238</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>15</td>
<td>Gasket - Oil Cooler Cover to Engine Block</td>
<td>12-305-7731</td>
<td>12-376-3287</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>16</td>
<td>Guard - Heatshield; Engine Compartment (<em>Note: Non-ACM NIIN is for the bare guard and two asbestos free panels to be riveted in place</em>)</td>
<td>12-314-6910</td>
<td>12-381-8340*</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>17</td>
<td>Gasket - Engine; Waterpump</td>
<td>12-320-0431</td>
<td>Not Known</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>18</td>
<td>Gasket - Transmission rear bearing cap #2</td>
<td>12-197-3200</td>
<td>66-128-6988</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>19</td>
<td>Gasket - Engine; Compressor Drive Blanking Plate on engine block</td>
<td>12-176-8995</td>
<td>12-351-3128</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>20</td>
<td>Gasket - Engine oil filter housing to block</td>
<td>12-173-7783</td>
<td>12-335-8039</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>21</td>
<td>Gasket - Engine; thermostat housing</td>
<td>12-173-7791</td>
<td>12-329-9067</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>22</td>
<td>Gasket - Engine; coolant manifold to thermostat housing</td>
<td>12-173-7793</td>
<td>12-326-1589</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>23</td>
<td>Gasket - Transmission; Selector plate air actuator mtg</td>
<td>12-173-7796</td>
<td>12-376-2268</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>24</td>
<td>Gasket - Transfer Gearcase; Fwd/Rev shift cyl mtg</td>
<td>12-173-7798</td>
<td>12-354-2840</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>25</td>
<td>Gasket - Waterpump outlet elbow</td>
<td>12-174-2894</td>
<td>12-337-6165</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>26</td>
<td>Gasket - Engine; coolant manifold to cylinder head</td>
<td>12-174-2895</td>
<td>12-329-0403</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>27</td>
<td>Gasket - Engine; exhaust turbo elbow to tailpipe</td>
<td>12-177-4758</td>
<td>66-157-1002</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>28</td>
<td>Gasket - Engine; cylinder head</td>
<td>66-117-2298</td>
<td>12-330-2134</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>29</td>
<td>Gasket - Air compressor parts kit</td>
<td>12-303-5862</td>
<td>66-158-5364</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>30</td>
<td>Gasket - Engine; waterpump repair kit</td>
<td>12-301-3225</td>
<td>12-358-8920</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>31</td>
<td>Gasket - Engine; rocker cover</td>
<td>12-322-3458</td>
<td>01-229-3513</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
<tr>
<td>32</td>
<td>Kit - Steering Box Overhaul</td>
<td>12-197-8260</td>
<td>Not Known</td>
<td>YES</td>
<td>NO</td>
<td>YES</td>
</tr>
<tr>
<td>33</td>
<td>Gasket - Engine; Timing Cover,</td>
<td>12-179-3403</td>
<td>12-324-5739</td>
<td>YES</td>
<td>YES</td>
<td>YES</td>
</tr>
</tbody>
</table>
ENGINE GROUP

Asbestos is a hazardous material and a carcinogen. Airborne asbestos fibre poses a serious danger to personnel and can lead to acute health concerns and eventual death.

The Unimog Family of Vehicles (FOV) was originally fitted with a number of items including; gaskets, seals and washers known to have contained asbestos.

Since 2009, all genuine OEM supplied gaskets, seals and washers are asbestos free. If it is unknown as to whether the material contains asbestos, such items are to be removed, handled and disposed of in accordance with EMEI Workshop E 410.

Gasket Replacement Procedures
31. The following engine gaskets can be replaced:
   a. cylinder head cover gasket (Para 32);
   b. exhaust pipe gasket (Para 74);
   c. turbocharger gaskets (Para 41);
   d. exhaust manifold gaskets (Para 41);
   e. timing gear case gasket (Para 34);
   f. oil cooler gaskets (Para 35);
   g. sump gasket (Para 39);
   h. engine side-cover gasket (Para 33);
   i. dipstick housing gasket (Para 39);
   j. crankshaft spigot seal (Para 34);
   k. coolant pump gasket (Para 61); and
   l. thermostat housing gasket (Para 62).

Cylinder Head Cover Gasket
32. Replacement. Replace the cylinder head cover gasket as follows:
   a. Remove the bonnet, brushguard and radiator grille assemblies (Para 14).
   b. Raise and secure the cabin (Para 25).
   c. Detach the air duct from the turbocharger.
   d. Remove the vent hose between the cylinder head cover breather and the main air intake duct.
   e. Detach the sensing line between the sensing port on the cylinder head cover and the smoke limiter on the fuel injection pump.
   f. Remove the eight bolts holding the cylinder head cover to the cylinder head.
   g. Move the expansion tank bracket clear of the cylinder head cover.
   h. Remove the cylinder head cover.
Possible Asbestos Containing Material. If it cannot be confirmed by the vehicle’s GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

i. Remove the cylinder head cover gasket.

CAUTION

Ensure that no foreign material enters the cylinder head inlet ports when cleaning the top of the cylinder head.

j. Clean the sealing surfaces.
k. Fit a new gasket onto the cylinder head.l. Fit the cylinder head cover.
m. Reposition the coolant expansion tank over the exhaust manifold bolts.
n. Tighten the two exhaust manifold bolts to 30 N.m.
o. Secure the cylinder head cover with the six bolts.
p. Tighten the bolts to 25 N.m.

NOTE

Tighten the bolts sequentially working from the central area towards each end.

q. Tighten the nuts on the two exhaust manifold bolts.
r. Fit the sensing line between the smoke limiter on the fuel injection pump and the sensing port on the cylinder head cover.
s. Fit the vent hose between the engine breather and the main air intake duct.
t. Fit the air duct between the air cleaner and the turbocharger.
u. Start the engine and check for leaks (repair any leaks).
v. Lower and secure the cabin.
w. Fit the radiator grille, brushguard and bonnet assemblies (Para 14).

Side Cover Gasket

33. Replacement. Replace the side cover gasket as follows:

a. Raise and secure the cabin (Para 25).
b. Disconnect the negative lead from the battery and then disconnect the positive lead.
c. Drain the coolant from the radiator.
d. Remove the generator drive belt (Para 50).
e. Disconnect the generator cable connector.
f. Remove the generator (Para 182).
g. Detach the three cable clamps from the engine by unscrewing the three cable clamp retaining bolts.
h. Detach the tachometer pulse generator from the tachometer angle drive (Figure 26).
Figure 26  Tachometer Pulse Generator

i. Disconnect the throttle linkage at the fuel injection pump and move the linkage away from the engine side cover.

j. Remove the tachometer angle drive support bracket from the cylinder head (Figure 26).

k. Unscrew the four retaining bolts and sealing washers from the engine side cover.

l. Discard the sealing washers.

**WARNING**

Possible Asbestos Containing Material. If it can not be confirmed by the vehicle’s GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

m. Remove the engine side cover and discard the gasket.

n. Inspect and clean the crankcase sealing surfaces.

o. Inspect and clean the engine side cover.

**NOTE**

Remove any gasket residue from the gasket groove.

p. Lightly grease a new gasket with XG-291.

q. Fit the gasket to the groove in the side cover.

r. Fit new sealing washers to the side cover retaining bolts.

**CAUTION**

Handle the gasket with care to prevent damage.

s. Fit the side cover to the crankcase.

t. Insert the four cover retaining bolts.

u. Torque the bolts between 4 and 6 N.m.

v. Reconnect the throttle linkage.
w. Fit the tachometer pulse generator support bracket to the cylinder head.
x. Secure it with the two bolts.
y. Fit the tachometer pulse generator to the pulse generator bracket.
z. Secure it with the two bolts.
aa. Attach the three cable clamps to the engine.
bb. Lower and secure the cabin.
cc. Install and connect the generator (Para 182).
dd. Close the radiator drain tap.
e. Fill the cooling system with coolant.

NOTE

Ensure that the coolant expansion tank is two-thirds full.

ff. Connect the battery positive lead and then connect the negative lead.
gg. Start and run the engine for a brief period.
hh. Check for any fluid leaks from the engine side cover (repair where necessary).
ii. Stop the engine.
jj. Check the coolant level (top up if necessary).

Timing Gear Case Gasket and Crankshaft Spigot Seal

34. Replacement. Replace the timing gear case gasket and the crankshaft spigot seal as follows:
a. Remove the bonnet, brushguard, radiator grille, brushguard mounting bracket (Para 14) and the sump guard (Para 39.d. to 38.f.).
b. Remove the deflector plate and the centre bolt for the engine front mounting (Para 46.b.).
c. Remove all drive belts from the crankshaft pulley (Para 49).
d. Remove the six socket head bolts from the crankshaft pulley (Figure 27).

![Figure 27 Crankshaft Pulley](image)

e. Lock up the crankshaft pulley at the transmission end.
f. Unscrew the centre bolt from the crankshaft pulley.
g. Remove the pulley.
h. Remove the thrust ring from the vibration damper.
The crankshaft vibration damper is not repairable if damaged. Do not drop or strike the damper when removing it from or fitting it to the crankshaft.

i. Pull the vibration damper off the crankshaft using steering wheel puller (Table 1, Item 4) (Figure 28).

j. Remove the woodruff key from the crankshaft.

k. Remove the six retaining bolts from the coolant-pump pulley (Figure 29).

l. Remove the pulley.

m. Remove the 13 bolts holding the timing-gear cover and timing pointer to the timing-gear case.

Possible Asbestos Containing Material. If it can not be confirmed by the vehicle's GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

n. Remove the cover and the timing pointer.

o. Remove and discard the gasket.

p. Remove the scuff-ring from the crankshaft (Figure 30).
q. Remove the crankshaft spigot seal from the cover using the timing seal remover/replacement tool (Table 1, Item 5) and the drift (Table 1, Item 3) (Figure 31).

r. Inspect and clean the sealing surface on the timing-gear case; inspect and clean the cover.

s. Fit a new spigot seal into the cover using the timing seal remover/replacement tool (Table 1, Item 5) (Figure 32).

t. Attach a new gasket to the timing gear case using gasket cement (Loctite 573 or equivalent).

u. Fit the cover and timing pointer to the timing gear case.

v. Insert the 13 cover securing bolts.

w. Hand-tighten the bolts.

x. Centre the cover on the timing gear case using the seal inserter (Table 1, Item 6) (Figure 33).
Tighten the securing bolts to 8 N.m.

Fit a new scuff-ring to the crankshaft.

Fit the drive pulley of the coolant pump to the drive shaft.

Fit the six bolts to the drive pulley (Figure 29).

Tighten the bolts to 20 N.m.

Slide the vibration damper on to the crankshaft.

Fit the woodruff key.

**NOTE**

A jack screw may be used to drive the vibration damper against the locating shoulder on the crankshaft.

Fit the crankshaft pulley with thrust plate to the crankshaft.

Fit the bolts around the crankshaft centre bolt hole.

Tighten the bolts to 47 N.m.

Lock-up the crankshaft pulley at the transmission end.

Fit the pulley centre bolt.

---

**CAUTION**

Do not torque the centre bolt with an impact wrench.

Tighten the bolt between 500 and 550 N.m.

Fit the engine bearer and engine front mounting (Para 46).

Fit the drive belts to the crankshaft pulley (Para 49).

Check the tension of the drive belts and adjust the tension if necessary (refer to the note preceding Para 44).

Fit the deflector plate and the centre bolt for the engine front mounting.

Torque the bolt to 140 ±20 N.m.

Fit the brushguard mounting bracket, radiator grille, brushguard, bonnet (Para 14) and sump guard (Para 40).

**Oil Cooler Gasket**

**35. Replacement.** Replace the oil cooler gasket as follows (Figure 34):
Figure 34  Oil Cooler Assembly

a. Raise and secure the cabin (Para 25).
b. Drain all the coolant from the system.
c. Remove the turbocharger (Para 45).
d. Remove the filler line between the coolant expansion tank and the T-junction on the coolant line to the bottom of the radiator.
e. Remove the exhaust manifold (Para 41).
f. Remove the starter motor (Para 181).
g. Remove the inner starter motor securing stud from the crankcase.
h. Remove the oil return line (Figure 40, Item 8) between the turbocharger and the cooler.
i. Remove the 35 bolts (Item 3) securing the cover to the oil cooler assembly.

**WARNING**

Possible Asbestos Containing Material. If it can not be confirmed by the vehicle's GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

j. Remove the assembly from the vehicle.
k. Discard the gasket (Item 2).
l. Remove and inspect the oil pressure relief valve (Item 5), discard any worn or damaged components.
m. Remove the oil filter (Item 7) from the casing.

n. Discard the oil filter element and sealing rings.

o. Remove the oil cooler (Item 1) from the casing.

**WARNING**

Possible Asbestos Containing Material. If it cannot be confirmed by the vehicle’s GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

p. Discard the sealing rings.

**CAUTION**

When cleaning the oil cooler, ensure that no damage occurs to the cooling fins or oil galleries. All debris must be removed from the oil cooler fins.

q. Clean and inspect the oil cooler (replace the oil cooler if damaged).

**NOTE**

If there is a possibility that metal fragments from failed engine components have entered the oil cooler or the filter, then the cooler or filter must be replaced. They are not to be cleaned.

r. Clean the crankcase sealing surface.

s. Clean the oil cooler casing.

t. Check the casing for distortion (replace the casing if distorted).

u. Fit the oil cooler to the casing using new sealing rings (Item 8).

v. Tighten the four retaining bolts.

w. Install a new element into the oil filter cover.

**CAUTION**

Ensure that the oil cooler sealing ring does not get twisted in the groove.

x. Fit a new sealing ring into the groove in the casing.

y. Fit the element and the cover to the casing.

z. Tighten the retaining bolt to 60 N.m.

aa. Insert the oil pressure relief valve (Item 5) into the casing and tightened it.

bb. Lightly grease a new gasket with XG-291.

cc. Attach the gasket to the sealing surface on the crankcase.

**CAUTION**

Ensure that the position of the gasket is not disturbed.

dd. Position the casing against the gasket.

ee. Install the 35 securing bolts.

ff. Tighten the bolts to 35 N.m.
**NOTE**

Tighten the bolts sequentially starting from the centre working outwards.

**gg.** Fit the oil return line between the turbocharger and the cooler.

**hh.** Fit the inner securing stud for the starter motor to the crankcase and tighten it.

**ii.** Fit the starter motor to the crankcase (Para 181).

**jj.** Fit the exhaust manifold (Para 42).

**kk.** Fit the filler line between the coolant expansion tank and the T-junction on the coolant line to the bottom of the radiator.

**ll.** Fit the turbocharger (Para 42).

**mm.** Fill the cooling system with coolant.

**NOTE**

Ensure that the coolant expansion tank is two-thirds full.

**nn.** Lower and secure the cabin (Para 26).

**oo.** Check the engine oil level.

**pp.** Crank the engine without starting the engine until the oil pressure has built up to within the correct operating range.

**qq.** Start the engine and idle it for a short period.

**rr.** Check the engine for any oil leaks (repair if necessary).

**ss.** Shut down the engine.

**tt.** Fit the bonnet, radiator grille and brushguard (Para 14).

**uu.** Road test the vehicle.

**Oil Filter Elements**

**NOTE**

There are two versions of oil filters fitted to the engine. The early version has two bowls and the later version has a single bowl. The replacement procedures for both versions are similar, except that the single bowl has a sealing ring above and below the filter element. Adjust the procedure as applicable in Para 36 for replacement of an element if the vehicle is fitted with a single bowl.

36. **Replacement.** Replace the elements as follows (Figure 35):

**a.** Remove the drain plugs (Item 7) and drain the oil into a suitable container.

**b.** Discard the sealing washers (Item 6).

**c.** Remove the retaining bolts (Item 9) holding the bowl/s to the filter head.

**d.** Discard the sealing washers (Item 8).

**e.** Detach the bowl/s (Item 5) with the elements (Item 4) from the filter head.

**f.** Discard the elements (Item 4).

**g.** Remove and discard the O rings (Item 3).

**h.** Clean and inspect the filter head and bowls.

**NOTE**

Discard the bowls if they are cracked or damaged.

**i.** Lightly lubricate the new O rings with clean engine oil.

**j.** Fit the O ring into the groove in the oil filter head.
NOTE

Ensure the O ring is not twisted in the filter head groove.

k. Insert a new filter element into the oil filter bowl.

l. Position the filter bowl against the O ring in the filter head.

m. Fit a new sealing washer to the filter bowl retaining bolt.

n. Install the retaining bolt.

o. Torque the retaining bolts between 40 and 45 N.m.

p. Fit the drain plug with a new sealing washer.
q. Install the drain plug on the filter bowl.

r. Torque the drain plug to 17 N.m.

s. Refil engine with OMD 115 engine oil to correct level.

t. Start and run the engine at low idle speed for a brief period to allow the engine oil pressure to build up to operating pressure.

u. Check for oil leaks around the filter head area (rectify if required).

v. Stop the engine, check the oil level and top up if required.

Oil Filter Assembly

NOTE

There are two versions of oil filters fitted to the engine. The early version has two bowls and the later version has a single bowl. The two different versions are installed in the same way. Adjust the procedure in Para 37, if a single bowl filter is installed.

37. **Removal.** Remove the oil filter assembly as follows (Figure 36):

![Figure 36 Oil Filter Head Replacement](image)

a. Raise and secure the cabin (Para 25).

b. Remove the two drain plugs and drain the oil into a suitable container.

c. Discard the sealing washers.

d. Remove the banjo bolt from the filter head (Item 5).

e. Detach the oil line between the fuel injection pump and the filter head.

f. Remove the tube nut from the filter head.

g. Detach the oil line between the air-compressor and filter head.

h. Disconnect the cable from the oil pressure sensor (Item 4).

i. Remove the three bolts (Item 6) securing the oil filter assembly to the crankcase.

**WARNING**

Possible Asbestos Containing Material. If it can not be confirmed by the vehicle’s GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

j. Remove the assembly from the crankcase.
k. Discard the gasket (Item 3).
l. Remove the oil pressure sensor from the filter head.
m. Clean the oil filter head mating surface on the crankcase.

38. Installation. Install the oil filter assembly as follows (Figure 36):
   a. Fit the oil pressure sensor to the filter head, using a new sealing washer.
   b. Lightly grease the new gasket (Item 3) with XG-291.
   c. Attach the gasket to the filter head mating surface.

   **CAUTION**
   Do not disturb the position of the gasket.

   d. Position the filter head against the crankcase.
   e. Secure the filter head with the three retaining bolts (Item 6).
   f. Torque the bolts to 60 N.m.
   g. Connect the cable to the oil pressure sensor (Item 4).
   h. Attach the oil line between the air compressor and oil filter head.
   i. Tighten the cap-nut.
   j. Attach the oil line between the injection pump and oil filter head.
   k. Install the banjo bolt using a new sealing washer.
   l. Tighten the banjo bolt.
   m. Fit the drain plugs to the bowls, using new sealing washers.
   n. Tighten the drain plugs to 17 N.m.
   o. Refill engine with OMD 115 engine oil to correct level.
   p. Lower and secure the cabin.
   q. Start and run the engine at low idle speed for a brief period to allow the oil pressure to build up to the correct operating pressure.
   r. Check for any oil leaks from the filter head area (repair as necessary).
   s. Stop the engine and check the oil level (top up as necessary).
   t. Lower and secure the bonnet.

Sump

39. Removal. Remove the sump as follows (Figure 37):
a. Remove the sump plug and drain the engine oil.

**WARNING**

Possible Asbestos Containing Material. If it can not be confirmed by the vehicle’s GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

b. Discard the oil and the sealing washer from the sump plug.

c. Clean off any dirt and metal particles adhering to the sump plug.

**WARNING**

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

d. Support the sump guard with a jack.

e. Remove the four mounting bolts and spacers securing the sump guard to the chassis.

f. Lower the sump guard on the jack and remove it from the vehicle.

g. Remove the turbocharger oil return line.

h. Remove the oil filter assembly (Para 37).

i. Remove the drag link (Para 173).

j. Remove the three bolts and spring washers holding the dipstick housing to the sump.

k. Remove the dipstick housing (Item 3), the dipstick guide tube (Item 1) and the gasket from the sump.
Possible Asbestos Containing Material. If it can not be confirmed by the vehicle’s GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

l. Discard the gasket.

m. Remove the 20 sump retaining bolts, four nuts, and spring washers securing the sump to the engine crankcase.

n. Remove the sump.

o. Remove and discard the sump gasket.

Ensure that foreign material or dirt does not enter the crankcase when cleaning the sump sealing surfaces.

p. Clean the sump and the sump sealing surfaces.

q. Clean the crankcase sealing surfaces and bolt holes.

40. **Installation.** Install the sump as follows:

a. Attach the new sump gasket to the crankcase sealing surfaces with gasket cement (Loctite 587 or equivalent).

b. Fill any gap between the sump gasket and the front and rear main seals with sealant Dirko-Transparent (part number 001 989 29 20) or equivalent (Figures 38 and 39).

c. Carefully lift the sump up to the crankcase.

d. Insert the 20 sump retaining bolts and spring washers.

e. Install the four nuts and flat washers on the studs.

f. Torque the 20 bolts to 8 N.m and the four nuts to 12 N.m.

g. Fit a new sealing washer to the sump plug.

h. Install the plug in the sump.

i. Torque the plug between 50 and 60 N.m.

j. Refit the drag link (Para 173).

k. Clean the mating areas of the dipstick housing and the sump.
Do not damage the gasket.

l. Fit a new gasket to the dipstick housing.
m. Secure the dipstick housing to the sump using the three bolts.
n. Install the oil filter assembly (Para 38).
o. Fit the turbocharger oil return line.
p. Fill the engine with 14.5 litres of oil (SAE Grade 40, OMD-115).
q. Start and run the engine for a brief period.
r. Check for leaks (repair where necessary).
s. Stop the engine and check the oil level (top up as necessary).
Support the sump guard with a jack prior to fitting the sump guard mounting bolts.

t. Fit the sump guard to the chassis with the aid of a jack.
u. Secure the guard with the four mounting bolts, spring and flat washers.

Exhaust Manifold

41. **Removal.** Remove the exhaust manifold as follows (Figure 40):

a. Raise and secure the cabin (Para 25).
b. Disconnect the engine brake linkage from the actuating shaft on the engine brake manifold (Item 5).
c. Remove the two bolts securing the oil supply and return lines to the turbocharger.

d. Remove the oil lines from the turbocharger.
e. Disconnect the air intake hose (Item 1) from the turbocharger air inlet.
f. Loosen the hose clamp securing the charge air duct (Item 2) to the turbocharger.
g. Loosen the two hose clamps securing the charge air duct to the cylinder head cover.
h. Lift the air duct away from the turbocharger.
i. Remove and discard the O ring from the charge air duct.
j. Remove the three nuts, spring washers and bolts holding the exhaust pipe to the engine brake manifold.

Possible Asbestos Containing Material. If it can not be confirmed by the vehicle’s GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

Care is to be taken so as not to damage the gasket between the exhaust pipe and the engine brake manifold.

k. Carefully lower the exhaust pipe away from the engine brake manifold.
l. Remove the four nuts and spring washers connecting the turbocharger to the engine exhaust manifold.

Care is to be taken so as not to damage the gasket between the turbocharger and the engine exhaust manifold.

m. Carefully pull the turbocharger away from the engine exhaust manifold.
n. Carefully remove and inspect the gasket (replace if damaged).
o. Remove the cylinder head cover bolt and the two exhaust manifold bolts from the coolant expansion tank bracket.

p. Move the tank to one side.

q. Remove the remaining six bolts holding the exhaust manifold clamps to the cylinder head.

r. Remove the manifold clamps and the exhaust manifold.

s. Remove the two exhaust manifold gaskets.

**CAUTION**

Ensure that no foreign material enters the cylinder head or the exhaust manifold.

t. Clean the cylinder head and exhaust manifold mating surfaces with a wire brush.
42. **Installation.** Install the exhaust manifold as follows:

- **CAUTION**
  Ensure that the gaskets are correctly aligned.

- **a.** Fit two new gaskets to the exhaust manifold.
- **b.** Fit the exhaust manifold to the cylinder head.
- **c.** Position the coolant expansion tank.
- **d.** Insert the cylinder head cover bolt.
- **e.** Tighten the bolt to 25 N.m.
- **f.** Fit the front exhaust manifold clamp.
- **g.** Insert two 10 x 110 mm bolts.
- **h.** Tighten the bolts to 30 N.m (Figure 41).

![Exhaust Manifold Bolts](image)

**Figure 41  Exhaust Manifold Bolts**

- **i.** Tighten the coolant expansion tank bracket securing nuts.

- **CAUTION**
  Ensure that the bolts are correctly located.

- **j.** Fit the rear exhaust manifold clamp and the remaining six bolts (Figure 41).
- **k.** Tighten the six bolts to 30 N.m.
Ensure that no foreign material enters the turbocharger or the exhaust manifold.

l. Clean the turbocharger and exhaust manifold mating surfaces with a wire brush.
m. Fit the turbocharger exhaust/turbine gasket.
n. Fit the turbocharger to the exhaust manifold.

CAUTION

Ensure that the gasket is correctly aligned.
o. Fit the four bolts, spring washers and nuts.
p. Tighten the nuts to 30 N.m.

CAUTION

Ensure that the gasket is correctly aligned.
q. Fit the gasket to the engine brake manifold (Item 5).
r. Raise the exhaust pipe until the exhaust pipe flange mates with the engine brake manifold.
s. Fit the three bolts, spring washers and nuts.
t. Tighten the nuts to 45 N.m.
u. Fit a new O ring to the charge air duct.
v. Lower the charge air duct (Item 2) on to the charge air output flange.
w. Align the air duct with the flange.
x. Secure the air duct with the hose clamp.
y. Tighten the two hose clamps connecting the air duct to the cylinder head cover.
z. Connect the air intake hose (Item 1) to the turbocharger air inlet.

aa. Fit the gasket to the oil return line.
bb. Connect the oil return line to the turbocharger.
c. Secure the line with the two bolts.
dd. Fill the turbocharger bearing cavity with clean engine oil through the oil supply port.
e. Fit the gasket to the oil supply line.
ff. Connect the oil supply line to the turbocharger.
gg. Secure the line with the two bolts
hh. Connect the engine brake linkage to the actuating shaft on the engine brake manifold.
i. Lower and secure the cabin.
jj. Start the engine, check for leaks and repair as necessary.

Air Cleaner Element

43. Replacement. The air cleaner element is replaced as a single unit. The procedure is as follows (Figure 42):
a. Raise and secure the bonnet.
b. Remove the radiator grille assembly (Para 19).
c. Unscrew and remove the bolt (Item 2) holding the air cleaner element in the casing.
d. Remove and discard the air cleaner element.

dust deposits in the intake ducts are a reliable indication of leaks in the system. To prevent damage to the turbocharger and engine, repair leaks immediately.

e. Thoroughly clean the casing and dust discharge valve.
f. Carefully remove any compacted dust deposits.
g. Check all hose clamps (tighten or replace where necessary).
h. Check all hoses for serviceability (replace if holed or cracked).
i. Fit a new air cleaner element into the casing.
j. Install and tighten the bolt holding the air cleaner element in the casing.
k. Actuate the push-button on the service indicator (Item 1) to reset the red warning band.
l. Check the engine oil and coolant levels.
m. Start and run the engine for a brief period, checking for any leaks (repair where necessary).
n. Fit the radiator grille (Para 20).
o. Lower and secure the bonnet.

Cylinder Head Cover

44. Remove and install the cylinder head cover as described in Para 32.

Turbocharger

45. **Removal and Installation.** Remove and install the turbocharger as described in Para 41.

Engine Front Mount

46. **Replacement.** Replace the engine front mount as follows:

a. Remove the bonnet, brushguard, brushguard mounting bracket, radiator grille (Para 14) and sump guard (Para 39.d. to 38.f.).
b. Unscrew the engine front mounting bolt and remove the deflector plate (Figure 43).
c. Remove all drive belts from the crankshaft pulley (Para 49).

d. Detach the power steering pump from the engine support frame; do not disconnect the hydraulic lines (Figure 44).

e. Remove the three retaining bolts from the front air compressor bracket (Figure 45).

f. Remove the air compressor bracket from the engine bearer.
Do not attempt to raise the engine in the vehicle by jacking on the sump. Lift the engine from the sling hooks provided using a block and tackle with a capacity greater than 500 kg.

g. Raise the engine slightly until the bearer and mount are clear of the chassis front member.

Do not use hydraulic jacks or trolleys to support the engine. Rigid supporting devices must be used.

h. Support the engine with a rigid supporting device.
i. Unscrew the retaining bolts from the engine support frame (Figure 46).

Figure 46  Engine Bearer Retaining Bolts – LHS

j. Remove the frame from the engine.
k. Remove the rubber bumper and spacer from the support frame.
l. Discard the bumper and spacer.
m. Coat the new rubber bumper with a rubber lubricant.
n. Insert the bumper.
o. Place the engine support frame in a press.
p. Press the spacer into the rubber bumper using the engine mount sleeve installer (Table 1, Item 7) (Figure 47).
Figure 47  Engine Mount Spacer Installation

q.  Fit the support frame to the crankcase.

r.  Secure the frame with the four bolts.

s.  Torque the bolts to 170 ±20 N.m.

Ensure that the engine mount is aligned with the chassis member.

t.  Remove the supports and slowly lower the engine.

u.  Secure the air compressor bracket to the support frame with the three retaining bolts.

v.  Torque the three bolts to 75 N.m.

w.  Attach the power steering pump to the support frame.

x.  Torque the retaining bolt to 80 N.m.

y.  Fit and correctly tension all drive belts (Para 49).

z.  Fit the deflector plate.

aa.  Insert the engine front mount bolt.

bb.  Torque the bolt to 140 ±20 N.m.

c.  Remove the lifting device.

dd.  Fit the brushguard mounting bracket, radiator grille, bonnet, brushguard (Para 14) and sump guard (Para 40).

ee.  Road test the vehicle.

Engine Rear Mount

NOTE

Only the left-hand mount can be removed from the vehicle. The right-hand engine mount is part of the block and the rubber bumpers and spacers must be removed with the engine mount fitted to the engine.

47.  Replacement. Replace the left-hand rear engine mount as follows (Figure 48):
There will be only the front rubber bumper and spacer installed on a standard Unimog. When a Unimog has a PTO fitted both rubber bumpers and spacers are installed on the engine mount.

a. Raise and secure the cabin (Para 25).
b. Disconnect the negative lead from the battery and then disconnect the positive lead.
c. Disconnect the cables from the starter motor.
d. Detach the propeller shaft from the flange on the clutch output shaft.
e. Detach the cable loom, vent line, fuel line and leak-off line from the clutch housing and engine.

**WARNING**

Do not use hydraulic jacks or trolleys to support the engine. Rigid supporting devices must be used.

f. Support the engine using a suitable rigid supporting device available in the workshop.
g. Remove the bolts (Item 1) and retaining plates (Item 7) from the left-hand mounting bracket (Item 5).
h. Remove the four bolts securing the left-hand bracket to the engine.
i. Remove the left-hand bracket.

**NOTE**

This part of the procedure is carried out with the right-hand mount fitted to the engine.

j. Remove the rubber bumpers (Item 3) and spacers (Item 4) from the mounting brackets.
Discard the old rubber bumpers and spacers.

Inspect and clean the mounting brackets.

NOTE
Remove all residues from all mounting components.

Coat the new rubber bumpers with rubber lubricant.

Insert the new rubber bumpers into the mounting brackets.

Place the left-hand mounting bracket in a press.

Press the new spacers into the rubber bumpers of the left-hand bracket with the engine mount sleeve installer (Table 1, Item 7) (Figure 47).

NOTE
Press the new rubber bumpers into the right-hand mounting bracket by applying a constant pressure with a lever to the engine mount sleeve installer until the bumpers are located in the bracket. If the pressure is released before the bumper is fully installed, the bumper will spring back out of the bracket.

Press the new spacers into the rubber bumpers of the left-hand bracket using the engine mount sleeve installer and a suitable lever.

Secure the left-hand engine mount to the engine with the four bolts.

Tighten the bolts to 110 ± 20 N.m.

CAUTION
Ensure that the engine mount is correctly aligned with the chassis mounting points.

Remove the supports and carefully lower the engine.

Fit the bolts and the retaining plate to the bracket.

Tighten the bolts to 140 ± 20 N.m.

Remove the support stands.

Attach the cable loom, vent line, fuel line and leak-off line to the engine and clutch housing.

Attach the propeller shaft to the flange on the clutch output shaft.

Connect the cables to the starter motor.

Connect the positive lead to the battery and then connect the negative lead.

Lower and secure the cabin.

Run the engine.

Check for any leaks (repair where necessary).

Road test the vehicle.

Check the mounting bolts and tighten to the correct torque if necessary.

Oil Pump Pressure Relief Valve

Replacement. Remove and install the pressure relief valve as follows (Figure 49):

NOTE
The pressure relief valve in the oil pump can be replaced with the oil pump fitted to the engine.
a. Drain all the oil from the engine.
b. Remove the sump (Para 39).
c. Remove the retaining plug (Item 1) from the oil pump housing.
d. Remove the compression spring and piston from the oil pump housing.
e. Clean and check all parts.
f. Replace worn or damaged parts. Table 4 lists the spring dimensions.

g. Coat the retaining plug with Loctite 270.
h. Fit the piston, compression spring and retaining plug into the oil pump.
i. Torque the retaining plug between 15 and 25 N.m.
j. Fit the sump (Para 40).
k. Fill the engine with OMD 115 engine oil.
l. Start and run the engine for a brief period checking for any leaks; repair if necessary.

NOTE
Ensure that the oil pressure is within the correct operating limits.

m. Stop the engine and check the oil level, top up if necessary.

DRIVE BELTS

NOTE
Tension on the drive belts should be set to give a thumb test depression of between 5 mm and 10 mm. Replacement belts must be checked after one hour of operation and the tension adjusted to compensate for stretching of the belts.
49. The drive belts fitted to the engine are as follows:

NOTE

Before proceeding to adjust or replace a drive belt, remove the radiator grille (Para 19), raise and secure the bonnet. On completion of the adjustment or replacement, replace the radiator grille (Para 20), lower and secure the bonnet.

a. the generator drive belt (Para 50);
b. the fan intermediate drive belt (Para 52);
c. the air compressor drive belt (Para 51);
d. the steering pump drive belt (Para 54);
e. the cooling pump drive belt (Para 55); and
f. the fan final drive belt (Para 57).

Generator Drive Belt

50. **Adjustment or Replacement.** Adjust or replace the generator drive belt as follows (Figure 50):

![Generator Drive Belt Diagram]

1. Bracket mounting bolts  
2. Tension nut

**Figure 50 Generator Drive Belt**

a. Adjustment:
   - (1) Loosen the two mounting bolts (Item 1).
   - (2) Adjust the tension nut (Item 2) to give the correct tension.
   - (3) Tighten the mounting bolts.

b. Replacement:
   - (1) Loosen the two mounting bolts (Item 1).
   - (2) Adjust the tension nut (Item 2) to loosen the belt.
   - (3) Remove the generator drive-belt.
   - (4) Fit a new belt.
   - (5) Adjust the tension nut to give the correct tension.
(6) Tighten the mounting bolts.

Air-compressor Drive Belt

51. Adjustment or Replacement. Adjust or replace the air compressor drive belt as follows (Figure 51):

![Figure 51: Air-compressor Drive Belt](image)

a. Adjustment:

(1) Loosen the four base bolts (Item 3) and two retaining bolts (Item 4).
(2) Adjust the tension screw (Item 2) to give the correct tension.
(3) Tighten the four base bolts to 22 N.m.
(4) Tighten the two retaining bolts to 75 N.m.

b. Replacement:

(1) Remove the fan intermediate drive belt (Para 52).
(2) Loosen the four base bolts (Item 3) and two retaining bolts (Item 4).
(3) Loosen the tension screw (Item 2).
(4) Remove the air compressor drive belt (Item 1).
(5) Fit a new belt.
(6) Adjust the tension screw to give the correct tension.
(7) Tighten the four base bolts to 22 N.m.
(8) Tighten the two retaining bolts to 75 N.m.

Fan Intermediate Drive Belt

NOTE

A tension arm sets the tension of the fan intermediate drive belt. To check and adjust the tension arm, it is necessary to remove the drive belt.

52. Removal. Remove the fan intermediate drive belt as follows (Figure 52):

a. Depress the tension arm (Item 1).

b. Remove the belt from the tension arm pulley, the intermediate pulley and the crankshaft pulley.
53. **Installation.** Install the fan intermediate drive belt as follows:

a. Check that the alignment mark (Figure 53, Item 1) on the tension bearing housing is aligned with the corner of the tension arm (Figure 53, Item 2).

b. If the alignment mark is not aligned with the corner of the tension arm, loosen the locknut (Figure 54, Item 1), and align the two.

c. Tighten the locknut.
d. Depress the tension arm and install the belt on the tension arm pulley, the intermediate pulley and the crankshaft pulley.

Power Steering Pump Drive Belt

54. **Adjustment or Replacement.** Adjust or replace the power steering pump drive belt as follows (Figure 55):

(a) Adjustment:
   1. Loosen the mounting bolt (Item 1).
   2. Adjust the tension screw (Item 2) to give the correct tension.
   3. Tighten the mounting bolt.

(b) Replacement:
   1. Remove the fan intermediate drive belt (Para 52).
   2. Remove the air compressor drive belt (Para 51).
   3. Loosen the mounting bolt (Item 1).
   4. Loosen the tension screw (Item 2).
   5. Remove the power steering pump drive belt.
   6. Fit a new belt.
   7. Adjust the tension screw to give the correct tension.
   8. Tighten the mounting bolt.
   9. Fit and tension the air compressor drive belt (Para 51).
  10. Fit and tension the fan intermediate drive belt (Para 53).

Coolant Pump Drive Belt

55. **Adjustment or Replacement.** Adjust or replace the coolant pump drive belt as follows (Figure 56):
Figure 56  Coolant Pump Drive Arrangement

a. Adjustment:
(1) Loosen the mounting bolts (Item 3) on the tension pulley.
(2) Position the tension pulley (Item 2) to obtain the correct tension.
(3) Tighten the mounting bolts.

b. Replacement:
(1) Remove the generator drive belt (Para 50).
(2) Remove the fan intermediate drive belt (Para 52).
(3) Remove the air compressor drive belt (Para 51).
(4) Remove the power steering pump drive belt (Para 54).
(5) Loosen the mounting bolts (Item 3) on the tension pulley (Item 2).
(6) Remove the coolant pump drive belt (Item 1).
(7) Fit a new drive belt.
(8) Position the tension pulley to obtain the correct tension.
(9) Tighten the mounting bolts.
(10) Fit and tension the steering pump drive belt (Para 54).
(11) Fit and tension the air compressor drive belt (Para 51).
(12) Fit and tension the fan intermediate drive belt (Para 53).
(13) Fit and tension the generator drive belt (Para 50).
Fan Final Drive Belt

56. **Adjustment or Replacement.** Adjust or replace the fan final-drive-belt as follows (Figure 57):

![Figure 57 Fan Final Drive Belt](image)

**Figure 57 Fan Final Drive Belt**

a. Adjust the belt as follows:
   
   1. Loosen the mounting nut (Item 1) on the tension pulley (Item 2).
   2. Position the tension pulley to give the correct tension.
   3. Tighten the mounting nut on the tension pulley.

b. Replace the belt as follows:
   
   1. Remove the nuts from both ends of the radiator support (Item 3).
   2. Remove the radiator support.
   3. Loosen the mounting nut (Item 1) on the tension pulley (Item 2).
   4. Remove the fan final drive belt.
   5. Fit a new belt.
   6. Position the tension pulley to obtain the correct tension.
   7. Tighten the mounting nut on the tension pulley.
   8. Fit the radiator support.
   9. Fit and tighten the nuts on the radiator support.

**COOLING SYSTEM**

57. Engine cooling system components can be replaced, repaired or tested as follows:

   a. replacement procedures (Para 58);
   b. repair procedures (Para 65); and
   c. test procedures (Para 68).
Replacement Procedures

58. The following components of the engine cooling system are replaceable at Light Grade Repair:
   a. radiator (Para 59);
   b. coolant expansion tank and mounting bracket (Para 60);
   c. coolant pump (Para 61);
   d. thermostat (Para 62);
   e. cooling fan (Para 63); and
   f. hoses, pipes and rubber sleeves (Para 64).

Radiator

59. Replacement. Replace the radiator as follows (Figure 58):
   a. Remove the brushguard, bonnet and radiator grille (Para 14).
   b. Drain the coolant from the radiator.
   c. Remove the upper coolant hose (Item 3) from the radiator (Item 33).
   d. Remove the lower coolant hose (Item 35) from the radiator.
   e. Remove the radiator vent hose (Item 28) from the top of the radiator.
   f. Unscrew the eight fan shroud bolts (Item 32) from the fan shroud (Item 31).

   **CAUTION**

Avoid damaging the radiator cooling fins.

   g. Lift the radiator up and out of the engine bay.
   h. Install a new radiator.
   i. Position the fan shroud on the radiator.
   j. Insert and tighten the eight shroud bolts (Item 32).
   k. Attach the radiator vent hose (Item 28) to the top of the radiator.
   l. Attach the lower coolant hose (Item 35).
   m. Attach the upper coolant hose (Item 3).
   n. Fill the cooling system with coolant, until the coolant expansion tank (Item 26) is two-thirds full.
   o. Check the cooling system for leaks (Para 69) (repair if necessary).
   p. Fit the radiator grille, bonnet and brushguard (Para 14).
   q. Test drive the vehicle.
   r. Inspect the cooling system for leaks (repair if necessary).
Figure 58  Engine Cooling System Components
Coolant Expansion Tank and Mounting Bracket

**60. Replacement.** Replace the coolant expansion tank and the mounting bracket as follows (Figure 58):

a. Raise and secure the bonnet.
b. Drain sufficient coolant from the radiator to empty the coolant expansion tank (Item 26).
c. Disconnect the radiator vent line (Item 28) from the expansion tank.
d. Disconnect the thermostat vent line (Item 29) from the expansion tank.
e. Disconnect the filler line (Item 27) from the expansion tank.
f. Disconnect the overflow line (Item 18) from the expansion tank.
g. Remove the clamp nut (Item 23).
h. Move the mounting bracket (Item 22) away from the expansion tank.
i. Remove the expansion tank.
j. Remove the heater hoses from the restraining clamp (Item 24).
k. Loosen the two mounting bracket securing nuts (Item 25).
l. Remove the cylinder head cover bolt (Item 20).
m. Remove the expansion tank bracket (Item 21).
n. Position the expansion tank bracket on the cylinder head cover and the exhaust manifold bolts.
o. Insert the cylinder head cover bolt (Item 20).
p. Tighten the bolt to 25 N.m.
q. Tighten the two mounting bracket securing nuts (Item 25).
r. Fit the heater hoses into the restraining clamps.
s. Fit the expansion tank.
t. Place the mounting bracket over the expansion tank.
u. Fit and tighten the clamp nut (Item 23).
v. Connect the overflow line (Item 18) to the expansion tank.
w. Connect the filler line (Item 27) to the expansion tank.
x. Connect the thermostat vent line (Item 29) to the expansion tank.
y. Connect the radiator vent line (Item 28) to the expansion tank.
z. Fill the cooling system with coolant until the coolant expansion tank is two-thirds full.
aa. Close the bonnet.
bb. Test drive the vehicle.
cc. Check the cooling system for leaks (repair if necessary).

Coolant Pump

**61. Replacement.** Replace the coolant pump as follows (Figure 58):

a. Remove the brushguard, bonnet and radiator grille (Para 14).
b. Drain the coolant from the radiator.
c. Remove the fan intermediate drive belt, the coolant pump drive belt and the generator drive belt (Para 49).
d. Remove the two thermostat housing bolts (Item 15).
e. Remove the thermostat body (Item 14) from the coolant pump (Item 5).
f. Remove the six pulley bolts (Item 11).
g. Remove the coolant pump drive pulley (Item 12).

h. Remove the lower coolant hose (Item 35) from the coolant pump.

i. Remove the three inlet pipe bolts (Item 6).

j. Remove the inlet pipe (Item 7) from the coolant pump.

k. Remove the inlet pipe gasket (Item 8).

l. When removing the upper mounting bolt from the compressor bracket, remove the bolt and the spacer (Figure 59).

m. Remove the five mounting bolts.

n. Remove the coolant pump.

o. Remove the coolant pump gasket (Item 4).

p. Clean the mating surfaces.

q. Remove the thermostat housing gasket (Item 13).

r. Clean the mating surfaces.

s. Fit a new coolant pump gasket (Item 4).

t. Fit the coolant pump.

u. Fit the spacer (Figure 59).

v. Secure with the five bolts as shown in Figure 59.

w. Tighten the bolts to 50 N.m.

x. Fit a new inlet pipe gasket (Item 8) to the inlet flange.

y. Fit the inlet pipe.

z. Install the three bolts.
z.  Tighten the three bolts to 30 N.m.

aa. Attach the lower coolant hose to the inlet pipe.

bb. Fit a new gasket (Item 13) to the thermostat housing.

c.  Fit the thermostat body to the coolant pump.

dd. Install the two thermostat housing bolts.

ee.  Tighten the bolts between 10 and 15 N.m.

ff.  Fit the coolant pump drive pulley (Item 12).

gg.  Install the six retaining bolts (Item 11).

hh.  Tighten the bolts to 20 N.m.

ii.  Fit and correctly tension the generator drive belt, coolant pump drive belt and fan intermediate drive belt (Para 49).

jj.  Fill the cooling system with coolant until the coolant expansion tank is two-thirds full.

kk.  Fit the radiator grille, bonnet and brushguard (Para 14).

ll.  Test drive the vehicle.

mm.  Check the cooling system for leaks (repair if necessary).

Thermostat

62.  Replacement. Replace the thermostat as follows (Figure 58):

a.  Remove the brushguard, bonnet and radiator grille (Para 14).

b.  Drain coolant until the coolant level is below the thermostat body (14).

c.  Remove the four upper housing bolts (Item 1).

d.  Remove the upper thermostat body (Item 2).

e.  Remove the upper housing gasket (Item 17).

f.  Clean the mating surfaces.

g.  Remove the thermostat element (Item 16).

h.  Test the thermostat element (Para 68) (replace the element if necessary).

NOTE

The element is not repairable.

i.  Place the thermostat element in the thermostat body.

j.  Fit a new upper housing gasket (Item 17) to the thermostat body.

k.  Fit the upper thermostat body.

l.  Install the four bolts.

m.  Tighten the bolts between 10 and 15 N.m.

n.  Fill the cooling system until the coolant expansion tank is two-thirds full.

o.  Fit the radiator grille, bonnet and brushguard (Para 14).

p.  Test drive the vehicle.

q.  Check the cooling system for leaks (repair if necessary).

Cooling Fan

63.  Replacement. Replace the cooling fan as follows (Figure 60):
a. Remove the brushguard, bonnet and radiator grille (Para 14).
b. Remove the nuts (Item 8) at both ends of the radiator support (Item 9).
c. Remove the radiator support.
d. Release the tension pulley (Item 7) and remove the fan final drive belt.
e. Remove the two rear bolts (Item 4) from the tension bearing housing (Item 6).
f. Unscrew the four fan bracket retaining bolts (Item 11).
g. Remove the fan bracket (Item 10) from the fan shroud (Item 1).
h. Unscrew the six fan bolts (Item 13).
i. Remove the fan (Item 2).
j. Fit the fan to the fan hub.
k. Insert and tighten the six fan bolts (Item 13).
l. Fit the fan bracket to the fan shroud.
m. Insert and tighten the four bracket retaining bolts (Item 11).
n. Insert the two rear bolts (Item 4) from the tension bearing housing (Item 6).
o. Secure the bolts with the nuts (Item 5).
p. Fit and correctly tension the fan final drive belt (Para 56).
q. Fit the radiator support (Item 9) and tighten the nuts (Item 8).

r. Fit the radiator grille, bonnet and brushguard (Para 14).

Hoses, Pipes and Rubber Sleeves

64. The engine cooling system components are connected by hoses, pipes and rubber sleeves. These items are either a push-fit on to the parent component or are secured by worm-drive hose clamps.

   a. Before removing any connector, ensure that the coolant has been drained to below the level of the connector.

   b. After replacing the connector top up the coolant until the coolant expansion tank is two-thirds full.

   c. Run the engine and check for any leaks (repair as necessary).

Coolant Pump Repair

65. Dismantle. Dismantle the coolant pump as follows (Figure 61):

   a. Remove the two rear housing bolts (Item 13).

   b. Remove the two front housing bolts (Item 17).

   c. Remove the pump cover (Item 14).

   d. Remove the gasket (Item 15) and clean all the mating surfaces.

   e. Remove the six seal housing bolts (Item 3).

   f. Press the shaft assembly (Item 20) out of the impeller (Item 16).

   g. Remove the O ring (Item 5).

   h. Press the shaft (Item 19), complete with the bearings (Items 6 and 7), out of the hub (Item 1) and seal ring housing (Item 4).

   i. Remove the outer shaft seal (Item 2) from the seal housing.

   j. Press the shaft out of the front bearing (Item 6).

   k. Press the shaft out of the rear bearing (Item 7).

   l. Remove the inner shaft seal (Item 18) from the pump body (Item 9).

   m. Remove the face seal (Item 10) from the pump body.

   n. Remove the thrust ring (Item 11) and boot (Item 12) from the impeller.

66. Inspection. Inspect the coolant pump for components which are worn or damaged. Obtain the appropriate repair kit (Ref RPS 02155) and replace worn or damaged components.

WARNING

Possible Asbestos Containing Material. If it can not be confirmed by the vehicle’s GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.
Figure 61  Coolant Pump

1. Hub
2. Outer shaft seal
3. Seal housing bolt
4. Seal housing
5. O-ring
6. Front bearing
7. Rear bearing
8. Plug
9. Pump body
10. Face seal
11. Thrust ring
12. Boot
13. Rear housing bolt
14. Pump cover
15. Gasket
16. Impeller
17. Front housing bolt
18. Inner shaft seal
19. Shaft
20. Shaft assembly
67. **Assembly.** Assemble the coolant pump as follows (Figure 61):
   
a. Fit the thrust ring (Item 11) and boot (Item 12) into the impeller (Item 16).
b. Fit the face seal (Item 10) into the pump body (Item 9).
c. Fit the inner shaft seal (Item 18) into the pump body.
d. Press the rear bearing (Item 7) onto the shaft.
e. Press the front bearing (Item 6) onto the shaft.
f. Fit the outer shaft seal (Item 2) into the seal housing (Item 4).
g. Place the seal housing and hub (Item 1) on the shaft (Item 19) and press the hub onto the shaft.
h. Fit the O ring (Item 5) over the shaft, into the recess in the rear of the seal housing.
i. Press the shaft assembly (Item 20) into the pump body (Item 9).
j. Fit and tighten the six seal housing bolts (Item 3).
k. Press the impeller (Item 16) onto the shaft until the outer surface of the impeller (Item a) is flush with the flange surface of the pump body.
l. Check that the clearance (Item b) between the impeller and the pump body is between 0.3 mm and 1.1 mm.
m. Fit a new gasket (Item 15) to the pump body (Item 9) using a non-curing sealant (Loctite 573 or equivalent).
n. Fit the pump cover (Item 14) to the pump body.
o. Fit and tighten the two front housing bolts (Item 17).
p. Fit and tighten the two rear housing bolts (Item 13).
q. Remove the plug (Item 8).
r. Pack the shaft cavity with XG-291 grease.
s. Refit and tighten the plug.

**Test Procedures**

68. Test procedures carried out on the cooling system are as follows:
   
a. leak tests (Para 69);
b. coolant expansion tank cap test (Para 70); and
c. thermostat test (Para 71).

69. **Leak Testing.** Test the system for leaks as follows (Figure 62):
   
a. Open the heater shut-off valve.
b. Open the bonnet.
c. Ensure that the expansion tank coolant level is two-thirds full.
d. Detach the rubber buffer (Item 3) from the radiator pressure tester (Table 1, Item 8).
e. Fit the rubber buffer to the cap end of the coolant tank adaptor (Table 1, Item 9).
f. Fit the other end of the coolant tank adaptor to the radiator pressure tester.
g. Remove the coolant expansion tank cap.
h. Fit the cap end of the coolant tank adaptor to the coolant expansion tank.
i. Operate the hand pump (Item 1) on radiator pressure tester until the pressure gauge shows one bar (100 kPa).
j. Observe the pressure gauge for approximately five minutes.
k. If the pressure drops, locate and rectify the leak.
l. Remove the radiator pressure tester and the coolant tank adaptor.
m. Fit the coolant expansion tank cap.
n. Close the bonnet.
o. Close the heater shut-off valve.

70. **Expansion Tanks Cap Testing.** Test the coolant expansion tank cap as follows (Figure 62):

a. Open the bonnet.
b. Attach the connector (Item 4) to the clips on the radiator pressure tester (Table 1, Item 8).
c. Remove the coolant expansion tank cap (Item 5) and fit it to the expansion tank adaptor.
d. Operate the hand pump (Item 1) on the radiator pressure tester.
e. Check that the valve opens at 0.7 ±0.1 bar as read on the gauge on the radiator pressure tester.
f. Replace the cap if it fails the test.
g. Remove the radiator pressure tester and the expansion tank adaptor.
h. Fit the cap to the coolant expansion tank.
i. Close the bonnet.
71. **Thermostat Testing.** Test the thermostat as follows (Figure 63):

![Figure 63 Thermostat Testing](image)

- a. Remove the thermostat element from the thermostat body (Para 62).

**CAUTION**

Do not let the thermostat touch the sides or bottom of the container.

- b. Fill a suitable container with water.
- c. Place the container of water over a heating device.
- d. Rest the thermostat element flange on the support plate so that the heat sensitive element is fully immersed in the water.
- e. Heat the water until the main valve opens enough to insert a strip of paper between the main valve and the thermostat body.
- f. Remove the thermostat from the water so that the main valve closes on the paper.
- g. Cool the water slightly by adding cold water.
- h. Place the thermostat on the support plate and heat the water slowly while agitating the water.
- i. Hold the thermometer bulb near the heat sensitive element and note the temperature at which the main valve opens sufficiently to release the paper.
- j. This temperature should be between 82.8 °C and 83.2 °C.
- k. The main valve should be fully open at 95 °C.
- l. Replace the thermostat element if it fails the test.
- m. Fit the element into the thermostat body (Para 62).
EXHAUST SYSTEM

72. Replace exhaust system components as follows:

NOTE

Repairs to the exhaust system are largely dependent on the experience of the mechanic carrying out the repair work. If the system or its components are excessively corroded or holed, replace the faulty components. If not, repairs can be made using normal welding or brazing techniques.

a. exhaust manifold (Para 41);
b. exhaust muffler (Para 73); and
c. exhaust pipe (Para 74).

Exhaust Muffler

73. Replacement. The exhaust muffler can be replaced without removing the exhaust pipe. Replace the exhaust muffler as follows:

a. Lubricate the muffler inlet pipe and the muffler and tailpipe securing clamps with suitable penetrating oil.
b. Loosen the clamp securing the muffler to the exhaust pipe.
c. Loosen the clamp securing the muffler to the tailpipe.
d. Remove the two lower bolts from the bracket securing the rear of the muffler to the chassis.
e. Remove the bolt securing the exhaust pipe to the chassis.
f. Remove the muffler from the exhaust pipe and the tailpipe.

NOTE

If difficulty is experienced when removing the muffler, apply heat to the muffler connections to assist with removal.

g. Discard the muffler.
h. Use a wire brush to clean the mating surfaces on the exhaust pipe and the tailpipe.
i. Carefully fit the muffler inlet pipe over the exhaust pipe and push it home.
j. Fit the tailpipe to the muffler.

NOTE

Ensure that the muffler and tailpipe are correctly positioned.

k. Position and tighten the clamps securing the muffler to the exhaust pipe and tailpipe.
l. Fit and tighten all clamps securing the muffler and exhaust pipe to the chassis.
m. Start and run the engine for a brief period checking for any leaks (repair where necessary).

Exhaust Pipe

74. Replacement. Replace the exhaust pipe as follows:

a. Raise and secure the cabin (Para 25).
b. Lubricate the exhaust pipe flange, the muffler inlet pipe and all nuts and bolts on the clamps securing the exhaust pipe to the chassis with penetrating oil.
c. Unscrew and remove the three bolts and nuts securing the exhaust pipe to the engine brake manifold.
Possible Asbestos Containing Material. If it cannot be confirmed by the vehicle's GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

d. Lower the exhaust pipe away from the engine brake manifold.
e. Remove and discard the gasket.
f. Loosen the clamp securing the exhaust pipe to the muffler.
g. Remove the nut and bolt securing the exhaust pipe to the bracket on the chassis forward of the muffler.
h. Remove the exhaust pipe from the muffler.

NOTE
If difficulty is experienced when removing the muffler, apply heat to the muffler connections to assist with removal.
i. Remove and discard the exhaust pipe.
j. Use a wire brush to clean the mating surfaces on the engine brake and exhaust pipe manifolds.
k. Fit the new pipe into the muffler inlet pipe.

NOTE
Do not tighten the securing clamp.
l. Fit a new gasket to the flange on the exhaust pipe.

CAUTION
Care is to be taken so as not to damage the gasket.
m. Carefully raise the exhaust pipe until the flange on the pipe mates correctly with the flange on the engine brake.
n. Install the three securing bolts and nuts.
o. Tighten the bolts to 45 N.m.
p. Tighten the clamp on the muffler inlet pipe.
q. Fit and tighten the nut and bolt securing the exhaust pipe to the bracket on the chassis forward of the muffler.
r. Lower and secure the cabin (Para 26).
s. Start and run the engine for a brief period checking for any leaks (repair where necessary).

FUEL SYSTEM
75. Replacement, repair and adjustment procedures for the following components of the fuel system are described in this section as follows:

a. fuel injection pump (Para 76);
b. injection and injector leak-off pipes (Para 77);
c. pre-cleaner element (Para 78);
d. two-stage filter elements (Para 79);
e. lift pump (Para 80);
f. fuel tank (Para 81);
g. bleeding the fuel system (Para 83); and
Fuel Injection Pump

76. **Replacement.** Replace the fuel injection pump as follows:

a. Remove the brushguard, bonnet and radiator grille (Para 14).

b. Disconnect the negative lead from the battery and then disconnect the positive lead.

c. Disconnect the electrical cables from the generator.

d. Remove the generator (Para 182).

e. Disconnect the vent line between the steering fluid reservoir and the timing gear case.

f. Remove the taper plug from the timing gear case.

g. Rotate the engine until No 1 piston is at the start of fuel delivery position on the compression stroke; ensure that the timing marks are aligned exactly with the timing pointers.

h. Release and detach the throttle linkage from the injection pump (Figure 66).
i. Disconnect the fuel input line (Figure 67, Item 5) from the injection pump.

j. Disconnect the oil feed line (Figure 67, Item 7) to the fuel injection pump.
k. Disconnect the excess fuel return line (Figure 67, Item 3) from the fuel injection pump.
l. Discard the sealing washers on the banjo bolt.
m. Disconnect the two fuel lines (Figure 67, Item 6) from the fuel lift pump.
n. Discard the sealing washers on the banjo bolts.

Do not disconnect the electrical cable from the pulse generator.

o. Detach the tachometer pulse generator from the tachometer angle drive (Figure 67, Item 1).
p. Disconnect the boost pressure sensing line (Figure 67, Item 2) from the smoke limiter.
q. Discard the sealing washers on the banjo-bolt.
r. Remove the six injection pipe cap-nuts from the fuel injection pump using the injector pump cap-nut wrench (Table 1, Item 10) (Figure 68).

Figure 68 Injection Pipe Cap-nuts

s. Remove the five bolts and spring washers holding the fuel injection pump to the timing gear case.
t. Remove the fuel injection pump from the engine and discard the mounting gasket.

Ensure that no dirt or foreign material enters the timing gear case.

u. Clean the mating surface on the timing gear case.

NOTE
Remove all gasket residue from the timing gear case.

When fitting a fuel injection pump to the engine, ensure that the scribed tooth on the gear that drives the injection pump is exactly aligned with the pointer in the timing gear case (Figure 64).

v. Remove the securing nut from the injection pump drive shaft.
w. Pull the drive gear off the injection pump drive shaft.
x. Remove the four nuts and washers from the drive gear cover.
y. Remove the cover.
z. Discard the gasket.

aa. Remove the four studs from the old injection pump.
bb. Coat the studs with Loctite 220.
cc. Insert the four studs into the new injection pump.
dd. Fit the new gasket to the drive gear cover.
e. Fit the cover to the new injection pump.
ff. Secure the cover with the four nuts and washers.

gg. Press the drive gear onto the injection pump drive shaft.
hh. Reinstall the securing nut on the drive shaft.
ii. Remove the lift pump from the old injection pump.
jj. Fit the lift pump to the new injection pump.

kk. Lightly coat the new mounting gasket with XG-291 grease.
ll. Fit the gasket to the mounting flange on the fuel injection pump.

**CAUTION**

Take care not to damage or disturb the position of the gasket.

mm. Fit the fuel injection pump to the timing gear case.
nn. Coat the five retaining bolts with Curil K 2 sealant (or equivalent).

oo. Install and tighten the five retaining bolts and spring washers.

pp. Fit the six cap-nuts on the injection pipes to the fuel injection pump.

qq. Torque the cap-nuts to 25 N.m using the injector pump cap-nut wrench (Figure 68).

rr. Use new sealing washers on the banjo bolt and connect the boost pressure sensing line (Figure 69, Item 2) to the smoke limiter.

ss. Connect the two fuel lines (Figure 67, Item 6) to the fuel lift pump, using new sealing washers on the banjo-bolts.

tt. Connect the oil feed line (Figure 67, Item 7) to the fuel injection pump, using new sealing washers on the banjo bolts.

uu. Connect the excess fuel return line (Figure 67, Item 3) to the fuel injection pump.

vv. Connect the throttle linkage to the fuel injection pump control lever (Figure 66).

ww. Connect the vent line between the steering fluid reservoir and the timing gear case.

xx. Fit the taper plug into the timing gear case.

yy. Bleed the fuel system (Para 83).

zz. Fit the generator and connect the electrical cables to the generator (Para 182).

aaa. Connect the positive lead to the battery and then connect the negative lead.

bbb. Start and run the engine for a brief period checking for any leaks, rough idling and/or hunting (repair any leaks and adjust the pump timing where necessary).

ccc. Fit and secure the radiator grille, bonnet and brushguard (Para 14).

ddd. Road test the vehicle.
Injection and Injector Leak-off Pipes

77. Replacement. Replace the injection and injector leak-off pipes as follows:

NOTE
This procedure describes the replacement of all six injector pipes. For the removal of a single injector pipe modify the procedure as required.

a. Remove the brushguard, bonnet and radiator grille (Para 14).
b. Raise and secure the cabin (Para 25).
c. Disconnect the negative lead from the battery and then disconnect the positive lead.
d. Remove the two bolts and nuts holding the fuel filter assembly to the mounting bracket (Figure 71, Item 4).
e. Detach the assembly from the bracket.

NOTE
Do not disconnect the fuel lines.
f. Detach the tachometer pulse generator (Figure 67, Item 1) from the angle drive.

NOTE
Do not disconnect the electrical cable from the tachometer pulse generator.
g. Detach the boost pressure sensing line (Figure 67, Item 2) from the smoke limiter.
h. Discard the sealing washers from the banjo bolt.
i. Remove the cylinder head cover and discard the gasket (Para 32).

Ensure that no dirt enters the injectors when removing the injection and leak-off pipes.
j. Unscrew and remove the six banjo bolts (Figure 69, Item 3) holding the leak-off pipe (Figure 69, Item 1) to the injectors.
k. Discard the sealing washers (Figure 69, Item 2).
l. Remove the six injection pipe cap-nuts (Figure 69, Item 11) from the injectors using the injector pump cap-nut wrench (Figure 68).
m. Remove the gland-nut (Figure 69, Item 12) in the cylinder head.
n. Remove the leak-off pipe.
o. Remove the six injection pipe cap-nuts (Figure 69, Item 11) from the injectors using the injector pump cap-nut wrench (Figure 68).
p. Unscrew and release the six gland-nuts (Figure 69, Item 4) holding the injection pipes in the cylinder head.
q. Remove the six injection pipe cap-nuts (Figure 69, Item 7) from the injection pump using the injector pump cap-nut wrench.
r. Detach the two brackets (Figure 69, Item 10) securing the injection pipes together.
Open and remove the brackets and rubbers from the injection pipes.
t. Remove the injection pipes from the engine.

u. Fit new injection pipes to the engine.

v. Hold the injection pipes in the cylinder head and hand tighten the gland-nuts (Figure 69, Item 4).

w. Fit the six cap-nuts (Figure 69, Item 11) on the injection pipes to the injectors.

x. Hand-tighten the cap-nuts.

y. Fit the cap-nuts (Figure 69, Item 7) to the injection pump.

z. Hand-tighten the cap-nuts.

aa. Fit the two brackets and rubbers (Figure 69, Item 10) to the injection pipes.

bb. Fit a new leak-off pipe (Figure 69, Item 1) to the six injectors and the cylinder head.

c. Install new sealing washers (Figure 60, Item 2) on the banjo bolts (Figure 60, Item 3).

d. Install and tighten the bolts between 15 and 20 N.m.

e. Tighten the gland-nut (Figure 69, Item 12) holding the leak off pipe in the cylinder head to 6 N.m.

f. Tighten the cap-nuts on the injectors and the injection pump to 25 N.m using the injector pump cap-nut wrench.

gg. Tighten the six gland-nuts holding the injection pipes in the cylinder head to 25 N.m.

hh. Lightly coat a new cylinder head cover gasket with XG-291 grease and position it on the cylinder head.

ii. Fit the cylinder head cover (Para 32).

jj. Use new sealing washers on the banjo bolt and attach the boost pressure sensing line (Figure 69, Item 2) to the smoke limiter.

kk. Attach the tachometer pulse generator to the angle drive (Figure 67, Item 1).

ll. Fit the fuel filter assembly to the mounting bracket (Figure 71).

mm. Bleed the fuel system (Para 83).

nn. Lower and secure the cabin.

oo. Connect the positive lead to the battery and then connect the negative lead.

pp. Start and run the engine for a brief period checking for leaks (repair where necessary).

qq. Fit the radiator grille, bonnet and brushguard (Para 14).

rr. Road test the vehicle.

Pre-cleaner Element

78. **Cleaning or Replacement.** The pre-cleaner element can be cleaned or replaced with the lift pump fitted to the fuel injection pump. Clean or replace the pre-cleaner element as follows (Figure 70):
a. Raise and secure the bonnet.
b. Remove the radiator grille assembly (Para 19).
c. Remove the generator (Para 182).
d. Loosen the knurled nut (Item 3), while holding the glass bowl (Item 1).
e. Swing the U-bolt (Item 2) to one side and remove the glass bowl and pre-cleaner element.
f. Remove and discard the sealing ring from the ring groove in the body of the lift pump.
g. Remove the pre-cleaner element and spring from the fuel bowl.
h. Inspect the pre-cleaner element (replace if damaged).
i. Wash the pre-cleaner element, fuel bowl, spring and lift pump (remove any dirt from the ring groove) with clean fuel.
j. Dry the pre-cleaner element, fuel bowl and lift pump with compressed air.
k. Lightly lubricate the new sealing ring with clean fuel.

Ensure that the ring is not twisted in the groove.

l. Fit the ring into the groove in the lift pump body.
m. Place the spring into the glass bowl.
n. Place the pre-cleaner element into the glass bowl on top of the spring.
o. Fit the glass bowl to the lift pump.

CAUTION

Do not over tighten the nut as the glass bowl may crack.

p. Clamp the U-bolt (2) over the bowl and tighten the knurled nut (3).
q. Bleed the fuel system (Para 83).
r. Refit the generator (Para 182).
s. Start and run the engine for a brief period.
t. Check for any leaks (repair where necessary).
u. Fit the radiator grille assembly to the vehicle (Para 20).
v. Lower and secure the bonnet.
w. Road test the vehicle.

Two-stage Filter Elements

79. Replacement. The two-stage filter elements can be replaced as separate units, with the filter assembly fitted to the engine. Replace the filter elements as follows (Figure 71):

![Figure 71 Fuel Filters Elements](image)

a. Raise and secure the bonnet.
b. Remove the radiator grille and brushguard (Para 19 and 21).
c. Remove the generator (Para 182).
d. Unscrew and remove the two bowl retaining bolts (Item 2) from the fuel-filter head.
e. Remove the bowls and the fuel filter elements.
f. Discard the fuel filter elements.
g. Remove and discard the sealing rings from the ring grooves in the fuel filter head.
h. Wash the bowls and the filter head (remove any dirt from the ring grooves) using clean fuel.
i. Dry the bowls and the filter head with compressed air.
j. Lightly lubricate the new sealing rings with clean fuel.
Ensure that the rings are not twisted in the ring grooves. Twisted rings will result in fuel leaks.

k. Insert the rings into the ring grooves in the filter head.
l. Insert a new fuel filter element into the bowl.
m. Fill the bowl with clean fuel.
n. Fit the bowl to the fuel filter head.
o. Install and tighten the retaining bolt (Item 2).
p. Repeat steps l. to o. for the second bowl.
q. Bleed the fuel system (Para 83).
r. Refit the generator (Para 182).
s. Start and run the engine for a brief period.
t. Check for any leaks (repair where necessary).
u. Fit the radiator grille and brushguard (Para 14).
v. Lower and secure the bonnet.
w. Road test the vehicle.

**Lift Pump**

80. **Replacement.** The lift pump can be replaced with the fuel injection pump fitted to the engine. Replace the lift pump as follows:

a. Raise and secure the bonnet.
b. Remove the radiator grille (Para 19).
c. Remove the generator (Para 182).
d. Release the clamp (Figure 72, Item 2) and nut (Figure 72, Item 1) on the air delivery line from the air compressor and move the line to one side.

![Figure 72 Fuel Lift Pump Connections](image_url)
e. Disconnect the two fuel lines (Figure 72, Item 3) from the fuel lift pump.

f. Discard the sealing washers from the banjo bolts.

g. Remove the three nuts and spring washers holding the lift pump to the fuel injection pump.

h. Remove the lift pump from the injection pump.

i. Discard the gasket.

**CAUTION**

Ensure that no dirt or gasket residue enters the fuel injection pump.

j. Clean the mating surface on the fuel injection pump.

k. Lightly coat a new gasket with XG-291 grease.

l. Fit the gasket over the retaining studs on the fuel injection pump.

m. Position the lift pump on the retaining studs.

n. Fit and tighten the three retaining nuts and spring washers on the studs.

o. Fit new sealing washers on the banjo-bolts.

p. Secure the two fuel lines (Figure 72, Item 3) to the lift pump with the banjo-bolts.

q. Connect the air delivery line to the air compressor and tighten the clamp (Figure 72, Item 2).

r. Bleed the fuel system (Para 83).

s. Refit the generator (Para 182).

t. Refit the radiator grille (Para 20).

u. Lower and secure the bonnet.

v. Start and run the engine for a brief period checking for any leaks (repair if necessary).

w. Road test the vehicle.

### Fuel Tank

**81. Repair or Replacement.** Replace or repair the fuel tank as follows:

**WARNING**

Specialised techniques are used to repair fuel tanks. Serious injury or death can result from failure to observe safety precautions. Refer to EMEI Workshop E 405 and current Workshop safety orders before repairing the fuel tank.

**WARNING**

Possible Asbestos Containing Material. If it can not be confirmed by the vehicle’s GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

a. Drain all fuel from the fuel tank into a suitable container.

b. Disconnect the cable from the fuel level sensor.

c. Disconnect the fuel lines from the fuel tank.
Have a second person support the tank during its replacement.

d. Remove a cotter pin from one end of the pin securing the strap to the bracket on top of the tank.
e. Remove the pin from the strap.
f. Remove a cotter pin from the pin securing the second strap to the bracket on top of the tank.
g. Remove the nut securing the strap to the bracket on the underside of the tank.
h. Remove the strap from the bracket.
i. Remove the nut securing the second strap to the bracket on the underside of the tank.
j. Remove the strap from the bracket.
k. Remove the fuel tank.
l. Replace or repair the fuel tank observing all safety precautions.
m. Fit the fuel tank to the chassis.
n. Place the straps over the tank.
o. Fit the pins through the straps and brackets on top of the tank.
p. Secure the straps to the lower bracket with the nut.
q. Secure the pins to the brackets on top of the tank with a new cotter pin.
r. Connect the fuel lines to the tank.
s. Connect the cable to the fuel level sensor.
t. Fill the tank with fuel.
u. Check for leaks (repair where necessary).
w. Bleed the fuel system (Para 83).
x. Start and run the engine for a brief period.
y. Check for any leaks (repair where necessary).

Fuel System Bleeding

82. The fuel system must be bled when:

a. routine maintenance or repairs to the fuel system are carried out involving a break in the fuel system circuit, or

b. an air-lock occurs in the fuel system for any other reason.

83. Bleeding. Bleed the fuel system as follows (Figure 73):
a. Fill the fuel tank.
b. Raise and secure the bonnet.
c. Remove the generator (Para 182).
d. Unlock the priming pump handle by rotating the knurled handle anticlockwise.
e. Pump the handle until slight pressure is felt.
f. Continue to pump the handle.
g. Loosen the bleed screws on the top of the two stage fuel filter housing by one or two turns.
h. Pump the priming pump until bubble free fuel escapes from the bleed screws on the fuel filter.
i. Tighten the bleed screws on the fuel filter.
j. Loosen the bleed screw on the top of the fuel injection pump.
k. Continue pumping until bubble free fuel escapes from the bleed screw on the fuel injection pump.
l. Continue pumping and tighten the bleed screw.
m. Fully depress the priming pump handle and screw it clockwise to lock it in the depressed position.
n. Refit the generator (Para 182).
o. Lower and secure the bonnet.
p. Road test the vehicle.

Engine Idling Speed

84. The idling speed is preset by the governor and cannot be internally adjusted on the vehicle. Incorrect adjustment of the accelerator/hand throttle linkage can over-ride the governor preset idle speed and either stall the engine at idle speed or give too high an idle speed.

85. The correct engine idle speed is 700 to 800 rpm with the engine at normal operating temperature. The idle speed should be checked when the following work has been carried out:
   a. replacement of the fuel injection pump;
   b. replacement of, or repairs to, the accelerator/hand throttle linkages; or
   c. any other work on the engine that may cause an alteration to the idle speed.

86. Early production vehicles up to ARN 39010 have to be modified in accordance with EMEI Vehicle G 617-1, Vehicle G 617-4 and Vehicle G 617-7 before the accelerator throttle linkage can be adjusted correctly.
Throttle Linkage

87. Adjustment. Adjust the throttle linkage as follows:

**CAUTION**

The part of the left-hand bracket which rests against the stop, has been modified by EMEI Vehicle G 617-7 (Figure 74).

a. Check all linkages and brackets for damage (repair if necessary).

b. Check that the straight edge at the rear of the left-hand bracket is centred on the vertical (Figure 74).

c. Check the angle of the right-hand lever using the template at Figure 75.

**NOTE**

Place the vertical edge of the template against the rear of the engine block.

d. Adjust the angle of the bracket by removing the bolt at the spindle and rotating the bracket until it approximately aligns with the template.

**NOTE**

Moving the bracket one groove on the spline will rotate the bracket 10.3°.

e. Refit and tighten the bolt.

f. Move and hold the injection pump control lever to full load without compressing the spring cylinder.
g. Measure the distance (Figure 76, Item A) between the rear of the engine block and the centre of the ball joint.

h. Adjust the linkage until the distance (Figure 76, Item A) measured is 90 mm.

i. Hold the injection pump control lever at full load.

j. Depress the accelerator pedal until the full fuel position is attained.

NOTE
Check the control rod to ensure the full fuel position is attained without compressing the spring loaded plunger built into the control rod assembly.

k. Measure the distance between the top of the accelerator pedal and the cabin floor.

NOTE
The distance measured should be approximately 70 mm.

l. If the distance measured is not approximately 70 mm adjust the accelerator pedal position as follows:

1) Raise the cabin slightly using an overhead lifting device.
NOTE

If there are no overhead lifting devices available refer the vehicle to the next-in-line Workshop for further adjustment.

(2) Remove the bolt from the end of the accelerator pedal shaft.

NOTE

Rotating the pedal one spline on the accelerator pedal shaft will move the top of the pedal approximately 45 mm.

(3) Rotate the accelerator pedal shaft until the top of the accelerator pedal is approximately 70 mm from the cabin floor in the full fuel position.

(4) Replace and tighten the bolt.

(5) Lower the cabin.

m. With the accelerator pedal held at the full fuel position, adjust the pedal stop bolt until there is a clearance of 10 mm between the bolt head and the cabin floor (Ref EMEI Vehicle G 617-4).

n. Lock the locknut on the pedal stop bolt.

o. Fully depress the accelerator pedal until the stop-bolt touches the floor.

p. Adjust the roller so that there is no free-play between the roller and the intermediate spindle lever (Figure 77).

Figure 77 Adjusting the Roller

NOTE

If there is not enough adjustment at the roller proceed as follows.

q. Centre the roller in the elongated hole.

r. Remove the bolt from the spindle on the end of the accelerator pedal shaft (Figure 78).
s. Adjust the bracket until the roller rests on the intermediate spindle lever.

**NOTE**

The hand control lever will move.

t. Refit and tighten the bolt.

u. Release the accelerator and the injection pump control lever.

v. Operate the engine exhaust brake.

w. Adjust the adjustment screw (Item 4) at the intermediate spindle lever (Item 6) until a clearance (Item A) of 1 to 2 mm is obtained from the intermediate spindle lever (Figure 79).

x. Release the engine exhaust brake.

y. Fully depress the accelerator pedal until the stop bolt touches the floor.
z. Adjust the locknut (Figure 80, Item 10) on the lower end of the vertical control rod until it is positioned with a clearance of approximately 2 to 4 mm below the lower lever arm.

![Diagram of Accelerator Linkage]

**Figure 80 Accelerator Linkage**

**aa.** Check that the hand throttle is correctly adjusted.

**NOTE**
If adjustment of the hand throttle is required, carry out the procedure in Para 88.

**bb.** Fit the engine cover.

**cc.** Road test the vehicle.

**Hand Throttle Adjustment**

**88.** To allow for the possible differences in linkage settings of individual vehicles, the idle speed can be simply reset by loosening the two lock screws on the hand throttle plastic stop (Figure 81) and moving the stop up or down. Moving the stop down will increase the idle rpm, moving it up will decrease the rpm. If the correct idle speed cannot be attained within the allowable movement of the plastic stop, it will be necessary to reset the accelerator/hand throttle linkage before the idle speed can be adjusted vide the plastic stop.

**89.** To reset the hand throttle linkage proceed as follows:

**a.** Set the hand throttle lever in the cabin to the idle position.

**NOTE**
Ensure the plastic stop is centrally located by the two mounting bolts.

**b.** Remove the engine cover from the inside of the cabin bulkhead.
Figure 81 Hand Throttle

c. Loosen the locknut (Figure 80, Item 11) at the ball joint at the upper end of the control rod connected to the hand throttle upper lever arm (Figure 80, Item 8).
d. Start the engine.
e. Allow the engine to reach operating temperature.
f. Adjust the vertical control rod (Figure 80, Item 7) down until the collar on the rod positions the lower lever arm (Figure 80, Item 9) to maintain the engine idle between 700 and 800 rpm.

NOTE

Turning the control rod can be simplified by raising the hand throttle lever slightly to ease the load on the rod. Reposition the lever to check the idle rpm.

g. Secure the locknut.
h. Fit the engine cover to the inside of the cabin bulkhead.
i. Road test the vehicle.
j. Check the idling speed (adjust if necessary).

CLUTCH

90. Repair and adjustment procedures for the following components of the clutch are described in this section:

a. the master cylinder (Para 91);
b. the pedal mechanism (Para 96);
c. the slave cylinder, without winch (Para 101);
d. the slave cylinder, with winch (Para 105);
e. pedal adjustment (Para 109); and
f. bleeding (Para 110).
Master Cylinder

91. The master cylinder can be removed from the pedal mechanism. The relevant procedures are as follows:
   a. removal (Para 92);
   b. dismantling (Para 93);
   c. assembly (Para 94); and
   d. installation (Para 95).

92. **Removal.** Remove the master cylinder from the pedal mechanism as follows (Figure 82):

   ![Figure 82 Clutch Master Cylinder](image)

   a. Unscrew the tube nut (Item 18) from the union (Item 20) on the engine side of the bulkhead.
   b. Carefully push the hydraulic line (Item 17) away from the union.

   **NOTE**

   Use a suitable container to collect the hydraulic fluid which drains from the union.

   c. Operate the clutch pedal repeatedly until the clutch hydraulic fluid reservoir is empty.
   d. Discard the collected hydraulic fluid.
   e. Disconnect the hose from the inlet pipe (Item 24).
   f. Detach the clip (Item 5) and washer (Item 6) from the push rod pin (Item 9).
   g. Pull the push rod pin out of the rod end (Item 7).
h. Remove the mounting bolts (Item 10), spring washers (Item 2) and mounting nuts (Item 1) holding the master cylinder (Item 3) to the clutch pedal bracket (Item 26).
i. Unscrew the tube nut (Item 21) from the union on the cabin side of the bulkhead.
j. Detach the banjo union (Item 23) and hydraulic line (Item 22) from the master cylinder.
k. Remove the master cylinder from the clutch pedal bracket.

93. Dismantling. Dismantle the master cylinder as follows (Figure 82):
   a. Pull the piston push rod (Item 7) and locknut (Item 4) out of the master cylinder.
   b. Remove the needle roller bearing (Item 8) from the rod end.
   c. Remove the dust boot (Item 11) from the master cylinder.
   d. Remove the circlip (Item 12), piston (Item 14) and spring (Item 16) from the master cylinder.
   e. Remove the dust cap and unscrew the bleeder screw (Item 25) from the master cylinder.
   f. Discard the dust boot, circlip and piston seals (Items 13 and 15).
   g. Clean and check all parts (replace any worn or damaged parts).
   h. Renew all seals.

94. Assembly. Assemble the master cylinder as follows (Figure 82):
   a. Obtain a clutch master cylinder seal kit (Ref RPS 02155).
   b. Screw the bleed screw (Item 25) into the master cylinder.
   c. Fit the dust cap to the bleed screw.
   d. Lubricate the piston (Item 14) and seals (Items 13 and 15) with clean hydraulic fluid.
   e. Fit the seals to the piston.
   f. Lightly smear the inside of the master cylinder with clean hydraulic fluid.
   g. Install the spring in the master cylinder.
   h. Push the piston into the master cylinder.
   i. Fit the circlips (Item 12) into the groove, in the master cylinder.
   j. Fit the dust boot (Item 11) to the master cylinder.
   k. Fit the piston push rod (Item 7) and locknut (Item 4) into the master cylinder through the dust boot.
   l. Fit the hydraulic line (Item 22) to the end of the master cylinder.
   m. Hand-tighten the banjo union (Item 23).
   n. Grease the needle roller bearing (Item 8) with XG-291.
   o. Fit the bearing into the rod end.

95. Installation. Install the master cylinder in the pedal mechanism as follows (Figure 82):
   a. Fit the master cylinder and hydraulic line to the clutch pedal bracket.
   b. Insert the mounting bolts (Item 10), spring washers (Item 2) and mounting nuts (Item 1).
   c. Tighten the nuts to 40 N.m.
   d. Fit the push rod pin (Item 9) through the clutch pedal arm, piston push rod end (Item 7) and needle roller bearing (Item 8).
   e. Fit the washer (Item 6) and clip (Item 5).
   f. Connect the hydraulic line (Item 22) to the union (Item 20) on the cabin side of the bulkhead.
   g. Tighten the tube nut (Item 21) and the banjo union (Item 23).
   h. Connect the line from the clutch fluid reservoir to the inlet pipe (24).
i. Adjust the master cylinder and the clutch pedal (Para 109).

**Pedal Mechanism**

96. The pedal mechanism can be removed from the vehicle for repair. The relevant procedures are as follows:
   a. removal (Para 97);
   b. dismantling (Para 98);
   c. assembly (Para 99); and
   d. installation (Para 100).

97. **Removal.** Remove the pedal mechanism as follows (Figure 83):
Figure 83  Pedal Mechanism

1. Pedal mounting bracket
2. Bracket securing bolt
3. Push rod
4. Needle roller bearing
5. Push rod pin
6. Locknut
7. Upper spring-seat
8. Pedal return spring
9. Lower spring-seat
10. Pin securing nut
11. Spacer tube
12. Needle roller bearing
13. Pedal shaft
14. Washer
15. Circlip
16. Pedal rubber
17. Clutch pedal
18. Pedal boss
19. Cylinder push-rod pin
20. Washer
21. Circlip
98. **Dismantling.** Dismantle the pedal mechanism as follows (Figure 83):

a. Place the pedal bracket in a vice.
b. Remove the circlips (Item 15) and washer (Item 14).
c. Compress the helper spring (Item 8) on the spring push rod (Item 3) using the clutch pedal spring compressor (Table 1, Item 11) (Figure 84).
d. Remove the circlips (Item 15) from the push rod pin (Item 5).
e. Pull the pin and the needle roller bearing (Item 4) out of the rod end (Item 3).
f. Keeping the helper spring compressed, remove the spring push rod together with the pre-load nut (Item 6), upper spring seat (Item 7), helper spring (Item 8) and lower spring seat (Item 9).
g. Move the clutch pedal upwards.
h. Remove the circlips (Item 21) and washer (Item 20) from the pedal pivot shaft (Item 13).
i. Remove the shaft from the pedal bracket.
j. Remove the pedal arm (Item 17) from the pedal bracket.
k. Remove the needle roller bearing (Item 12) and the spacer tube (Item 11) from the pedal arm.
l. Clean and check all parts (replace any worn or damaged parts).

99. **Assembly.** Assemble the pedal mechanism as follows (Figure 83):

a. Press the spacer tube (Item 11) into the pedal arm (Item 17).
b. Grease the needle roller bearing (Item 12) with XG-291.
c. Fit the bearing into the spacer tube.
d. Clamp the bracket assembly in a vice.

Figure 84  Helper Spring Compression

e. Insert the pedal arm (Item 17) into the bracket.
f. Fit the pedal pivot shaft (Item 13) into the arm.
g. Secure the shaft with the washer (Item 20) and circlip (Item 21).
h. Force the clutch pedal upwards.
i. Lightly smear grease XG-291 into the eye of the spring push rod (Item 3).
j. Insert the needle roller bearing (Item 4).
k. Compress the helper spring using the clutch pedal spring compressor (Table 1, Item 11) (Figure 84).
l. Assemble and secure the pre-load nut (Item 6), upper spring seat (Item 7), helper spring (Item 8) and lower spring seat (Item 9) onto the spring push rod (Item 3).

NOTE

Ensure that the spring is fitted with the closer turns at the lower spring seat end.
m. Coat the push rod pin (Item 5) with grease XG-291.
n. Install the spring push rod (Item 3) in the pedal mounting bracket (Item 1).
o. Secure the spring push rod (Item 3) with the push rod pin (Item 5).
p. Secure the push rod pin with the washer (Item 20) and the circlips (Item 15).

100. Installation. Install the pedal mechanism in the cabin as follows (Figure 75).
a. Secure the pedal bracket (Item 1) to the bulkhead with the four mounting bolts (Item 2) and spring washers.
b. Fit the master cylinder (Para 95).

Slave Cylinder – Cargo, Without Winch

101. The slave cylinder can be removed from the clutch bell housing for repair. The relevant procedures are as follows:

a. removal (Para 102);
b. repair (Para 103); and

c. installation (Para 104).

102. Removal. Remove the slave cylinder from the clutch bell housing as follows (Figure 85):

a. Unscrew the tube nut (Item 5) from the rear of the slave cylinder (Item 3).
b. Remove and plug the hydraulic line (Item 4).
c. Move the hydraulic line (Item 4) to one side.
d. Unscrew and remove the two mounting bolts (Item 1) and spring washers.
e. Remove the slave cylinder from the clutch bell housing (Item 2).

103. Repair. Repair the slave cylinder as follows (Figure 86):

- a. Remove the rod boot (Item 1).
- b. Remove the circlips (Item 3), the push rod (Item 2), the piston (Item 4), the piston seal (Item 5) and the spring (Item 6).
- c. Remove the dust cap (Item 8).
- d. Remove the bleed screw (Item 9).
- e. Discard the rod boot and piston seal.
- f. Thoroughly clean and check all parts (replace any worn or damaged parts).
- g. Screw the bleed screw into the cylinder.
- h. Fit the dust cap to the bleed screw.
- i. Lubricate the piston and new piston seal with clean hydraulic fluid.
- j. Lightly smear the inside of the body (Item 7) with clean hydraulic fluid.
- k. Push the spring, piston seal and piston into the body.

**NOTE**

Ensure that the piston seal is pushed beyond the circlip groove.

- l. Fit the circlip into the cylinder.
- m. Fit the push rod.
- n. Fit the new rod boot to the cylinder.

Figure 86  Slave Cylinder Components (Cargo, Without/Winch)
104. **Installation.** Install the slave cylinder to the clutch bell housing as follows (Figure 85):
   
a. Apply Loctite 573 to the mounting surface of the clutch bell housing.
   
b. Apply Loctite 241 to the mounting bolts (Item 1).
   
c. Secure the slave cylinder (Item 3) to the clutch bell housing (Item 2) with the two mounting bolts and spring washers.
   
d. Torque the bolts to 21 N.m.
   
e. Remove the plug from the hydraulic line.
   
f. Fit the line to the slave cylinder with the tube nut.
   
g. Tighten the tube nut (Item 5).
   
h. Bleed the clutch system (Para 110).
   
i. Road test the vehicle.

**Slave Cylinder – Cargo, With Winch**

105. The slave cylinder can be removed from the clutch housing for repair. The relevant procedures are as follows:
   
a. removal (Para 106);
   
b. repair (Para 107); and
   
c. installation (Para 108).

106. **Removal.** Remove the slave cylinder from the transmission housing as follows (Figure 87):

![Figure 87 Slave Cylinder Location (Cargo, With Winch)](image)

   a. Unscrew the tube nut (Item 1) from the rear of the slave cylinder.
   
b. Remove and plug the hydraulic line.
   
c. Move the hydraulic line to one side.
   
d. Remove the two mounting bolts (Item 2) and spring washers.
   
e. Remove the slave cylinder from the transmission housing.
107. **Repair.** Repair the slave cylinder as follows (Figure 88):

   ![Slave Cylinder Components (Cargo, With Winch)](image)

   a. Remove the spring clip (Item 1), the push rod (Item 2), rod boot (Item 3), boot washer (Item 4), piston (Item 5) and return spring (Item 7).
   b. Remove the dust cap (Item 9) and unscrew the bleed screw (Item 10).
   c. Discard the rod boot and piston seal.
   d. Thoroughly clean and check all parts (replace any worn or damaged parts).
   e. Screw the bleed screw into the cylinder.
   f. Fit the dust cap to the bleed screw.
   g. Lubricate the piston and new piston seal with clean hydraulic fluid.
   h. Fit the piston seal on the piston.
   i. Lightly smear the inside of the body with clean hydraulic fluid.
   j. Push the spring and piston into the body.
   k. Insert the boot washer and push rod with rod boot into the body.
   l. Fit the spring clip into the groove in the body.

108. **Installation.** Install the slave cylinder to the transmission housing as follows (Figure 87):

   a. Apply Loctite 573 to the mating surface of the transmission housing.
   b. Apply Loctite 241 to the mounting bolts.
   c. Fit the slave cylinder to the transmission housing with the two mounting bolts (Item 2) and spring washers.
   d. Torque the bolts to 21 N.m.
   e. Remove the plug from the hydraulic line.
   f. Fit the line to the slave cylinder with the tube nut.
   g. Tighten the tube nut (Item 1).
   h. Bleed the clutch system (Para 110).
   i. Road test the vehicle.
Pedal Adjustment

109. Adjust the clutch pedal and master cylinder as follows (Figure 82):

a. Raise and secure the bonnet.
b. Unscrew the tube nut (Item 18) from the union (Item 20) on the engine side of the bulkhead.
c. Carefully push the hydraulic line (Item 17) away from the union.
d. Use a suitable container to collect the hydraulic fluid which drains from the union.
e. Operate the clutch pedal repeatedly until the clutch hydraulic fluid reservoir is empty.
f. Discard the collected hydraulic fluid.
g. Attach the clutch master cylinder bleed adaptor (Table 1, Item 12) to the union on the bulkhead (Figure 89).

![Figure 89 Master Cylinder Pressurisation](image)

h. Reduce the pressure in the compressed air tanks to approximately two bar (200 kPa).
i. Fit the tyre inflating hose to the clutch master cylinder bleed adaptor.

**NOTE**

The following procedures require two people, one person to adjust the clutch pedal and one to listen at the fluid reservoir.

j. Fit the other end of the tyre inflating hose to the tyre inflating connection on the compressed air receiver.
k. Push the dust boot (Item 11) towards the master cylinder to expose the locknut (Item 4) on the piston push rod (Item 7).
l. Release the locknut.
m. Screw out the push rod until no air can be heard escaping from the fluid delivery line in the fluid reservoir.
n. Screw in the push rod until air just starts to escape.
o. Screw in the push rod a further one turn.
p. Hold the push rod in this position and tighten the locknut.
q. Disconnect the tyre inflating hose and the clutch master cylinder bleed adaptor.
r. Refit the tube nut (Item 18) to the union (Item 20) on the engine side of the bulkhead.
s. Bleed the clutch (Para 110).
Bleeding

110. The procedure for bleeding the clutch system using pressure bleeder AAMCO 7400 (Table 1, Item 13), is as follows:

   a. Preparation of pressure bleeder (Para 111); and
   b. Master and slave cylinder bleeding (Para 112).

111. Preparation of the AAMCO 7400 Pressure Bleeder. Prepare the pressure bleeder as follows (Figure 90):

   a. Open the air vent (Item 2) one turn.
   b. Remove the filler plug (Item 1).
   c. Fill the bleeder with clean hydraulic fluid.
   d. Fit and tighten the filler plug.
   e. Close the air vent (Item 2).
   f. Remove the valve cap from the pressurisation valve (Item 3).
   g. Pressurise the bleeder to one bar (100 kPa/14.5 PSI).
   h. Refit the valve cap.
   i. Bleed any air from the bleeder through the adapter nozzle (Item 1).

112. Bleeding. The procedure for bleeding the master and slave cylinders is the same. Bleed the cylinders as follows:

   a. Raise and secure the bonnet.
   b. Unscrew and remove the clutch hydraulic reservoir cap.
   c. Fit the bleeder adapter to the reservoir.
d. Connect the bleeder to the bleeder adapter.

e. Remove the dust cap from the bleed screw of the cylinder.

f. Connect one end of a hose to the bleed screw and submerge the other end of the hose in a container of clean hydraulic fluid.

g. Loosen the bleed screw on the cylinder to allow fluid to drain into the container of clean hydraulic fluid.

h. Wait until no bubbles appear in the hydraulic fluid.

i. Close the bleed screw and remove the hose.

j. Fit the dust cap to the bleed screw.

k. Disconnect the bleeder adapter from the bleeder.

l. Remove the bleeder adapter from the clutch hydraulic reservoir.

m. Fit the filler cap to the clutch hydraulic reservoir.

n. Road test the vehicle.

TRANSMISSION

Main Transmission

113. Replacement and repair procedures for the main transmission components are as follows:

a. input shaft seal (Para 114);

b. shift mechanism (Para 115);

c. shift cylinder (Para 121);

d. gear shift lever and linkage (Para 127); and

e. forward/reverse lever and linkage (Para 128).
Input Shaft Seal

114. Replacement. The replacement procedures for the input shaft seal are as follows (Figure 91):

Figure 91  Main Transmission Input Shaft Seal

a. Remove the spare wheel.
b. Remove the four bolts and spring washers securing the metal cover (Item 1) to the transmission housing.
c. Remove the metal cover.
d. Remove the four bolts and spring washers from the flanges (Item 9) on the rear end of the propeller shaft (Item 10).
e. Carefully move the propeller shaft to one side.
f. Remove the centre bolt (Item 8), spring washer (Item 7), thrust washer (Item 6) and O ring (Item 5) from the input shaft flange (Item 4).
g. Lever the input shaft flange off the input shaft using the steering wheel puller (Table 1, Item 4).
h. Remove and discard the shaft seals (Item 3) from the transmission housing (Item 2).
i. Clean and inspect all parts (replace any worn or damaged parts).
j. Clean the shaft seal housing.
k. Coat the new input shaft seals with XG-291 grease.
l. Press the seals into the housing with the transmission input shaft seal installer (Table 1, Item 14) (Figure 92).
Figure 92  Installing the Input Shaft Seals

m. Coat the input shaft splines with XG-291 grease.

n. Lock up the transmission.

o. Fit the input shaft flange (Item 4) to the input shaft.

p. Fit the O ring (Item 5) into the shaft flange.

q. Secure the shaft flange with the centre bolt (Item 8), spring washer (Item 7) and thrust washer (Item 6).

r. Tighten the bolt to 100 N.m.

s. Unlock the transmission.

t. Coat the propeller securing bolts with Loctite 241.

u. Secure the rear end the propeller shaft (Item 10) with the bolts.

v. Tighten the bolts to 75 N.m.

w. Coat the four cover securing bolts with Loctite 241.

x. Secure the metal cover (Item 1) on the transmission housing with the bolts and spring washers.

y. Tighten the bolts to 25 N.m.

z. Refit the spare wheel.

aa. Road test the vehicle.

Shift Mechanism

115. The shift mechanism can be removed from the transmission housing for repair. The relevant procedures are as follows:

   a. removal (Para 116);
   b. dismantling (Para 117);
   c. assembly (Para 118);
   d. installation (Para 119); and
   e. adjustment (Para 120).

116. Removal. Remove the shift mechanism from the transmission housing as follows (Figure 93):

   a. Remove the spare wheel.
   b. Loosen but do not remove the two bolts and nuts holding the universal coupling between the shift shaft (Item 11) and the shift rod.
   c. Ease the coupling on the shift rod away from the shift shaft.
   d. Move the shift rod to one side.
   e. Disconnect the cable from the gate position switch (Item 9).
f. Disconnect the input line from the 4/2 shift valve (Item 8).
g. Mark the two output lines from the 4/2 shift valve to ensure correct reconnection.
h. Disconnect the lines.
i. Remove the eight bolts and spring washers securing the shift housing (Item 1) to the transmission housing.

**WARNING**

Possible Asbestos Containing Material. If it cannot be confirmed by the vehicle’s GM120 that the item has been replaced after 2009 remove the item in accordance with EMEI Workshop E 410 including use of PPE.

j. Remove the cover and the shift mechanism.

117. **Dismantling.** Dismantle the shift mechanism as follows (Figure 93):

a. Clamp the shift housing in a vice.
b. Unscrew and remove the gate position switch (Item 9).
c. Remove the two bolts and spring washers securing the 4/2 shift valve (Item 8) to the shift housing (Item 1).
d. Remove the 4/2 shift valve from the shift housing.
e. Remove and discard the gasket.
f. Remove the boot from the shift shaft (Item 11).
g. Unscrew the slotted nut on the shaft.
h. Move the tab washer and the shift arm (Item 14) on the shift shaft to expose the woodruff key (Item 16).
i. Remove the key.
j. Slide the shift shaft out of the front of the shift housing.
k. Remove the cap, the slotted nut, the tab washer and the shift arm.
l. Discard the tab washer.
m. Remove the two dowel pins (Item 17) from the cover.
n. Remove the end cover (Item 15) from the shift housing.
o. Slide the cross shaft (Item 21) out of the shift housing.
p. Remove the shift finger assembly (Item 12) from the shift housing.
q. Remove the shift housing from the vice.
r. Clean and check all parts (replace any worn or damaged parts).
s. Replace the tab washer and the O ring.
1. Shift housing 8. 4/2 Shift valve 15. End cover
2. Lower detent plate 9. Gate position switch 16. Woodruff key
3. Detent stop 10. Cam plate 17. Dowel pin

Figure 93  Shift Mechanism
118. **Assembly.** Assemble the shift mechanism as follows (Figure 93):

a. Lubricate all the bearings in the shift housing with XG-291 grease.

b. Clamp the shift housing in a vice.

c. Lubricate the bushes on the shift finger assembly with XG-291 grease.

d. Coat the shift fingers with XG-291 grease.

e. Fit the shift finger assembly into the shift housing.

f. Slide the cross shaft (Item 21) through the shift housing into the shift finger assembly.

g. Coat the head of the shift arm (Item 14) with XG-291 grease.

h. Fit the arm into the shift finger assembly.

i. Ensure the small end of the tapered bore of the shift arm is near the blind hole of the shift housing.

j. Slide the shift shaft (Item 11) into the shift housing through the shift arm, the new tab washer and the slotted nut.

k. Refit the cap on the shift shaft.

l. Fit the woodruff key (Item 16) into the keyway in the shift shaft.

m. Bend a tab on the tab washer and insert the tab into the shift arm keyway.

n. Screw the slotted nut against the tab washer and the shift arm.

o. Lock the slotted nut in position with the tab washer.

p. Coat the end cover (Item 15) with Loctite 241 and fit it into the shift housing.

q. Fit the boot over the shift shaft and the flange on the shift housing.

r. Coat the threads of the gate position switch (Item 9) with Loctite 241.

s. Screw it into the shift housing.

t. Fit the new O ring onto the shift housing.

u. Fit the 4/2 shift valve (Item 8).

v. Secure with the two bolts and spring washers.

w. Torque the bolts to 25 N.m.

119. **Installation.** Install the shift mechanism on the transmission housing as follows (Figure 93):

a. Set the shift mechanism to the neutral position.

b. Coat the eight mounting bolts with Loctite 241.

c. Fit the new gasket and the shift mechanism onto the transmission housing using the eight bolts and spring washers.

d. Tighten the bolts to 25 N.m.

e. Identify the two 4/2 shift valve (Item 8) output lines by the marks made during removal.

f. Connect the two lines to the 4/2 shift valve.

g. Connect the input line to the 4/2 shift valve.

h. Connect the cable to the gate position switch (Item 9).

i. Ease the coupling on the shift rod onto the shift shaft (Item 11).
j. Adjust the shift mechanism (Para 115).

k. Tighten the nuts and bolts on the universal coupling to 32 N.m.

l. Refit the spare wheel.

m. Road test the vehicle.

120. **Adjustment.** Adjust the shift mechanism as follows:
   a. Remove the spare wheel.
   b. Loosen the two bolts and nuts on the universal coupling between the shift shaft and the shift rod.
   c. Move the gear shift lever in the cabin to the neutral position between first and second gear.
   d. Set the distance between the shift lever knob and the inside of the passenger door to 930 mm.
   e. Set the distance between the shift lever knob and the inside of the cabin rear wall to 680 mm.
   f. Torque the two bolts and nuts on the universal coupling between the shift shaft and the shift rod to 32 N.m.

**Shift Cylinder**

121. The shift cylinder can be removed from the transmission housing for repair. The relevant procedures are as follows:
   a. removal (Para 122);
   b. dismantling (Para 123);
   c. assembly (Para 124);
   d. installation (Para 125); and
   e. adjustment (Para 126).

122. **Removal.** Remove the shift cylinder from the transmission housing as follows (Figure 94):

   a. Drain the compressed air tanks.
b. Unscrew and remove the two hollow screws holding the two banjo unions to the shift cylinder.

c. Mark the ends of the air hoses to ensure correct positioning on replacement.

d. Remove the banjo unions and the air hoses from the shift cylinder.

e. Move them to one side.

f. Remove the cotter pin from the pivot pin in the clevis (Item 15) of the selector lever; remove the pivot pin.

g. Remove and discard the two self locking bolts holding the shift cylinder mounting bracket to the transmission housing.

h. Remove the shift cylinder and bracket.

123. Dismantling. Dismantle the shift cylinder as follows (Figure 94):

a. Remove the circlip (Item 1) and washers (Item 2) holding the bracket to the shift cylinder.

b. Remove the bracket from the shift cylinder.

c. Remove and discard the dust boot (Item 12).

d. Remove the clevis (Item 15) and locknut (Item 13) from the shaft (Item 8).

e. Remove the four bolts (Item 4) and washers (Item 5) holding the base (Item 16) to the housing (Item 9).

f. Remove and discard the O ring (Item 6), the piston seal (Item 7) and the shaft seal (Item 11) from the housing.

g. Clean and inspect all parts (replace any worn or damaged parts).

124. Assembly. Assemble the shift cylinder as follows (Figure 94):

a. Obtain a repair kit for the shift cylinder.

b. Lubricate the bushes (Items 3 and 10) with XG-291 grease.

c. Lightly coat the new shaft seal (Item 11) with rubber grease and fit it into the housing (Item 9).

d. Lightly coat the new piston seal (Item 7) with rubber grease and fit it into the housing (Item 9).

e. Fit the shaft through the housing.

f. Lightly coat the new O ring (Item 6) with rubber grease and fit it into the base.

g. Fit the base to the housing with the four bolts (Item 4) and washers (Item 5).

h. Tighten the bolts to 25 N.m.

i. Fit the locknut (Item 13) and clevis (Item 15) to the shaft.

j. Fit the new dust boot (Item 12) over the shaft and onto the housing.

k. Fit the bracket to the shift cylinder with the washers (Item 2) and circlip (Item 1).

125. Installation. Install the shift cylinder on the transmission housing as follows (Figure 94):

a. Obtain two new self locking bolts (RPS 02155 Group FDB Item 25) and coat them with Loctite 241.

b. Fit the mounting bracket and bolts to the transmission housing.

c. Tighten the bolts to 50 N.m.

d. Identify the two air hoses by the marks made when removing the shift cylinder.

e. Fit the hoses to the shift cylinder using the two hollow screws.

f. Coat the pivot pin with XG-291 grease.

g. Fit the clevis over the selector lever.

h. Align the holes in the selector lever with the holes in the clevis.

i. Insert the pivot pin.
j. Secure the pivot pin with the cotter pin.

k. Adjust the shift cylinder (Para 126).

l. Road test the vehicle.

126. **Adjustment.** Adjust the shift cylinder as follows (Figure 94):

a. Start the engine.

b. Build up the air pressure until the pressure gauge on the dashboard reads 12 bar (1.2 MPa).

...
129. **Adjustment.** After repair, adjust the linkage as follows:

a. Shift the forward/reverse lever to the forward position.

b. Adjust the threaded rod (Item 2) so that the shift arm on the main transmission is in the forward position.

c. Shift the forward/reverse lever to the reverse position.

d. Check that the shift arm on the main transmission is in the reverse position (adjust the threaded rod (Item 2) if necessary).

e. Tighten the locknuts (Item 1) on the linkage.

**PTO TRANSMISSION**

130. PTO transmission repair, adjustment and replacement procedures are as follows:

a. Output shaft to the main transmission shaft seal (Para 131);

b. Output shaft to the winch shaft seal (Para 132); and

c. PTO select lever and linkage (Para 133).

**Output Shaft to Main Transmission Shaft Seal**

131. **Replacement.** Replace the output shaft seal as follows (Figure 97):

a. Remove the four bolts (Item 2) and spring washers (Item 3) from the propeller shaft flange (Item 4).

b. Carefully move the propeller shaft (Item 1) to one side.

c. Remove the self-locking bolt (Item 5) and the thrust plate (Item 6) from the output flange (Item 7).

d. Discard the self-locking bolt.

e. Lever the flange (Item 7) off the output shaft.

f. Remove and discard the shaft seal (Item 8) from the PTO transmission housing.

g. Clean and check all parts (replace any worn or damaged parts).

h. Clean the output shaft seal housing.

i. Coat the new shaft seal with rubber grease.
Figure 97  Output Shaft to Main Transmission Shaft Seal

j. Press the seal into the PTO transmission housing with the press tool (Table 1, Item 15) (Figure 98).

Figure 98  Shaft Seal Installation
k. Coat the output shaft splines with XG-291 grease.
l. Fit the flange to the output shaft.

NOTE
Ensure that the shaft seal lips are correctly seated on the flange.

m. Check that the park brake is on and engage first gear.

n. Fit a new self-locking bolt and the thrust plate to the output shaft.
o. Tighten the bolt to 92 N.m.
p. Align the propeller shaft flange with the output flange.
q. Fit the four bolts and spring washers.
r. Tighten the bolts to 75 N.m.

Output Shaft to the Winch Shaft Seal

132. Replacement. Replace the output shaft seal as follows (Figure 99):

a. Remove the four bolts (Item 1) from the propeller shaft flange (Item 2).
b. Carefully move the propeller shaft to one side.
c. Remove the centre bolt (Item 3) from the output shaft.
d. Lever the flange (Item 4) off the output shaft.
e. Remove and discard the shaft seal (Item 5) from the PTO transmission housing (Item 6).
f. Clean and check all parts (replace any worn or damaged parts).
g. Clean the output shaft seal housing.
h. Coat the shaft seal with rubber grease.
i. Press the seal into the housing with the press tool (Table 1, Item 16) (Figure 100).
j. Coat the output shaft splines with XG-291 grease.

k. Fit the flange to the output shaft.

NOTE

Ensure that the shaft seal lips are correctly seated on the flange.

l. Check that the park brake is on and engage first gear.

m. Screw the centre bolt into the output shaft.

n. Tighten the bolt to 300 N.m.

o. Align the propeller shaft flange with the output flange.

p. Fit the four bolts and washers.

q. Tighten the bolts to 75 N.m.

PTO Select Lever and Linkage

133. Repair of the PTO select lever and linkage is only necessary when the component parts are damaged or worn. Repair is by replacement of the component parts shown in Figure 101.
134. Adjustment. After repair, adjust the PTO select lever and linkage as follows (Figure 101):

a. Move the PTO select lever to the engaged position.
b. Check that the shift lever on the PTO transmission housing has moved to the engaged position.
c. Adjust the rod ends (Item 1) by loosening the locknuts (Item 2) on the threaded connecting rod.
d. Adjust the effective length of the connecting rod assembly by loosening the locknuts (Item 3) and adjusting the turnbuckle (Item 4).
e. Move the PTO select lever to the disengaged position.
f. Check that the shift lever on the PTO housing has moved to the disengaged position.
g. Adjust the turnbuckle again, if necessary.
h. Tighten all locknuts.
i. Road test the vehicle.

AXLE GROUP

WARNING

Do not work on the vehicle without the use of an axle stand beneath the axle. Place the axle stand as close to the raised wheel as possible.

Wheel Studs

135. Replacement. The wheel studs can be replaced as individual units and are a splined drive fit in the hub flange. Replace the wheel studs as follows (Figure 102):

a. Chock the wheels at the front and at the rear, excluding the wheel that is to be raised.
b. Raise the wheel that is to be removed until it is clear of the ground (Para 27).
c. Support the vehicle with axle stands (Para 28).
d. Remove the wheel, wheel hub and brake disc (Para 142).
e. Separate the hub and disc (Para 142).

f. Drive the damaged stud or studs (Item 2) out of the wheel hub (Item 3) with a soft drift and hammer.

g. Clean and inspect the wheel hub, ensuring the splines in the stud hole are clean.

**CAUTION**

The wheel stud heads have flats which assist in locking the studs in position in the flange of the hub. When installing new studs, the flats must face towards the centre of the wheel hub.

h. Position the new stud, or studs, correctly.

i. Use a soft drift and hammer to drive the stud into the splined hole in the hub flange until it is fully home.

j. Assemble and install the hub and disc and fit the wheel (Para 142).

k. Remove the axle stands.

l. Lower the wheel to the ground.

m. Tighten the wheel nuts to 400 N.m.

n. Remove the chocks.

**Suspension**

**136. Shock Absorber Replacement.** The only components of the suspension system replaceable at Light Grade Repair are the shock absorbers. Remove and install the shock absorbers as follows:

a. Raise and secure the cabin (Para 25).

b. Lubricate the bolts holding the shock absorbers to the upper and lower mounting brackets with penetrating oil.

c. Remove the bolt holding the shock absorber to the upper mounting bracket.

**NOTE**

If the bolt is seized or tight in the ring bracket of the shock absorber, use a soft drift to remove the bolt.

d. Remove the shock absorber from the upper mounting bracket.

e. Remove the bolt holding the shock absorber to the lower mounting bracket.

**NOTE**

If necessary, use a soft drift to remove the bolt.

f. Remove and discard the shock absorber.

g. Use a wire brush to clean the upper and lower mounting brackets.

h. Fit a new shock absorber to the upper mounting bracket.

i. Fit, but do not tighten, the retaining bolt.

j. Fit the shock absorber to the lower mounting bracket.

k. Fit the retaining bolt.

l. Torque the upper and lower bolts to 400 N.m.

m. Lower and secure the cabin.

n. Road test the vehicle; after the road test, check the shock absorber mounting bolt torques.
### BRAKES

**WARNING**

Do not work on the vehicle without the use of an axle stand beneath the axle. Place the axle stand as close to the raised wheel as possible.

**WARNING**

Genuine brake pads are asbestos free. If it is unknown as to whether the brake pad material contains asbestos, then the brake pads are to be disposed of in accordance with EME1 Workshop E 410.

137. Procedures for repairing the brake system are as follows:
   a. front brake pad replacement (Para 138);
   b. rear brake pad replacement (Para 139);
   c. front brake calliper replacement (Para 140);
   d. rear brake calliper replacement (Para 141);
   e. brake disc replacement (Para 142);
   f. disc rotor machining (Para 143);
   g. park brake actuating cylinder adjustment (Para 145);
   h. service brake valve replacement (Para 146);
   i. trailer brake control valve replacement (Para 147);
   j. trailer brake supply coupling replacement (Para 148);
   k. trailer brake control coupling replacement (Para 149);
   l. repair guide for metal air lines (Para 150);
   m. metal air line replacement (Para 151);
   n. repair guide for plastic hoses (Para 152);
   o. plastic hose replacement (Para 153);
   p. plastic hose repair (Para 154); and
   q. brake system bleeding (Para 155).

**Front Brake Pads**

138. **Replacement.** Replace the front brake pads as follows (Figure 103):
   a. Chock the wheels.
   b. Raise the vehicle (Para 27).
   c. Support the vehicle with axle stands (Para 28).
   d. Remove the wheel.
   e. Remove the brake calliper protection shroud.
   f. Remove the protective plate (Item 1) from the brake calliper (Item 4).
   g. Remove the brake wear indicator cable (if fitted) at the brake pads and the back plate.
   h. Knock out the two dowel pins (Item 8).
   i. Remove the spring clip (Item 2).
j. Remove the brake pads (Item 3) using the brake disc pad remover (Table 1, 17) (Figure 104).

k. Use the brake piston retractor (Table 1 Item 18) to push the brake pistons into the calliper to give sufficient clearance for the new brake pads (Figure 105).
Figure 105  Retracting the Brake Pistons

l. Fit the new brake pads.
m. Fit the spring clip.
n. Insert the dowel pins.
o. Connect the brake wear indicator cable (if fitted).
p. Fit the protective plate.
q. Fit the brake calliper protection ring.
r. Fit the wheel.
s. Lower the vehicle off the axle stands (Para 29).
t. Tighten the wheel nuts to 400 N.m.
u. Road test the vehicle.

Rear Brake Pads

139. Replacement. Replace the rear brake pads as follows (Figure 106):

a. Chock the vehicle.
b. Raise the vehicle (Para 27).
c. Support the vehicle with axle stands (Para 28).
d. Remove the wheel.
e. Remove the brake calliper protection ring.
f. Remove the protective plate (Item 1) from the brake calliper (Item 4).
g. Remove the wear indicator cable (if fitted).
h. Knock out the two dowel pins (Item 12) and remove the spring clip (Item 2).
i. Remove the brake pads (Item 3) using the brake pad remover (Table 1, Item 17) (Figure 104).
Figure 106  Rear Brake Assembly

j. Remove the 12 mm protective plug and seal ring (Item 13) to expose the inner adjusting screw.

k. Release the locknut on the outer adjusting screw.

Ensure the adjusting screws are wound off simultaneously on the rear brakes (Paras k and l).

l. Turn the inner adjusting screw anticlockwise and simultaneously press the piston into the calliper with the brake piston retractor (Table 1, Item 18).

m. Turn the outer screw clockwise and simultaneously press the piston into the calliper with the brake piston retractor (Table 1, Item 18).

n. Fit new brake pads.

o. Fit the spring clip.

p. Insert the dowel pins.
Ensure the adjusting screws are wound on simultaneously.

q. Using the inner and outer adjusting screws, move the brake pads to obtain a clearance of 0.25 mm between the pads and the brake discs.

NOTE
If the brake disc is grooved, adjust the pads until they are touching the brake disc and then wind the adjusting screws off until the brake disc rotates freely.

r. Tighten the locknut on the outer adjusting screw to 40 N.m.

s. Fit the protective seal ring and the plug.

t. Tighten the plug between 16 and 19 N.m.

u. Connect the brake wear indicator cable (if fitted).

v. Fit the protective plate.

w. Fit the brake calliper protection ring.

x. Fit the wheel.

y. Lower the vehicle off the axle stands (Para 29).

z. Tighten the wheel nuts to 400 N.m.

aa. Road test the vehicle to bed in the new pads.

bb. Test the hand brake by trying to drive the vehicle with the hand brake engaged (the vehicle should not move), adjust as necessary.

Front Brake Calliper
140. Replacement. Replace the front brake callipers as follows (Figure 103):

a. Chock the vehicle.

b. Raise the vehicle (Para 27).

c. Support the vehicle with axle stands (Para 28).

d. Remove the wheel.

e. Remove the brake calliper protection ring.

f. Disconnect the hydraulic line at the calliper.

g. Plug the end of the line.

h. Disconnect the brake wear indicator cable (if fitted).

i. Unscrew the two retaining bolts (Figure 103, Item 7) using the hex key socket (Table 1, Item 19) (Figure 107).

NOTE
Use only a 17 mm hex key on the lower calliper mounting bolt.
Figure 107  Removing The Retaining Bolts

j. Remove the calliper.
k. Fit a new calliper.
l. Install the retaining bolts.
m. Tighten the retaining bolts to 500 N.m.
n. Connect the brake wear indicator cable (if fitted).
o. Connect the hydraulic line to the input fitting.
p. Fit the brake calliper protection ring.
q. Fit the wheel.
r. Lower the vehicle off the axle stands (Para 29).
s. Tighten the wheel nuts to 400 N.m.
t. Bleed the brake system (Para 155).
u. Check for any leaks (repair where necessary).
v. Road test the vehicle.

Rear Brake Calliper

141. Replacement. Replace the rear brake callipers as follows (Figure 106):
   a. Chock the vehicle.
b. Raise the vehicle (Para 27).
c. Support the vehicle with axle stands (Para 28).
d. Ensure that the truck air pressure is fully charged.
e. Remove the wheel.
f. Remove the brake calliper protection ring.
g. Release the park brake.
h. Remove the cotter pin and the pivot bolt (Item 7) from the pull-rod fork (Item 8) of the park brake actuating cylinder (Item 9).
i. Disconnect the hydraulic line from the calliper input fitting.
j. Plug the end of the line.
k. Disconnect the brake wear indicator cable (if fitted).
l. Remove the upper retaining bolts (Figure 103, Item 11) using the hex key socket (Table 1, Item 19) (Figure 107).
NOTE

Use only a 17 mm hexkey on the lower retaining bolt.

m. Remove the calliper.

n. Drain all the compressed air tanks.

o. Fit a new calliper.

p. Install the two retaining bolts.

q. Tighten the retaining bolts to 500 N.m.

r. Connect the brake wear indicator cable (if fitted).

s. Connect the hydraulic line.

WARNING

A sudden increase in air pressure may cause the pull rod fork to extend rapidly and uncontrollably. Keep hands clear of the area between the pull rod fork and the park brake lever whilst guiding the pull rod fork.

t. Slowly pressurise the compressed air tanks, while guiding the pull-rod fork (Item 8) over the park brake lever (Item 6).

u. Align the hole in the pull rod fork and the park brake lever.

v. Coat the pivot bolt (Item 7) with XG-276 grease.

w. Insert the bolt.

x. Secure the bolt with the cotter pin.

y. Fit the wheel.

z. Lower the vehicle off the axle stands (Para 29).

aa. Tighten the wheel nuts to 400 N.m.

bb. Bleed the brake system (Para 155).

cc. Check for any leaks (repair where necessary).

dd. Road test the vehicle.

Brake Disc

142. Replacement. Replace the brake disc as follows:

a. Chock the vehicle.

b. Raise the vehicle (Para 27).

c. Support the vehicle with axle stands (Para 28).

d. Remove the wheel.

e. Remove the brake calliper (Para 140 for the front brake callipers and Para 141 for the rear brake callipers).

f. Loosen (crack) the eight wheel hub and brake disc securing bolts using a 14 mm hex key socket (Table 1, Item 21) and the eight wheel hub fastening bolts using a 17 mm hex key socket (Table 1, Item 19).

g. Remove two opposing wheel hub fastening bolts (Figure 108).
Figure 108  Removing the Two Wheel Hub Bolts

h. Insert two disc brake guides (Table 1, Item 20) into the hub (Figure 109).

Figure 109  Inserting Special Tool – Disc Brake Guide

i. Remove the remaining wheel hub securing bolts.
j. Remove the wheel hub and brake disc assembly.

NOTE
Replace the seal ring and runner if necessary.
k. Unscrew the eight wheel hub and brake disc securing bolts (Figure 110).

Figure 110  Detaching the Brake Disc

l. Detach the brake disc from the wheel hub.
m. Install and securely fasten a new brake disc onto the wheel hub using the eight retaining bolts.
n. Position the wheel hub and brake disc assembly over the two disc brake guides.
o. Insert the wheel hub fastening bolts.
Remove the two disc brake guides.

Insert the remaining two wheel hub fastening bolts.

Torque the eight wheel hub fastening bolts to 600 N.m.

Torque the eight wheel hub and brake disc securing bolts to 400 N.m.

Fit the brake calliper (Para 140 for front brake callipers and Para 141 for rear brake callipers).

Fit the wheel.

Lower the vehicle off the axle stands (Para 29).

Torque the wheel nuts to 400 N.m.

Bleed the brake system (Para 155).

Check for any leaks (repair where necessary).

Road test the vehicle (Check the performance of the park and service brakes).

**Machining.** The specifications for the disc rotors are as follows (Figure 111):

![Disc Rotor](image)

**Figure 111 Disc Rotor**

<table>
<thead>
<tr>
<th>Specification</th>
<th>Measurement</th>
</tr>
</thead>
<tbody>
<tr>
<td>New</td>
<td>30 mm</td>
</tr>
<tr>
<td>Maximum Machining</td>
<td>28 mm</td>
</tr>
<tr>
<td>Maximum Wear Limit</td>
<td>26 mm</td>
</tr>
</tbody>
</table>

Rotors that are worn to 26 mm or less are to be replaced.

**Park Brake Actuating Cylinder Adjustment**

Adjust the park brake actuating cylinder as follows:

Ensure the air system is fully charged.

Chock the wheels.

Release the hand brake.

Remove the actuating cylinder rod to actuating arm clevis pin.

Set the park brake lever to ‘ENGAGED’.
f. Drain the three air tanks.
g. Check that the actuating arm is fully against its stop (towards the wheel).
h. Measure the distance between the clevis pin holes (Figure 112).

![Figure 112  Measuring the Actuator](image)

i. If the distance is greater or less than 80 mm adjust the actuating cylinder as follows:
   (1) Loosen the actuating cylinder securing bolts.
   (2) Slide the actuating cylinder on its mounts to achieve the correct measurement.
   (3) Tighten the actuating cylinder securing bolts.
j. Set the parking brake lever to ‘DISENGAGED’.
k. Slowly pressurise the brake air system whilst guiding the actuating cylinder rod over the actuating arm.
l. Coat the clevis pin with XG-276 grease.
m. Align the clevis pin holes, insert the clevis pin and secure it.
n. Test the operation of the park brake.

Service Brake Valve
146. Replacement. Replace the service brake valve as follows (Figure 113):
   a. Drain the compressed air tanks.
   b. Remove the two bolts securing the access panel located above and to the right of the foot controls.
   c. Remove the panel.
   d. Tag and disconnect the air lines from the service brake valve.
   e. Disconnect the plug (Item 3) from the brake light switch.
   f. Remove the two upper mounting bolts (Item 1) holding the service brake valve mounting bracket (Item 4) to the cabin frame.
   g. Ease out the bracket.
   h. Remove the four lower mounting bolts (Item 2) holding the service brake valve to the mounting bracket.
   i. Remove the service brake valve.
**Figure 113  Service Brake Valve**

j. Install a new service brake valve into the mounting bracket using the four lower mounting bolts.

k. Tighten the bolts.

l. Install the mounting bracket to the cabin frame with the two upper mounting bolts.

m. Connect the air lines.

n. Connect the brake light switch plug.

o. Fit and secure the access panel.

p. Road test the vehicle.

**Trailer Brake Control Valve**

147. **Replacement.** Replace the trailer brake control valve as follows (Figure 114):

a. Drain all the air tanks.
b. Disconnect the shuttle valve (Item 3) from the control valve (Item 1).
c. Disconnect and tag all the air lines from the control valve.
d. Remove the securing nuts (Item 2).
e. Remove the control valve.
f. Fit a new control valve.
g. Secure the control valve with the nuts.
h. Connect the shuttle valve to the control valve.
i. Connect all air lines to the control valve.
j. Charge the air tanks.
k. Connect a trailer to the vehicle and road test the trailer brakes.

**Trailer Brake Supply Coupling**

148. **Replacement.** Replace the trailer brake supply coupling as follows (Figure 115):

![Figure 115 Trailer Brake Supply Coupling](image)

1. Air line
2. Retaining nut
3. Trailer-brake supply coupling

- a. Drain all the air tanks.
- b. Disconnect the air lines (Item 1) from the trailer brake supply coupling.
- c. Remove the retaining nuts (Item 2).
- d. Remove the trailer-brake supply coupling.
- e. Fit a new coupling.
- f. Fit and tighten the retaining nuts.
- g. Connect the air lines.
- h. Charge the air tanks.
- i. Connect a trailer to the vehicle and road test the trailer brakes.

**Trailer Brake Control Coupling**

149. **Replacement.** Replace the trailer brake control coupling as follows (Figure 116):
Figure 116  Trailer Brake Control Coupling

a. Drain all the compressed air tanks.
b. Disconnect the air line (Item 1) from the trailer brake control coupling.
c. Unscrew the retaining nut (Item 2).
d. Remove the trailer brake control coupling.
e. Fit a new trailer brake control coupling.
f. Fit and tighten the retaining nut.
g. Connect the air line.
h. Charge the air tanks.
i. Connect a trailer to the vehicle and road test the trailer brakes.

Repair Guide for Metal Air Lines

150. Observe the following guidelines for the replacement of metal air lines:

a. Do not subject pipes to stresses or chafing.
b. Use a special purpose pipe bender to form the pipes.
c. Form the replacement pipe to the shape of the pipe which is removed.
d. Do not use heat when bending the pipe, heat destroys the surface protection of the pipe and oxidisation will occur.

151. Replacement. Replace the metal air lines as follows (Figure 117):

Figure 117  Metal Air-line Coupling

a. Bend the replacement pipe to the required shape (use the old pipe as a template).
b. Cut the pipe at right angles.
c. De-burr the inside and outside of the pipe using a file or hand scraper.
d. Clean the pipe (use compressed air to remove internal debris).
e. Place the cap-nut (Item 4) and ferrule (Item 3) on the pipe (Item 2).
f. Insert the pipe into the fitting (Item 1).

NOTE
Ensure that the pipe bottoms on the tube stop.

g. Hold the pipe against the stop and tighten the cap-nut finger tight.

NOTE
Ensure that the pipe does not rotate.

h. Tighten the cap-nut a further one and three-quarter turns.
i. Loosen the cap-nut and remove the pipe.
j. Check that a ridge of metal has been raised around the pipe by the bite edge of the ferrule.
k. Check that there is a slight indentation all around the end of the pipe, indicating that the pipe has bottomed on the fitting.
l. Fit the pipe and tighten the cap-nut finger tight.
m. Tighten the cap-nut until a torque build up is felt and then tighten one-sixth of a turn further.

Repair Guide for Plastic Hoses

Observe the following guidelines for replacement of plastic hoses:

a. Do not subject plastic hoses to chafing.
b. Do not bend plastic hoses with radii less than the minimum allowable (Table 4).
c. Plastic hoses are to be fixed by cable clips/ties at 50 cm intervals.
d. Cable clips and cable ties must permit the hoses to move when the clips and ties are tightened.
e. Protect or remove plastic hoses before drilling or welding operations are carried out.

<table>
<thead>
<tr>
<th>Serial</th>
<th>Hose Dimensions OD x ID (mm)</th>
<th>Wall Thickness (mm)</th>
<th>Minimum Bend Radius (mm)</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>4 x 2</td>
<td>1</td>
<td>20</td>
</tr>
<tr>
<td>2</td>
<td>6 x 4</td>
<td>1</td>
<td>30</td>
</tr>
<tr>
<td>3</td>
<td>8 x 4</td>
<td>2</td>
<td>40</td>
</tr>
<tr>
<td>4</td>
<td>8 x 6</td>
<td>1</td>
<td>40</td>
</tr>
<tr>
<td>5</td>
<td>11 x 8</td>
<td>1.5</td>
<td>55</td>
</tr>
<tr>
<td>6</td>
<td>12 x 9</td>
<td>1.5</td>
<td>60</td>
</tr>
<tr>
<td>7</td>
<td>15 x 12</td>
<td>1.5</td>
<td>75</td>
</tr>
</tbody>
</table>
153. **Replacement.** Replace plastic hoses as follows (Figure 118):

- **a.** Cut the hose at right angles.
- **b.** Insert the sleeve (Item 5) into the hose.
- **c.** Place the cap-nut (Item 4) and ferrule (Item 3) on the hose.
- **d.** Insert the hose into the fitting (Item 1) until it bottoms on the hose stop (Item 2).
- **e.** Tighten the cap-nut finger tight.
- **f.** Tighten the cap-nut a further one and three-quarter turns.

**NOTE**

Ensure that the hose does not rotate.

- **g.** Loosen the cap-nut and remove the hose.
- **h.** Check that the ferrule bite-edge is seated firmly in the hose and that a slight bulge is present around the front of the ferrule.
- **i.** Fit the hose.
- **j.** Tighten the cap-nut finger tight.
- **k.** Tighten the cap-nut until a torque build up is felt and then tighten a further one-sixth of a turn.

154. **Repair.** Damage to a portion of a plastic hose does not necessitate replacement of the entire hose. The damaged section can be cut out and a repair effected using a double adapter (Figure 119). The two hose connections are made as described in Para 153.
Brake System Bleeding

155. The procedure for bleeding the brake system using the AAMCO pressure bleeder, Model 7400 (Table 1, Item 13) is carried out as follows:

   a. preparation of AAMCO pressure bleeder; and
   b. bleeding the brakes (Para 156).

Preparation of the AAMCO Pressure Bleeder. Prepare the AAMCO pressure bleeder (shown at Figure 90) in accordance with the detail at paragraph Para 111 (clutch system bleeding).

156. Bleeding. Bleed the brakes as follows (Figure 120):

   a. Fill both hydraulic reservoirs.
   b. Fit the adaptors (Table 1, Item 22) to the hydraulic reservoirs.
   c. Connect the hose (Table 1, Item 23) to the adaptors.
   d. Connect the other end of hose to the AAMCO pressure bleeder.
   e. Connect a bleed hose to the bleed screw on one of the brake callipers.
   f. Submerge the other end of the hose in a container of clean hydraulic fluid.
   g. Loosen the bleed screw.
   h. Wait until no bubbles appear in the hydraulic fluid.
   i. Tighten the bleed screw.
   j. Repeat steps Sub-paras e. to i. for the other brake callipers.
   k. Disconnect the hose from the adaptors.
   l. Remove the adaptors from the hydraulic reservoirs.
   m. Replace the caps on both hydraulic reservoirs.
   n. Road test the vehicle.
   o. Check the performance of the brakes.
   p. Inspect the brake system for leaks (repair as necessary).

NOTE

When changing the brake fluid, let the fluid run out of every bleed point until the colour of the brake fluid indicates it is fresh brake fluid.

STEERING

157. Steering system components can be replaced, adjusted or aligned as follows:

   a. Replacement procedures (Para 158);
   b. Drag link and tie-rod adjustment (Para 177); and
   c. Wheel alignment (Para 178).
Replacement Procedures

158. Procedures for replacement of steering system components are as follows:

a. the steering wheel (Para 159);
b. steering column (Para 160);
c. steering transverse shaft (Para 161);
d. bevel gear box (Para 164);
e. upper steering shaft (Para 167);
f. lower steering shaft (Para 170);
g. drag link (Para 173);
h. tie rod (Para 174);
i. right side steering arm (Para 175); and
j. left side steering arm (Para 176).

Steering Wheel

159. Replacement. Replace the steering wheel as follows (Figure 121):
Figure 121  Steering Wheel to Steering Box Linkages

a. Position the front wheels in the straight ahead position.
b. Remove the cap (Item 3) at the centre of the steering wheel (Item 1).
c. Unscrew the retaining nut (Item 2) at the centre of the steering wheel.
d. Remove the steering wheel using the steering wheel puller (Table 1, Item 4) (Figure 122).
Figure 122  Steering Wheel Removal

e.  Install the steering wheel (Item 1) with spokes horizontal.
f.  Install the steering wheel retaining nut (Item 2).
g.  Torque the nut to 65 N.m.
h.  Fit the cap (Item 3) at the centre of the steering column.
i.  Road test the vehicle.

Steering Column

160.  Replacement.  The steering column and right-hand side bevel gear box form an integral unit which must be removed to replace the steering column. Replace the steering column as follows (Figure 121):

a.  Ensure that the front wheels are in the straight ahead position.
b.  Unscrew the retaining bolts and screws and remove the protective cover from the steering column and transverse shaft.
c.  Remove the steering wheel (Para 159).
d.  Remove the two retaining bolts and detach the combination switch from the steering column (Item 18).
e.  Remove the clamp bolt (Item 5) and nut clamping the universal joint on the transverse shaft (Item 6) to the output shaft of the steering column.
f.  Unscrew the bolts (Item 4) securing the steering column to the cabin bulkhead.
g.  Remove the steering column from the transverse shaft.
h.  Position the new unit so that the splines on the output shaft are aligned with the splines in the universal joint on the transverse shaft (Item 6).

NOTE

A soft headed hammer may be used to drive the unit fully home.
i.  Position the steering column (Item 18) against the cabin bulkhead so that the bolt holes align.
j.  Push the steering column into the transverse shaft.
k.  Install and tighten the retaining bolts (Item 4).
Clamp bolts (pinch bolts) and self locking nuts securing the steering linkage universal joints are not to be re-used. Install new, genuine Mercedes-Benz self-locking nuts and bolts.

1. Install and tighten the clamp bolt (Item 5) and nut clamping the universal joint on the transverse shaft (Item 6) to the output shaft on the steering column (Item 18).

2. Fit the combination switch to the steering column and tighten the retaining bolts.

3. Fit the steering wheel (Para 159).

4. Check the position of the steering wheel in relation to the position of the front wheels (adjust if necessary).

5. Fit and secure the protective cover over the steering column and transverse shaft.

6. Road test the vehicle.

Steering Transverse Shaft

161. Replacement. The steering transverse shaft consists of a steel shaft with a universal joint at each end; it is replaced as a complete unit.

162. Removal. Remove the steering transverse shaft as follows (Figure 121):

   a. Ensure that the front wheels are in the straight ahead position.

   b. Unscrew the retaining bolts and screws and remove the protective cover from the steering column and transverse shaft.

   c. Remove the steering wheel (Para 159).

   d. Remove the two retaining bolts and detach the combination switch from the steering column.

   e. Remove the clamp bolt (Item 5) and nut clamping the universal joint on the transverse shaft (Item 6) to the output shaft on the steering column (Item 18).

   f. Unscrew the retaining bolts (Item 4) securing the steering column to the cabin bulkhead.

   g. Remove the steering column from the transverse shaft.

   h. Remove the clamp bolt (Item 7) and nut clamping the universal joint on the transverse shaft (Item 6) to the input shaft in the bevel gear box (Item 8).

   i. Remove the transverse shaft (Item 6).

   j. Clean the splined shafts on the bevel gear box (Item 8) and the steering column (Item 18).

163. Installation. Install the steering transverse shaft as follows (Figure 121):

   a. Position the transverse shaft (Item 6) so that the clearance groove on the bevel gearbox (Item 8) input shaft spline aligns with corresponding clamp bolt hole on the universal joint.

   b. Push the universal joint fully home.

   WARNING

Clamp bolts (pinch bolts) and self locking nuts securing the steering linkage universal joints are not to be re-used. Install new, genuine Mercedes-Benz self-locking nuts and bolts.

   c. Install the clamp bolt (Item 7) and apply a light coating of Loctite 243 or equivalent to the thread.

   d. Tighten the clamp nut to 33 N.m.
e. Position the steering column (Item 18) so that the splines on the output shaft are aligned with the splines in the universal joint on the transverse shaft (Item 6).

**NOTE**

A soft headed hammer may be used to drive the unit fully home.

f. Position the steering column against the cabin bulkhead so that the bolt holes are aligned.

g. Install and tighten the retaining bolts (Item 4).

h. Position the transverse shaft (Item 6) so that the clearance groove on the steering column (Item 18) output shaft spline aligns with the corresponding clamp bolt hole on the universal joint.

i. Push the universal joint fully home.

j. Install the clamp bolt (Item 5) and apply a light coating of Loctite 243 or equivalent to the thread.

k. Tighten the clamp nut to 33 N.m.

l. Fit the combination switch to the steering column and tighten the retaining bolts.

m. Fit the steering wheel (Para 159).

n. Check the position of the steering wheel in relation to the position of the front wheels (adjust if necessary).

o. Fit the protective cover over the steering column and transverse shaft.

p. Road test the vehicle.

**Bevel Gear Box**

164. **Replacement.** The bevel gear box can be replaced as a separate unit.

165. **Removal.** Remove the bevel gear box as follows (Figure 121):

a. Ensure that the front wheels are in the straight ahead position.

b. Unscrew the retaining bolts and screws and remove the protective cover from the steering column and transverse shaft.

c. Remove the bolt (Item 7) and nut clamping the universal joint on the transverse shaft (Item 6) to the input shaft on the bevel gear box (Item 8).

d. Remove the bolt (Item 9) and nut clamping the universal joint on the upper steering shaft (Item 10) to the output shaft on the bevel gear box (Item 8).

e. Remove the retaining bolts securing the bevel gear box (Item 8) to the cabin bulkhead.

f. Remove the bevel gear box from the vehicle.

166. **Installation.** Install the bevel gear box as follows (Figure 121):

a. Position the new bevel gear box (Item 8) so that the splines on the input shaft and output shaft are aligned with the splines in the universal joints on the transverse shaft (Item 6) and upper steering shaft (Item 10).

b. Push it fully home.

c. Move the assembly into position against the cabin bulkhead so that the bolt holes are aligned.

d. Install and tighten the retaining bolts.

e. Check the position of the steering wheel in relation to the position of the front wheels (adjust if necessary).

f. Position the upper steering shaft (Item 10) so that the clearance groove on the bevel gear box (Item 8) output shaft spline aligns with the corresponding clamp bolt hole on the universal joint.

g. Push the universal joint fully home.
Clamp bolts (pinch bolts) and self locking nuts securing the steering linkage universal joints are not to be re-used. Install new, genuine Mercedes-Benz self locking nuts and bolts.

h. Install the clamp bolt (Item 9) and apply a light coating of Loctite 243 or equivalent to the thread.
i. Tighten the clamp nut to 33 N.m.
j. Position the transverse shaft (Item 6) so that the clearance groove on the bevel gearbox (Item 8) input shaft spline aligns with the corresponding clamp bolt hole on the universal joint.
k. Push the universal joint fully home.
l. Install the clamp bolt (Item 7) and apply a light coating of Loctite 243 or equivalent to the thread.
m. Tighten the clamp nut to 33 N.m.
n. Fit the protective cover over the steering column and transverse shaft.
o. Road test the vehicle.

Upper Steering Shaft

167. Replacement. The upper steering shaft is replaced as a separate unit.

168. Removal. Remove the upper steering shaft as follows (Figure 121):

a. Ensure that the front wheels are in the straight ahead position.
b. Unscrew the retaining bolts and screws and remove the protective cover from the steering column and transverse shaft.
c. Remove the bolt (Item 9) and nut clamping the universal joint on the upper steering shaft (Item 10) to the output shaft on the bevel gear box (Item 8).
d. Unscrew the retaining bolts (Item 11) securing the bearing cover (Item 12) on the upper steering shaft to the bulkhead and detach the cover.

The lower steering shaft consists of a split shaft with a sliding joint which must be secured from splitting apart before removing the upper steering shaft from the vehicle.

e. Remove the bolt (Item 13) and nut clamping the universal joint on the lower steering shaft (Item 14) to the upper steering shaft.
f. Remove the retaining bolts holding the bevel gear box to the cabin bulkhead.
g. Detach the bevel gear box from the upper steering shaft.
h. Remove the upper steering shaft ensuring that the lower steering shaft does not split apart.

169. Installation. Install the upper steering shaft as follows (Figure 121):

a. Install the new upper steering shaft (Item 10) in the vehicle so that the splines in the universal joint are aligned with the splines on the output shaft on the bevel gear box (Item 8).
b. Push it fully home.
c. Position the upper steering shaft so that the splines on the end of the shaft are aligned with the splines in the universal joint on the lower steering shaft (Item 14).
d. Push it fully home.
e. Check the position of the steering wheel in relation to the position of the front wheels (adjust if necessary).

f. Position the bevel gear box against the cabin bulkhead.
g. Install and tighten the retaining bolts.
h. Position the upper steering shaft (Item 10) so that the clearance groove on the bevel gear box (Item 8) output shaft spline aligns with the corresponding clamp bolt hole on the universal joint.
i. Push the universal joint fully home.

**WARNING**

*Clamp bolts (pinch bolts) and self locking nuts securing the steering linkage universal joints are not to be re-used. Install new, genuine Mercedes-Benz self locking nuts and bolts.*

j. Install the clamp bolt (Item 9) and apply a light coating of Loctite 243 or equivalent to the thread.
k. Tighten the clamp nut to 33 N.m.
l. Position the lower steering shaft (Item 14) so that the clearance groove on the upper steering shaft (Item 10) spline aligns with the corresponding clamp bolt hole on the universal joint.
m. Push the universal joint fully home.

n. Install the clamp bolt (Item 13) and apply a light coating of Loctite 243 or equivalent to the thread.
o. Tighten clamp nut to 64 N.m.
p. Align the bearing cover (Item 12) on the upper steering shaft with the bolt holes in the bulkhead.
q. Install and tighten the retaining bolts (Item 11).
r. Fit the protective cover over the steering column and transverse shaft.
s. Road test the vehicle.

**Lower Steering Shaft**

170. **Replacement.** The lower steering shaft, which consists of two universal joints, a convolute rubber gaiter and a split shaft with sliding joint, is replaced as a complete unit.

171. **Removal.** Remove the lower steering shaft as follows (Figure 121):

a. Ensure that the front wheels are in the straight ahead position.
b. Remove the bonnet, radiator grille and brushguard from the vehicle (Para 14).
c. Move the rubber gaiter (Item 16) on the lower section of the steering box shaft until it is clear of the universal joint on the steering box (Item 17).
d. Secure it in this position.
e. Remove the bolt (Item 15) and nut clamping the universal joint on the lower steering shaft (Item 14) to the input shaft on the steering box.
f. Detach the lower steering shaft from the steering box.
g. Remove the bolt (Item 13) and nut clamping the universal joint on the lower steering shaft to the upper steering shaft (Item 10).
h. Remove the shaft.
172. **Installation.** Install the lower steering shaft as follows (Figure 121):

**CAUTION**

The sliding joint on the steering shaft has a recess which must be aligned with the missing tooth on the splined section of the shaft.

a. Check the alignment of the sliding joint on the new shaft before installation (adjust if necessary).

b. Position the lower steering shaft (Item 14) so that the clearance groove on the upper steering shaft (Item 10) spline aligns with the corresponding clamp bolt hole on the universal joint.

c. Push the universal joint fully home.

**WARNING**

Clamp bolts (pinch bolts) and self locking nuts securing the steering linkage universal joints are not to be re-used. Install new, genuine Mercedes-Benz self locking nuts and bolts.

d. Install the clamp bolt (Item 13) and apply a light coating of Loctite 243 or equivalent to the thread.

e. Tighten clamp nut to 64 N.m.

f. Check the position of the steering wheel in relation to the position of the front wheels (adjust if necessary).

g. Position the lower steering shaft (Item 14) so that the clearance groove on the steering box (Item 17) input spline aligns with the corresponding clamp bolt hole on the universal joint.

h. Push the universal joint fully home.

**WARNING**

The distance between the end face of the universal joint and the steering box supporting ring must not exceed 2 mm.

Clamp bolts (pinch bolts) and self locking nuts securing the steering linkage universal joints are not to be re-used. Install new, genuine Mercedes-Benz self locking nuts and bolts.

i. Install the clamp bolt (Item 15) and apply a light coating of Loctite 243 or equivalent thread-lock to the thread.

j. Tighten clamp nut to 64 N.m.

k. Cover the universal joint with the rubber gaiter (Item 16).

l. Fit the bonnet, radiator grille and brushguard (Para 14).

m. Road test the vehicle.
Drag Link

173. **Replacement.** Replace the drag link as follows (Figure 123):

**Figure 123  Steering Box to Steering Knuckle Linkages**

a. Move the front wheels to the straight ahead position.

b. Unscrew the castellated nut (Item 13) and detach the drag link (Item 14) from the pitman arm (Item 12) using the ball joint remover (Table 1, Item 25) (Figure 124).

c. Unscrew the castellated nut (Item 15) and detach the drag link from the right-hand side steering arm (Item 1) using the ball joint remover (Table 1, Item 25) (Figure 125).
d. Attach the drag link to the right-hand side steering arm.

e. Fit and secure the castellated nut.

f. Attach the drag link to the pitman arm.

g. Fit and secure the castellated nut.

h. Measure the distance from the side rail to the centre of the hole in the pitman arm (Figure 126).

i. If necessary adjust the drag link (Para 177) so that this distance is 165 mm.

j. Tighten the castellated nuts to 230 ±20 N.m.

If the nut castellation are not aligned with the split pin mounting holes in the drag link after the initial torque tightening is reached, tighten the nut slightly to align the next split pin mounting holes. Do not loosen the nut to align the split pin mounting holes.

k. Insert the split pins.

l. Road test the vehicle.
Tie-rod

174. Replacement. Replace the tie-rod as follows (Figure 123):

- Move the front wheels to the straight ahead position.
- Remove the castellated nuts (Items 3 and 7).
- Detach the tie-rod (Item 6) from the right-hand side (Item 1) and left-hand side (Item 8) steering arms using the ball joint remover (Table 1, Item 25) (Figure 125).
- Attach the tie-rod to the right and left-hand side steering arms.

**WARNING**

Later versions of the tie-rod ball joints do not have split pin holes and are to be secured with Nyloc nuts. Apply Loctite 243 prior to installing the nut. Tighten the Nyloc nut to 220 N.m. Nyloc nuts are not to be reused.

- Secure the tie-rod with the original nuts.
- Check the wheel alignment (Para 178).
- Remove the original nuts.
- Apply Loctite to threads of the new Nyloc nuts.
- Secure the tie-rod with the new Nyloc nuts.
- Tighten the nuts to 220 N.m.
- Road test the vehicle.

Right Side Steering Arm

175. Replacement. Replace the right side steering arm as follows (Figure 123):

**CAUTION**

The steering arms must only be removed after the front axle has been raised and placed on axle stands. The steering arm retaining bolts also hold the lower swivel joint bearing cap.

- Raise the front of the vehicle so the wheels are free to turn (Para 27).
- Support the vehicle with axle stands (Para 28).
- Move the front wheels to the straight ahead position.
- Remove the castellated nuts (Items 3 and 15).
- Detach the drag link (Item 14) and tie-rod (Item 6) using the ball joint remover (Table 1, Item 25) (Figures 124 and 125).
- Remove the four steering arm retaining bolts (Item 2).
- Remove the steering arm together with the shell bearing half, thrust piece and thrust shell.
- Clean and inspect all parts of the bearing (replace any worn or damaged parts).
- Coat the shell bearing half with XG-291 grease.
- Install the steering arm with the thrust piece, thrust shell and bearing half shell.
- Secure it with the retaining bolts.
- Tighten the steering arm retaining bolts to 400 N.m.
Later versions of the tie-rod ball joints do not have split pin holes and are to be secured with Nyloc nuts. Apply Loctite 243 prior to installing the nut. Tighten the Nyloc nut to 220 N.m. Nyloc nuts are not to be reused.

m. Attach the tie-rod and the drag link to the steering arm.

n. Fit the castellated nuts.

o. Tighten them to 230 ± 20 N.m.

If the nut castellation are not aligned with the split pin mounting holes in the drag link after the initial tightening torque is reached, tighten the nut slightly to align the next split pin mounting holes. Do not loosen the nut to align the split pin mounting holes.

p. Insert the split pins.

q. Lower the vehicle off the axle stands.

r. Road test the vehicle.

Left Side Steering Arm

**176. Replacement.** Replace the left side steering arm as follows (Figure 123):

The steering arms must only be removed after the front axle has been raised and placed on axle stands. The steering arm retaining bolts also hold the lower swivel joint bearing cap.

a. Raise the front of the vehicle so the wheels are free to turn (Para 27).

b. Support the vehicle with axle stands (Para 28).

c. Move the front wheels to the straight ahead position.

d. Remove the castellated nuts (Items 3 and 15).

e. Detach the drag link (Item 14) and tie-rod (Item 6) using the ball joint remover (Table 1, Item 25) (Figures 124 and 125).

f. Remove the four steering arm retaining bolts (Item 2).

g. Remove the steering arm together with the shell bearing half, thrust piece and thrust shell.

h. Clean and inspect all parts of the bearing (replace any worn or damaged parts).

i. Coat the shell bearing half with XG-291 grease.

j. Install the steering arm with the thrust piece, thrust shell and bearing half shell.

k. Secure with the retaining bolts.

l. Tighten the steering arm retaining bolts to 400 N.m.
Later versions of the tie-rod ball joints do not have split pin holes and are to be secured with Nyloc nuts. Apply Loctite 243 prior to installing the nut. Tighten the Nyloc nut to 220 N.m. Nyloc nuts are not to be reused.

m. Attach the track rod and the drag link to the steering arm.

n. Fit the castellated nuts.

o. Tighten the nuts to 230 ±20 N.m.

If the nut castellation are not aligned with the split pin mounting holes in the drag link after the initial tightening torque is reached, tighten the nut slightly to align the next split pin mounting holes. Do not loosen the nut to align the split pin mounting holes.

p. Insert the split pins.

q. Lower the axle off the axle stands.

r. Road test the vehicle.

Drag Link and Tie-rod

177. Adjustment. The drag link and tie-rod are adjusted as follows (Figure 126):

a. Loosen the clamp (Item 5) at the end of the tie-rod (Item 6) or drag link (Item 14).

b. Unscrew the castellated nut (Items 3 or 15).

c. Detach the ball joint from the steering arm using the ball joint remover (Table 1, Item 25) (Figure 125).

d. Adjust the tie-rod or drag link by screwing the ball joint end in or out as necessary.

e. Attach the tie-rod or drag link.

Later versions of the tie-rod ball joints do not have split pin holes and are to be secured with Nyloc nuts. Apply Loctite 243 prior to installing the nut. Tighten the Nyloc nut to 220 N.m. Nyloc nuts are not to be reused.

f. Replace the castellated nut.

g. Tighten to 230 ± 20 N.m.

If the nut castellation are not aligned with the split pin mounting holes in the drag link after the initial tightening torque is reached, tighten the nut slightly to align the next split pin mounting holes. Do not loosen the nut to align the split pin mounting holes.

h. Insert the new split pin.

i. Tighten the clamp bolts (Item 4) to 90 ±3 N.m.
Wheel Alignment

178. **Alignment.** Wheel alignment is carried out as follows:

a. Park the vehicle on a horizontal surface with the front wheels straight ahead.

   **NOTE**
   
   It is recommended that the vehicle is unladen and that the tyres are cold.

b. Check the tyre pressures (adjust if necessary).

c. Measure the toe-out of the front wheels with a toe-in/out gauge (toe-out – zero to 4 mm). If required, adjust the tie-rod as follows:

   1. Loosen the clamp bolts (Figure 123, Item 4).
   2. Remove the split pin.
   3. Remove the castellated nut (Figure 123, Item 3).
   4. Detach the tie-rod (Figure 123, Item 6) from the righthand steering arm (Figure 123, Item 1) using the ball joint remover (Table 1, Item 25) (Figure 125).

   **CAUTION**
   
   Only adjust the tie-rod ball joint one turn at a time. Shorten the tie-rod to provide toe-out and lengthen the tie-rod to provide toe-in.

   5. Adjust the tie-rod by screwing the ball joint end in or out as required.
   6. Attach the tie-rod to the righthand steering arm.
   7. Secure the tie-rod with the old nut.
   8. Measure the toe-out (adjust as required steps 3 to 8).

   **WARNING**
   
   Later versions of the tie-rod ball joints do not have split pin holes and are to be secured with Nyloc nuts. Apply Loctite 243 prior to installing the nut. Tighten the Nyloc nut to 220 N.m. Nyloc nuts are not to be reused.

   9. Tighten the castellated nut to 230 ±20 N.m.
   10. Insert the new split pin.
   11. Road test the vehicle.
ELECTRICAL

Batteries

179. Replacement. Replace the batteries as follows:

**WARNING**

Wear protective clothing, acid resistant gloves and eye protection. There is a risk of explosion from gas, burns from spilt electrolyte, poisoning from swallowing electrolyte and damage to eyes and skin from contact with electrolyte.

No fire, sparks, naked flame or smoking is permitted.

Do not place conductive material on the batteries.

a. Open the battery box using the T-key.
b. Release the catch at the centre of the battery tray using the T-key.
c. Slide out the battery tray.
d. Disconnect the negative battery lead.
e. Disconnect the positive battery lead.
f. Disconnect the inter-battery lead.
g. Remove the nuts and clamps from the front and rear of the batteries.
h. Remove the batteries.
i. Install the batteries.
j. Fit clamps and nuts to the front and rear of the batteries.
k. Connect the inter-battery lead.
l. Connect the positive battery lead.
m. Connect the negative battery lead.
n. Slide in the battery tray.
o. Lock the central catch with the T-key.
p. Close and lock the battery box cover with the T-key.

Battery Box

180. Replacement. Replace the battery box as follows:

a. Remove the batteries (Para 179).
b. Remove the battery tray.
c. Remove the grommets from the rear of the battery box.
d. Feed the battery cables out through the holes.
e. Remove the four nuts and bolts from the base of the battery box.
f. Remove the battery box.
g. Install the battery box.
h. Secure it with the four nuts and bolts.
i. Feed the battery cables through the rear of the battery box.
j. Install the grommets.
k. Install the battery tray.
1. Install the batteries (Para 179).

**Starter Motor**

**181. Replacement.** Replace the starter motor as follows (Figure 127):

- Raise and secure the cabin (Para 25).
- Remove the supply cable (Item 1) from the starter motor.
- Remove the earth strap (Item 3) from the starter motor.
- Remove the two remaining securing nuts (Item 2).
- Remove the starter motor.
- Clean the flange surfaces.
- Coat the surfaces with Loctite 573.
- Coat the studs with a non-curing sealant.
- Install the starter motor over the studs.
- Secure with two nuts to the top studs.
- Connect the earth strap.
- Torque the securing nuts between 45 to 65 N.m.
- Connect the supply cable.
- Lower and secure the cabin.
- Check the operation of the starter motor.
Generator

182. **Replacement.** Replace the generator as follows (Figure 128):

![Figure 128 Generator](image)

1. **Upper clamp**
2. **Drive belt**
3. **Clamp bolts**
4. **Output cable**

**Figure 128  Generator**

- a. Remove the bonnet (Para 17).
- b. Disconnect the generator output cable (Item 4).
- c. Remove the generator drive belt (Item 2) (Para 50).
- d. Remove the four clamp bolts (Item 3).
- e. Remove the rear clamp (Item 1).
- f. Slide the generator out of the front clamp.
- g. Slide the generator into the front clamp.

**NOTE**

Ensure that the drive pulley on the generator is aligned with the drive pulley on the coolant pump.

- h. Fit the rear clamp.
- i. Fit the clamp bolts.
- j. Torque the bolts to 40 ±5 N.m.
- k. Fit and correctly tension the generator drive belt (Para 50).
- l. Connect the generator output cable.
- m. Fit and secure the bonnet (Para 18).
- n. Check the operation of the generator.
Headlights

183. Replacement. Replace the headlight as follows (Figure 129):

- a. Remove the four securing bolts (Item 1).
- b. Remove the headlight guard (Item 3).
- c. Remove the two moulding screws (Item 4).
- d. Remove the headlight moulding (Item 5).
- e. Unscrew the six mounting screws (Item 6).
- f. Ease the headlight forward.
- g. Disconnect the headlight cable.
- h. Remove the headlight and seal.
- i. Fit a new seal and headlight.
- j. Connect the headlight cable.
- k. Ease the headlight into the moulding.
- l. Install the six mounting screws.
- m. Adjust the headlight (Para 184).
- n. Fit the headlight moulding.
- o. Secure the moulding with the two screws.
- p. Fit the headlight guard.
- q. Secure it with the four bolts.
184. **Adjustment.** The headlights are adjusted as follows (Figure 129):
   a. Check the tyre pressures (adjust if necessary).
   b. Park the vehicle on a horizontal surface.
   c. Prepare the beam setter according to the manufacturer’s instructions.
   d. Remove the headlight guards and headlight mouldings (Para 183).
   e. Adjust the headlights using the vertical adjusting screw (Item 7) and the lateral adjusting screw (Item 8).
   f. Fit the headlight mouldings and the headlight guards (Para 183).

**Front Marker Lights**

185. The front marker lights are incorporated in the headlight units. For removal of the headlight units, carry out the procedure in accordance with Para 183.

**Tail Light Assembly**

186. **Replacement.** The tail light assembly contains the reversing light, turn indicator light and a combined brake/tail light. Replace the assembly as follows:
   a. Remove the two retaining screws holding the lens of the tail light.
   b. Remove the lens.
   c. Disconnect all the push-fit connectors.
   d. Remove the grommet at the rear of the assembly.
   e. Pull all wires out of the assembly.
   f. Remove the two nuts from the rear of the assembly.
   g. Remove the assembly.
   h. Fit a new tail light assembly.
   i. Secure it with the two nuts.
   j. Push all wires through the rear of the assembly.
   k. Fit the grommet.
   l. Connect all push-fit connectors.
   m. Fit the tail light lens.
   n. Secure it with the two retaining screws.

**Mirror Mounted Clearance Lights**

187. **Replacement.** Replace the mirror mounted clearance lights as follows:
   a. Remove the two retaining screws holding the clearance light to the mirror.
   b. Remove the lens cover.
   c. Remove the bulb.
   d. Detach the clearance light from the mirror to expose the wires.
   e. Unsolder the two connecting wires.
   f. Remove the clearance light.
   g. Solder the two connecting wires.
   h. Fit the new clearance light to the mirror.
   i. Fit the festoon bulb.
   j. Install the lens cover.
Front Turn Indicator Light
188. Replacement. Replace the front turn indicator light as follows:
   a. Remove the four retaining screws holding the light to the vehicle.
   b. Ease out the light.
   c. Disconnect the input connectors and breather tube.
   d. Remove the light.
   e. Connect the breather tube and input connectors to the new light.
   f. Install the light.
   g. Insert and tighten the retaining screws.

Reduced Headlight
189. Replacement. Replace the reduced headlight as follows:
   a. Disconnect the inline connector to the headlight.
   b. Remove the nut, bolt and spacers from the mounting bracket.
   c. Remove the headlight.
   d. Install the headlight.
   e. Insert the bolt and spacers.
   f. Fit and tighten the nut.
   g. Connect the inline connector.

Masked Front Marker Light
190. Replacement. Replace the masked front marker light as follows:
   a. Pull off the input connector.
   b. Remove the bolt and washers from the mounting bracket.
   c. Remove the light.
   d. Fit the light.
   e. Insert the bolt and washers.
   f. Tighten the bolt.
   g. Push on the input connector.

Masked Tail Light/Masked Brake Light Assembly
191. Replacement. Replace the masked tail light/masked brake light assembly as follows:
   a. Cut the cable tie holding the input wires to the mounting bracket.
   b. Disconnect the inline connectors.
   c. Remove the two bolts holding the assembly to the mounting brackets.
   d. Remove the assembly.
   e. Fit the assembly.
   f. Insert and tighten the mounting bolts.
   g. Connect the inline connectors.
   h. Strap the input wires to the mounting bracket using a new cable tie.
Convoy Cross Light

192. **Replacement.** Replace the convoy cross light as follows:
   a. Remove the bolts securing the spider to the rubber flap.
   b. Remove the spider.
   c. Remove the two bolts securing the light to the rubber flap.
   d. Disconnect the input lead.
   e. Remove the light.
   f. Fit the light.
   g. Connect the input lead.
   h. Insert and tighten the light securing bolts.
   i. Fit the spider.
   j. Insert and tighten the spider securing bolts.

Map Light

193. **Replacement.** Replace the map light as follows:
   a. Pull off the map light cover.
   b. Release the input connectors by unscrewing the wire retaining screws.
   c. Remove the two retaining bolts and nuts holding the light to the glove box cover.
   d. Remove the light.
   e. Install the light.
   f. Insert the two retaining bolts.
   g. Fit and tighten the nuts.
   h. Insert the input connectors and tighten the wire retaining screws.
   i. Fit the cover to the light.

Horn

194. **Replacement.** Replace the horn as follows:
   a. Pull off the two input connectors.
   b. Remove the bolt securing the horn to the mounting bracket.
   c. Remove the horn.
   d. Install the horn.
   e. Insert and tighten the retaining bolt.
   f. Push on the two input connectors.

Windscreen Wiper Motor

195. **Replacement.** Replace the windscreen wiper motor as follows:
   a. Remove the two bolts securing the access cover located to the right of the foot controls.
   b. Remove the cover.
   c. Remove the nut and washer from the motor output shaft.
   d. Pull off the drive arm.
   e. Remove the three bolts securing the motor.
   f. Disconnect the input plug at the rear of the motor.
g. Remove the motor.

**CAUTION**

Ensure that the input plug is not knocked loose or damaged when fitting the motor.

h. Connect the input plug to the rear of the motor.

i. Fit the new motor.

j. Insert and tighten the three retaining bolts.

k. Push the drive arm onto the motor output shaft.

l. Fit the securing nut and washer.

m. Tighten the nut.

n. Fit the access cover.

o. Secure the cover with the two bolts.

**Windscreen Washer Motor**

196. **Replacement.** Replace the windscreen-washer motor as follows:

a. Raise and secure the bonnet.

b. Remove the radiator grille (Para 19).

c. Unscrew the centre bolt on the air filter.

d. Remove the air filter.

e. Release the spring clip on the air filter cover.

f. Remove the cover.

g. Disconnect the two push-fit input connectors from the motor.

h. Remove the output pipe from the motor.

**NOTE**

The motor is a push fit into the washer bottle when the motor is removed the water in the bottle will run out.

i. Pull the motor out of the washer bottle.

j. Insert the motor into the washer bottle.

k. Connect the output pipe to the motor.

l. Push on the two input connectors.

m. Fill the washer bottle.

n. Fit and secure the air filter cover and the air filter.

o. Fit the radiator grille (Para 20).

p. Close and secure the bonnet.
Blower Motor Control Switch

197. Replacement. Replace the blower motor control switch as follows:
   a. Open the glove box.
   b. Remove the five screws securing the glove box.
   c. Ease out the glove box.
   d. Disconnect the map light in line connector.
   e. Remove the glove box.
   f. Pull off the control switch knob.
   g. Disconnect the input wires from the switch.
   h. Compress the retaining clips and remove the switch.
   i. Fit the new switch and connect the input wires.
   j. Fit the control switch knob.
   k. Connect the map light in line connector.
   l. Fit the glove box.
   m. Secure the glove box with the five screws.
   n. Close the glove box.

Combination Switch

198. Replacement. Replace the combination switch as follows:
   a. Remove the four bolts securing the dashboard.
   b. Ease out the dashboard.
   c. Remove the two cross head bolts securing the combination switch to the steering column.
   d. Disconnect the combination switch in-line connectors behind the dashboard.
   e. Remove the combination switch and cable.
   f. Connect the in-line connectors behind the dashboard to the new combination switch.
   g. Fit the switch to the steering column.
   h. Secure with the two retaining bolts.
   i. Fit the dashboard.
   j. Secure the dashboard with the four bolts.

Brake Light Switch

199. Replacement. Replace the brake light switch as follows (Figure 130):
   a. Remove the two bolts securing the access cover located to the right of the foot controls.
   b. Remove the cover.
   c. Disconnect the cable (Item 1) from the brake light switch (Item 3).
   d. Remove the retaining nut (Item 2).
   e. Remove the switch.
   f. Fit a new switch.
   g. Secure it with the retaining nut.
   h. Connect the cable to the switch.
Figure 130    Brake Light Switch

i.  Fit the access cover.

j.  Secure the cover with the two bolts.

Reversing Light Switch

200.  Replacement. Replace the reversing light switch as follows (Figure 131):

   a.  Remove the spare wheel.

   b.  Disconnect the cable (Item 1) from the reversing light switch located on the left-hand side of the main transmission housing (Item 2).

   c.  Unscrew and remove the switch (Item 3).

   d.  Remove and discard the sealing ring.

   e.  Fit a new sealing ring to the switch.

   f.  Screw the switch into the transmission housing.

   g.  Connect the cable to the switch.

   h.  Refit the spare wheel.
Door Light Switch

201. **Replacement.** Replace the door light switch as follows:

a. Open the driver's door.
b. Pull out the light switch.
c. Disconnect the input cables.
d. Remove the switch.
e. Connect the input cables to the new switch.
f. Push fit the switch.
g. Close the driver's door.

Ignition Switch

202. **Replacement.** Replace the ignition switch as follows:

a. Remove the four bolts securing the dashboard.
b. Ease out the dashboard.
c. Disconnect the inline connector in the ignition switch input cable.
d. Remove the switch retaining nut from the front of the switch.
e. Remove the switch.
f. Fit a new switch.
g. Secure the switch with the retaining nut.
h. Connect the input cable.
i. Fit the dashboard.
j. Insert and tighten the securing bolts.
Hazard Lights Switch

203. **Replacement.** Replace the hazard lights switch as follows:

a. Remove the four bolts securing the dashboard.
b. Ease out the dashboard.
c. Remove the input plug from the rear of the switch.
d. Compress the expander clips and remove the switch.
e. Fit a new switch.
f. Connect the input plug.
g. Fit the dashboard.
h. Insert and tighten the securing bolts.

Windscreen Washer Switch

204. **Replacement.** Replace the windscreen washer switch as follows:

a. Remove the four bolts securing the dashboard.
b. Ease out the dashboard.
c. Remove the input plug from the rear of the switch.
d. Compress the expander clips and remove the switch.
e. Fit a new switch.
f. Connect the input plug.
g. Fit the dashboard.
h. Insert and tighten the securing bolts.

Main Light Switch

205. **Replacement.** Replace the main light switch as follows:

a. Remove the four bolts securing the dashboard.
b. Ease out the dashboard.
c. Pull the knob off the light switch.
d. Record the colour codes of the wires to the eleven switch terminals.
e. Unscrew the wire retaining screws and disconnect the wires.
f. Remove the retaining nut from the front of the switch.
g. Remove the switch.
h. Fit a new switch.
i. Secure the switch with the retaining nut.
j. Connect the wires to the switch as recorded at Sub-para d.
k. Push the knob onto the switch shaft.
l. Fit the dashboard.
m. Insert and tighten the securing bolts.

Voltmeter

206. **Replacement.** Replace the voltmeter as follows:

a. Remove the four bolts securing the dashboard.
b. Ease out the dashboard.
c. Disconnect the input connectors from the voltmeter.
d. Unscrew the two thumb nuts.
e. Remove the bracket from the rear of the voltmeter.
f. Remove the voltmeter.
g. Fit a new voltmeter.
h. Fit the bracket.
i. Secure the bracket with the two thumb nuts.
j. Connect the input connectors to the voltmeter.
k. Fit the dashboard.
l. Insert and tighten the securing bolts.

Instrument Cluster

207. **Replacement.** Replace the instrument cluster as follows:

   a. Remove the four bolts securing the dashboard.
   b. Ease out the dashboard.
   c. Drain all the air reservoirs.
   d. Disconnect the air lines from the rear of the instrument cluster.
   e. Disconnect the input connectors from the instrument cluster.
   f. Remove the instrument cluster.
   g. Fit a new instrument cluster.
   h. Connect the input connectors and the air lines.
   i. Start the engine.
   j. Pressurise the air tanks to at least 12 bar (1.2 MPa).
   k. Stop the engine.
   l. Inspect the air line connectors for air leaks (rectify as required).
   m. Fit the dashboard.
   n. Insert and tighten the securing bolts.

Tachometer

208. **Replacement.** Replace the tachometer as follows:

   a. Remove the four bolts securing the dashboard.
   b. Ease out the dashboard.
   c. Disconnect the input connectors from the tachometer.
   d. Remove the tachometer.
   e. Fit a new tachometer.
   f. Connect the input connectors.
   g. Fit the dashboard.
   h. Insert and tighten the securing bolts.
Speedometer

209. **Replacement.** To replace the speedometer refer to EMEI Vehicle A 019-1 and proceed as follows:

a. Remove the four bolts securing the dashboard.

b. Ease out the dashboard.

c. Unscrew the speedometer drive cable between the reduction gear and the speedometer.

d. Disconnect the input connectors.

e. Remove the speedometer from the grommet.

f. Push a new speedometer into the grommet.

g. Connect the input connectors.

h. Fit and tighten the drive cable.

i. Fit the dashboard.

j. Insert and tighten the securing bolts.

Trailer Lighting Socket

210. **Replacement.** Replace the trailer lighting socket as follows:

a. Remove the four nuts, bolts and washers securing the socket to the rear chassis member.

b. Pull the lighting socket clear of the chassis member.

c. Pull back the rubber boot from the rear of the socket.

d. Unscrew the plastic retaining ring from the rear of the socket.

e. Pull the rubber wire spacer clear of the rear of the socket.

f. Record the colour codes of the wires to each socket.

g. Unsolder the wires.

h. Remove the socket.

i. Remove and discard the rubber wire spacer, plastic retaining ring and rubber boot from the input cable.

j. Slip the new rubber boot and plastic retaining ring onto the cable.

k. Feed the individual wires through the new rubber wire spacer.

l. Solder the wires to the new socket as recorded in Sub-para f.

m. Screw on the plastic retaining ring.

n. Fit the rubber boot.

o. Fit the socket in the rear chassis member.

p. Secure the socket cover and the socket with the four nuts, bolts and washers.

Bulb Base Configurations and Circuit Breaker Ratings

211.  Tables 5 and Table 6 provide a list of circuit breaker cut-out ratings. Table 7 provides a list of bulb ratings and Figure 132 depicts the bulb forms.
### Table 5  Circuit Breaker Cut-out Ratings A–Bank

<table>
<thead>
<tr>
<th>Serial</th>
<th>Rating (Amps)</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>Left high beam, high beam indicator</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>Right high beam</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Left low beam</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>Right low beam</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>Brake lights</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>Horn</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>Windscreen washer</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Windscreen wiper motor and switch, instrument lights</td>
</tr>
<tr>
<td>9</td>
<td>12</td>
<td>Ventilation blower motor</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>Instrument cluster and tachometer, indicator and warning lights, generator sensing-line</td>
</tr>
<tr>
<td>11</td>
<td>12</td>
<td>Turn and dashboard indicators, reversing lights, neutral indicator, headlight flasher, dome light</td>
</tr>
<tr>
<td>12</td>
<td>8</td>
<td>Hazard lights switch</td>
</tr>
</tbody>
</table>

### Table 6  Circuit Breaker Cut-out Ratings B–Bank

<table>
<thead>
<tr>
<th>Serial</th>
<th>Rating (Amps)</th>
<th>Load</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>8</td>
<td>Left front marker, left clearance-light, windscreen washer switch-light.</td>
</tr>
<tr>
<td>2</td>
<td>8</td>
<td>Right front marker, neutral indicator, light/dark relay, right clearance light</td>
</tr>
<tr>
<td>3</td>
<td>8</td>
<td>Left rear marker</td>
</tr>
<tr>
<td>4</td>
<td>8</td>
<td>Right rear marker</td>
</tr>
<tr>
<td>5</td>
<td>8</td>
<td>Speedometer, map light</td>
</tr>
<tr>
<td>6</td>
<td>8</td>
<td>Dashboard power socket</td>
</tr>
<tr>
<td>7</td>
<td>8</td>
<td>Trailer lighting socket (pin K)</td>
</tr>
<tr>
<td>8</td>
<td>8</td>
<td>Reduced headlight</td>
</tr>
<tr>
<td>9</td>
<td>8</td>
<td>Convoy cross light</td>
</tr>
<tr>
<td>10</td>
<td>8</td>
<td>Masked rear markers</td>
</tr>
<tr>
<td>11</td>
<td>8</td>
<td>Masked left front marker</td>
</tr>
<tr>
<td>12</td>
<td>8</td>
<td>Masked right front marker</td>
</tr>
</tbody>
</table>
**Figure 132  Bulb Forms**

**Table 7  Bulb Ratings**

<table>
<thead>
<tr>
<th>Serial</th>
<th>Power Rating (Watts)</th>
<th>Form (Note)</th>
<th>Use</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>55/50</td>
<td>A</td>
<td>Headlights high/low</td>
</tr>
<tr>
<td>2</td>
<td>4</td>
<td>HL</td>
<td>Parking lights</td>
</tr>
<tr>
<td>3</td>
<td>18</td>
<td>R</td>
<td>Blackout marker lights</td>
</tr>
<tr>
<td>4</td>
<td>18</td>
<td>R</td>
<td>Reduced headlights</td>
</tr>
<tr>
<td>5</td>
<td>21</td>
<td>RL</td>
<td>Turn indicator lights</td>
</tr>
<tr>
<td>6</td>
<td>4</td>
<td>L</td>
<td>Mirror clearance lights</td>
</tr>
<tr>
<td>7</td>
<td>21/5</td>
<td>SL</td>
<td>Stop/tail lights</td>
</tr>
<tr>
<td>8</td>
<td>2</td>
<td>H</td>
<td>Blackout tail and brake lights</td>
</tr>
<tr>
<td>9</td>
<td>21</td>
<td>RL</td>
<td>Warning and indicator lights</td>
</tr>
<tr>
<td>10</td>
<td>2</td>
<td>H</td>
<td>Convoy cross light</td>
</tr>
<tr>
<td>11</td>
<td>2</td>
<td>H</td>
<td>Map reading light</td>
</tr>
<tr>
<td>12</td>
<td>10</td>
<td>G</td>
<td>Reversing-light</td>
</tr>
<tr>
<td>13</td>
<td>10</td>
<td>K</td>
<td>Dome light</td>
</tr>
<tr>
<td>14</td>
<td>1.2</td>
<td>W5</td>
<td>Gate position indicator light</td>
</tr>
</tbody>
</table>

*Note:* Table, Bulb Ratings, refers to Figure 132, Bulb Forms.

**Circuit Diagram**

**212.** The circuit diagram for the vehicle is depicted at Figure 140.
Pintle Hook

213. **Replacement.** Replace the pintle hook as follows (Figure 133):

- a. Remove the dust cover from the pintle hook.
- b. Remove the split pin (Item 6) from the castellated nut (Item 7).
- c. Remove the castellated nut from the pintle hook shaft.
- d. Remove the washer (Item 4), thrust plate (Item 5) and rubber bush (3 Item).
- e. Withdraw the pintle hook from the flanged bracket.
- f. Remove the four retaining bolts and nuts (Item 1) from the bracket (discard the nuts).
- g. Remove the bracket from the chassis cross-member.
- h. Use a wire brush to clean the chassis cross-member and bolt holes.
- i. Clean the bracket retaining bolts.
- j. Position the new flanged bracket against the cross-member so that the bolt holes are aligned.
- k. Install the four retaining bolts.
- l. Secure the bracket with four new locknuts.
- m. Torque the nuts to 125 N.m.
- n. Fit a rubber bush and the rear thrust plate to the pintle shaft.
- o. Fit the pintle shaft into the flanged bracket.
- p. Position the second rubber bush, front thrust plate and wave washer onto the pintle shaft.
- q. Secure them with the castellated nut.
- r. Torque the castellated nut between 300 and 400 N.m, aligning the slot in the castellated nut with the hole in the pintle shaft.
- s. Install a new split pin.
t. Fit the dust cap over the castellated nut and push it home.

**Front Lifting Brackets**

214. **Replacement.** Replace the lifting brackets as follows:
   a. Remove the two vertical bolts from the bracket.
   b. Remove the five horizontal bolts from the bracket.
   c. Remove the bracket from the vehicle.
   d. Fit the new bracket to the vehicle.
   e. Secure it with the seven bolts. Use spacer washers to ensure there is no gap between the bracket and the chassis rail, (ref EMEI Vehicle G 617-11).
   f. Torque the M16 horizontal bolt and the vertical bolts to 240 N.m.
   g. Torque the M12 horizontal bolts to 120 N.m.
   h. Torque the M10 horizontal bolts to 90 N.m.

**Rear Lifting Brackets**

215. **Replacement.** Replace the lifting brackets as follows:
   a. Remove the four bolts and nuts holding the lifting bracket to the cross-member.
   b. Remove the bracket from the vehicle.
   c. Use a wire brush to clean the cross-member and the bolt holes.
   d. Position the new lifting bracket against the cross-member so that the bolt holes are aligned.
   e. Install the two inner bolts and hand tighten them.
   f. Align the air hose bracket with the upper, outer mounting hole.
   g. Install a bolt and hand tighten it.
   h. Install the last nut and bolt.
   i. Torque all nuts to 200 N.m.

**CABIN HEATING AND COOLING**

**Blower Assembly**

216. **Replacement.** Replace the blower assembly as follows:
   a. Remove the bonnet (Para 17).
   b. Remove the six spring clips holding the two halves of the shell together.
   c. Split the shell.
   d. Remove the leads from the blower motor.
   e. Remove the motor and the right-hand half of the shell from the vehicle.
   f. Remove the hex head grub screw holding the blower fan.
   g. Detach the fan from the motor.
   h. Remove the rubber-bonded retaining bolts holding the motor to the housing.
   i. Detach the motor from the housing.
   j. Clean and inspect the housing and motor (replace if defective or damaged).
   k. Position the motor in the housing.
   l. Insert and tighten the rubber-bonded retaining bolts.
m. Attach the fan to the motor.
n. Secure it with the hex head grub screw.
o. Position the right hand shell against the left-hand shell.
p. Secure it with the six spring clips.
q. Start and run the engine until the correct operating temperature is reached.
r. Operate the cabin heating/cooling system and check for any leaks (repair if necessary).
s. Fit and secure the bonnet (Para 18).

Heater Core

217. Replacement. The heater core is located in the cabin beneath the dashboard. Replace the heater core as follows:

a. Remove the bonnet (Para 17).
b. Drain all coolant from the radiator.
c. Remove the cover over the electrical cut-outs.
d. Remove the retaining screws and detach the instrument panel from the dashboard.
e. Tilt it towards the steering column.
f. Remove the upper cover over the dashboard.
g. Remove the retaining bolts and detach the glove box from the dashboard.
h. Detach the demister lines from the both sides of the heater unit.

CAUTION

The heater line to the left-hand side foot-well is removed with the heater core. Ensure that the fastening and guide lugs on plastic pieces are not damaged during removal and installation.

i. Detach the heater lines from both sides of the foot-well.
j. Remove the access plate from the cabin bulkhead.
k. Detach the two cabin heater lines from the system.
l. Disconnect the cable for the hot/cold control at the valve lever.
m. Disconnect the cable for the air control flap at the flap hinge.
n. Remove the air distribution box from the system.
o. Remove the control knobs from the front panel of the system.
p. Remove the retaining bolts at the bottom of the front panel.
q. Remove the panel.
r. Separate the core housing.
s. Remove the left-hand side of the housing with the heater core.
t. Remove the retaining plate.
u. Unscrew the connector unions from the supply and return lines.

CAUTION

Do not damage the foam rubber sealing rings.
v. Remove the heater core from the left-hand side housing.
w. Clean the core housing and dashboard area.
x. Inspect the cabin heater lines (replace if cracked or damaged).

**CAUTION**

Do not damage the foam rubber sealing rings.

y. Position the new heater core in the left-hand side housing.
z. Fit and tighten the connector unions to the supply and return lines.
aa. Assemble the left-hand side and right-hand side core housing.
bb. Fit the retaining plate to the assembly.
c. Fit the front panel to the assembly.
dd. Secure at the bottom of the panel with the retaining bolts.
e. Fit the control knobs to the front of the panel.
ff. Position the air distribution box on the system.
g. Secure it with the retaining bolts.
hh. Connect the cable for the air control flap to the flap hinge.
ii. Connect the cable for the hot/cold control to the valve lever.
jj. Replace the cabin bulkhead access plate.
k. Attach the heater lines to both side foot-wells.
l. Attach the demister lines to the both sides of the heater unit.
m. Replace the glove box.
n. Fit the upper cover to the dashboard.
oo. Position the instrument panel.
pp. Secure it with the retaining screws.
qq. Install the cover over the electrical cut-outs.
r. Fill the system with coolant until the coolant expansion tank is two-thirds full.
ss. Start and run the engine until the correct operating temperature is reached.
t. Operate the cabin heating/cooling system.
uu. Check for any leaks (repair if necessary).
vv. Fit and secure the bonnet (Para 18).

**Heater Lines**

**218. Replacement.** The cabin heater lines are located in the engine compartment and are attached to the cabin heating/cooling system and the engine thermostat housing. The heater lines must be replaced if cracked or damaged in any way. Replace the cabin heater lines as follows (Figure 134):
Figure 134  Cabin Heater Lines

a. Raise and secure the bonnet.
b. Drain the coolant from the radiator.
c. Remove the access plate from the cabin bulkhead.
d. Loosen the worm drive clamps and detach the heater lines from the cabin heating/cooling system.
e. Loosen the worm drive clamps and detach the heater lines from the thermostat housing (Item 2).
f. Remove the heater lines from the retaining brackets.
g. Remove the lines from the vehicle.
h. Position the new heater lines in the engine compartment.
i. Check the lines for correct length.
j. Fit the heater lines into the retaining brackets.

NOTE

Use new worm drive clamps on the heater lines.

k. Attach the new heater lines to the thermostat housing and tighten the worm drive clamps.
l. Attach the heater lines to the cabin heating/cooling system and tighten the worm drive clamps.
m. Replace the access plate to the cabin.
n. Fill the cooling system with coolant until the expansion tank is two-thirds full.
o. Start and run the engine for a brief period.
p. Check for leaks (repair if necessary).
CABIN

Roof Panel

219. **Replacement.** Replace the roof panel as follows:

   a. Remove the dome light.
   b. Remove the inner grab handle adjacent to the cupola (Para 224).
   c. Remove the push clips securing the roof panel to the cabin roof.

   **NOTE**

   The push clips can be removed by levering them downwards using a screwdriver.

   d. Remove the panel by inserting a screwdriver along the side of the panel where it is located into the recess in the roof and levering the panel away from, and over, the fixed clips in the recess.
   e. Repeat this procedure on the four sides of the panel until it is free of the fixed clips.
   f. Remove the roof panel from the cabin.
   g. Clean the area where the roof panel was removed.
   h. Position the roof panel so that the clip holes are aligned.
   i. Insert the push clips and push them fully home.
   j. Secure the panel by inserting a screwdriver along the side of the panel where it locates into the recess and levering the panel away from, and under, the fixed clips in the recess.
   k. Repeat this procedure on the four sides of the panel until it is completely home and in position in the roof.
   l. Fit the inner grab handle adjacent to the cupola (Para 224).
   m. Fit the dome light.

Door Panel

220. **Replacement.** Replace the door panel as follows:

   a. Remove the centre screw securing the window winder handle to the winder shaft in the door.
   b. Lever the handle off the winder shaft with a screwdriver.
   c. Use a screwdriver to lever the push clips, which hold the door panel in place, out of the clip holes in the door.
   d. Remove the panel from the cabin.
   e. Clean the area of the door where the panel was removed.
   f. Position the panel against the door so that the clip holes are aligned.
   g. Insert the push-clips and push them fully home.
   h. Press the window winder handle onto the winder shaft.
   i. Insert and tighten the centre screw holding the window handle to the winder shaft.

Weapon Mount - Butt Box

221. **Replacement.** Replace the butt box as follows:

   a. Unscrew the three screws securing the butt box to the support bracket on the cabin floor adjacent to the right-hand side of the driver's seat.
   b. Remove the butt box from the cabin.
   c. Clean the support bracket.
d. Position the new butt box against the support bracket so that the screw holes are aligned.
e. Secure the butt box with the three screws.

Weapon Mount - Rifle Clip

222. **Replacement.** Replace the rifle clip as follows:
   a. Unscrew and remove the two nuts, bolts and spring washers securing the rifle clip to the support bracket on the cabin rear wall.
   b. Remove the rifle clip from the cabin.
   c. Clean the support bracket.
   d. Position the new rifle clip against the support bracket so that the bolt holes are aligned.
   e. Secure it with the two nuts, bolts and spring washers.

Grab Handle – Door Pillar

223. **Replacement.** Replace the grab handle as follows:
   a. Remove the upper and lower retaining screws securing the grab-handles to the door pillar.
   b. Remove the grab handle from the cabin.
   c. Clean the area of the door pillar where the grab handle was removed.
   d. Position the grab-handle against the door pillar so that the screw holes are aligned.
   e. Secure it with the upper and lower retaining screws.

Grab Handle – Cupola

224. **Replacement.** Replace the grab handle as follows:

   ![CAUTION]

   **The end covers on the grab handles are a slide fit and must not be forced downwards when removing.**
   a. Lever the end covers outwards and off the handle with a screwdriver.
   b. Remove the four retaining screws securing the grab handles in place.
   c. Remove the grab handle from the cabin.
   d. Clean the area of the roof where the handle was removed.
   e. Position the new grab handle against the roof so that the screw holes are aligned.
   f. Secure it with the four retaining screws.
   g. Position the covers over the end of the grab handle.
   h. Push the covers inwards until they lock in place.

Sun Visor

225. **Replacement.** Replace the sun visor as follows:
   a. Lever the cover off the visor retaining bracket with a screwdriver.
   b. Remove the five screws securing the visor bracket to the windscreen cross pillar.
   c. Remove the visor from the cabin.
   d. Clean the area of the cross pillar from where the visor was removed.
   e. Position the sun visor and bracket against the cross pillar so that the screw holes are aligned.
   f. Secure it with the five screws.
g. Position the cover over the bracket.

h. Press the cover home until it locks in place.

**Clothes Hook**

**226. Replacement.** Replace the clothes hook as follows:

   a. Remove the two screws securing the hook to the door pillar.
   b. Remove the hook from the cabin.
   c. Clean the area of the pillar where the hook was removed.
   d. Position the hook against the door pillar so that the screw holes are aligned.
   e. Secure it with the two screws.

**Window Winder**

**227. Replacement.** Replace the window winder as follows:

   a. Remove the screw securing the window winder handle to the winder shaft in the door.
   b. Lever the handle off the winder shaft with a screwdriver.
   c. Clean the winder shaft.
   d. Press the window winder handle onto the winder shaft.
   e. Secure the screw.

**Interior Door Lock**

**228. Replacement.** Replace the door lock as follows:

   a. Remove the centre screw securing the red plastic slide to the mechanism in the door.
   b. Remove the slide from the cabin.
   c. Position the red plastic slide against the door so that the screw holes are aligned.

   **CAUTION**

   *Do not over tighten the screw as the plastic may crack.*

   d. Secure it with the retaining screw.

**Driver’s Seat**

**229. Replacement.** Replace the driver’s seat as follows:

   a. Remove the four bolts and spring washers securing the seat assembly to the cabin floor.
   b. Remove the assembly from the cabin.
   c. Move the seat and the sliding rails into such a position that the securing bolts are accessible.
   d. Remove the bolts that hold the sliding rails on the seat to the base frame.
   e. Remove the base frame from the seat.
   f. Clean the area of the cabin floor where the assembly was removed.
   g. Clean the base frame.
   h. Move the sliding rails on the seat so that the bolt holes are accessible.
   i. Position the seat on the base frame so that the bolt holes in the sliding rails are aligned with the bolt holes in the base frame.
   j. Secure it with the retaining bolts.
k. Check the seat for ease of movement (lubricate and adjust if necessary).
l. Position the assembly on the cabin floor so that the bolt holes are aligned.
m. Secure it with the four retaining bolts and spring washers.

Passenger Seat

230. Replacement. Replace the passenger seat as follows:
   a. Remove the bolts and spring washers securing the base frame to the cabin floor and the cabin rear wall.
   b. Remove the bolts, nuts and spring washers securing the two brackets on the rear of the base frame to the two rear wall brackets in the cabin.
   c. Release the two clip-locks on the backrest.
   d. Remove the seat from the cabin.
   e. Remove the bolts that secure the seat to the base frame.
   f. Detach the seat from the base frame.
   g. Clean the area of the cabin where the seat was removed.
   h. Clean the base frame.
   i. Position the seat on the base frame so that the bolt holes are aligned.
   j. Insert and tighten the retaining bolts.
   k. Position the base frame in the cabin so that the bolt holes are aligned.
   l. Install and hand tighten the bolts and spring washers that secure the base frame to the cabin floor and the cabin rear wall.
   m. Insert and tighten the bolts, spring washers and nuts that secure the two brackets on the rear of the base frame to the two rear wall brackets in the cabin.
   n. Tighten the bolts and spring washers that hold the base frame to the cabin floor and the cabin rear wall.
   o. Position the backrest so that the clip-locks are centred.
   p. Push back and lock the backrest in position.

Rear Seat

231. Replacement. Replace the rear seat as follows:
   a. Fully extend the seat legs.
   b. Release the vinyl straps and fold the seat down until the legs are on the tray floor.
   c. Remove the retaining bolts and nuts securing the seat brackets over the tray drop sides.
   d. Lift and remove the seat from the vehicle.
   e. Fully extend the legs on the seat.
   f. Position the seat against the tray drop side so that the bolt holes are aligned.
   g. Secure it with the retaining nuts and bolts.
   h. Fold the seat up against the drop side.
   i. Secure it in place with the securing straps.
   j. Close the seat legs.
Seat Belts

WARNING

Only genuine OEM supplied seat belt kits are to be fitted to the Unimog family of vehicles. The use of multi-fit (universal) belt kits is not permitted. The quality of such non-genuine belts in the event of vehicle accident is not known.

232. Replacement. Replace the seat belts as follows:
   a. Lever the plastic cover off the upper mounting bracket using a screwdriver.
   b. Remove the retaining bolt.
   c. Detach the bracket from the door pillar.
   d. Remove the retaining bolt from the inertia reel.
   e. Detach the inertia reel.
   f. Remove the bolt securing the belt to the seat base.
   g. Remove the seat belt.
   h. Remove the retaining bolt from the seat belt stalk on the left-hand side of the seat.

   NOTE
   The seat belt stalks on the co-driver’s side are attached to the cabin rear bulkhead.
   i. Detach the buckle.
   j. Clean the recess in the door pillar.
   k. Align the inertia reel in the recess in the door pillar.
   l. Secure it with the bolt, washer and spacer.
   m. Torque the bolt to 35 N.m.
   n. Extend the belt sufficiently to allow the upper mounting bracket to be positioned against the door pillar with the bolt hole aligned with the mounting hole.
   o. Secure the retaining bolt.
   p. Torque the bolt to 35 N.m.
   q. Install the spacer, seat belt and washers on the seat base.
   r. Secure it with the retaining bolt.
   s. Torque the bolt to 35 N.m.
   t. Install the seat belt stalk and washers on the left-hand side of the driver’s seat.
   u. Secure it with the bolt.
   v. Torque the bolt to 35 N.m.
   w. Position the cover over the upper mounting bracket.
   x. Press the cover home until it locks in place.

Rear Vision Blind Spot Mirrors

233. To eliminate the rear vision blind spot problem associated with ‘West Coast’ type mirrors fitted to Medium and Heavy B vehicles, a convex surface spot mirror is attached to the bottom of each main mirror glass.
234. **Installation.** Install the spot mirror as follows:

   a. Thoroughly clean the mirror glass with a suitable solvent.
   b. Remove the protective cover and apply araldite to the adhesive surface of the convex mirror.
   c. Fix the convex mirror to the mirror glass in the position shown in Figure 135.

   ![Figure 135 Spot Mirror Location on Main Mirror](image)

235. **Replacement.** Replace the winch rope as follows:

   **WARNING**

   Leather gloves must be worn when handling the winch rope.

   a. Select the DISENGAGED position on the cabin PTO selector lever.
   b. Rotate the brake knob on the right-hand side of the winch in the counterclockwise direction.
   c. Pull out the winch clutch knob on the left-hand side of the winch.
   d. Detach the cable hook from the vehicle.
   e. Spool the rope off the winch drum.
   f. Rotate the drum backwards until the rope anchor pocket in the drum is accessible through the inspection port in the top of the winch casing.
   g. Release the anchor wedge and remove it from the pocket.
   h. Remove the rope from the wedge.
   i. Remove the rope from the winch.
   j. Clean the winch.
The rope guide that guides the rope onto the drum must be 2.5 rope widths from the right-hand side of the winch when installing a new rope. Adjust the position of the shuttle by rotating the winch drum either backwards or forwards.

k. Zero the rope guide 2.5 rope widths from the right-hand edge of the drum.

l. Extend the new rope to its full length in front of the vehicle.

m. Guide the end of the new rope through the rope guide and winding mechanism.

n. Insert the rope into the anchor pocket.

NOTE

Leave sufficient length at the end of the rope for two turns around the wedge.

o. Insert the wedge into the anchor pocket over the rope.

p. Ensure that the end of the rope or the loops around the wedge do not protrude above the anchor pocket.

q. Wind two turns of the rope around the wedge.

r. Clamp the rope into place by giving it several sharp tugs.

s. Push in the control knob on the left-hand side of the winch in until it locks into place.

CAUTION

Ensure that the rope feeds correctly onto the drum.

CAUTION

Ensure that the rope feeds correctly onto the drum.

u. Slowly winch the rope onto the drum while maintaining some tension on the rope.

v. Disengage the cabin PTO lever.

w. Stop the engine.

x. Rotate the knob on the right-hand side of the winch in a clockwise direction until the winch brake is applied.

y. Pull out the winch clutch knob on the left-hand side of the winch and insert the safety clip.

z. Secure the cable hook to the vehicle by tying it with rope.

WHEEL HUB SEAL

236. Replacement. Replace the wheel hub seal as follows:

a. Remove the brake disc and wheel hub (Para 142 a to 141 i).

b. Drain the oil from the wheel hub drive.

c. Remove the oil baffle (Figure 136).
Do not tilt the wear ring during removal as this may damage the roller bearing.

d. Remove the wear-ring and wheel hub seal (Figure 137).

NOTE

If a new seal is not immediately available, insert the wheel hub bearing retainer (Table 1, Item 29) into the roller bearing to prevent the loss of rollers from the bearing (Figure 138).
e. Coat the new seal with XG-276 grease.

f. Install the seal using the wheel bearing and hub seal remover/replacement tool (Table 1, Item 28) and the two guides (Table 1 Item 30) (Figure 139).

![Figure 138 Wheel Hub Bearing Retention Ring](image1)

Figure 138 Wheel Hub Bearing Retention Ring

f. Install the seal using the wheel bearing and hub seal remover/replacement tool (Table 1, Item 28) and the two guides (Table 1 Item 30) (Figure 139).

![Figure 139 Wheel Hub Seal Installation](image2)

Figure 139 Wheel Hub Seal Installation

g. Install the wear-ring and oil baffle using a soft faced hammer.

NOTE

If the dust lip of the seal is pressed into the wear-ring, pull the lip out using a wire.

h. Fill the wheel hub drive with 0.6 L of OEP-220.

i. Fit the brake disc, wheel hub (Para 142.m to y), brake callipers (Para 140 for the front brake callipers and Para 141 for the rear brake callipers) and the wheel.
Figure 140  Circuit Diagram