

**TRUCK, SURVEILLANCE, LIGHTWEIGHT, WINCH, MC2 — LAND ROVER 110  
REGIONAL FORCE SURVEILLANCE VEHICLE (RFSV)**

**MEDIUM AND HEAVY GRADE REPAIR**

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

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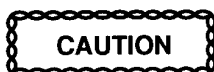
## **INTRODUCTION**

1. This EMEI contains procedures for removing, dismantling, repairing, assembling and installing various components of the Truck, Surveillance, Lightweight, with Winch. Where applicable, instructions for the adjustment, lubrication and minor servicing of these items are included. The EMEI is segregated into both Medium and Heavy Grade Repair at the appropriate paragraphs; common information is listed prior to specific repair criteria. This EMEI supersedes EMEI Vehicle G 134-1 Issue 1.



**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.



**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.

4. Discard all used gaskets, seals, cotter pins, tab washers, lock pins, key washers and lock washers. Dispose of all contaminated fuel and lubricants drained from the vehicle in accordance with current local instructions.

5. Use only those fuels and lubricants specified in the Servicing Instruction, EMEI Vehicle G 109, the User Handbook and this instruction 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.

7. The engine cooling system contains Nalcool corrosion inhibitor, in water, at a ratio of 1:12.



**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.**

8. This vehicle is painted in polyurethane paint.

### **Associated Publications**

9. Reference may be necessary to the latest issue of the following documents:

- a. Defence Road Traffic Instructions;
- b. Complete Equipment Schedules (CES), Truck, Surveillance, Lightweight, Winch, MC2 – Land Rover 110:
  - (1) SCES 12109, and
  - (2) Equipment Kit SCES 12036.
- c. Block Scale 2406/31 Issue 1 – Special Tools for RAEME- B Vehicles – Truck Utility and Truck Light MC2 (Land Rover Model 110);
- d. EMEI Vehicle A 029 Vehicles General – Servicing of B Vehicles, Trailers, Motorcycles, Stationary Equipment, Auxiliary and Small Engines;

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- e. EMEI Vehicle G 103 Truck, Utility, Lightweight, MC2, Land Rover 110 and Truck, Utility Lightweight, Winch, MC2, Land Rover 110 – Light Grade Repair;
- f. EMEI Vehicle G 104-1 Truck, Utility, Lightweight, MC2, Land Rover 110 and Truck, Utility Lightweight, W/Winch, MC2, Land Rover 110 – Medium Grade Repair;
- g. EMEI Vehicle G 104-2 Truck, Utility, Lightweight, MC2, Land Rover 110 and Truck, Utility Lightweight, W/Winch, MC2, Land Rover 110 – Heavy Grade Repair;
- h. EMEI Vehicle G 109 Truck, Lightweight, MC2, Land Rover 110 4X4 All Types – Servicing Instruction;
- i. EMEI Vehicle G 130 Truck, Surveillance, Lightweight, Winch, MC2, Land Rover 110 – Data Summary;
- j. EMEI Vehicle G 132 Truck, Surveillance, Lightweight, Winch, MC2, Land Rover 110 – Technical Description;
- k. EMEI Vehicle G 133 Truck, Surveillance, Lightweight, Winch, MC2, Land Rover 110 – Light Grade Repair;
- l. EMEI Workshop D 701 Painting of Army Equipment – Repair Policy for Equipment Painted in Polyurethane Paint;
- m. Repair Parts Scale 02207;
- n. [Defence Safety Manual](#) (SAFETYMAN); and
- o. [Material Safety Data Sheets](#) (MSDS).

10. A number of modifications and improvements have been made during the service life of the vehicle. Reference to the following publications may be required during repair activities. Any effect of these publications pertaining to the technical content of this document has been included in the text:

- a. EMEI Vehicle G 137-1 Truck, Surveillance, Lightweight, Winch, MC2, Land Rover 110 – Fitting of Roll Over Protection and Head Restraints; and
- b. EMEI Vehicle G 137-2 Truck, Surveillance, Lightweight, Winch, MC2, Land Rover 110 – Relocation of the Fuse Box.

**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.**

**GENERAL**

**Location of Identification Numbers**

11. The location of identification numbers on components of the vehicle are described in Table 1.

**Table 1 Location of Identification Numbers**

Serial	Identification Number	Location
1	Chassis	Right-hand side of the chassis, forward of the spring mounting turret
2	Chassis nameplate	Left-hand seat box, in the cab
3	Engine	Left-hand side of the engine block
4	Injection pump identification	Side of the pump
5	Transmission and transfer case	Rear of the transfer case
6	Torque limiter	Rear end of the drive plate
7	Front axle	Adjacent to the axle breather
8	Rear axle	Adjacent to the axle breather
9	Air compressor	Front outer mounting point

**Special Tools and Gauges**

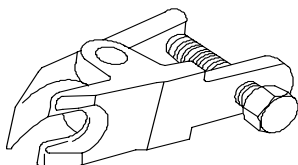
12. The special tools required are as listed in Table 2 and illustrated in Figure 1.

**NOTE**

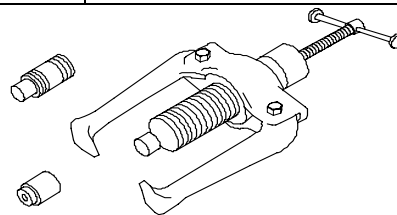
NSN and Manufacturers part numbers and designations used in this EMEI were current at the date of issue. If twelve months or more have expired since issue, the NSN and Manufacturers part number should be checked for supersession.

**Table 2 Special Tools**

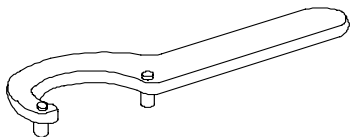
Part No.	NSN	Item Name	Use
18G1063	5120-66-128-4304	Separator, Ball Joint	Ball joint separator
MS252A			Steering arm remover
LST120	5120-66-128-4334	Spanner, C-Type	Worm adjuster locknut C-spanner
LST119	5120-66-128-4335	Wrench, Spanner, Steering	Worm adjuster socket
606602			Rotary valve ring expander
606603			Rotary valve ring compressor
R01015			Input shaft seal saver
R01016			Steering box torque setting tool
606604			Sector shaft seal saver
JD10			Power steering test set – main tool



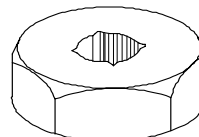
18G1063  
BALL JOINT SEPARATOR



JAW OPENING 3 INCH  
MS252A  
STEERING ARM REMOVER



LST 120  
WORM ADJUSTER LOCK NUT  
C-SPANNER

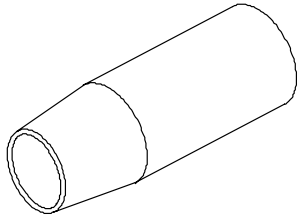


LST 119  
WORM ADJUSTER SOCKET

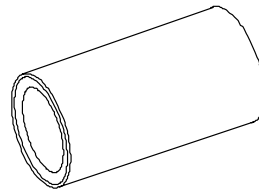
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**Figure 1 Special Tools**

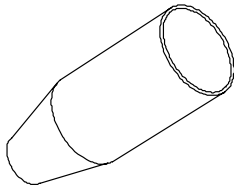
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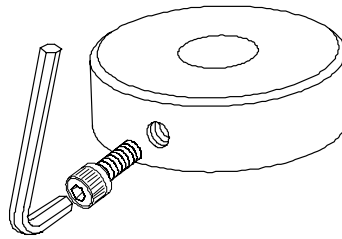
606602  
ROTARY VALVE RING EXPANDER



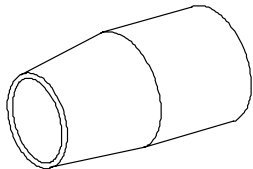
606603  
ROTARY VALVE RING COMPRESSOR



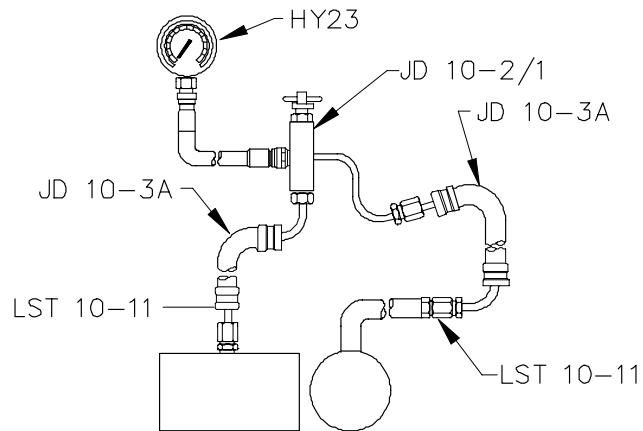
R01015  
INPUT SHAFT SEAL SAVER



R01016  
STEERING BOX TORQUE  
SETTING TOOL



606604  
SECTOR SHAFT SEAL SAVER



JD10 MAIN TOOL  
POWER STEERING TEST SET  
-MAIN TOOL

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Figure 1 Special Tools (Continued)

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13. The list of lubricants is detailed in Table 3.

**Table 3 List of Lubricants**

Serial	Equipment	Lubricant	Capacity (litres)
1	Engine (including filter)	OMD-115	8.5
2	Transmission	OMD-115	2.7
3	Transfer case (without PTO)	OMD-115	3.2
4	Transfer case (with PTO)	OMD-115	5.8
5	Front differential	OEP-220	1.7
6	Rear differential	OEP-220	2.3
7	Swivel pin housings	Molytex Grease	EP00 Sachet
8	Brake master cylinder	OX (Aust) 8	Fill to level
9	Clutch master cylinder	OX (Aust) 8	Fill to level
10	Power steering system reservoir	OX 46	1.25
11	Wheel bearings	XG-291	As required
12	Winch rope	Rocol wire rope lube NSN 9150-99-337-1498	As required
13	Radiator inhibitor	Nalcool	As required (1:12 ratio)
14	Clutch pedal trunnion	XG-291	As required
15	Speedometer cable	XG-291	As required
16	Propeller shaft	XG-291	As required
17	Winch drive line	XG-291	As required
18	Parking brake adjuster	XG-291	As required
19	Windscreen wiper drive cable	XG-291	As required
20	Winch	OEP-220	1.3
21	Air compressor	XG-291	As required

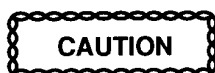
**MEDIUM GRADE REPAIR**

**STEERING – GROUP 14**

**Steering Box**

14. **Removal.** Remove the steering box as follows:

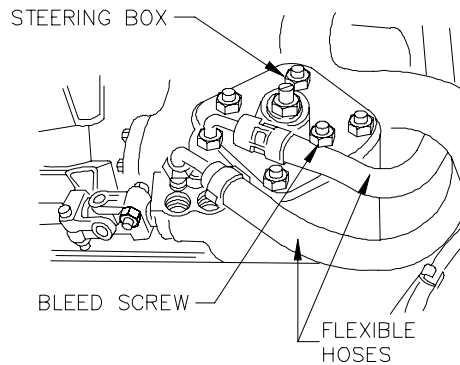
- a. Remove the filler cap from the steering fluid reservoir.



**DO NOT reuse the fluid drained from the steering fluid reservoir.**

- b. Disconnect the high pressure hose from the connector on the power steering pump and drain the fluid from the system via the disconnected hose into a suitable container. Reinstall the filler cap and connect the high pressure hose to the steering pump.
- c. Remove the two bolts securing the steering shaft cover to the inner guard and remove the cover.
- d. Using special tool, 18G1063, disconnect the drop-arm ball joint.
- e. Disconnect the flexible hoses from the steering box housing (Figure 2), then plug the disconnected hoses and connections, to prevent ingress of foreign matter.

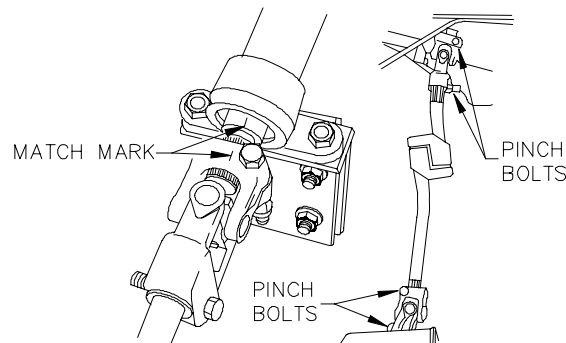
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**Figure 2 Removal of the Flexible Hoses to the Steering Box**

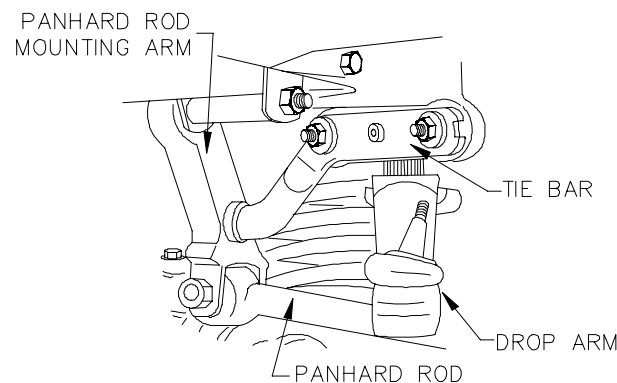
- f. Chock the rear wheels, then using a suitable hydraulic jack, raise the front of the vehicle and support it on axle stands.
- g. Ensure the front wheels and the steering wheel are in the straight ahead position, then match-mark the relationship of the steering column inner shaft to the top universal joint (Figure 3).



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**Figure 3 Alignment of the Steering Column**

- h. Remove the pinch bolt and locknut securing the universal joint to the steering box worm shaft. Slacken the two pinch bolts securing the upper universal joint, then slide the collapsible shaft and lower universal joint off the steering box worm shaft. Discard the locknuts.
- i. Slacken the locknut securing the tiebar to the Panhard rod mounting arm. Remove the two locknuts, washers and bolts securing the tiebar to the steering box (Figure 4), then swing the tiebar clear of the steering box. Discard the locknuts.



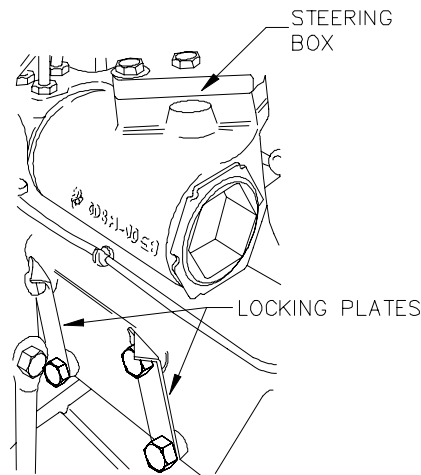
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**Figure 4 Removal of the Tiebar**

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- j. Bend back the tabs on the locking plates, then remove the bolts securing the steering box to the chassis frame and remove the steering box. Discard the locking plates (Figure 5).



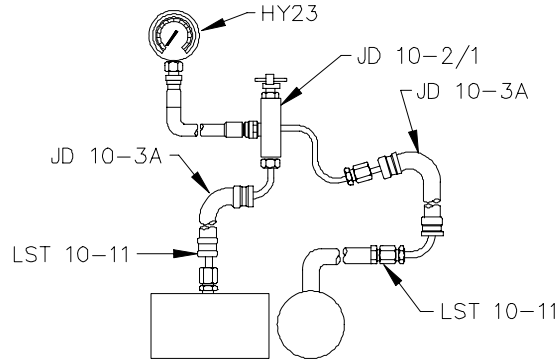
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**Figure 5 Removal of the Steering Box**

- 15. Installation.** Install the steering box as follows:
- a. Ensure the four mounting bolts and the locking plates are positioned through the chassis, then install the steering box on the bolts. Fit the four flat washers and new lock-plates then torque the nuts to 80 N.m. Bend the lock-plate tabs over the heads of the four bolts.
  - b. Check that the steering wheel is in the straight ahead position, then set the steering to the mid way lock-to-lock position.
  - c. Taking care not to turn the steering wheel, align the match-mark and install the top universal joint to the steering column inner shaft, then connect the lower universal joint on the steering box worm shaft and install the pinch bolts. Fit new locknuts to all the pinch bolts, then torque them to 35 N.m.
  - d. Fit the steering shaft cover on the inner guard and secure it with the two bolts and washers.
  - e. Install the tiebar on the steering box, but do not tighten the two nuts and bolts.
  - f. Using a new locknut secure the tiebar to the Panhard rod mounting arm, do not tighten at this time. Slacken the two tiebar retaining bolts, then tighten them securely. Torque the locknut securing the tiebar to the Panhard rod mounting arm to 80 N.m.
  - g. Connect the drag link to the drop-arm and torque the nut to 40 N.m, then insert a new split pin.
  - h. Remove the plugs from the steering box hoses and connections, then connect the flexible hoses to the steering box. Tighten the connections securely.
  - i. Remove the filler cap and fill the reservoir with a recommended fluid to the full level marked on the dipstick. Install the filler cap.
  - j. Using a suitable hydraulic jack, raise the front of the vehicle and remove the axle stands. Lower the vehicle and remove the chocks from the rear wheels.
  - k. Bleed the power steering system in accordance with EMEI Vehicle G 133 – Group 14.

### **Power Steering System Test**

- 16. Test Procedure.** Test the power steering system using the following procedure:
- a. Connect the components of the test equipment JD10 to the steering system as shown in Figure 6.



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**Figure 6 Installation of the Test Equipment**

- b. Ensure that the system is free from leaks and check that the power steering reservoir fluid is at the correct level. Top up if necessary.
- c. Open the tap in the adapter, then start and run the engine and bleed the system, taking care not to overload the pressure gauge.



**Do not hold the steering in full-lock position for more than 30 seconds in any one minute, otherwise overheating of the steering fluid and possible seal damage could result.**

- d. Run the engine at 1000 rpm, turn the steering on hard full-lock and check for a reading of 5860 to 6550 kPa then repeat the test on the opposite lock.
- e. Run the engine at idle, then turn the steering on hard full-lock and check for a reading of 2745 kPa. Repeat the test on the opposite lock.
- f. Release the steering wheel and with the engine idling, check for a pressure below 685 kPa.
- g. If the pressures registered are not to specification, close off the valve tap for no more than five seconds, and with the engine idling, check for a pressure of approximately 2745 kPa. If the pressure fails to reach specification, repair or replace the pressure relief valve and retest the system.
- h. If the pressures shown are to specification when the valve tap is closed off, the fault is in the rotary valve on the steering box input shaft. Repair or replace the rotary valve (input shaft) as necessary.

**Table 4 Power Steering Fault Finding**

Serial	Symptom	Probable Cause	Action
1	Oil leaking at output shaft of steering box.	Clogged oil filter in reservoir (high back pressure)	Replace reservoir
		Restricted oil return line	Check and rectify as necessary
2	Oil leaking between the reservoir and pump.	Loose at connections or adapter	Check and rectify as necessary
		Damaged pressure or return lines	Replace as necessary
3	Oil forced from the oil reservoir	Clogged oil filter in reservoir	Replace reservoir
		Air in system	Bleed the system and check for air leaks
4	Engine oil in the power steering reservoir	Faulty oil pump shaft seal	Repair power steering pump
5	No power steering on a cold start	Vanes in power steering pump not extending	Increase engine speed to extend vanes and start pump action. Usually a temporary or infrequent occurrence, pump repair or replacement not required
6	Hard steering	Faulty power steering pump	Repair or replace pump

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## ELECTRICAL – GROUP 15

### Fuse Box

17. The fuse box in this variant has been relocated to a higher position in the dash area to reduce water ingress during fording operations. Refer to EMEI Vehicle G 137-2 for details of the location of the fuse box.

## BODY – GROUP 17

### Roll Over Protection

18. The vehicle is fitted with a roll over protection structure (ROPS). Refer to EMEI Vehicle G 137-1 for fitting instructions.

#### WARNING

The roll over protection assembly is to be replaced if the vehicle has been involved in a roll over accident.

The roll over protection assembly is to be replaced where distortion has occurred to the roll over structure or capping rails.

The roll over protection assembly is to be replaced if any welds are cracked or have failed.

#### CAUTION

The roll over protection is NOT to be modified or repaired by drilling, grinding or welding the structure. The ROPS is to be repaired by replacement.

Loose/damaged rivnuts used for mounting the camouflage net carrier are authorised to be repaired in accordance with the procedure detailed in EMEI Vehicle G 199-2.

#### NOTE

The ROPS fitted to this vehicle is different to the ROPS fitted to other Land Rover 110 variants. Ensure the fitting procedures in EMEI Vehicle G 137-1 are adhered to.

## HEAVY GRADE REPAIR

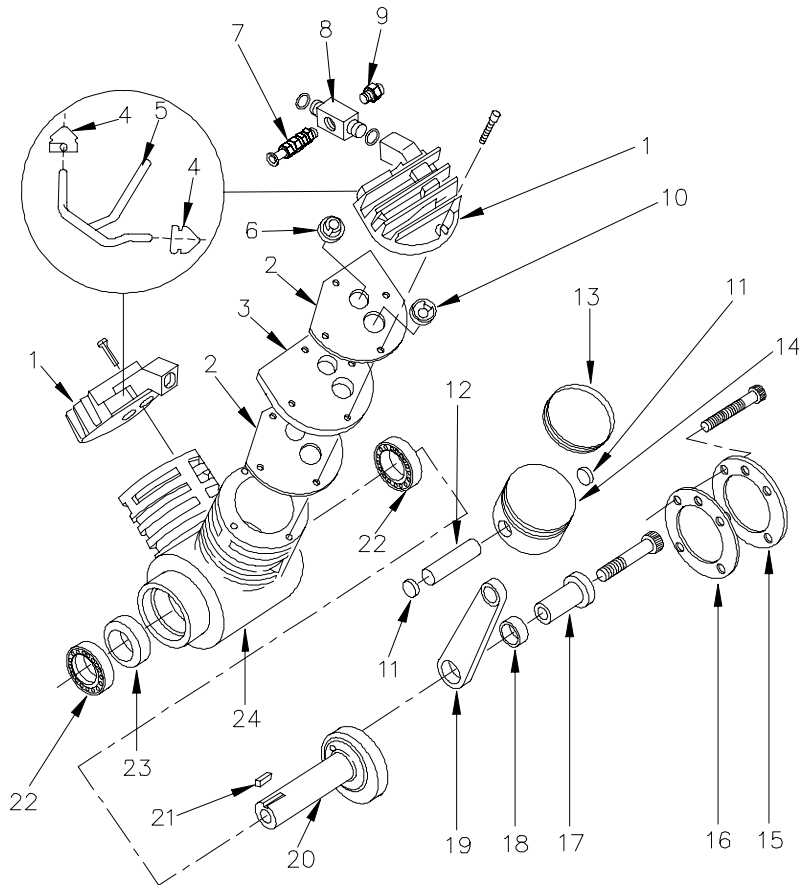
## ENGINE – GROUP 1

### Air Compressor

19. **Disassembly.** Disassemble the air compressor as follows:

- a. Remove the air compressor in accordance with EMEI Vehicle G 133 – Group 1.
- b. Remove the remote breather pipe and the sealing blocks from the cylinder heads.
- c. Remove the Allen screws securing the cylinder heads, (Figure 7) then remove the cylinder heads, valve plates and gaskets. Separate the cylinder heads from the outlet manifold, and discard the O rings.

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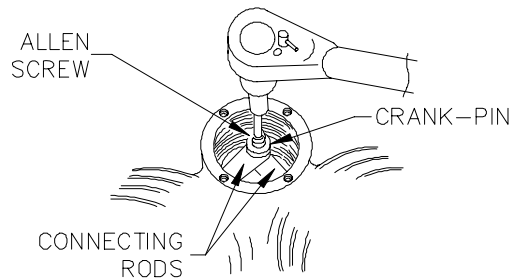


- |                         |                       |                         |
|-------------------------|-----------------------|-------------------------|
| 1. CYLINDER HEAD        | 9. AIR LINE CONNECTOR | 17. CRANK-PIN           |
| 2. GASKET               | 10. OUTLET VALVE      | 18. CONNECTING ROD BUSH |
| 3. VALVE PLATE          | 11. TEFLON PLUG       | 19. CONNECTING ROD      |
| 4. SEALING BLOCK        | 12. GUDGEON PIN       | 20. CRANKSHAFT          |
| 5. REMOTE BREATHER PIPE | 13. PISTON RING       | 21. KEY                 |
| 6. INLET VALVE          | 14. PISTON            | 22. CRANKSHAFT BEARING  |
| 7. RELIEF VALVE         | 15. END PLATE         | 23. SPACER              |
| 8. OUTLET MANIFOLD      | 16. END PLATE GASKET  | 24. CYLINDER BLOCK      |

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**Figure 7 Air Compressor Exploded View**

- d. Remove the four Allen screws securing the end-cap to the crankcase, remove the cap and all excess lubricant.
- e. Clamp the crankshaft in a suitable vice fitted with soft jaw clamps and remove the Allen screw securing the crank-pin (Figure 8). Using suitable pliers, remove the crank-pin.



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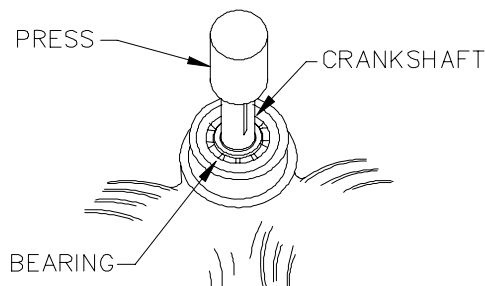
**Figure 8 Removal of the Crank-pin**

- f. Remove each piston and connecting rod out through the cylinder bores. Remove the teflon pads from the gudgeon pin bore of the piston and press the gudgeon pin out using a suitable arbor and press.

**NOTE**

The crankshaft, inner bearing and spacer will be removed as an assembly.

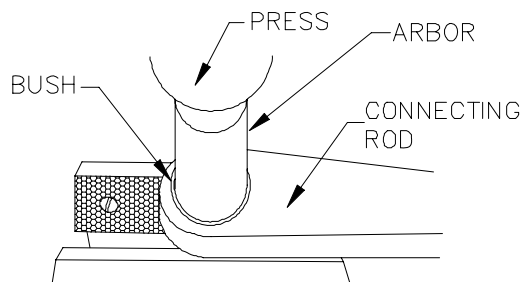
- g. Using a suitable press, remove the crankshaft out of the crankcase (Figure 9).



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**Figure 9 Removal of the Crankshaft**

- h. Using a suitable press, remove the bearing from the crankshaft.
- i. Using a suitable arbor, press the outer bearing from the crankcase.
- j. Using a suitable arbor, press out the bush from the connecting rod (Figure 10).



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**Figure 10 Removal of the Connecting Rod Bush**

- 20. **Cleaning and Inspection.** Clean all parts in a suitable cleaning agent and inspect for excessive wear (Table 5). Replace worn or defective parts as necessary.

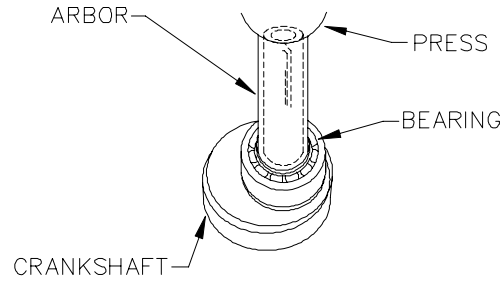
**Table 5 Compressor Wear Limits**

Serial	Item	Wear Limit (mm)
1	Crankcase bore maximum diameter	40.060
2	Piston minimum diameter	39.875
3	Connecting rod bush maximum internal diameter	12.731
4	Crank-pin minimum diameter	12.598

- 21. **Reassembly.** Reassemble the air compressor as follows:

- a. Using a suitable press, install the inner bearing on the crankshaft (Figure 11), ensuring that the bearing is hard against the crankshaft web.

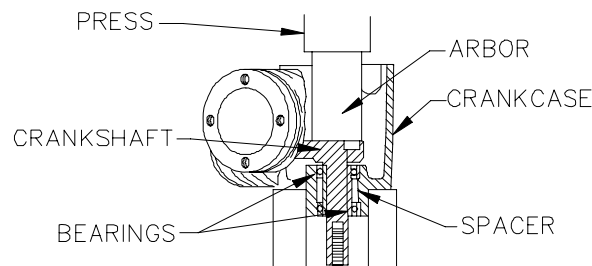
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**Figure 11 Installation of the Crankshaft Inner Bearing**

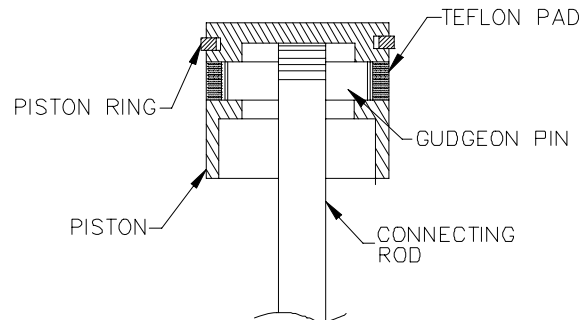
- b. Suitably support the compressor and press the crankshaft and bearing into the crankcase, ensuring the bearing is correctly installed (Figure 12). Install the spacer and press in the outer bearing.



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**Figure 12 Installation of the Crankshaft**

- c. Press in the new connecting rod bearings, then using the oil supply hole in the connecting rods as a guide, drill a 3 mm hole through the wall of the bearings. Clean the connecting rods, then install the connecting rods, gudgeon pins and Teflon pads in the pistons (Figure 13).

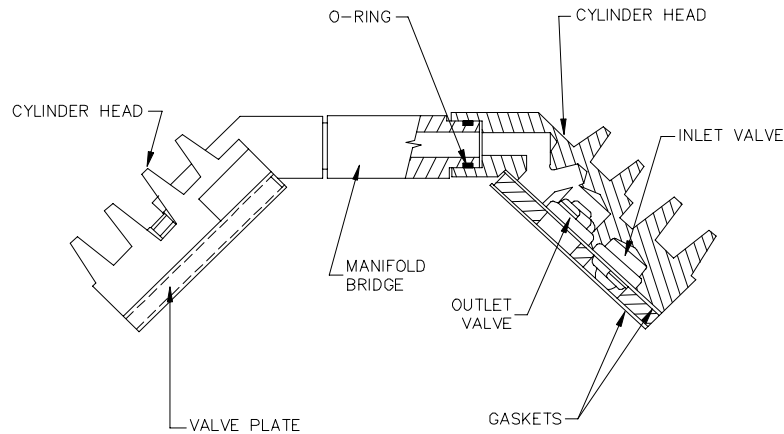


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**Figure 13 Installation of the Connecting Rod**

- d. Lightly smear the cylinder bores and gudgeon pins with a suitable grease (Table 3, Serial 21), then insert the pistons in the bores.
- e. Align both connecting rod pin-holes with the crankshaft pin-hole. Apply Loctite 222 to the threads of the Allen screw then insert the crank-pin and Allen screw into the crankshaft. Tighten the Allen screw securely.
- f. Install two new O rings onto the manifold bridge and fit the cylinder heads to the ends (Figure 14). Fit the inlet and exhaust valves in the head and retain them in position with new gaskets and the valve plate. Install the cylinder heads complete with the manifold bridge.

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**Figure 14 Installation of the Manifold Bridge**

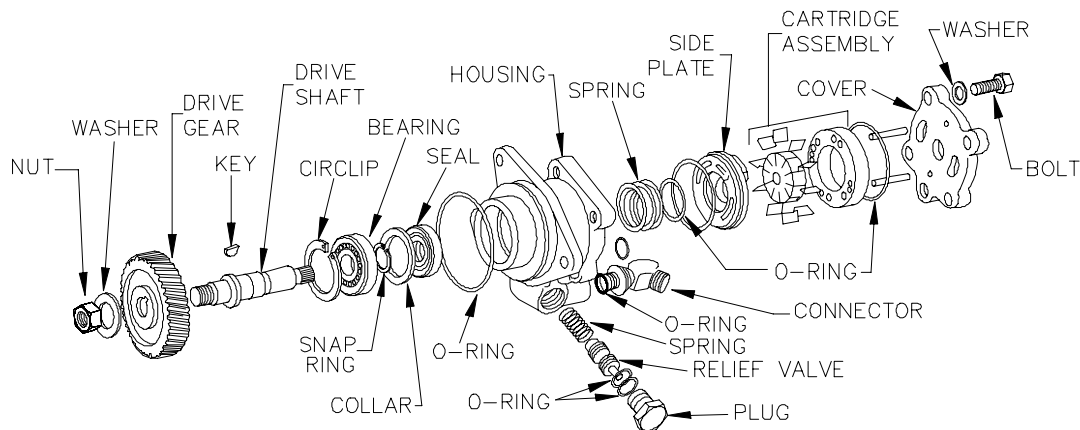
- g.** Install the eight cylinder head screws and tighten them securely.
- h.** Fill the crankcase to approximately two thirds full with a suitable grease (Table 3, Serial 21), install a new gasket on the crankcase then fit the end cover. Install the four Allen screws and tighten securely.
- i.** Install the sealing blocks in the cylinder heads, then install the remote breather pipe.
- j.** Install the compressor in accordance with EMEI Vehicle G 133 – Group 1.

**STEERING – GROUP 14**

**Power Steering Pump**

**22. Disassembly.** Disassemble the power steering pump as follows:

- a.** Remove the power steering pump from the engine in accordance with EMEI Vehicle G 133 – Group 14.
- b.** Secure the pump in a vice with the side cover facing up.
- c.** Remove the plug from the pump housing and withdraw the relief valve and spring (Figure 15).

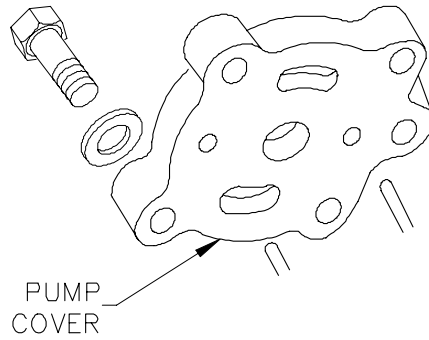


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**Figure 15 Power Steering Pump Exploded View**

- d.** Remove the four bolts and washers securing the side cover to the power steering pump (Figure 16). Remove the cover.

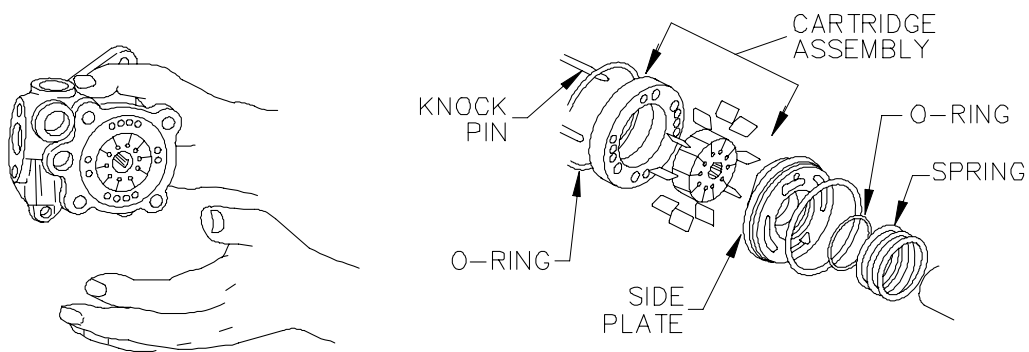
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**Figure 16 Removal of the Steering Pump Cover**

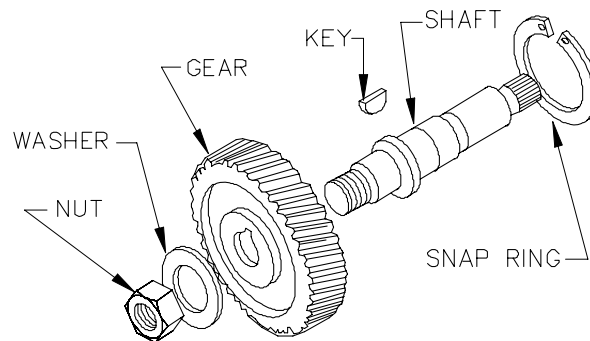
- e. Remove the power steering pump from the vice and by gently shaking the pump, remove the cartridge and coil spring (Figure 17).



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**Figure 17 Removal of the Cartridge and Coil Spring**

- f. Remove the nut and washer securing the oil pump drive gear to the shaft, then remove the drive gear from the shaft (Figure 18).



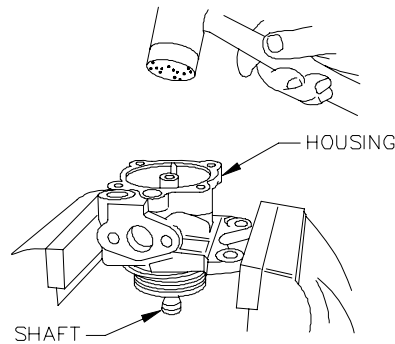
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**Figure 18 Removal of the Drive Gear**

- g. Using pointed nose pliers, remove the snap-ring, then remove the pump shaft from the housing by lightly tapping the shaft with a soft hammer (Figure 19).

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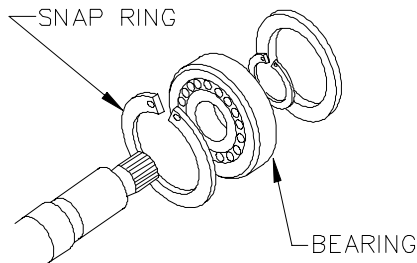




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**Figure 19 Removal of the Pump Shaft**

- h.** Using a suitable lever, pry the oil seal from the pump housing, then remove the snap-ring retaining the bearing (Figure 20). Remove the bearing housing.



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**Figure 20 Removal of the Bearing**

- 23. Cleaning and Inspection.** Clean and inspect the power steering pump as follows:
- a.** Thoroughly clean all the parts with a solvent which is compatible with the system fluid, then dry all the parts with filtered, dry, compressed air. Keep all the parts clean during inspection and reassembly, otherwise damage of close tolerance parts may result.
  - b.** Inspect the wearing surfaces of the body, cam-ring and rotor for scoring or excessive wear. Remove light score marks by lapping, and replace heavily scored or badly worn parts.
  - c.** Inspect the vanes for burrs, wear or excessive play in the rotor slots. Replace badly worn or scored parts.
  - d.** Inspect the oil seal wearing surface on the shaft for scoring or wear. If marks are present and cannot be removed by light polishing, replace the shaft.
  - e.** Check for free movement of the relief valve in the cover bore. Remove any burrs with light polishing, taking care not to round off the sharp edges of the lands. Do not attempt to rework the valve bore. Replace the cover if the bore is damaged.
  - f.** Check that the spool when inserted in its housing does not stick by manually operating the spool control valve.
  - g.** Measure the outside of the flow control valve spool and the inside diameter of the spool hole, if the measurement exceeds 0.030 mm, replace the control valve spool.
- 24. Reassembly.** Reassemble the power steering pump as follows:
- a.** Apply a suitable lubricant to all parts prior to reassembly. A small amount of petroleum jelly can be used to hold the O rings in position during reassembly.
  - b.** Secure the pump body in a vice and using a suitable mandrel, tap the oil seal into position in the pump body. Lubricate the seal lip with petroleum jelly.

- c. Position the Woodruff key in the key-way on the drive shaft, then install the drive gear on the drive shaft and secure with the washer and nut. Torque the nut to 73 to 84 N.m.
- d. Support the bearing and press the shaft into the bearing, then install the bearing retainer snap-ring.
- e. Install the snap-ring in the groove on the bearing, then slide the shaft and collar into the body until the bearing is correctly seated. A light tap with a soft hammer may be necessary to correctly seat the bearing.
- f. Install the inner and outer O rings to the side plate, then install the spring and the side plate into the pump body.

**NOTE**

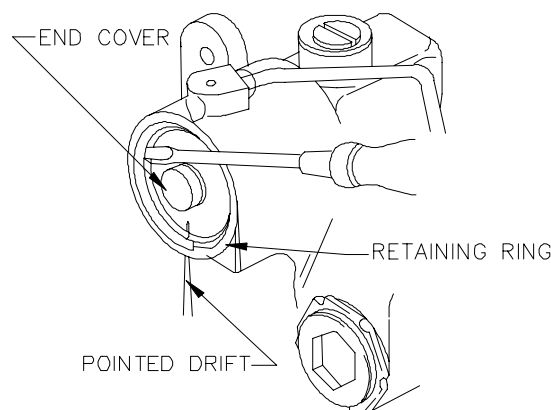
Due to the possibility of damage to the machined cartridge parts during handling and shipping, all sharp edges should be oil-stoned prior to reassembly.

- g. Assemble the cartridge assembly, ensuring that the R-shaped area of the vanes touch the surface of the cam profile.
- h. Install the cartridge into the pump body, ensuring that the reference holes in the side plate and cam-ring are aligned in the same direction.
- i. Fit the O ring into the pump body, then install the locating pins in the side cover and position the cover on the pump, install the bolts and torque them to 30 to 40 N.m.
- j. Insert the flow control spring, valve and O rings into the bore in the body, then install the O ring on the plug. Install the plug and torque it to 73 to 84 N.m.
- k. Carefully fit the discharge connector and torque it to 68 to 78 N.m.
- l. Install the power steering pump on the engine in accordance with EMEI Vehicle G 133 – Group 14.

**Steering Box**

**25. Disassembly.** Disassemble the steering box as follows:

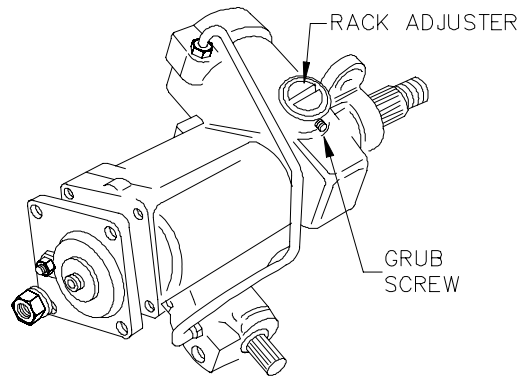
- a. Centralize the sector shaft with the input shaft worm, then match-mark the drop-arm to the sector shaft, then remove the drop-arm using special tool MS252A.
- b. At the rack and piston bore in the housing, rotate the retaining ring (if necessary) until one end is approximately 12 mm from the extractor hole, then insert a suitable pointed drift into the extractor hole to unseat the retaining ring from the groove (Figure 21). Remove the retaining ring, then rotate the steering input shaft toward the right-hand lock, until the piston pushes the end cover out from the rack and piston bore.



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**Figure 21 Removal of the Rack and Piston Retaining Ring**

- c. Remove the grub screw from the rack pad adjuster, then with a suitable screwdriver remove the rack pad adjuster (Figure 22). Remove and discard the sealing ring and the nylon rack pad.



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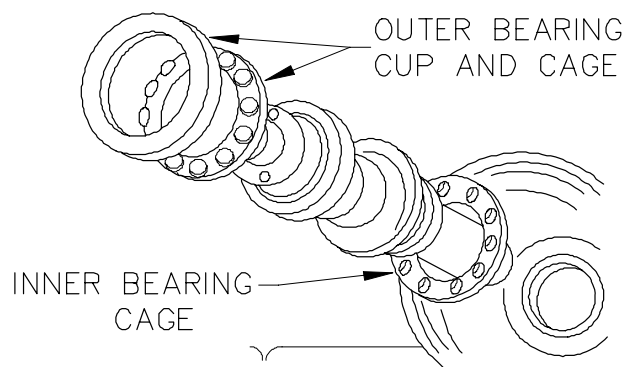
**Figure 22 Removal of the Rack Pad Adjuster**

- d. Remove the sector shaft locknut from the top of the steering box, then remove the four bolts and washers securing the sector shaft cover to the top of the steering box. With the aid of a suitable screwdriver, screw the sector shaft adjuster in until the cover can be removed. Remove the cover, then slide the sector shaft out from the steering box. Discard the O ring.
- e. Remove the piston from the rack and piston bore by threading a suitable bolt into the tapped hole in the piston, and pulling the piston from the bore.
- f. Using a C-spanner, special tool LST120, remove the locknut from the worm adjuster, then remove the worm adjuster using special tool LST119 (socket).

**NOTE**

To remove the inner bearing cup and shims, jar the steering box housing on the work bench or use a suitable extractor, e.g. a bronze drift and a hammer.

- g. Using a soft-headed hammer, tap the splined end of the input shaft to free the bearing from the housing. Remove the outer bearing cup and cage, then withdraw the input (worm) shaft assembly together with the inner bearing cage, from the housing (Figure 23). Remove the inner bearing cup, together with the shims and retain the shims.



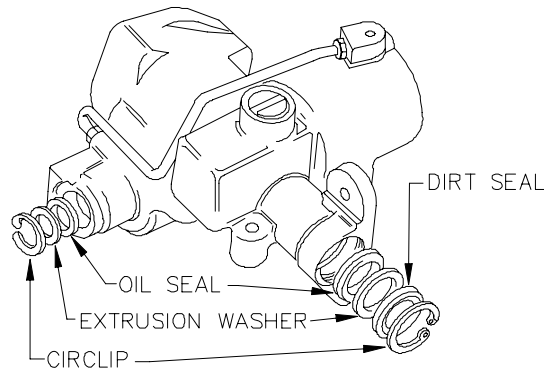
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**Figure 23 Removal of the Input Shaft and Bearings**

- h. Remove the circlips and seals from the sector shaft bore and the input shaft bore (Figure 24).

**NOTE**

Do not remove the sector shaft bushes from the shaft bore unless replacement is necessary.



DE(EME)3424-24

**Figure 24 Removal of the Sector and Input Shaft Seals**

- 26. Cleaning and Inspection.** Clean and inspect the steering box as follows:
- a. Clean all parts with a suitable cleaning agent, ensuring that all gasket material is removed, then blow them dry with compressed air.
  - b. Remove and discard the plastic ring and rubber seal from the piston, then check the piston for scoring, wear or damage and check the teeth on the rack for wear or damage. Replace the rack and piston assembly if excessive wear or damage is evident.

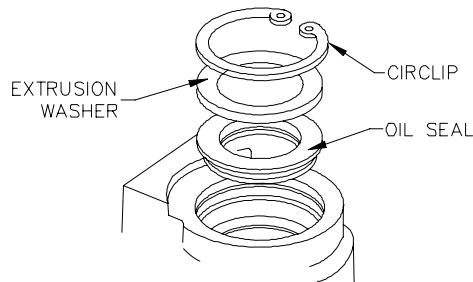
**NOTE**

Ensure that the tubing is a neat fit in the sector shaft bore and butts squarely against the bush.

- c. Check the sector shaft bushes for ovality or damage and replace them as required. If replacement is necessary, use a suitable piece of tubing and a hammer (or press) to drive the bushes from the housing.
- d. Inspect the piston bore for scoring, gouging or wear and replace the housing as necessary.
- e. Inspect the transfer pipe for signs of cracking and replace as necessary.
- f. Check all threaded holes, ports and bores for damaged threads. If necessary, use suitable taps to clean or dress threads, or replace the housing if thread damage is severe.
- g. Inspect the sector shaft for uneven wear on the gear teeth, worn or badly damaged adjuster screw thread, obvious side play on the rollers and excessive wear on the bush running area of the shaft. Replace the sector shaft if any of these faults are evident.
- h. Check the bush in the sector shaft cover for wear and replace the cover as an assembly if wear is evident.
- i. Check the valve rings on the valve and worm assembly for cuts, scratches, grooves or other damage and replace as necessary. If replacement is required, install the new rings using the ring expander, special tool 606602. If necessary, warm the valve rings and the expander with hot water to assist with installation, then install the ring compressor, special tool 606603, to cool the rings.
- j. Check that the bearing running surfaces and the worm on the valve and worm assembly are smooth and without any sign of pitting, galling, indentations or uneven wear. Check for wear in the torsion bar assembly pins; no free movement should exist between the input shaft and the worm. Replace the valve and worm assembly if any wear or damage is evident.
- k. Inspect the rack thrust pad adjuster and the adjuster grub screw for wear or damage and replace them as necessary. Replace the nylon thrust pad.
- l. Inspect the rack and piston assembly for worn or damaged rack teeth, damaged thrust pad bearing surface, damage to the outer diameter of the piston and scoring or damage to the seal and ring groove of the piston. Replace the rack and piston assembly if any of these faults is evident.

**27. Reassembly.** Reassemble the steering box as follows:

- a. Install a new oil seal, with the open side toward the housing, into the input shaft bore. Ensure that the seal flange butts against the shoulder in the bore, then install the extrusion washer and a new circlip (Figure 25).



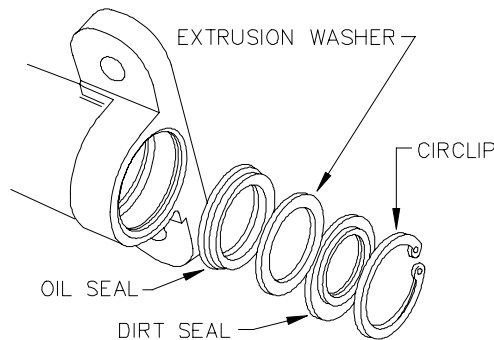
DE(EME)3424-25

**Figure 25 Installation of the Input Shaft Oil Seal**

**NOTE**

Ensure that the tubing is a neat fit in the sector shaft bore and butts squarely against the bush.

- b. If removed, install new bushes into the sector shaft bore in the housing. Align and start each bush into the housing, then with the aid of a press and a suitable piece of tubing, press the bushes into position.
- c. Install a new oil seal, with the lip side in, into the sector shaft bore, then install the extrusion washer and a new dirt seal with the lip side out. Install a new circlip to retain the seals in position (Figure 26).



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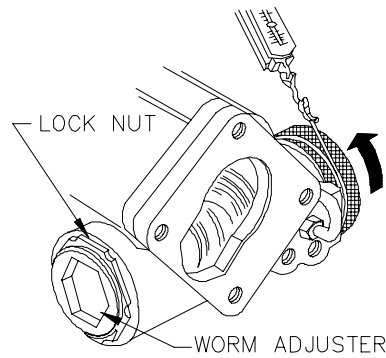
**Figure 26 Installation of the Sector Shaft Oil Seals**

**NOTE**

If the original shims are not available, install shims with a nominal thickness of 0.76 mm.

- d. Lubricate the new input shaft bearings with petroleum jelly, then install the inner bearing cup together with the original shims, or shims of equivalent thickness, into the input shaft bore of the housing.
- e. Position the inner bearing cage on the input shaft, then install a seal saver, special tool R01015 over the splined end of the input shaft. Smear the sealing lip of the input shaft seal with petroleum jelly, then install the input shaft into the housing and position the outer bearing cage and cup on the input shaft.
- f. Install a new sealing ring on the worm adjuster and loosely screw the adjuster into the housing, then install the locknut, but do not tighten it. Screw the worm adjuster in until the input shaft end-float is almost eliminated. Install the torque setting tool R01016 onto the input shaft, then coil a length of cord several times around the tool and attach a suitable spring scale to one end of the cord. Pull on the scale with a slow and steady pull until the input shaft rotates (Figure 27). Record the load indicated on the scale required to keep the input shaft turning slowly and evenly.

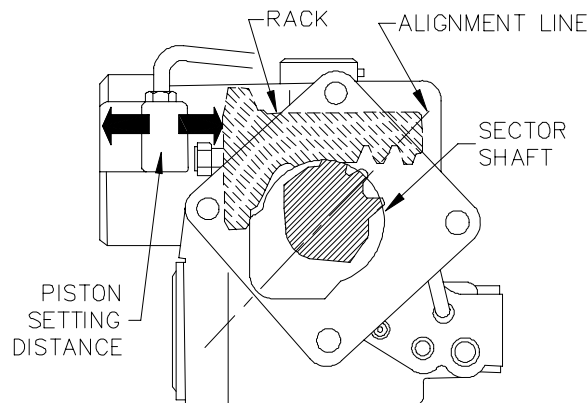
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**Figure 27 Adjustment of the Input Shaft**

- g. Using the worm adjusting socket, special tool LST119, screw in the worm adjuster to increase the previously recorded rolling resistance by 1.8 to 2.2 kg, on a setting tool radius of 31.7 mm, to settle the bearings. Back off the worm adjuster until the previously recorded rolling resistance is increased by 0.9 to 1.3 kg, then tighten the locknut using a C-spanner, special tool LST120, and check that the rolling resistance has not altered.
- h. Install a new rubber seal into the groove on the piston, ensure that the seal is not twisted, then smear the seal with petroleum jelly. Heat the nylon ring with hot water, then install the ring alongside the seal in the piston groove and allow the ring to cool.
- i. Thread a suitable bolt into the tapped hole in the piston, then with the aid of the bolt, insert the piston and rack assembly into the bore in the housing until the crown of the piston is 63.5 mm from the outer end of the bore.
- j. Install the seal saver, special tool 606604, onto the threaded end of the sector shaft, then liberally coat the sector shaft with clean power steering fluid. Smear the seal lips on both the oil seal and dirt seal, in the sector shaft bore, with petroleum jelly and liberally coat both the worm and the rack with clean power steering fluid. Start the sector shaft into the housing and align the pitch of the centre tooth of the rack with the centre tooth of the sector shaft gear (Figure 28). Insert the sector shaft while simultaneously rotating the input shaft about a small arc to engage the sector shaft roller with the worm.



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**Figure 28 Installation of the Sector Shaft**

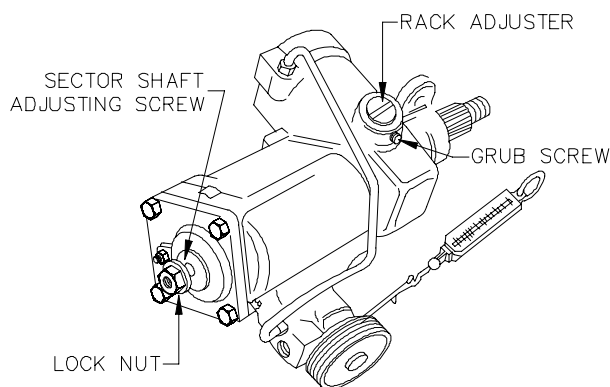
- k. Install a new sealing ring on the rack adjuster and install the adjuster, together with a new nylon thrust pad, into the housing. Screw in the adjuster until the thrust pad makes contact with the rack, then back the adjuster out half a turn. Screw in the grub screw until it contacts the rack adjuster, but do not tighten it.

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**NOTE**

Before securing the cover to the housing, rotate the input shaft to ensure that the sector shaft roller moves freely on the input shaft worm.

- l.** Position a new O ring in the sector shaft cover, then screw the cover fully onto the sector shaft adjusting screw. Align the bolt holes in the cover with those in the housing, then tap the cover with a soft-headed hammer to joint the cover fully with the housing. If necessary, back off the sector shaft adjusting screw to allow the cover to joint fully with the housing.
- m.** Install the sector shaft cover retaining bolts and torque the bolts to 22 to 27 N.m.
- n.** Install a new sealing ring on the piston bore cover and smear the sealing ring with petroleum jelly. Remove the bolt from the piston, then install the cover into the piston bore. Press the cover into the bore sufficiently to clear the retaining ring groove, then install a new retaining ring, ensuring that one end of the ring is approximately 12 mm from the extractor hole.
- o.** Centralize the sector shaft on the worm by halving the number of turns of the input shaft when turned from lock to lock. Slacken the sector shaft adjusting screw to obtain backlash between the input shaft and the sector shaft, then screw the adjusting screw in until the backlash is just eliminated. Using the spring scale and the torque setting tool (previously installed on the input shaft), measure and record the maximum rolling resistance of the input shaft (Figure 29). Loosely install a new locknut onto the sector shaft adjusting screw while holding the screw stationary, then screw the adjusting screw in until the recorded rolling resistance has been increased by 0.9 to 1.3 kg when the locknut is tightened. Readjust as necessary.



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**Figure 29 Adjustment of the Sector Shaft**

- p.** With the spring scale and torque setting tool on the input shaft, adjust the rack adjuster until the rolling resistance is 0.9 to 1.3 kg above the final rolling resistance setting of the sector shaft. Ensure that the rolling resistance does not exceed 7.25 kg, then tighten the grub screw to lock the rack adjuster in position.

**NOTE**

An adjustment of 0.07 mm to the thickness of the shims will move the position of the highest reading by approximately a quarter of a turn of the input shaft.

- q.** Using the torque setting tool and the spring scale, measure the rolling resistance of the worm and roller. Turn the input shaft to the left-hand full-lock position and attach the spring scale to the torque setting tool. Place a chalk mark on the torque setting tool (for reference purposes), then pull the spring scale with a slow and steady pull. The highest reading on the spring scale should occur when the sector shaft roller travels across the centre of the worm (approximately one and a half turns from the left full-lock position). If the highest reading occurs before reaching the centre of travel, reduce the thickness of the shims located between the input shaft inner bearing and the housing. If the highest reading occurs after the centre of travel, increase the thickness of the shims.
- r.** Once the correct shim and adjustment has been made, reassemble the steering box and repeat the adjustment procedures (sub-para e, f, g, j, l, m, o, p and q).

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- s. Centralize the sector shaft with the input shaft worm, then position the drop-arm on the sector shaft, ensuring that the match-marks are aligned. Install the retaining nut, together with a new tab washer, and torque the nut to 169 N.m.
- t. Install the steering box (Para 15) and bleed the power steering system in accordance with EMEI Vehicle G 133 – Group 14.

**Table 6 Steering Group Specifications**

Serial	Item	Specification
1	Power steering pump flow control valve spool-to-spool hole clearance	0.030 mm
2	Power steering pump gear to drive shaft tightening torque	73 to 84 N.m
3	Power steering pump side cover to pump body tightening torque	30 to 40 N.m
4	Power steering pump control valve plug tightening torque	73 to 84 N.m
5	Power steering pump discharge connector tightening torque	68 to 78 N.m
6	Input shaft shims nominal thickness	0.76 mm
7	Input shaft bearing rolling resistance	Add 1.8 to 2.2 kg to initial resistance obtained (see text), then back-off the worm adjuster until the initial resistance is increased by only 0.9 to 1.3 kg
8	Piston and rack assembly installation setting	Crown of piston 63.5 mm from outer end of bore
9	Sector shaft cover bolts tightening torque	22 to 27 N.m
10	Piston bore cover retaining ring	End of ring to be 12 mm from extractor hole
11	Sector shaft resistance adjustment	Input shaft rolling resistance to be increased by 0.9 to 1.3 kg with sector shaft adjuster locknut tightened
12	Rack resistance adjustment	Input shaft rolling resistance to be increased by 0.9 to 1.3 kg above the resistance setting for the sector shaft, but must not exceed 7.25 kg
13	Sector shaft-to-input shaft resistance position	Alteration to the input shaft bearing shim thickness of 0.07 mm alters the position of the highest resistance by a quarter of a turn of the input shaft
14	Drop-arm nut tightening torque	169 N.m
15	Steering box mounting bolts and nuts tightening torque	80 N.m
16	Steering column universal joint pinch bolts tightening torque	35 N.m
17	Tiebar to Panhard rod mounting tightening torque	80 N.m
18	Drag link to drop arm retaining nut tightening torque	40 N.m
	Power steering test pressures	
19	Full-lock with engine at 1000 rpm	5860 to 6550 kPa
20	Full-lock with engine at idle	2745 kPa
21	Steering wheel released with engine at idle	685 kPa
22	Valve tap closed with engine at idle	2745 kPa

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**END**

Distribution List: **VEH G 16.6 – Code 3** (Maint Level)  
(Sponsor: LV SPO, Light B Vehicles)  
(Authority: TRAMM)