TRUCK, UTILITY, LTWT AND TRUCK, UTILITY, LTWT, WINCH, MC2 - LAND ROVER 110 4X4

LIGHT GRADE REPAIR

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

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF TABLES

Blank Page

INTRODUCTION

1. This EMEI contains procedures for removing, dismantling, repairing, assembling and installing various components of the Truck, Utility, Lightweight, 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. Failure to comply may result in damage to the vehicle electrical system.

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. Discard all contaminated fuel and lubricants drained from the truck.

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

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

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

Since 2009, all genuine Land Rover Australia 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 IAW Defence WHSManual.

NOTE

Prior to the disruption, removal or replacement of items contained within Table 1, the vehicle logbook (GM120) should be reviewed. If the item has been replaced since 2009 and noted in Part 4 of the GM120 the item can safely be handled as being asbestos free.

8. The following table provides a list of all known, in-situ, items including; parts, gaskets, seals and washers found in Land Rover 4X4 FOV which may contain asbestos. If an item in Table 1 is to be replaced, the GM120, Part 4 should be reviewed. If the item in question has been replaced after 2009 and noted in Part 4 of the GM120 the item can safely be handled as being asbestos free. If no evidence can be found in Part 4 the item is to be considered contaminated with asbestos. The item is to be replaced IAW Defence WHSManual Vol 2, Part 3A, Chap 5, Asbestos Management in Defence and recorded in the GM120 Part 4.

Table 1 Items Previously Known To Have Contained Asbestos

Serial	ACM NIIN	NON-ACM NIIN	Item name	Description	RPS: 02188 ISSUE 3 MAR 00	Entry into GM120 Part 4 YES/NO
1	991373054	661566324	Gasket, transmission magnetic plug	Fibre washer for the transmission magnetic plug	FBA 011	
2	991373055	661566325	Gasket, transmission oil strainer plug	Filler plug fibre washer	FBA 016 / FBB 013	
3	661284266	661285409	Gasket, exhaust manifold	Exhaust manifold gasket	ABA 013	
4	998221518	661566345	Gasket, cover plate transfer casing reverse idler access	Transmission side plate gasket	FBA 007	
5	998221519	661566343	Gasket, transfer casing housing dog clutch	Transmission to PTO housing gasket	FBC 016	
6	998221724	661566352	Gasket, transfer casing lower cover plate	Transfer case bottom plate gasket	FBB 010	
7	998221850	661566360	Gasket, transmission pneumatic valve	PTO actuator fibre washer	FEA 019	
8	998240915	661566354	Gasket, transmission oil pump cover	Transmission oil pump cover gasket	FC 012	
9	998498732	661566323	Gasket, transmission oil pump cover	Filler plug gasket for transfer case, front axle housing, rear / intermediate axle housing.	FBA 016 / FBB 013	
10	997980214	994957906	Brake shoe set, transmission handbrake	Handbrake brake shoes	MFB 001	
11	998221517	661566341	Gasket, transmission top cover plate	Transmission top plate gasket	FBA 005	
12	998238297	661568461	Ring oil pick up	Transmission front cover plate oil pickup ring	FC 004	
13	661284264	661586333	Gasket	Oil cooler housing gasket	BE 005	
14	661284450	661446255	Gasket, Pipe, Inlet Manifold	Intake manifold pipe gaskets	ABA 003	
15	661285045	661284582	Gasket inlet manifold	Inlet air manifold gasket	ABA 001	
16	997628209	661566325	Joint washer	Filler plug fibre washer transfer case	FBA 016 / FBB 013	
17	998221722	661566353	Gasket Speedometer case	Speedo drive housing gasket	FBC 005	
18	997920835	661566324	Gasket Magnetic Plug	Filler plug fibre washer transfer case	FBA 011	
19	997472708	661566323	Washer flat, Rear Differential Filler Plug	Rear diff filler plug fibre washer	JA 007	
20	661284268	661450532	Gasket	Thermostat to engine block gasket	BF 007	

Paint

WARNING

This vehicle is painted with polyurethane (PUP). Precautions should be taken prior to carrying out repairs which include painting, sanding, scraping or welding. Fine PUP partials from sanding, filing or welding are eye and lung irritants. Refer to EMEI Workshop D 701 – Repair Policy for Equipment Painted in Polyurethane Paint.

WARNING

The primer used on this vehicle contains chromates. Precautions should be taken prior to carrying out repairs which include painting, sanding, scraping or welding. Fine partials from sanding, filing or welding the primer will contain traces of chromate which are skin, eye and lung irritants. PPE is as for PUP.

WARNING

Do not use compressed air to remove dust from areas which vehicle paint has been sanded, filed or drilled. Fine partials of dust will contain chromates and polyurethane which are skin, eye and lung irritants.

9. This vehicle is painted with polyurethane paint. The primer may contain chromium or zinc chromates. Both PUP and primer are most carcinogenic when in a liquid state but are still harmful if exposed to dust or fumes during repairs which include sanding, filing, welding or drilling through or removing paint layers. Wet sanding methods and / or local extract ventilation will minimise and control exposure from dust or fumes generated.

10. PPE Requirements. During repairs that involve sanding, filing, welding or drilling of the paint the following PPE must be worn:

- **a.** safety glasses,
- **b.** rubber or PVC gloves,
- **c.** overalls or full length clothing,
- **d.** fully enclosed foot wear, and
- **e.** a Class P1 (Particulate) respirator.

General Safety Warnings

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 WHSManual, ChemAlert and EMEI Workshop E series requirements.

Under no circumstances is compressed air to be used to remove dust from the clutch assembly and flywheel housing or the brake drums/discs and brake linings. Dust from the brake linings can be a health risk if inhaled.

Associated Publications

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

a. Defence Road Transport Manual (DRTM);

b. Complete Equipment Schedules (CES):

(1) SCES 12035 ..... Truck, Utility, Lightweight, MC2;

(2) SCES 12037 ..... Truck, Utility, Lightweight, W/Winch, MC2;

(3) Equipment Kit SCES 12036..... Land Rover 110.

c. Block Scale 2406/31 – Special Tools for RAEME – B Vehicles – Truck, Utility and Truck, Light, MC2 (Land Rover Model 110);

d. EMEI Vehicle A 019-1 – Replacement of Vehicle Speedometers/Hourmeters and Odometers;

e. EMEI Vehicle A 319-1 – Vehicle/Trailer Electrical Connectors – 12 Pin NATO – Wiring Diagrams;

f. EMEI Vehicle A 291-1 – Tyres and Tubes – Care And Maintenance Of B Vehicles;

g. EMEI Vehicle A 291-5 – Tyres and Tubes – General Service B Vehicles Tyre Guide;

h. EMEI Vehicle A 459-2 – Hydraulic Brake Fluid Deterioration – Miscellaneous Instruction;

i. EMEI Vehicle G 008-1 – Truck, Lightweight, MC2, All Types – Inspection Of Towing Pintle Assembly;

j. EMEI Vehicle G 100 – Truck, Utility, Lightweight and Truck, Utility, Lightweight, Winch, MC2 – Land Rover 110 4X4 – Data Summary;

k. EMEI Vehicle G 102 – Truck, Utility, Lightweight, MC2 – Land Rover 110 and Truck, Utility, Lightweight, W/Winch, MC2 – Land Rover 110 – Technical Description;

l. EMEI Vehicle G 109 – Truck, Utility, Lightweight, MC2 – Land Rover 110 4x4, All Types – Servicing Instruction;

m. EMEI Vehicle G 188 – Truck, Lightweight, MC2, Land Rover 110 4X4, All Types and Truck, Light, MC2, Land Rover 110 6X6, All Types – Inspection Guidelines;

n. EMEI Vehicle G 188–1 – Truck, Lightweight, MC2, Land Rover 110 4X4, All Types and Truck, Light, MC2, Land Rover 110 6X6, All Types – Suspension and Steering Inspection Procedure;

o. EMEI Vehicle G 189-18 – Truck, Lightweight, MC2, Land Rover 110 4X4, All Types and Truck, Light, MC2, Land Rover 110 6X6, All Types – Wheel Balancing

p. EMEI Vehicle D 108 – Recovery Equipment – Inspection Of Recovery Equipment;

q. EMEI Workshop D 701 – Repair Policy for Equipment Painted in Polyurethane Paint;

r. Defence Work Health and Safety Manual (WHSManual);

s. Electronic Supply Chain Manual (ESCM);

t. ChemAlert;

u. Technical Regulation of ADF Materiel Manual - Land version 5(TRAMM-L);

v. RPS 02188 (Base Scale);

w. RPS 02207 (RFSV); and

x. RPS 02227 (SRV).

12. 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:

NOTE

Any effect of these publications pertaining to the technical content of this document has been included in the text.

a. EMEI Vehicle G 107-2 – Truck, Utility, Lightweight, MC2, Land Rover 110 and Truck, Utility, Lightweight, Winch, MC2, Land Rover 110 – Roll Over Protection and Fitting of Head Restraints;

b. EMEI Vehicle G 107-3 – Truck, Utility, Lightweight, MC2, Land Rover 110 and Truck, Utility, Lightweight, Winch, MC2, Land Rover 110 – Fitting of Stretcher Retaining Clamps;

c. EMEI Vehicle G 187-1 – Truck, Utility, Lightweight, MC2, Land Rover 110 4X4 and Truck, Cargo, Light, MC2, Land Rover 110 6X6 – Fitting of Link Cable to the Headlamp Electrical Circuit;

d. EMEI Vehicle G 187-2 – Truck, Lightweight, MC2, Land Rover 110, All Types and Truck, Light, MC2, Land Rover 110, All Types – Fitting of Mudguard Reinforcement Plates;

e. EMEI Vehicle G 187-3 – Truck, Utility, Lightweight, MC2, Land Rover 110, All Types and Truck, Cargo, Light, MC2, Land Rover 110, All Types – Fitting of an Extra Earth Strap;

f. EMEI Vehicle G 187-4 – Truck, Utility, Lightweight, MC2, Land Rover 110, All Types and Truck, Cargo, Light, MC2, Land Rover 110, All Types – Fitting of Spot Mirrors;

g. EMEI Vehicle G 187-5 – Truck, Utility, Lightweight, MC2, Land Rover 110, All Types and Truck, Cargo, Light, MC2, Land Rover 110, All Types – Fitting of Instument Blackout Cover;

h. EMEI Vehicle G 187-6 – Truck, Utility, Lightweight, MC2, All Types, Land Rover 4X4 and Truck, Cargo, Light, MC2, All Types, Land Rover 6X6 – Fitting of External Bonnet Release;

i. EMEI Vehicle G 187-7 – Truck, Utility, Lightweight, MC2, All Types, Land Rover 4X4 and Truck, Cargo, Light, MC2, All Types, Land Rover 6X6 – Air Cleaner Bracket Mounting;

j. EMEI Vehicle G 187-8 – Truck, Lightweight, MC2, Land Rover 110 4X4, All Types with Winch and Truck, Light, MC2, Land Rover 110 6X6, All Types, with Winch – Rework of the Winch Drum Grooves and Replacement of the Winch Rope and Chain;

k. EMEI Vehicle G 187-9 – Truck, Lightweight, MC2, Land Rover 110 4X4, All Types, Not Fitted With Snorkel and Truck, Light, MC2, Land Rover 110 6X6, All Types, Not Fitted With Snorkel – Repositioning of the Air Inlet Hose and Rear Axle Breather;

l. EMEI Vehicle G 187-10 – Truck, Lightweight, MC2, All Types, Land Rover 4X4 and Truck, Light, MC2, All Types, Land Rover 6X6 – Fitting of Seat Belt Protector Sleeve;

m. EMEI Vehicle G 187-12 – Truck, Lightweight and Truck, Light, MC2, Land Rover 110 4X4 and 6X6, All Types – Strengthening of Bonnet Stay;

n. EMEI Vehicle G 187-13 – Truck, Lightweight and Truck, Light, All Types, Land Rover 110 4X4 and 6X6 – Fitting of Trailer Safety Chain Brackets;

o. EMEI Vehicle G 187-14 – Truck, Utility, Lightweight, FFR, MC2, Land Rover 110, All Types, Truck, Utility, Light, FFR, Land Rover Series 3, All Types and Truck, Cargo, Light, FFR, MC2, Land Rover 110, All Types – Rewiring of the 28V Voltmeter Circuit;

p. EMEI Vehicle G 187-15 – Truck, Lightweight and Truck, Light, All Types, Land Rover 110 4X4 and 6X6 – Replacement of 24V Power Distribution Box Cables Between Generator Input Plug and Battery Connections;

q. EMEI Vehicle G 187-16 – Truck, Lightweight, MC2, All Types, Land Rover 110 4X4 and Truck, Light, MC2, All Types, Land Rover 110 6X6 – Conversion From Oil Filled to Grease Filled Swivel Pin Housings;

r. EMEI Vehicle G 189-6 – Truck, Utility, Lightweight, MC2, All Variants, Land Rover 110 4X4 and Truck, Cargo, Light, MC2, All Variants, Land Rover 110 6X6 – Reclaiming Broken Indicator Switch;

s. EMEI Vehicle G 189-12 – Truck, Lightweight, MC2, All Types, Land Rover 110 4X4 and Truck, Light, MC2, All Types, Land Rover 110 6x6 – Fitting of Speedi-Sleeves;

t. EMEI Vehicle G 189-15 – Truck, Lightweight and Truck, Light, All Types, Land Rover 110 4X4 and 6X6 – Chassis Repairs;

u. EMEI Vehicle G 197-1 – Truck, Utility, LTWT, MC2, Land Rover (110) All Types – Stowage Bin Drain Holes and Fitting Modification Record Plate;

v. EMEI Vehicle G 197-2 – Truck, Utility, LTWT, MC2, Land Rover (110) All Types – Dimming of Map Light;

w. EMEI Vehicle G 197-3 – Truck, Utility, Lightweight, W/Winch, MC2, Land Rover 110 – Fitting of Counter Sunk Screws to Winch Guard;

x. EMEI Vehicle G 197-4 – Truck, LTWT, MC2, Land Rover (110), All Types – Fitting of Transfer Case Caution Decal;

y. EMEI Vehicle G 197-5 – Truck, Utility, LTWT, MC2, Land Rover (110), All Types – Fitting of Heater Cable Securing Straps;

z. EMEI Vehicle G 197-6 – Truck, Utility, Lightweight, MC2, Land Rover 110, All Types – Fitting of the Steering Protection Plate and Improved Winch Fairlead Plate Mounting Bolts;

aa. EMEI Vehicle G 197-7 – Truck, Utility, Lightweight, MC2, Land Rover 110, All Types – Fusing of Additional Circuits;

bb. EMEI Vehicle G 197-8 – Truck, Utility, Lightweight, MC2, Land Rover 110, All Types – Slotting of the Brake Caliper Feed Line Retaining Bracket;

cc. EMEI Vehicle G 197-9 – Truck, Utility, Lightweight, MC2, Land Rover 110, All Types – Relocation of the Engine Stop Control;

dd. EMEI Vehicle G 197-10 – Truck, Utility, Lightweight, MC2, Land Rover 110, All Types – Replacement of the Maplight Securing Clip and Securing of the Maplight Wiring;

ee. EMEI Vehicle G 197-11 – Truck, Utility, Lightweight, MC2, Land Rover 110, All Types – Fitting of Elbow to Transmission Differential Lock Control Valve;

ff. EMEI Vehicle G 197-12 – Truck, Utility, Lightweight, MC2; Truck, Utility, Lightweight, MC2, W/Winch, and Truck, Panel, Lightweight, SVY, FFR – Fitting of Lashing Rings;

gg. EMEI Vehicle G 197-13 – Truck, Lightweight, MC2, Land Rover 110 4X4, All Types – Fitting of Coil Spring Retainers; and

hh. EMEI Vehicle G 197-14 – Truck, Lightweight, MC2, Land Rover 110 4X4, All Types, With Manual Steering Box – Repair of Manual Steering Box Selector Shaft End Float.

Location of Identification Numbers

13. The locations of identification numbers on components of the vehicle are described in Table 2.

Table 2 Location Of Identification Numbers

Serial	Identification Number	Location
1	Chassis number	Right-hand side of the chassis, forward of the spring mounting turret
2	Chassis nameplate	Left-hand seat box, in the cab
3	Engine number	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	Front axle number	Adjacent to axle breather
7	Rear axle number	Adjacent to axle breather

Special Tools.

14. 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 3 and illustrated in Figure 1**.**

Table 3 Special Tools

Serial	Part No.	NSN	Item Name
1	5-85317-001-0	5220-66-128-4311	Adapter
2	5-8840-2008-0	5220-66-128-4310	Compression Gauge
3	LRT-57-014	5120-99-724-4444	Puller, Steering Wheel
4	205-053	5120-66-128-4300	Wrench, Adjustable
5	LRT-54-004	5120-99-735-2537	Drift, Pinion Oil Seal Replacer
6	EYA3953	5120-66-158-0612	Hub Adjusting Spanner
7	18G1349	5130-99-767-3075	Hub Oil Seal Replacer
8	LRT-99-503	5220-66-128-4307	Bracket, Dial Gauge Indicator
9	LRT-37-004	5120-99-725-6474	Adapter for stub axle bush and oil feed ring removal
10	LRT-99-004	5120-99-806-9013	Impulse Extractor
11	LRT-99-003	5120-99-874-1715	Replacer, Bearing and Oil Seal
12	LRT-70-500	5120-99-820-6918	Disc Brake Piston Compressor
13	LRT-57-018	5120-66-128-4304	Separator, Ball Joint
14	LRT-51-005	5130-99-767-3078	Remover, Ball Joint
15	NATO 12-pin socket tester	-	Trailer wiring tester

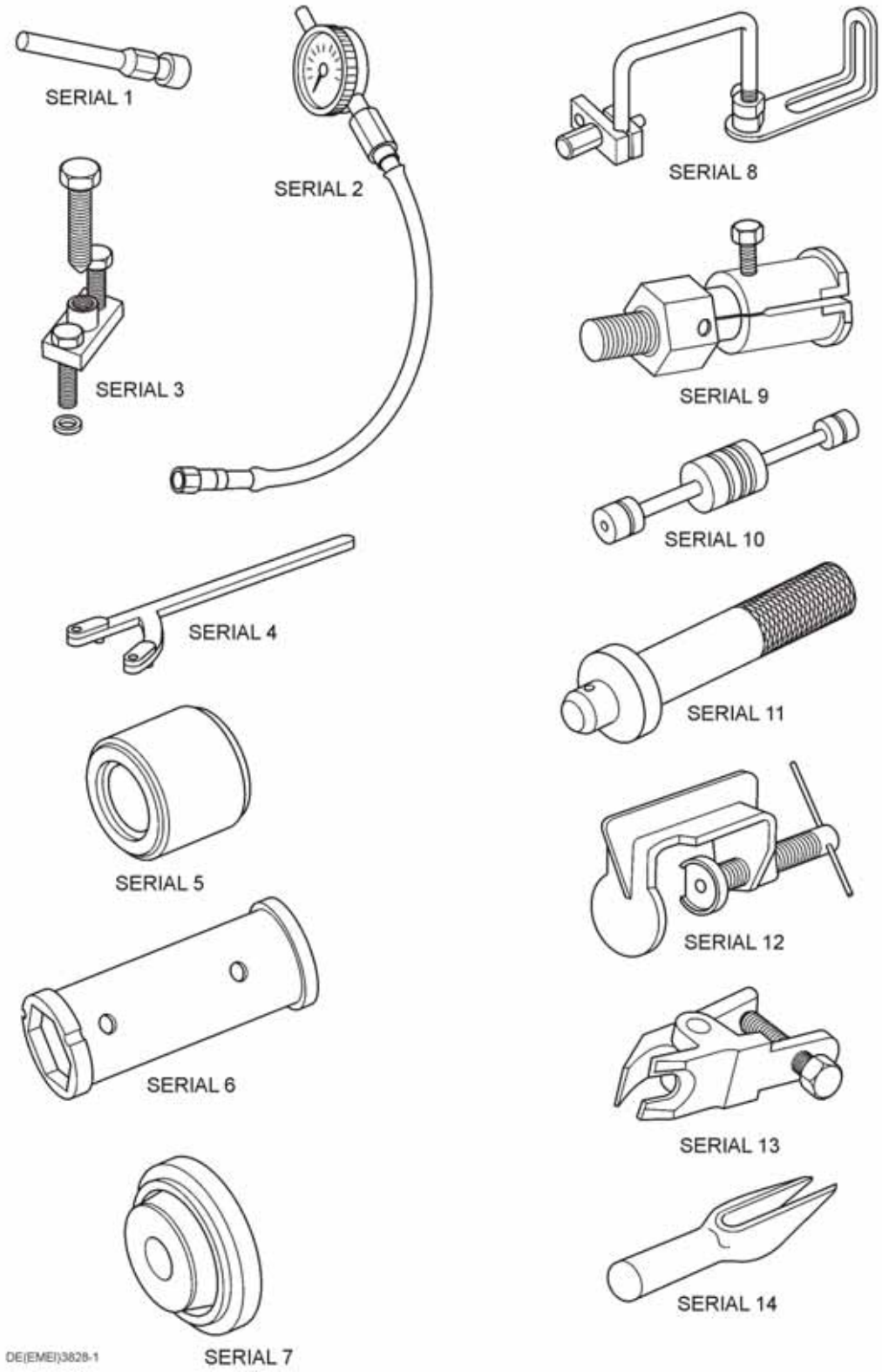


Figure 1 Special Tools

List of Lubricants

15. The list of lubricants is detailed in Table 4.

Table 4 List of Lubricants

Equipment	Lubricant	Capacity (Litres)
Engine (including filter)	SAE GRADE 40 (OMD-115)	8.5
Transmission	SAE GRADE 40 (OMD-115)	2.7
Transfer case	SAE GRADE 40 (OMD-115)	3.2
Power take-off	SAE GRADE 40 (OMD-115)	2.6
Front differential	OEP-220	1.7
Rear differential	OEP-220	2.3
Swivel pin housings	Molytex Grease	EP00 Sachet
Brake master cylinder	OX(Aust)8	Fill to level
Clutch master cylinder	OX(Aust)8	Fill to level
Steering box	OEP-220	0.45
Wheel bearings	XG-291	As required
Winch cable	Rocol wire rope lube NSN 9150-99-337-1498	As required
Radiator inhibitor	Nalcool	As required (1:12 ratio)
Clutch pedal trunnion	XG-291	As required
Speedometer cable	XG-291	As required
Propeller shaft	XG-291	As required
Winch driveline	XG-291	As required
Parking brake adjuster	XG-291	As required
Windscreen wiper drive cable	XG-291	As required
Winch	OEP-220	1.3

ENGINE

Oil Filter

16. Replacement. Replace the oil filter as follows:

- **a.** Wash the area around the oil filter.
- **b.** Blow it dry with compressed air.
- **c.** Remove the drain plug from the filter adapter.
- **d.** Drain the oil into a suitable container.
- **e.** Install the drain plug using a new sealing washer and tighten it securely (Figure 2).
- **f.** Unscrew the oil filter cartridge anticlockwise using a suitable oil filter removing tool if necessary.
- **g.** Apply a film of clean engine oil on the rubber seal and install the new filter until the seal contacts the adapter face.
- **h.** Tighten a further half-turn by hand.
- **i.** Check that there is sufficient oil in the engine.
- **j.** Start the engine and allow it to idle for several minutes, check for oil leaks and retighten the filter slightly.
- **k.** Top up with clean engine oil to the full level shown on the dipstick.

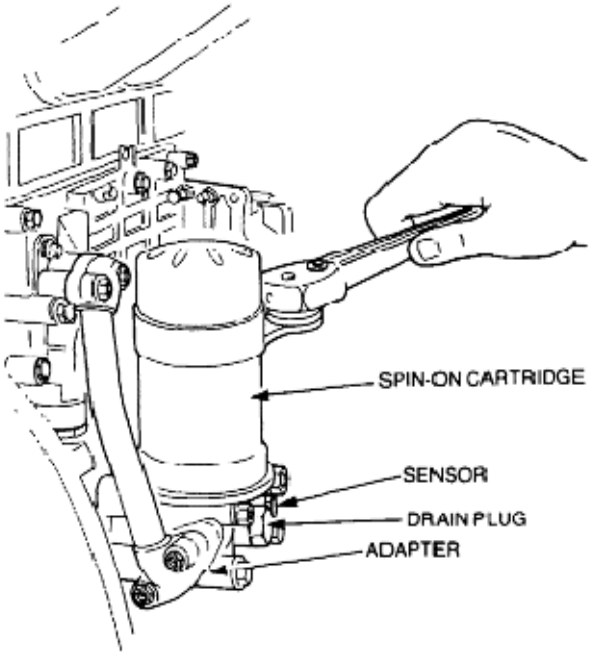


Figure 2 Oil Filter Cartridge Replacement

Engine Rear Mounting

17. Removal. Remove the engine rear mounting as follows:

- **a.** Remove the nuts and washers securing both mountings to the transmission and chassis mountings (Figure 3).
- **b.** Position a suitable jack beneath the transmission.
- **c.** Raise the jack sufficiently to take the weight of the transmission.
- **d.** Remove the three bolts and washers securing each mounting bracket to the chassis.
- **e.** Remove the brackets.
- **f.** Remove the mounting from the brackets.

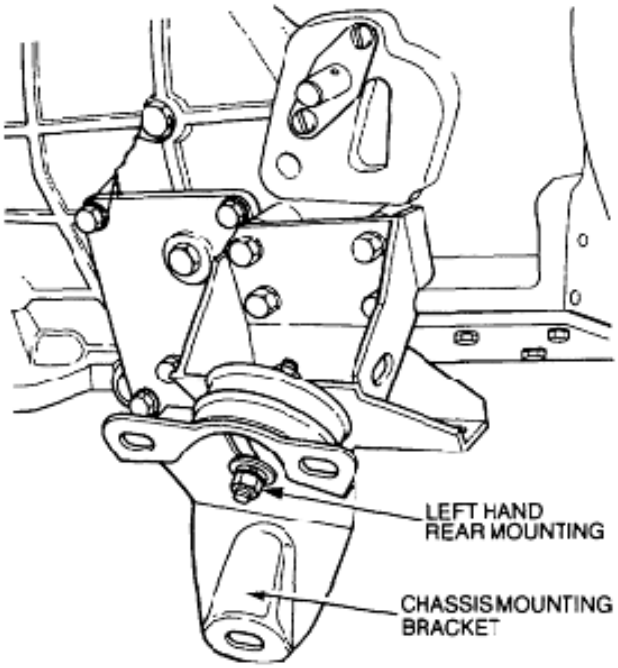


Figure 3 Engine Rear Mounting Removal

18. Installation. Install the engine rear mounting as follows:

a. Install the new mountings on the transmission mounting brackets and install the nuts, together with new washers.

b. Position the chassis mounting brackets over the mountings and install the nuts, together with new washers.

c. Align the mounting brackets with the bolt holes in the chassis.

d. Install and securely tighten the retaining bolts.

e. Carefully lower and remove the jack from under the vehicle.

f. Securely tighten the retaining nuts on both mountings.

Engine Front Mounting

19. Removal. Remove the engine front mounting as follows:

NOTE

The following procedure is applicable to both left-hand and right-hand mountings.

a. Place a suitable block of wood on a jack and position the jack under the engine sump.

b. Remove the bolts, nuts and washers securing the mounting and the earth strap (left-hand side only) to the mounting brackets.

CAUTION

When raising the engine using the jack, extreme care must be taken to prevent damage to any pipes, hoses, wiring harnesses and the front exhaust pipe.

c. Raise the engine enough to enable the mounting to be removed (Figure 4).

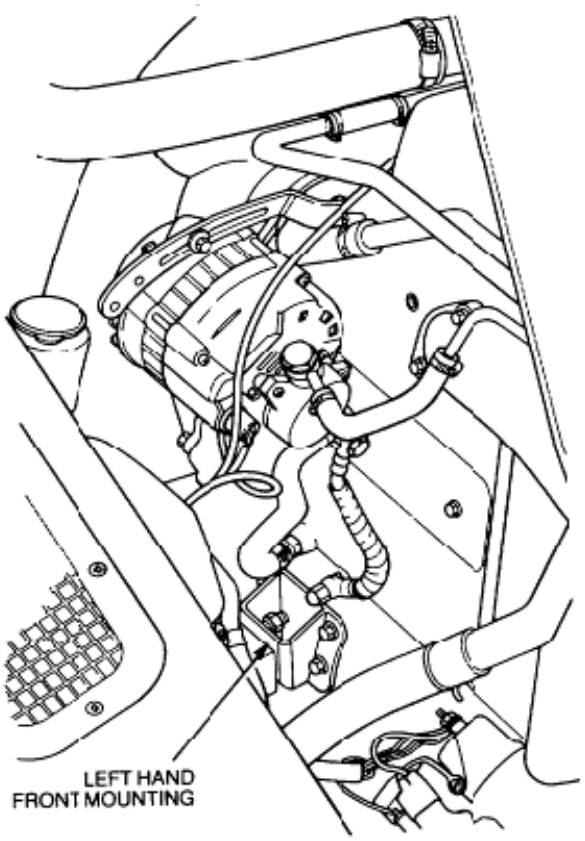


Figure 4 Left Engine Front Mounting

20. Installation. Install the engine front mounting as follows:

NOTE

The following procedure is applicable to both the left-hand and right-hand mountings.

a. Position the new engine mounting between the two brackets and install the bolts and the earth strap (left-hand side only) to the chassis bracket.

b. Install the nuts and washers to secure the mounting to the engine.

c. Carefully lower the jack and remove from under the vehicle.

d. Securely tighten the mounting nuts and bolts.

Exhaust Manifold

21. Removal. Remove the exhaust manifold as follows:

WARNING

New gaskets provided by Land Rover do not contain asbestos. Older gaskets still fitted to vehicles may contain asbestos. During this task some parts may contain asbestos; refer and comply with procedures and warnings in the introduction section of this EMEI under paragraph heading: Items Previously Known To Have Contained Asbestos.

a. Remove the nuts and washers securing the front exhaust pipe to the exhaust manifold flange.

b. Loosen the clamp securing the exhaust pipe to the support bracket, adjacent to the starter motor (Figure 5).

NOTE

It may be necessary to loosen the nut securing the support bracket to allow the exhaust pipe to be lowered.

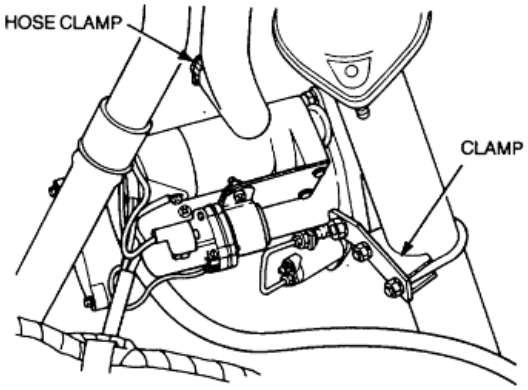


Figure 5 Engine Exhaust Pipe Removal

c. Loosen the hose clamp securing the engine breather pipe to the side cover and disconnect the hose (Figure 5).

d. Plug the hose with a suitable plastic plug.

e. Remove the five nuts and washers securing the crankcase breather and heat shield to the manifold.

f. Remove the breather and the heat shield.

g. Loosen the nuts and bolts securing the exhaust manifold to the cylinder head.

h. Remove the remaining four bolts and five nuts.

i. Remove the manifold.

22. Cleaning and Inspection. Clean and inspect the exhaust manifold as follows:

WARNING

New gaskets provided by Land Rover do not contain asbestos. Older gaskets still fitted to vehicles may contain asbestos. During this task some parts may contain asbestos; refer and comply with procedures and warnings in the introduction section of this EMEI under paragraph heading: Items Previously Known To Have Contained Asbestos.

a. Remove all trace of gasket material from the manifold and cylinder head.

b. Inspect the exhaust manifold for cracks and/or damage and replace as necessary.

c. Ensure that the machined faces are flat and smooth with no burn tracks or warping of the manifold. Replace the manifold if necessary.

d. Ensure that the cylinder head studs and manifold studs are not bent or damaged. Replace studs as necessary (Figure 6).

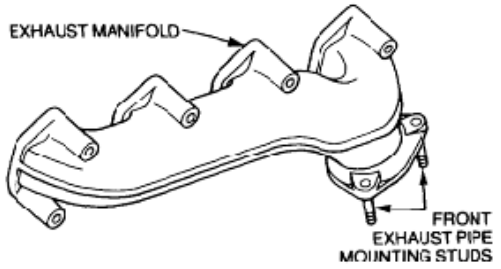


Figure 6 Exhaust Inspection

23. Installation. Install the exhaust manifold as follows:

a. Position two new exhaust manifold gaskets on the cylinder head so that the word 'TOP' is toward the manifold (Figure 7).

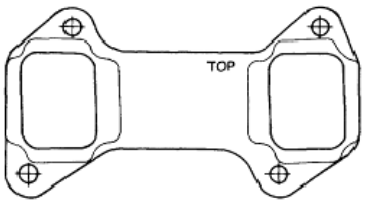


Figure 7 Exhaust Manifold Gasket Installation

b. Place the exhaust manifold over the gaskets, aligning the studs with the corresponding holes in the manifold.

c. Secure the manifold in position with the nuts and bolts and tighten them finger-tight.

d. Check that each gasket is correctly positioned and not distorted.

e. Tighten the manifold retaining nuts and bolts to 16–25 N.m (12–19 lbf.ft) using the tightening sequence as shown in Figure 8.

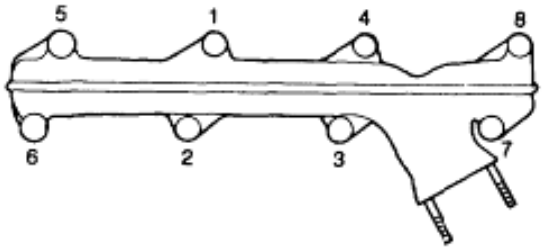


Figure 8 Exhaust Manifold Tightening Sequence

f. Secure the breather and heat shield assemblies to the manifold with the five retaining nuts and tighten them securely.

g. Connect the breather pipe to the side cover outlet and tighten the retaining clamp securely.

h. Install a new sealing ring on the exhaust pipe flange and secure the pipe to the manifold with the three nuts and new spring washers.

i. Tighten the nuts securely.

j. Tighten the support bracket and the securing nut.

Air Inlet Manifold

24. Removal. Remove the air inlet manifold as follows:

WARNING

New gaskets provided by Land Rover do not contain asbestos. Older gaskets still fitted to vehicles may contain asbestos. During this task some parts may contain asbestos; refer and comply with procedures and warnings in the introduction section of this EMEI under paragraph heading: Items Previously Known To Have Contained Asbestos.

a. Clean the area around the inlet manifold using a suitable cleaning agent and blow it dry with compressed air.

b. Remove the high pressure fuel lines (Para 53).

c. Remove and plug all the fuel lines from the fuel filter (Figure 9).

NOTE

Plug all openings in the injection pump and fuel filter adapter following the removal of the fuel lines to prevent the ingress of dirt.

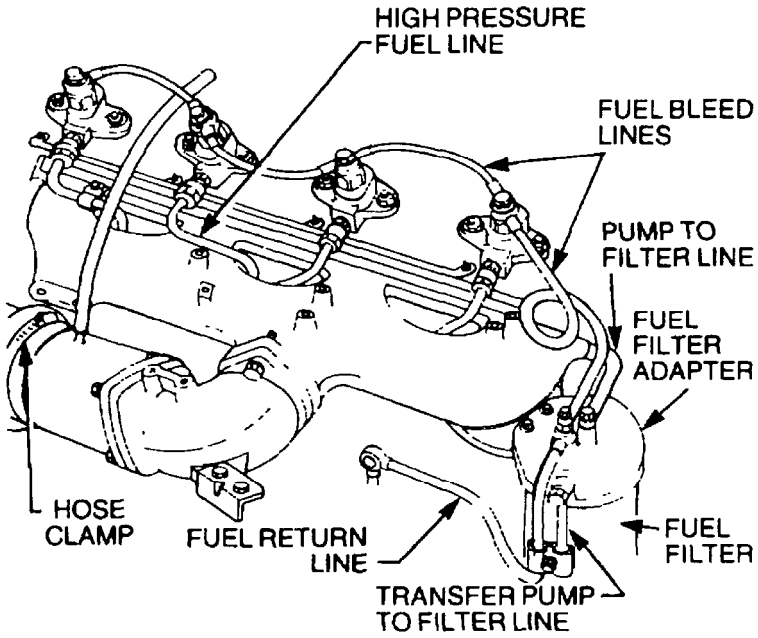


Figure 9 Air Inlet Manifold Removal

d. Remove the stop cable mounting bracket from the inlet manifold.

e. Remove the two bolts securing the fuel filter assembly to the inlet manifold.

f. Remove the filter assembly from the vehicle.

g. Loosen the hose clamps securing the air cleaner hose to the air inlet tube and disconnect the hose.

h. Disconnect the breather pipe from the air inlet tube.

i. Remove the bolts, nuts and washers securing the inlet manifold to the engine.

j. Remove the manifold.

25. Cleaning and Inspection. Clean and inspect the air inlet manifold as follows:

a. Remove all trace of gasket material from the manifold and cylinder head.

b. Inspect the manifold for cracks or damage. Replace the manifold if necessary.

c. Ensure that the machined face is flat and smooth with no warping or burn tracks. Replace the manifold if necessary.

26. Installation. Install the air inlet manifold as follows:

a. Position a new manifold gasket on the cylinder head with the projection uppermost and toward the rear of the engine (Figure 10).

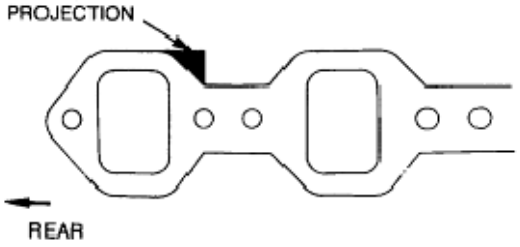


Figure 10 Air Inlet Manifold Gasket Installation

b. Place the inlet manifold over the gasket.

c. Align the studs with the corresponding holes in the manifold.

d. Secure the manifold in position with the six bolts and tighten the bolts finger-tight.

e. Check that the gasket is correctly positioned and not distorted.

f. Install the two nuts and washers.

g. Torque the nuts and bolts to 16–25 N.m (12–19 lbf.ft).

h. Connect the air cleaner hose and tighten the hose clamps.

i. Connect the breather pipe to the air inlet tube.

j. Position the fuel filter assembly on the inlet manifold.

k. Install the two retaining bolts and tighten them securely.

l. Using new sealing washers, install the main fuel lines between the transfer pump, fuel filter and injection pump.

m. Install the high pressure fuel lines (Para 53.e).

n. Install the stop cable bracket on the inlet manifold and adjust the cable (Para 66).

o. Using new sealing washers, connect the fuel return line to the fuel filter and tighten the banjo bolt securely.

p. Bleed the fuel system (Para 73).

Valve Clearance

27. Adjusting Valve Clearance. Adjust the valve clearance as follows:

WARNING

To avoid the possibility of the engine firing, ensure that the stop control is in the 'STOP' position (ignition turned off).

a. Remove the valve cover from the cylinder head.

b. Rotate the crankshaft by hand in the direction of rotation until the number four cylinder valves are on the rock.

c. Align the timing mark on the crankshaft pulley with the calibration mark on the timing cover.

d. Number one cylinder is now on top dead centre (TDC) compression stroke (Figure 11).

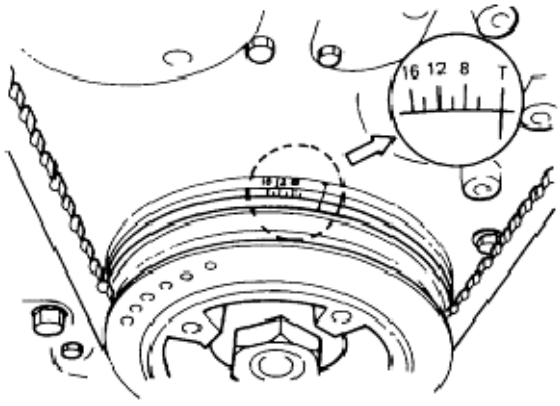


Figure 11 Timing Mark Alignment

e. Check that the clearance of the valves indicated in Figure 12 is 0.4 mm (0.016 in). Adjust the clearances as necessary.

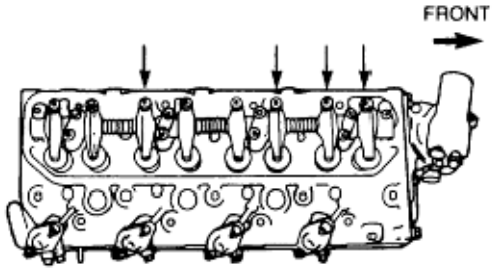


Figure 12 Valve Adjustment First Sequence

f. To adjust the remaining valves, rotate the crankshaft by hand in the direction of rotation for one complete revolution until the timing mark is aligned again (Figure 11).

g. Check that the clearance of the valves indicated in Figure 13 is 0.4 mm (0.016 in). Adjust the clearances as necessary.

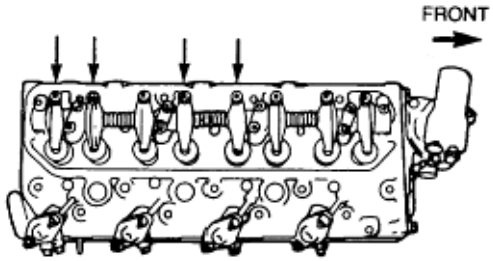


Figure 13 Valve Adjustment Second Sequence

28. Reassembly. Reassemble the valve cover as follows:

a. Using a new valve cover gasket and retaining nut seals, install the cover.

b. Tighten the three nuts to 19 N.m (14 lbf.ft).

Engine Sump

29. Removal. Remove the sump as follows:

a. Clean the area around the sump using a suitable cleaning agent and blow it dry with compressed air.

b. Remove the drain plug and drain the oil into a suitable container.

c. Install the drain plug with a new sealing washer and tighten it securely.

d. Remove the bolts and nuts securing the sump to the engine block.

e. Remove the sump and supporting plates (Figure 14).

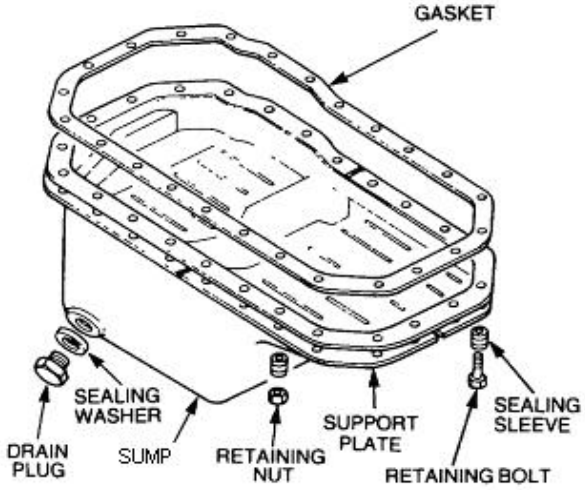


Figure 14 Engine Sump Removal

f. Remove all trace of gasket material from the engine block and the sump.

g. Clean the sump thoroughly.

30. Installation. Install the sump as follows:

a. Position a new gasket on the sump.

b. Position the supporting plates over the rim of the sump.

c. Position the sump complete with the gasket and supporting plates on the engine block.

d. Install the retaining bolts and nuts and tighten them to 10–20 N.m (8–15 lbf.ft).

e. Fill the engine with clean engine oil to the correct level.

Engine Side Cover Plate Gaskets

31. Rear Cover Plate Gasket Replacement. Replace the rear cover plate gasket as follows:

a. Clean the area around the rear cover plate using a suitable cleaning agent and blow it dry with compressed air.

b. Loosen the hose clamp securing the engine breather hose to the rear cover (Figure 15).

c. Remove the nuts and washers securing the breather to the exhaust manifold.

d. Remove the bolts securing the rear cover to the engine block.

e. Move the breather assembly away from the engine and remove the rear cover.

f. Remove all trace of gasket material from the engine block and rear cover.

g. Discard the packing washers fitted to the bolts.

h. Position a new gasket on the rear cover and new packing washers on the retaining bolts.

i. Install the rear cover and tighten the retaining bolts to 16–27 N.m (12–20 lbf.ft).

j. Position the engine breather on the engine.

k. Install and tighten the two retaining nuts to 16–25 N.m (12–19 lbf.ft).

l. Position the engine breather hose on the rear cover and tighten the clamp securely.

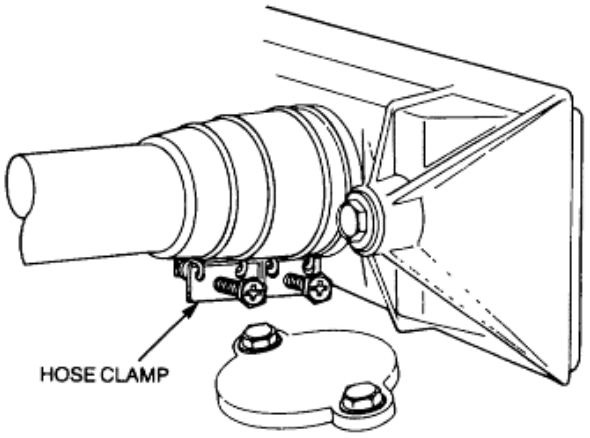


Figure 15 Rear Side Cover Plate Gasket Replacement

32. Front Cover Plate Gasket Replacement. Replace the front cover plate gasket as follows:

a. Loosen the alternator mounting bolts and remove the adjusting bolt (Figure 16).

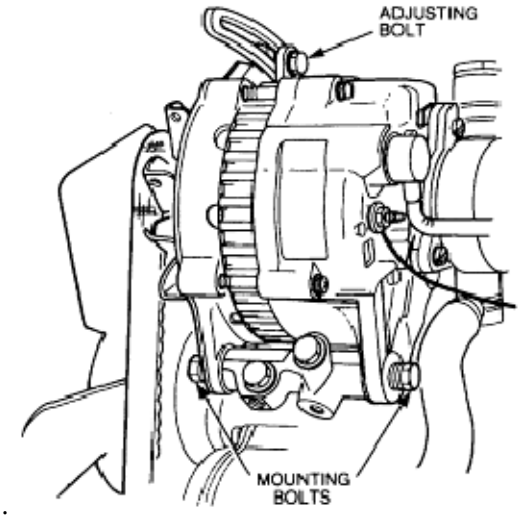


Figure 16 Alternator Adjusting Bolt

b. Remove the fanbelt from the alternator drive pulley.

c. Swing the alternator away from the engine.

d. Remove the two bolts securing the front cover to the engine block.

e. Remove the front cover.

f. Remove all trace of gasket material from the engine block and the front cover.

g. Discard the packing washers fitted to the bolts.

h. Position a new gasket on the front cover and new packing washers on the retaining bolts.

i. Install the front cover and tighten the retaining bolts to 16–27 N.m (12–20lbf.ft).

j. Install the fanbelt on the alternator drive pulley and adjust it (Para 36).

Compression Test Procedure

33. Carry out the compression test as follows:

a. Apply the handbrake.

b. Start the engine.

c. Stop the engine when it reaches normal operating temperature.

d. Remove the in-line fuse located in the stop motor wiring harness adjacent to the brake master cylinder.

WARNING

Removal of the in-line fuse may not prevent the engine from starting.

e. Using the ignition switch, crank the engine to check that it does not start.

f. Disconnect the wiring harness connected to the glow plug link strip.

g. Remove the nuts and washers securing the link strip to the glow plugs.

h. Using a 12 mm deep-socket, remove all the glow plugs.

i. Install the adapter (Table 3, Serial 1) into the first cylinder by using a 17 mm deep-socket and fit the compression gauge (Table 3, Serial 2).

j. Using the starter, crank the engine four to five revolutions and note the reading on the compression gauge.

k. Remove the compression gauge and adapter from the cylinder head.

l. Repeat sub-paras i to k for the remaining cylinders.

m. The compression pressure for each cylinder must be between 22 kgf/cm^2 (313 psi) and 30 kgf/cm^2 (441 psi) with a maximum variation of 5 kgf/cm^2 (71 psi) between cylinders.

n. Install the glow plugs and torque them to 22–27 N.m (16–20 lbf.ft).

o. Position the electrical strip link on the glow plugs and tighten the retaining nuts securely.

p. Connect the wiring harness to the glow plug link strip.

q. Install the in-line fuse adjacent to the brake master cylinder.

r. Ensure that the engine starts.

Engine System Specifications

34. The engine system specifications are detailed in Table 5.

Table 5 Engine System Specifications

Serial	Specification	Measurement
1	Air inlet manifold to cylinder head tightening torque	16–25 N.m (12–19 lbf.ft)
2	Exhaust manifold to cylinder head tightening torque	16–25 N.m (12–19 lbf.ft)
3	Rocker shaft tightening torque	20–30 N.m (15–22 lbf.ft)
4	Valve clearance inlet and exhaust	0.4 mm (0.016 in)
5	Valve cover tightening torque	19 N.m (14 lbf.ft)
6	Engine sump (sump) tightening torque	10–20 N.m (8–15 lbf.ft)
7	Engine side covers tightening torque	16–27 N.m (12–20 lbf.ft)
8	Fanbelt deflection	10–15 mm
9	Transfer pump fuel delivery pressure	176–245 kPa
10	Compression pressure	22–30 kgf/cm^2 (313–441 psi) [maximum variation 5 kgf/cm^2 (71 psi)]
11	Glow plug torque	22–27 N.m (16–20 lbf.ft)

Engine Fault Finding

35. The engine fault finding is detailed in Table 6.

Table 6 Engine Fault Finding

Serial	Symptom	Probable Cause	Action
1	Engine misfiring	Poor quality fuel, water or dirt in the fuel	Drain sedimenter. Drain and flush the fuel tank. Install new filters and fill tank with clean diesel fuel
		Air in fuel system	Check the system for air leaks. Air will generally enter the fuel system on the suction side of the transfer pump
		Broken or leaking high pressure fuel lines	Check for fuel leaks and replace defective parts
		Restriction in fuel lines or return lines	Check for fuel flow. If no flow, replace lines
		Low fuel supply pressure	Check that there is fuel in the fuel tank. Look for leaks, sharp bends or kinks in the fuel line between fuel tank and transfer pump. Check for a clogged or perforated suction pipe in the tank or a blocked fuel suction hose. Look for air in the system. Check fuel pressure. If it is less than 175 kPa, change the filter and recheck. If still low, replace the transfer pump. Check that the overflow valve is operating
		Improper valve adjustment	Check valve clearance, adjust to specification
		Defective fuel injection nozzle or fuel injection pump	Run the engine at a speed that gives maximum misfiring or rough running. Loosen the high pressure fuel line nuts, one at a time, on the injection pump cutting the fuel flow to the cylinder **NOTE** When fuel is cut from a given cylinder and running speed does not change, it is an indication that the cylinder is not firing. If however, no fuel is evident when the nut is loosened off, it is an indication that the injection pump is defective
		Engine improperly timed	Check and adjust timing
		Cylinder head gasket leaking	Check for visible signs of leaking e.g. coolant in the engine oil or oil traces in the coolant
2	Engine stalls at low speeds	Idle speed too low	Check the idle setting (580 rpm) and make the necessary adjustments
		Fuel tank vent blocked or partially blocked	Check the vent and hose, if blocked, replace
		Low fuel supply	Check that there is fuel in the tank. Look for leaks, sharp bends or kinks in the fuel supply lines. Check for air in the fuel system. Drain the sedimenter. Check that fuel pressure is approx. 175–245 kPa. If not, replace the fuel filter and recheck the pressure. If still low replace the transfer pump
		Injection pump overflow valve leaking, stuck open or closed	Repair or replace valve
3	Erratic engine speed	Air leaks in fuel suction line	Check for air leaks and correct as necessary
		Accelerator linkage loose or out of adjustment	Check all accelerator linkages and make the necessary adjustments
4	Excessive engine vibration	Crankshaft pulley loose	Tighten pulley retaining bolt
		Fan assembly not in balance	Loosen or remove fanbelt and operate the engine for a short time at the speed that the vibration was present. If the vibration disappears, replace the fan assembly
		Engine mountings are loose, worn or defective	Tighten all mounting bolts. Install new components as required
		Misfiring or running rough	Check as per Serial 1

Table 6 Engine Fault Finding (Continued)

Serial	Symptom	Probable Cause	Action
5	Low power **NOTE** When diagnosing low power complaints, it is possible the trouble can be traced to components other than the engine. Make sure the vehicle rolls freely when the brakes are released	Restrictions in the air intake system or clogged air filter	Check the air pressure in the air inlet manifold. Replace the air cleaner elements
		Damage or restrictions in the accelerator or stop cable linkage	Check the linkages, adjust to obtain sufficient travel
		Low fuel pressure	Check fuel supply pressure: Check that there is fuel in the fuel tank. Look for leaks, sharp bends or kinks in the fuel line between fuel tank and transfer pump. Check for a clogged or perforated suction pipe in the tank or a blocked fuel suction hose. Look for air in the system. Check fuel pressure. If it is less than 175 kPa, change the filter and recheck. If still low, replace the transfer pump. Check that the overflow valve is operating and is not sticking, binding or defective. Repair or replace as necessary
		Excessive valve clearance	Adjust valve clearance to specification
		Blocked in-line filter	Replace filter
6	Engine will not reach no-load governed speed	Air in fuel system	Check the fuel system for air leaks. Air will generally get into the fuel system on the suction side of the transfer pump
		Accelerator linkage loose or out of adjustment	Check all linkages and make the necessary repairs
		Restricted fuel lines or stuck overflow valve	Check flow in the fuel lines. Check the overflow valve for a defective spring, worn valve, and valve setting or sticking. Make all necessary repairs
		High idle speed incorrect	Replace injection pump
		Blocked in-line filter	Replace filter
7	Excessive black or grey smoke	Insufficient air for combustion	Replace air filter element
		High exhaust back pressure	Check for faulty exhaust piping or muffler obstruction. Repair or replace defective parts
		Faulty injection nozzle	Isolate faulty nozzle and report. Ref Serial 1
		Improper engine timing	Check the timing and make the necessary adjustments
8	Excessive blue or white smoke	Engine oil level too high	Remove excess oil. If oil is contaminated with either fuel or coolant, completely drain the system and replace the oil filter. Locate and rectify the source of the leak. Refill with clean engine oil (8.5 litres) and check level after running the engine for several minutes. DO NOT overfill
		Engine misfiring or running rough	Check all items listed under Serial 1
		Worn engine components	Report condition
9	Excessive fuel consumption	Restrictions in air induction system	Inspect system and remove restrictions
		External fuel system leak	Check fuel system piping for signs of fuel leakage. Repair or replace as necessary
		Faulty injection nozzle	Isolate faulty nozzle and report. Ref Serial 1
10	Excessive oil consumption	External oil leaks	Check the engine for visible signs of oil leaks. Check the front and rear crankshaft oil seals, check gaskets and sump drain plug
		Clogged engine breather pipe	Clean the pipe to remove the obstruction
		Excessive exhaust back pressure	Check for faulty exhaust piping or muffler obstruction. Repair or replace defective parts
		Worn engine components	Report condition

Table 6 Engine Fault Finding (Continued)

Serial	Symptom	Probable Cause	Action
11	Engine overheats	Coolant level low	Determine the cause. Replace leaking gaskets or hoses. Tighten connections and add coolant
		Loose or worn fanbelt	Adjust or replace
		Air flow through radiator restricted	Remove all obstructions from outer surface of radiator
		Radiator pressure cap defective	Check the pressure release of radiator cap 103 kPa (14 psi). Replace if necessary
		Defective thermostat or temperature gauge	Check the opening temperature and for correct installation of the thermostat. Replace as necessary. Check operation of the temperature gauge. Repair or replace as necessary
		Combustion gases in coolant	Report condition
		Blocked oil cooler	Report condition
		Defective water pump	Replace the pump
		Incorrect driving techniques	Advise driver
12	Low oil pressure	Insufficient oil, oil leaks	Check the oil level: add oil as required. Check for oil leaks, repair or report
		Incorrect or degraded engine oil	Drain the lubricating oil. Change the filters and refill with clean engine oil. Check the level. DO NOT overfill
		Defective oil pump	Repair or replace as necessary
		Dirty oil filter	Check the operation of the by-pass valve for the filter. Install new filter element. Drain engine oil and refill with clean engine oil (8.5 litres)
13	Oil in coolant or coolant in oil	Defective oil cooler core	Report condition
		Failed head gasket	Report condition
14	Low compression	Incorrect valve clearance	Adjust valves to specified clearance
		Failed head gasket	Report condition
		Broken or weak valve spring	Report condition
		Burned valves or seats	Report condition
		Piston failure	Report condition
		Worn rings	Report condition

COOLING SYSTEM

Fanbelt

36. Replacement. Replace the fanbelt as follows:

a. Loosen the alternator mounting bolts and the adjusting bolt (Figure 17).

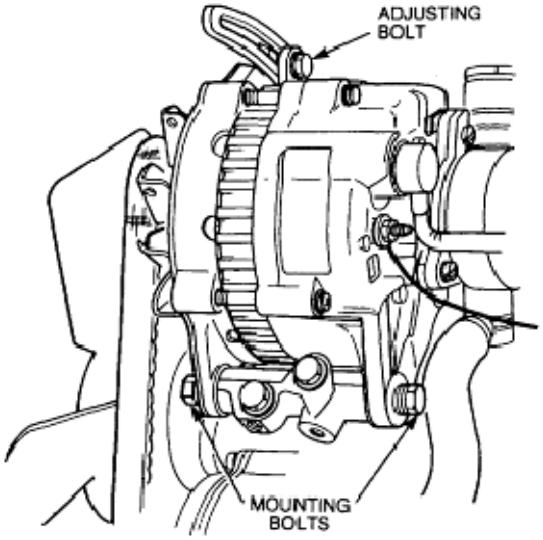


Figure 17 Fanbelt Replacement

b. Detach the fanbelt from the alternator drive pulley.

c. Remove the fanbelt from the crankshaft and water pump drive pulleys.

d. Install a new fanbelt.

NOTE

Ensure that the fanbelt is located in the grooves on all three drive pulleys.

e. Swing the alternator away from the engine.

f. Check the tension of the belt by applying moderate thumb pressure to the longest span of the belt.

g. When a belt deflection of 10–15 mm has been obtained, tighten the adjusting and mounting bolts.

h. Start and run the engine for approximately 20 minutes.

i. Stop the engine and recheck the belt deflection (sub-paras f and g).

j. Readjust as necessary.

Thermostat

37. Removal. Remove the thermostat as follows:

a. Clean the area around the thermostat housing using a suitable cleaning agent and blow it dry with compressed air.

b. Loosen a clamp on the bottom radiator hose.

c. Disconnect the hose and drain approximately 4 litres of coolant into a suitable clean receptacle.

NOTE

It may be necessary to loosen the expansion tank pressure cap to increase the flow of coolant.

d. Reconnect the hose and tighten the hose clamp.

e. Loosen the hose clamp securing the top radiator hose to the thermostat housing (Figure 18).

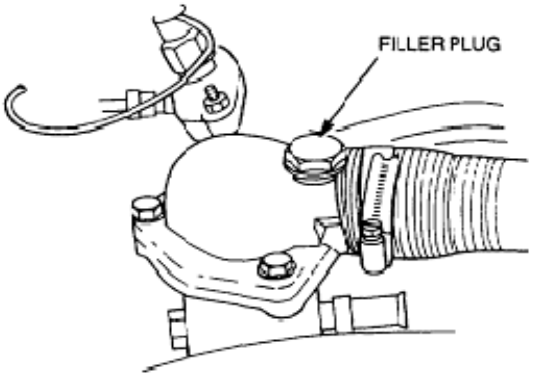


Figure 18 Thermostat Removal

f. Remove the hose from the housing.

g. Remove the three bolts securing the cover to the thermostat housing and remove the cover.

h. Remove and discard the gasket.

i. Lift out the thermostat.

j. Remove all trace of gasket material from the thermostat housing and the cover.

k. Inspect for corrosion, wear or damage. Repair or replace as necessary.

38. Installation. Install the thermostat as follows:

a. Install a thermostat of the correct temperature range (82ºC).

b. Position a new gasket on the housing.

c. Position the water outlet on the housing and install the three bolts.

d. Tighten the bolts securely.

e. Install the top hose onto the water outlet and tighten the top hose clamp securely.

f. Refill the cooling system (Para 39).

Coolant

39. Refilling Procedure. Refill the coolant system as follows:

a. Remove the brass filler plug from the thermostat housing (Figure 18).

b. Remove the expansion tank pressure cap.

c. Move the heater controls to the highest temperature position.

d. Using coolant with a mixture concentration of 1:12 ratio of Nalcool to water, refill the system through the filler hole and install the plug.

e. With the pressure cap removed, run the engine for a minimum of two minutes.

f. Stop the engine and remove the plug from the thermostat housing.

g. Top up as required and replace the plug.

h. Fill the expansion tank to the correct level and replace the cap.

i. Run the engine and check for leaks (rectify as necessary).

Water Pump

40. Removal. Remove the water pump as follows:

a. Clean the area around the water pump using a suitable cleaning agent and blow it dry with compressed air.

b. Loosen the bottom radiator hose securing clamp and drain the coolant into a suitable clean receptacle.

c. Install the hose and tighten the securing clamp.

d. Remove the fan belt (Para 36).

e. Remove the four bolts securing the water pump drive pulley to the water pump.

f. Remove the fan, spacer and pulley (Figure 19).

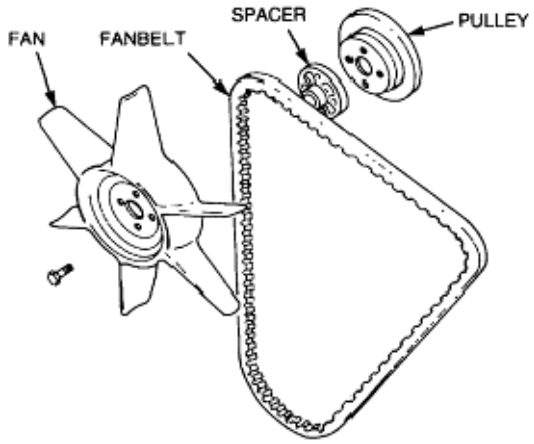


Figure 19 Fan, Spacer and Pulley

g. Loosen the hose clamps securing the bypass and heater hoses to the water pump and remove them (Figure 20).

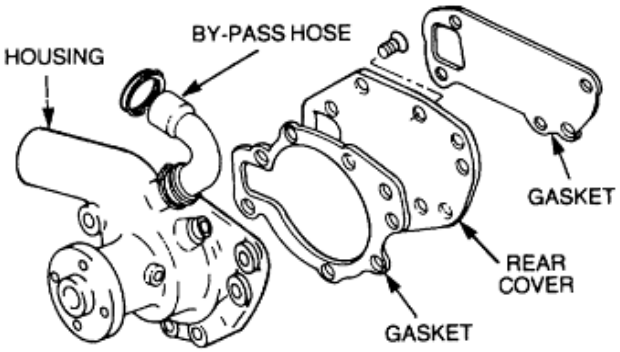


Figure 20 Water Pump Gasket Replacement

NOTE

As the water pump retaining bolts are different lengths, note their respective positions on removal.

h. Remove the bolts securing the water pump.

i. Remove the water pump.

j. Remove the screws securing the rear cover to the water pump and remove the rear cover.

k. Remove and discard the gaskets.

41. Cleaning and Inspection. Clean and inspect the water pump as follows:

NOTE

The water pump must be replaced if any bearing noise is present, or there is excessive end float or radial movement.

a. Remove all trace of gasket material from the water pump and engine block surfaces.

b. Inspect the water pump cover and housing for cracks, nicks, burrs or damage.

c. Inspect the housing for warping and check that the bearings rotate smoothly.

d. Replace the water pump as necessary.

42. Installation. Install the water pump as follows:

a. Using a new gasket and a liquid sealer, secure the rear cover to the water pump.

b. Tighten the screws securely.

c. Install the water pump retaining bolts in the positions noted on removal.

d. Using a new gasket and a suitable sealer, install the water pump and tighten the bolts to 44 N.m (32 lbf.ft).

e. Install the drive pulley, spacer and fan. Tighten the four bolts securely.

f. Connect the bypass and heater hoses and tighten the hose clamps securely.

g. Swing the alternator towards the engine.

h. Install the fanbelt (Para 36)

i. Fill the cooling system (Para 39).

Radiator

43. Removal. Remove the radiator as follows:

a. Loosen the bottom radiator hose securing clamp and drain the coolant into a suitable, clean receptacle.

b. Remove the bottom hose from the radiator.

c. Loosen the top radiator and overflow hose securing clamps and remove the hoses from the radiator.

d. Remove the five screws securing the shroud to the radiator and move the shroud towards the engine (Figure 21).

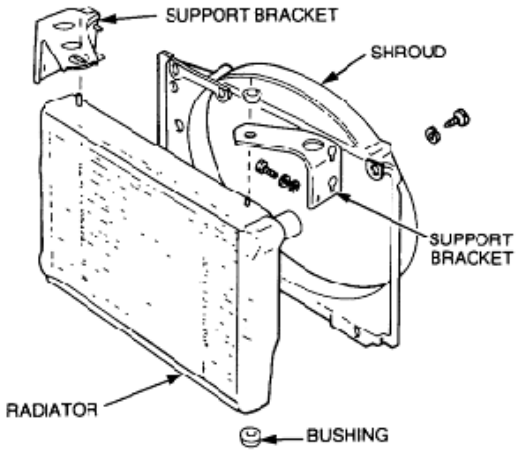


Figure 21 Radiator Assembly Exploded View

e. Remove the screws securing the two top support brackets and lift the radiator up and out of the vehicle.

44. Cleaning and Inspection

a. Inspect the radiator for damaged seams, choked or damaged fins, corrosion and restrictions in the core. Replace the radiator as necessary.

b. Inspect the rubber bushes for wear (replace as necessary).

45. Installation. Install the radiator as follows:

a. Install the radiator and bushes onto the lower mountings.

b. Install the two top support brackets, bushes and six screws. Tighten the screws securely.

c. Install the shroud and secure it using the five screws.

d. Install the top radiator hose and the overflow hose then tighten the clamps.

e. Install the bottom radiator hose and tighten the clamp.

f. Fill the cooling system (Para 39).

Cooling System Specifications

46. The cooling system specifications are detailed in Table 7.

Table 7 Cooling System Specifications

Serial	Specification	Measurement
1	Fanbelt deflection	10–15 mm
2	Thermostat opening temperature	82ºC
3	Water pump impeller to body clearance	0.3–0.8 mm
4	Water pump tightening torque	44 N.m (32 lbf.ft)
5	Pressure cap opening pressure	103 kPa (14 psi)
6	Expansion tank coolant level	Half-full (cold)
7	Cooling system capacity	12.5 Litres (cold)

EXHAUST SYSTEM

47. Removal. Remove the exhaust system as follows:

a. Remove the three nuts and washers securing the front exhaust pipe to the exhaust manifold (Figure 22).

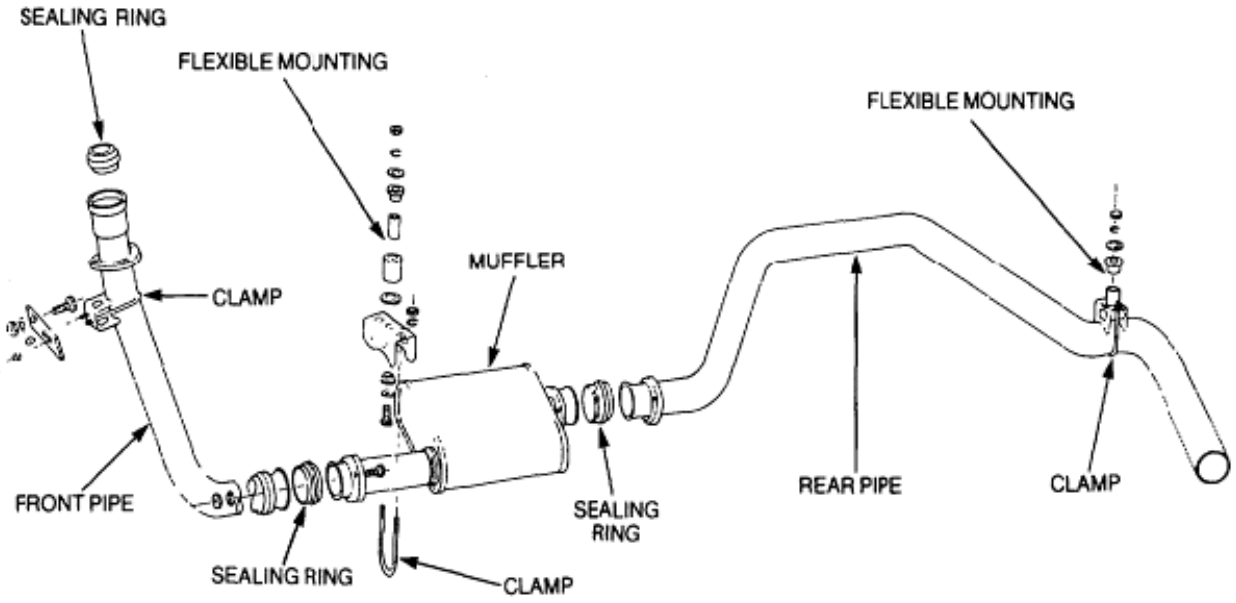


Figure 22 Exhaust System Exploded View

b. Remove and discard the sealing ring.

c. Remove the clamp securing the front exhaust pipe to the engine bracket.

d. Remove the bolts securing the muffler to the front exhaust pipe and remove the pipe.

e. Remove the bolts securing the muffler to the rear exhaust pipe.

f. Remove the clamp securing the muffler to the chassis flexible mounting.

g. Remove the muffler and sealing rings.

h. Remove the clamp securing the rear exhaust pipe to the chassis flexible mounting.

i. Remove the pipe from over the rear axle.

48. Installation. Install the exhaust system as follows:

a. Install the rear exhaust pipe over the rear axle and install the clamp in approximately the correct location.

NOTE

Do not tighten any clamp or flange bolts until the complete exhaust system is in position on the vehicle.

b. Secure the muffler to the flexible coupling with the clamp (Figure 22).

c. Using a new sealing ring, position the rear pipe on the muffler flange and install the three bolts.

d. Using a new sealing ring, secure the front exhaust pipe to the engine exhaust manifold with the three nuts and new washers.

e. Using a new sealing ring, position the front exhaust pipe on the muffler flange and install the three bolts.

f. Secure the front exhaust pipe to the mounting bracket with the clamp but do not tighten it.

g. Tighten the three nuts securing the front exhaust pipe to the exhaust manifold ensuring that the sealing ring is seated evenly in the flange.

h. Tighten the mounting bracket clamp.

i. Tighten the clamp and front flange bolts ensuring that the muffler does not foul the chassis.

j. Ensure the rear exhaust pipe does not foul the chassis or rear axle moving parts and tighten the rear clamp and the muffler flange bolts.

k. Start the engine, check for exhaust gas leaks and rectify as necessary.

FUEL SYSTEM

Fuel Tank

49. Removal. Remove the fuel tank as follows:

NOTE

When fuel lines/pipes are disconnected they must be plugged to prevent the ingress of dirt.

a. Remove the rubber mat and floor panel from the driver's side.

b. Remove the driver's seat base and the seat base lid.

c. Clean the areas around the fuel pipes using a suitable cleaning agent and blow them dry with compressed air.

d. Remove the hexagonal head drain plug from the fuel tank (Figure 23).

e. Drain the fuel into a suitable container and replace the drain plug.

f. Place a suitable support under the fuel tank.

g. Remove the tank front mounting bracket secured to the chassis.

h. Loosen the hose clamp around the filler pipe hose and remove the hose from the fuel tank.

i. Loosen the hose clamp securing the breather pipe to the tank and remove the hose from the fuel tank.

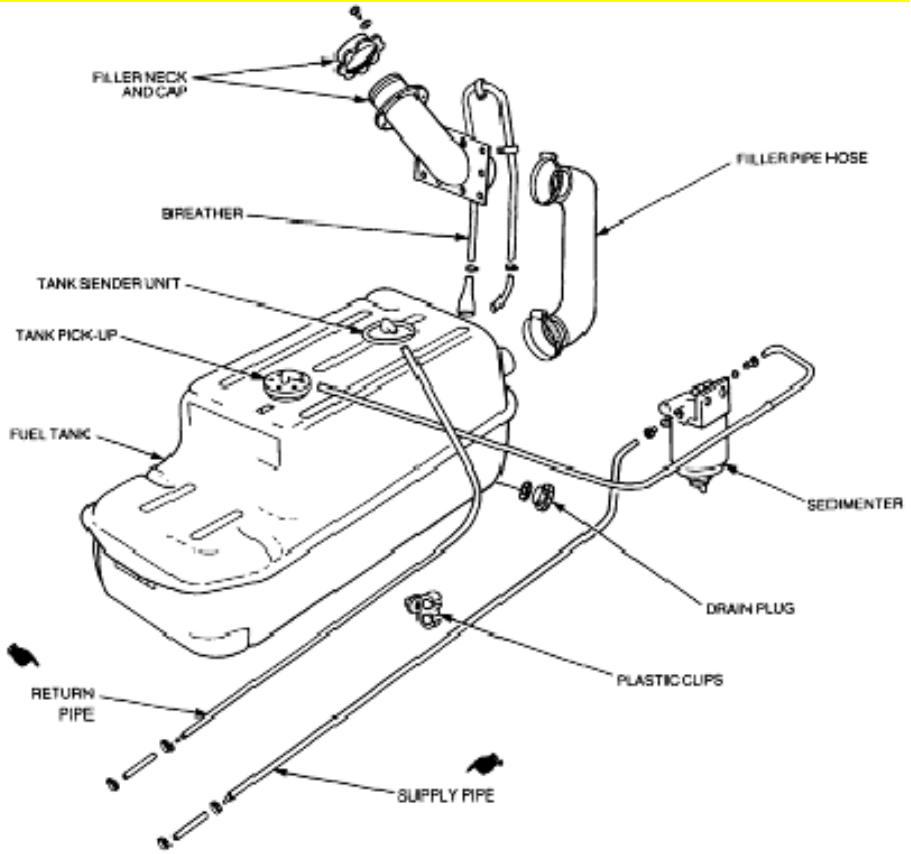


Figure 23 Fuel Tank Exploded View

j. Tag and remove the supply and return hoses from the tank sender unit and pick up pipe.

k. Disconnect the wiring harness from the tank sender unit.

l. Remove the three bolts, nuts and lock-washers securing the tank to the rear chassis bracket. Discard the lock-washers.

m. Lower the tank from under the vehicle.

50. Installation. Install the fuel tank as follows:

a. Raise the fuel tank into position and install the tank front-mounting bracket.

b. Secure the tank to the rear chassis bracket with the three bolts, nuts and new lock-washers and tighten them securely.

c. Install the supply and return fuel hoses on to the tank sender unit and pick up pipe and tighten the connectors securely.

d. Install the filler pipe and breather pipe hoses and tighten the hose clamps securely.

e. Reconnect the wiring harness to the tank sender unit.

f. Ensure that the drain plug is tight.

g. Refill the fuel tank with clean fuel.

h. Check all the connections for leaks (rectify as necessary).

i. Bleed the fuel system (Para 73).

j. Install the rubber mat and floor panel on the driver's side.

k. Install the driver's seat base and the seat base lid

Fuel Lines – Low Pressure

51. Removal. Remove the low pressure fuel lines as follows:

a. Clean the area around the fuel lines using a suitable cleaning agent and blow it dry with compressed air.

b. Tag and remove the supply and return lines from the fuel tank sender unit and pick-up pipe (Figure 24).

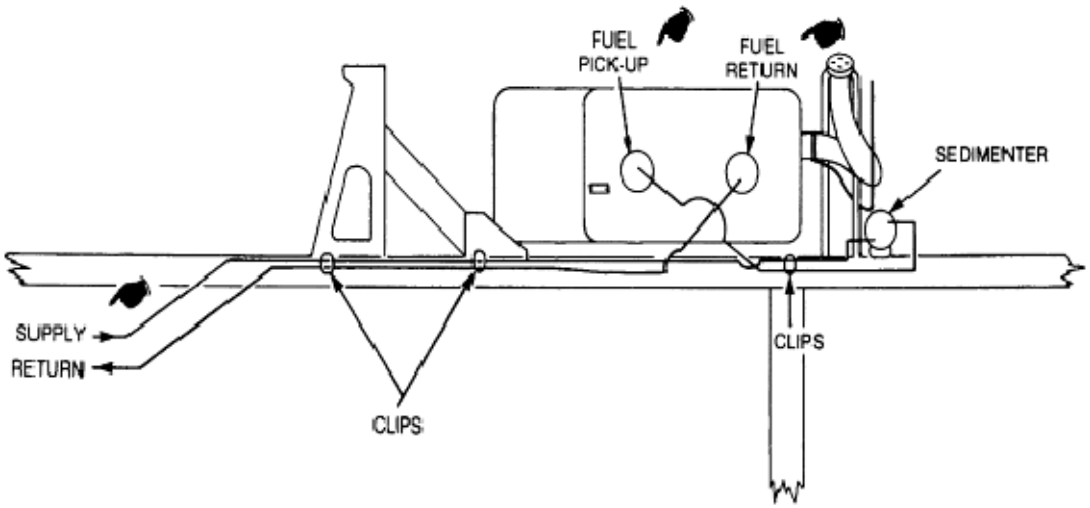


Figure 24 Fuel Lines Removal

c. Drain the fuel from the lines into a suitable receptacle.

d. Remove the connectors securing the two lines to the sedimenter.

e. Loosen the hose clamps securing the return and supply lines to the engine (Figure 25).

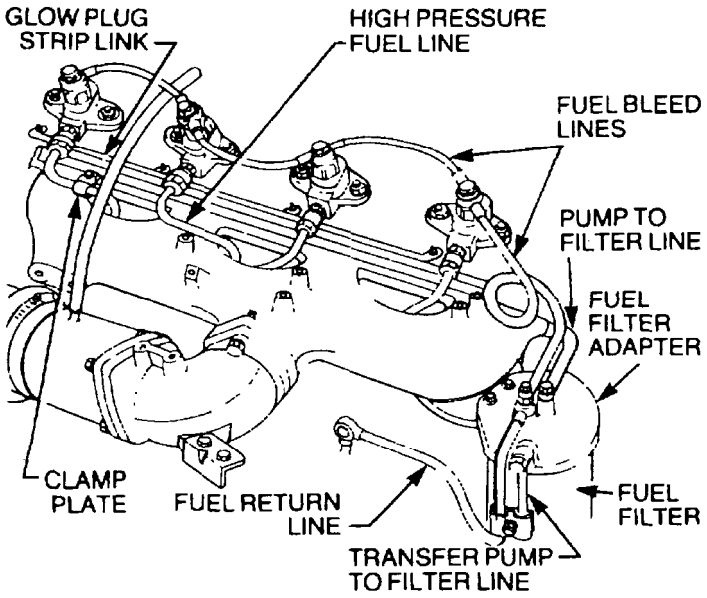


Figure 25 High Pressure Fuel Lines Removal

f. Remove the fuel lines complete with the steel tubing from the chassis plastic clips (Figure 23).

g. Remove the lines from the vehicle.

52. Installation. Install the fuel lines as follows:

a. Position the return fuel line along the chassis rail and connect the line to the sedimenter housing and to the spill return pipe on the engine (Figure 24).

b. Insert the return line into the plastic clips.

c. Position the supply fuel line along the chassis rail and connect the line to the tank sender unit and the fuel transfer pump (Figure 24).

d. Insert the supply line into the plastic clips.

e. Tighten the hose clamps that secure the supply and return lines to the engine (Figure 24).

f. Bleed the fuel system (Para 73).

g. Start the engine and check for leaks (rectify as necessary).

Fuel Lines – High Pressure

53. Removal. Remove the fuel lines as follows:

a. Clean the area around the high pressure fuel line that is to be removed and blow it dry with compressed air.

b. Crack open the nut securing the line to the injector to relieve residual pressure and loosen the nut completely (Figure 25).

c. Loosen the nut securing the fuel line to the injector pump.

d. Remove the clamp plates retaining the fuel line (Figure 26).

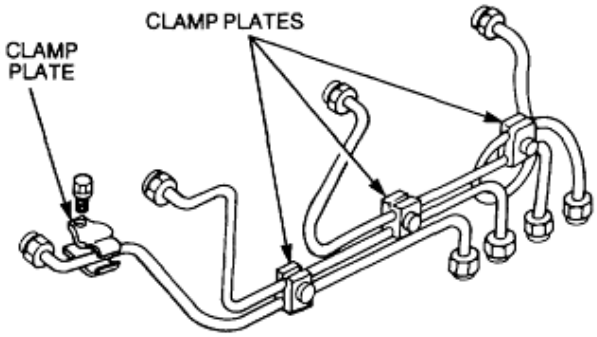


Figure 26 Clamp Plate Location

e. Remove the high pressure fuel line through the inlet manifold.

f. Install suitable plugs onto the injector pump and injector when the fuel line is removed.

54. Installation. Install the fuel lines as follows:

a. Install the high pressure fuel line, ensuring the line ends are seated correctly in the injector and the injector pump connectors.

b. Tighten the fuel line connecting nuts to 28–31 N.m (21–23 lbf.ft).

c. Install and tighten the clamp plates securely.

d. Bleed the fuel system (Para 73).

Fuel Filter

55. Replacement. Replace the fuel filter as follows:

a. Clean the area around the fuel filter using a suitable cleaning agent and blow it dry with compressed air.

b. Place a suitable container below the filter body.

c. Using a suitable filter removing tool, remove the fuel filter (Figure 27).

d. Inspect the filter housing surface to ensure that the rubber seal has not become detached from the filter.

e. Check the cover for signs of cracks or distortion and replace as necessary.

f. Check the threaded insert fitted to the cover and ensure that it is secure.

g. Smear clean fuel on the filter body rubber seal and install the filter on the cover.

h. Tighten the filter by hand until the rubber seal touches the cover face and tighten it one-half turn further.

i. Bleed the fuel system (Para 73).

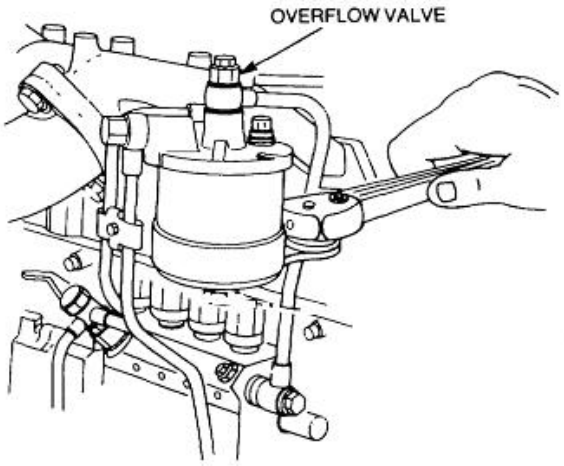


Figure 27 Fuel Filter Removal

Fuel Sedimenter

56. Removal. Remove the fuel sedimenter as follows:

a. Clean the area around the sedimenter using a suitable cleaning agent and blow it dry with compressed air.

b. Remove and plug the fuel lines from the sedimenter.

c. Remove the drain plug and drain the contents into a suitable container (Figure 28).

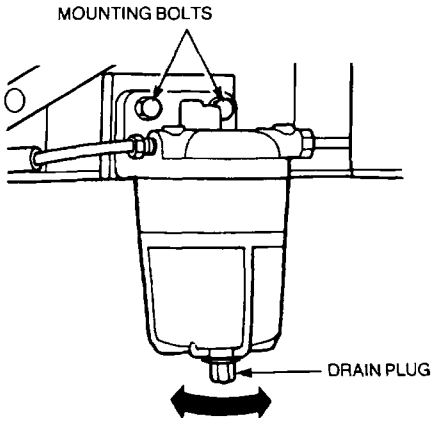


Figure 28 Fuel Sedimenter Removal

d. Remove the two bolts securing the sedimenter to the chassis bracket and remove the sedimenter.

57. Installation. Install the fuel sedimenter as follows:

a. Position the sedimenter on the chassis bracket and secure it with the two bolts.

b. Remove the plugs and install the supply and return lines and tighten them securely.

c. Tighten the drain plug.

d. Bleed the fuel system (Para 73).

Fuel Transfer Pump

58. Test Procedure. Test the fuel transfer pump as follows:

a. Prior to disconnecting any fuel pipes, clean the area around the transfer pump using a suitable cleaning agent and blow it dry with compressed air.

b. Disconnect the fuel outlet pipe from the fuel transfer pump.

c. Connect a T-connector between the transfer pump and the fuel outlet pipe.

d. Connect a suitable pressure gauge to the T-connector.

e. Bleed the air from the fuel system (Para 73).

f. Start the engine and check that the fuel pressure indicated is 175–245 kPa (25–35 psi).

g. Stop the engine.

h. If the pressure is less than specified, remove the in-line fuse located in the stop motor wiring harness adjacent to the brake master cylinder.

WARNING

Removal of the in-line fuse may not prevent the engine from starting. Ensure an operator has full control of the vehicle before proceeding to the next step to prevent injury to personnel and damage to the vehicle and / or the facility.

i. Using the ignition switch, crank the engine to check that it does not start.

j. Remove the T-connector and connect the pressure gauge directly to the transfer pump outlet.

k. Crank the engine for four to five turns and check the pressure on the gauge.

l. If the pressure shown is 333–412 kPa (48–60 psi), the pump is functioning correctly, indicating that the overflow valve is the cause of the initial low pressure and it requires replacement. If the pressure is not within these limits, the transfer pump is faulty and is to be replaced.

m. Crack loose the gauge connection at the transfer pump to allow the fuel (under pressure) to bleed off.

n. Remove the gauge and using new sealing washers, install the pipe on the transfer pump outlet.

o. Tighten the banjo bolt securely.

p. Install the in-line fuse located in the stop motor wiring harness adjacent to the brake master cylinder.

q. Bleed the fuel system (Para 73).

59. Removal. Remove the fuel transfer pump as follows:

a. Loosen the fuel line from the filter cover to the pump at the filter.

b. Loosen the clamp securing the two lines (Figure 29).

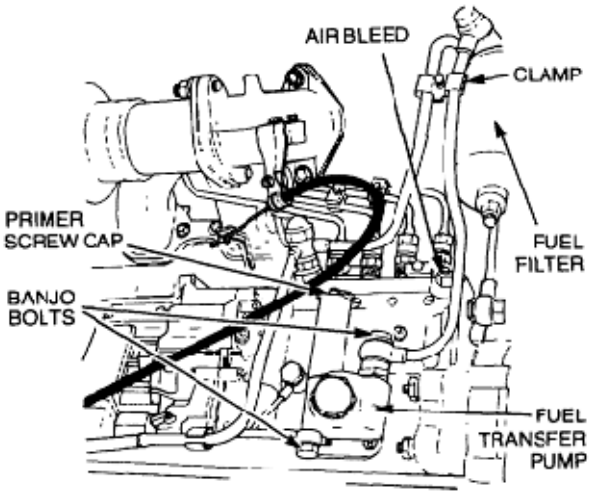


Figure 29 Fuel Transfer Pump Removal

c. Remove the two fuel lines from the pump and plug them with suitable plastic plugs.

d. Remove the three nuts and spring washers securing the transfer pump to the injection pump.

e. Discard the spring washers.

f. Remove the pump and the O ring. Discard the O ring.

60. Installation. Install the fuel transfer pump as follows:

a. Using a new O ring, install the transfer pump on the injection pump.

b. Using new spring washers install the three nuts and tighten them securely.

NOTE

An in-line filter is fitted to the inlet line banjo bolt on the transfer pump. The bolt head is marked with an arrow. Ensure the filter is clean and the arrow aligns with the fuel line on installation.

c. Remove the plugs from the fuel lines.

d. Using new sealing washers, install the two banjo bolts and tighten them securely.

e. Tighten the banjo bolt securing the fuel line to the filter adapter and tighten the pipe clamp.

f. Bleed the fuel system (Para 73).

Fuel Injection Pump

61. Removal. Remove the fuel injection pump as follows:

a. Disconnect the battery.

b. Wash the area around the injection pump using a suitable cleaning agent and blow it dry with compressed air.

c. Remove the high pressure fuel lines (Para 53).

d. Disconnect and plug the fuel return line from the injectors at the filter.

e. Remove the main fuel lines from the fuel filter to the injection and transfer pumps.

NOTE

Following the removal of the fuel lines, plug all openings in the injection pump and filter adapter to prevent the ingress of dirt.

f. Remove the stop cable mounting bracket from the inlet manifold and disconnect the cable from the pump control lever (Figure 35).

g. Disconnect the accelerator cable from the pump control lever.

h. Loosen the hose clamps securing the air cleaner tube to the inlet manifold.

i. Disconnect the crankcase breather pipe connected to the air inlet tube.

j. Remove the nuts and washers securing the inlet manifold to the engine and remove the manifold and gasket.

k. Disconnect the fuel supply and return lines (Para 51).

l. Remove the oil feed pipe from the injection pump and plug to prevent the ingress of dirt.

m. Remove the injection pump rear mounting bracket.

n. Rotate the crankshaft by hand in a clockwise direction to align the crankshaft pulley and the TDC mark on the timing cover (Figure 30).

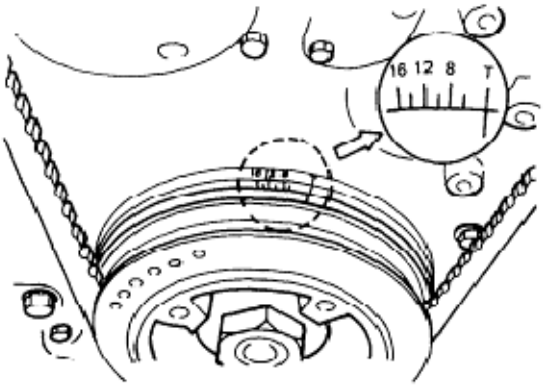


Figure 30 Timing Mark Alignment

o. With the TDC mark aligned, remove the inspection plate on the timing cover and ensure that the notched line is aligned with the arrow mark (Figure 31).

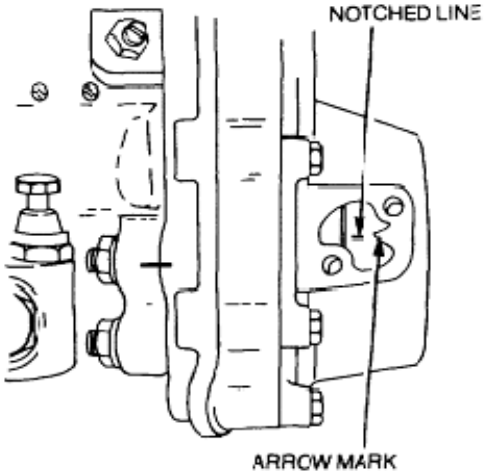


Figure 31 Injection Pump Timing Mark

p. If the arrow mark does not align with the notched line, rotate the crankshaft a further 360 degrees.

CAUTION

Do not rotate the engine once the timing mark is aligned.

q. Remove the timing cover plug.

r. Remove the seven injection pump mounting bolts (Figure 32).

s. Remove the injection pump.

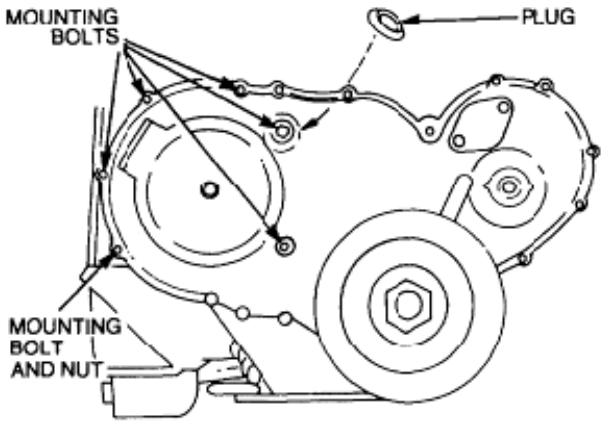


Figure 32 Injection Pump Removal

62. Installation. Install the fuel injection pump as follows:

a. Remove the valve cover.

b. Rotate the crankshaft by hand in the direction of rotation, until the number one cylinder is approaching TDC on the compression stroke and the number four cylinder valves are on the rock.

c. Continue to turn until the notched line on the crankshaft pulley is aligned with the 12 degree mark on the timing case.

NOTE

This is only a reference setting as the timing is set at TDC.

d. Align the pump advance notched line towards the mounting-flange notched line and rotate the pump clockwise until spring tension is felt.

e. Install a new flange gasket and the pump and check that the advance line is approximately 5 mm below the pointer on the timing case aperture (Figure 33).

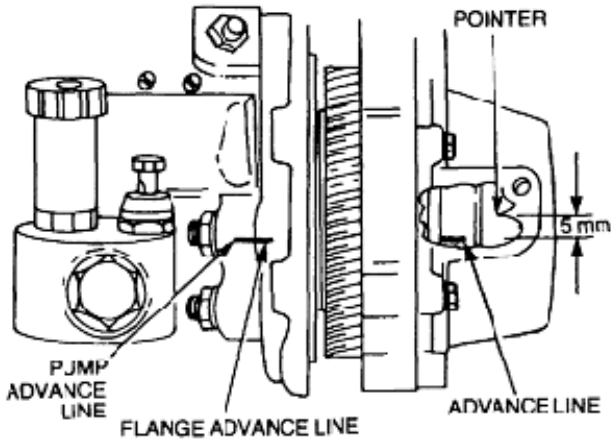


Figure 33 Injection Pump Installation

f. Align the notched line on the pump with the notched line on the mounting flange.

g. Secure the pump with one bolt to prevent radial movement.

h. Rotate the crankshaft by hand in the direction of rotation, until the TDC mark on the crankshaft pulley aligns with the timing mark on the timing case. The advance line should now be in line with the pointer (Figure 30).

i. Install the remaining bolts and tighten them securely.

j. Install the valve cover and tighten the retaining bolts securely.

k. Install the plug and inspection cover onto the timing case.

l. Using new sealing washers, install the oil feed pipe onto the injection pump and tighten the banjo bolt securely.

m. Connect the fuel supply and return lines (Para 52).

n. Install the oil filter adapter and cartridge and tighten the bolts securely.

o. Install the inlet manifold and new gasket onto the engine and tighten the nuts to 16–25 N.m (12–19 lbf.ft).

p. Reconnect the air cleaner tube and tighten the hose clamps.

q. Connect the crankcase breather pipe to the air inlet tube.

r. Install the fuel filter assembly onto the inlet manifold and tighten the two mounting bolts securely.

s. Using new sealing washers, install the main fuel lines between the fuel filter injection and the transfer pumps.

t. Install the high pressure fuel lines (Para 53.e).

u. Install the stop cable bracket onto the inlet manifold and adjust the cable.

v. Connect the accelerator cable and adjust it (Para 70.h).

w. Bleed the fuel system (Para 73).

x. Reconnect the battery.

Fuel Injectors

63. Removal. Remove the fuel injectors as follows:

a. Using a suitable cleaning agent, clean the cylinder head area around the injectors and all connections and blow them dry with compressed air.

b. Remove the fuel return line from the injectors and discard the sealing washers.

c. Remove the high pressure fuel lines from the injectors and plug the fuel lines with suitable plastic plugs.

d. Remove the injector retaining nuts.

CAUTION

Do not strike the injector tip on the cylinder head or on the rack as this can damage the spray holes.

e. Carefully remove the injectors from the cylinder head and place them in a suitable rack in numerical order, so that the injectors can be re-installed in the same cylinder from which they were removed.

NOTE

To remove a stuck injector, apply penetrating oil around the injector body and gradually extract the injector by inserting a suitable lever between the cylinder head and injector body.

f. Remove and discard the dust cap and nozzle gasket.

g. After removing the injectors from the cylinder head, plug the injector cavities with a suitable plastic plug to prevent contaminants from falling into the cylinder.

64. Installation. Install the fuel injectors as follows:

a. Using a new dust cap and nozzle gasket, install the injectors in the cylinder head.

b. Install the nuts and tighten them to 20–30 N.m (15–22 lbf.ft).

c. Install the fuel return line with new sealing washers. Tighten the five banjo bolts securely.

d. Connect the high pressure fuel lines to the injectors.

e. Tighten the retaining nuts securely and tighten all the clamps.

f. Bleed the fuel system (Para 73).

Engine Stop Motor

65. Removal. Remove the engine stop motor as follows:

a. Disconnect the battery.

b. Disconnect the stop cable end from the injection pump stop lever (Figure 34).

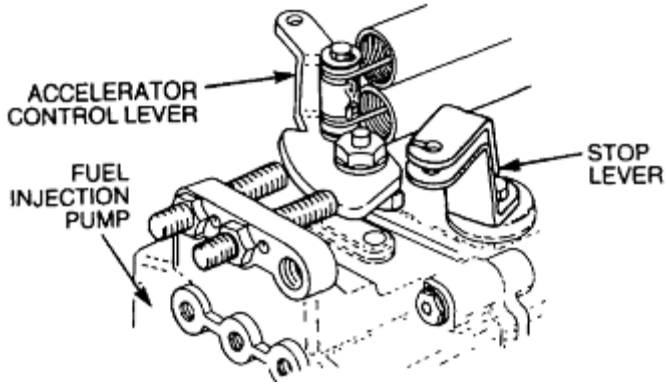


Figure 34 Engine Stop Cable Removal

c. Disconnect the white multi-pin connector from the stop motor.

d. Remove the cable bracket from the inlet manifold (Figure 35).

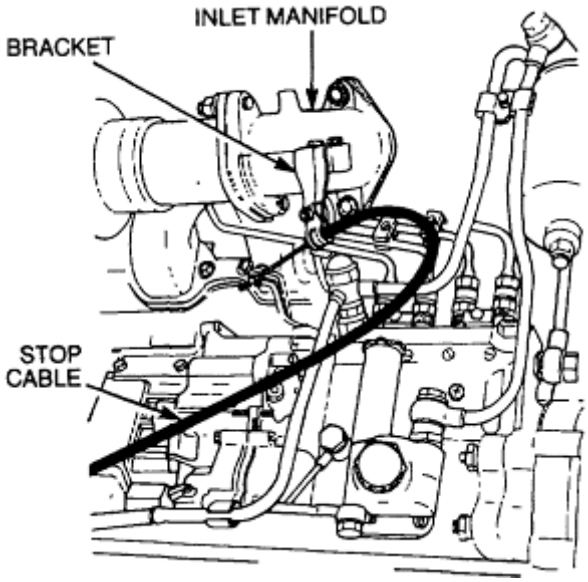


Figure 35 Stop Cable Mounting

e. Remove the locknuts securing the stop motor to the firewall (Figure 36).

f. Remove the motor, complete with the stop cable from the vehicle.

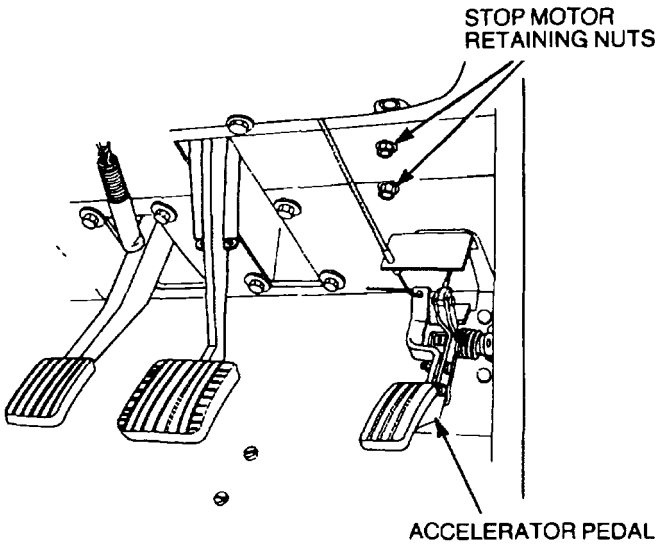


Figure 36 Stop Motor Removal

66. Installation. Install the engine stop motor as follows:

a. Position the stop motor and cable assembly on the firewall and secure them with the two retaining nuts.

b. Connect the wiring harness to the motor and connect the battery.

c. Turn the ignition switch ‘ON’ to obtain the maximum length on the engine stop cable.

d. Connect the cable end to the stop lever.

e. Ensure the stop lever is in the ‘ON’ position and adjust the stop cable to give approximately 1 mm of free play.

f. Install the cable bracket on the inlet manifold (Figure 35) and tighten the two bolts securely.

g. Turn the ignition ‘OFF’.

Hand Throttle Cable

67. Removal. Remove the hand throttle cable as follows:

a. Disconnect the battery.

b. Remove the screw securing the steering wheel cover and remove the cover.

c. With the front wheels in the straight ahead position, remove the steering wheel retaining nut and using the steering wheel puller (Table 3, Serial 3), remove the steering wheel from the column.

d. Remove the seven screws securing the shroud and remove the shroud with the hand throttle attached (Figure 37).

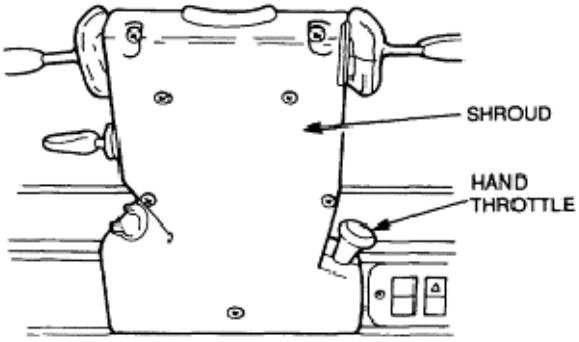


Figure 37 Steering Column Shroud Removal

e. Loosen the nut securing the cable outer to the shroud bracket (Figure 38).

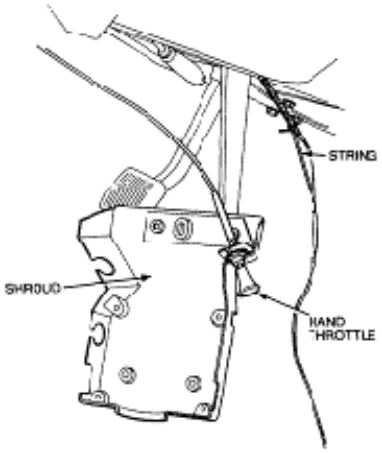


Figure 38 Hand Throttle Cable Removal

f. Disconnect the cable from the accelerator pedal by loosening the clamp screw.

g. Secure a piece of string to the end of the cable and carefully remove the cable from the fascia.

h. Remove the string from the cable, leaving the string in place.

68. Installation. Install the hand throttle cable as follows:

a. Ensuring the string is located behind the fascia, tie the end to the new cable.

b. Pull the string gently back through behind the fascia.

c. Fit the cable to the shroud bracket and install the shroud on the steering column.

d. Fit the seven screws and tighten securely.

NOTE

When installing the steering wheel, ensure the two prongs on the steering wheel hub engage the cut outs in the upper steering column bush. If necessary, rotate the bush to align with the two prongs, ensuring the arrow on the bush faces the indicator switch.

e. Install the steering wheel, shake proof washer and nut. Tighten the nut to 38 N.m (28 lbf.ft).

f. Fit the steering wheel cover and secure it with the screw.

g. Remove the string and insert the inner cable through the bracket.

h. Connect the cable onto the accelerator pedal.

i. Ensure the hand throttle is pushed in fully and tighten the pedal clamp screw.

j. Check the operation of the hand throttle and ensure the accelerator pedal returns without restriction.

Accelerator Cable

69. Removal. Remove the accelerator cable as follows:

a. Disconnect the cable from the pedal by removing the split pin and clevis pin (Figure 39).

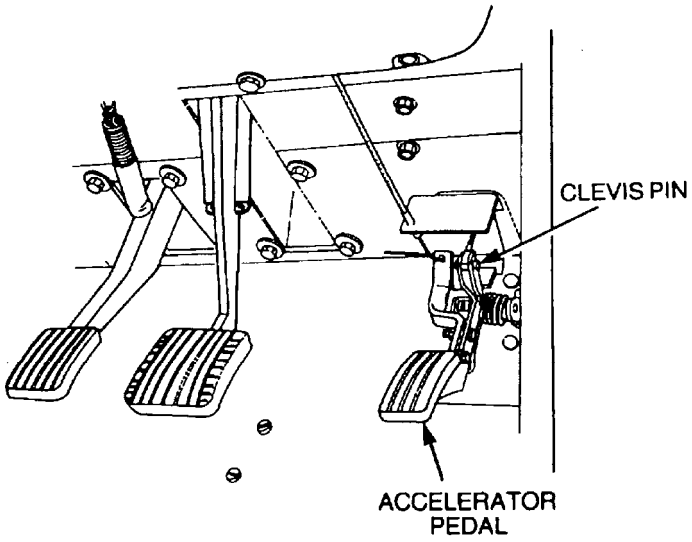


Figure 39 Accelerator Cable Removal

b. Remove the nut and washers securing the cable to the firewall.

c. Disconnect the cable from the fuel injection pump control lever.

d. Remove the clamp securing the cable to the engine.

e. Remove the cable from the vehicle.

70. Installation. Install the accelerator cable as follows:

a. Insert the cable through the firewall from the engine side.

b. Install the nut and washer and tighten them securely.

c. Connect the clevis to the accelerator pedal.

d. Insert the clevis pin and secure it with a new split pin.

e. Connect the clevis to the fuel injection pump control lever.

f. Insert the clevis pin, but do not secure it with the split pin at this stage.

g. Secure the cable to the engine clamp and tighten it securely.

h. Apply a sealant to the outer cable at the firewall.

i. Adjust the accelerator cable (Para 71).

Idle Speed and Accelerator Cable Adjustment

71. Adjust the idle speed and accelerator cable as follows:

a. Start the engine and run it until normal operating temperature is reached.

b. Ensure the control lever is in contact with the idle set bolt when the accelerator pedal is in the 'OFF' position (Figure 40).

c. Using a tachometer, check that the idle speed is approximately 580 rpm.

d. Adjust, as necessary, by turning the stop bolt clockwise to increase engine idle speed and anticlockwise to decrease engine idle speed.

e. Ensure the locknut is secure following adjustment.

f. With the accelerator pedal still in the 'OFF' position, adjust the cable length as required to ensure the stop lever is in contact with the stop bolt.

g. Increase the engine speed by operating the accelerator pedal and return to the 'OFF' position.

h. Check that the pedal returns correctly and the engine idle speed remains at approximately 580 rpm.

i. Fit a new split pin to the control lever clevis.

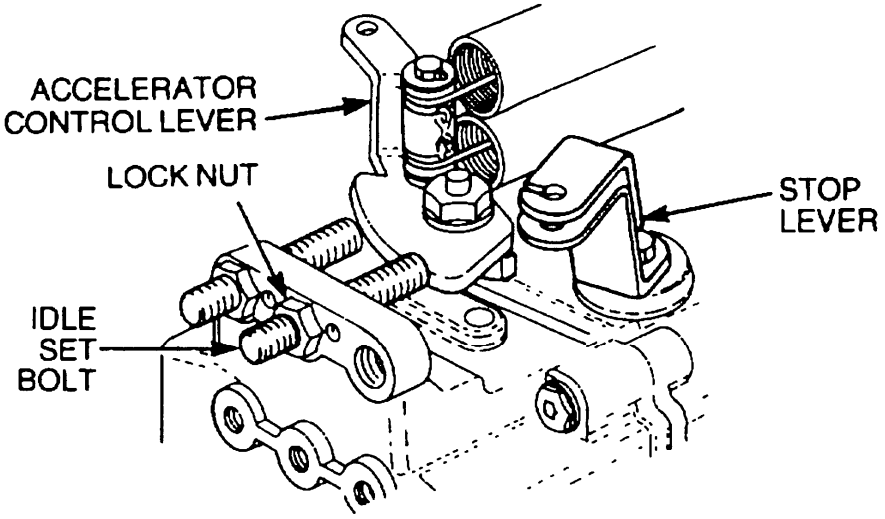


Figure 40 Accelerator Cable and Idle Speed Adjustment

Air Cleaner Elements

72. Replacement. Replace the air cleaner elements as follows:

a. Loosen the hose clamps securing the air inlet and outlet hoses to the air cleaner housing and disconnect the hoses.

NOTE

If the outlet hose is to be disconnected for an extended period of time, seal the open end of the hose to prevent contaminants entering the inlet manifold.

b. Remove the two wing nuts from the clamp bolts (Figure 41).

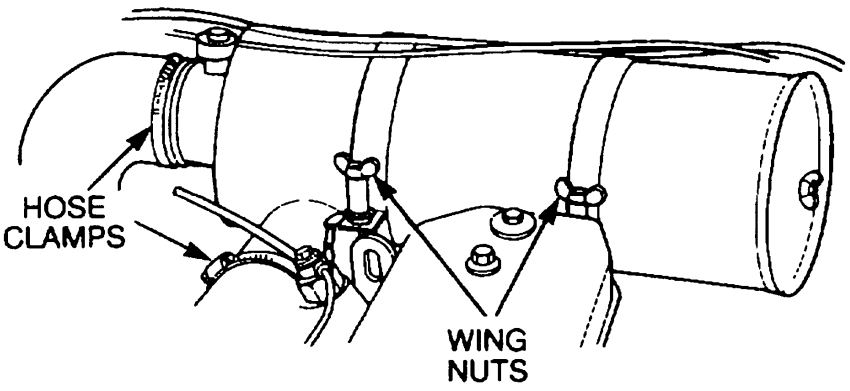


Figure 41 Air Cleaner Assembly Removal

c. Carefully lift the air cleaner out of the mounting brackets.

d. Remove the wing nuts securing the end cover (Figure 42) and remove the end cover.

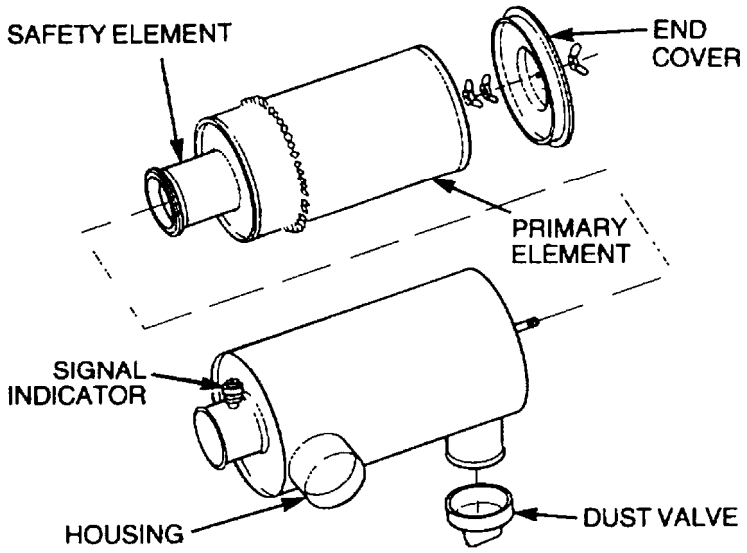


Figure 42 Air Cleaner Elements Replacement

e. Remove the wing nuts securing the elements and remove the elements.

f. Clean the air cleaner housing with a clean, damp cloth.

g. Inspect for signs of cracks and flaking paint.

h. Install a new safety element and primary element.

i. Secure the elements in position with their respective wing nuts.

j. Ensure the end cover gasket is fit for purpose.

k. Install the cover on the housing and tighten the wing nut.

l. Inspect the dust valve for cracks and replace it if necessary.

m. Position the air cleaner assembly in the mounting brackets and connect the inlet and outlet hoses.

n. Tighten the hose clamps and the two clamp-bolt wing nuts securely.

o. Depress the reset button on the signal indicator to enable the red signal to be released.

Bleeding the Fuel System

73. Procedure. Bleed the fuel system as follows:

a. Loosen the screw cap on the transfer pump and operate the primer.

b. Loosen the overflow valve on the fuel filter adaptor and continue operating the primer until a solid stream of fuel flows from the valve (Figure 43).

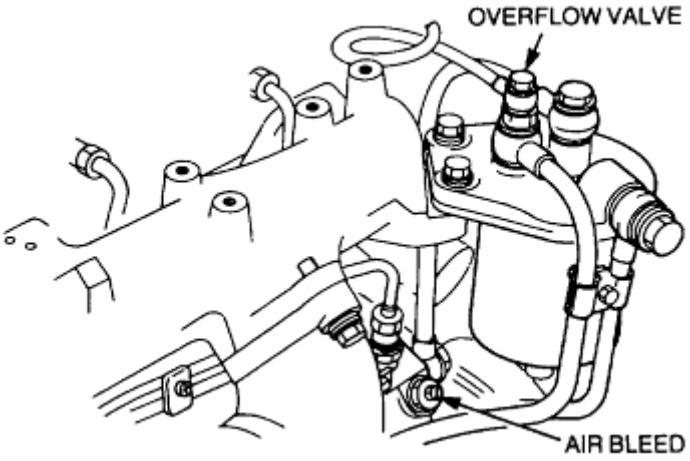


Figure 43 Bleeding the Fuel System

c. Tighten the overflow valve and continue operating the primer.

d. Loosen the air bleed screw and continue operating the primer until a solid stream of fuel flows from the air bleed screw.

e. Tighten the air bleed screw.

f. Secure the primer screw cap.

g. Start the engine.

h. Check for leaks (rectify as required).

i. Ensure that the engine runs smoothly (rectify if required).

Fuel System Specifications

74. The fuel system specifications are detailed in Table 8.

Table 8 Fuel System Specifications

Serial	Specification	Measurement
1	High pressure fuel line nuts tightening torque	28–31 N.m (21–23 lbf.ft)
2	Fuel transfer pump plug tightening torque	78–88 N.m (57–64 lbf.ft)
3	Fuel transfer pump primer tightening torque	40 N.m (28 lbf.ft)
4	Fuel transfer pump adapter tightening torque	12 N.m (10 lbf.ft)
5	Fuel injection pump timing	TDC
6	Fuel injector starting pressure	18 134 kPa (2 630 psi)
7	Fuel injector cap nut tightening torque	58–78 N.m (43–58 lbf.ft)
8	Fuel injector retaining nuts tightening torque	20–30 N.m (15–22 lbf.ft)
9	Engine idle speed	580 rpm
10	Air inlet manifold to cylinder head tightening torque	16–25 N.m (12–19 lbf.ft)

Fuel System Fault Finding

75. The fuel system fault finding is detailed in Table 9.

Table 9 Fuel System Fault Finding

Serial	Symptom	Probable Cause	Action
1	Difficult starting	Lack of fuel	Check tank contents
		Fuel contamination	Check fuel for water, dirt, wax or incorrect fuel
		Stop motor faulty	Check motor and cable adjustment
		Incorrect starting procedure	Check heater plugs, accelerator and stop cable operations
		Air in fuel system	Check all unions, lines and hoses. Bleed system
		Fuel restriction	Check filters and supply lines
		Low cranking speed	Check battery, starter, cables and engine oil type
		Incorrect timing	Check timing
		Fuel return restricted	Check fuel return lines
		Fuel flow incorrect	Check fuel lines not crossed
		Engine condition	Check cylinder compressions, valve timing and clearances and air cleaner condition
		Faulty injectors	Check injectors for correct type, starting pressures and spray patterns
		Fuel tank breather blocked	Check tank breather
		High pressure fuel lines leaking	Check and tighten lines
		Injection pump faulty	Replace injection pump
		Fuel transfer pump faulty	Replace transfer pump
2	Irregular idle.	Air in fuel system	Check all unions, lines and hoses. Bleed system
		Fuel restriction	Check filters and supply lines
		Fuel contamination	Check fuel for water, dirt, wax or incorrect fuel
		Incorrect timing	Check timing
		Fuel return restricted	Check fuel return lines
		Fuel flow incorrect	Check fuel lines not crossed
		Engine condition	Check cylinder compressions, valve timing and clearances and air cleaner conditions
		Faulty injectors	Check injectors for correct type, starting pressures and spray patterns
		High pressure fuel lines leaking	Check and tighten lines
		Injection pump faulty	Replace injection pump
		High pressure fuel line restriction	Check for kinks, bore reduction
		Idle speed incorrect	Adjust idle speed
		Incorrect accelerator cable adjustment	Adjust cable
		Engine vibration	Check engine mountings
		Injection pump loose	Check and tighten mounting bolts
3	Maximum speed excessive	Injection pump faulty	Replace injection pump
4	Engine will not shut down	Stop motor or cable faulty	Check motor and cable adjustment
		Injection pump faulty	Replace injection pump

Table 9 Fuel System Fault Finding (Continued)

Serial	Symptom	Probable Cause	Action
5	Insufficient maximum speed	Air in fuel system	Check all unions, lines and hoses. Bleed system
		Fuel restriction	Check filters and supply lines
		Injection pump faulty	Replace injection pump
		Incorrect accelerator cable adjustment	Adjust cable
		Fuel transfer pump faulty	Replace transfer pump
		Incorrect timing	Check timing
		Faulty injectors	Check injectors for correct type, starting pressure and spray patterns
		Vehicle brakes binding	Adjust brakes
6	Irregular engine output	Fuel restriction	Check filters and supply lines
		Fuel transfer pump faulty	Replace transfer pump
		Air in fuel system	Check all unions, lines and hoses. Bleed the system
		Fuel contamination	Check fuel for water, dirt, wax or incorrect fuel
		Injection pump faulty	Replace injection pump
		Faulty injector	Check injector for correct type, starting pressure and spray pattern
		Incorrect timing	Check timing
		Faulty advance mechanism	Report
		Incorrect stop and accelerator cable adjustment	Check and adjust
7	Excessive smoke	Fuel contamination	Check fuel for water, dirt, wax or incorrect fuel
		Incorrect timing	Check timing
		Engine condition	Check cylinder compressions, valve timing and clearances and air cleaner condition
		Injection pump faulty	Replace injector pump
		Faulty injector	Replace injector
8	Excessive knocking (Detonation)	Incorrect starting procedure	Check heater plugs
		Faulty injector	Replace injector
		Lack of coolant in radiator	Check level
		Lack of oil in engine	Check level and top up as necessary
		Incorrect timing	Check timing
		Faulty advance mechanism	Report

CLUTCH

Clutch Pedal

76. Removal. Remove the clutch pedal as follows:

a. Clean the area around the clutch master cylinder using a suitable cleaning agent and blow it dry with compressed air.

b. Disconnect and plug the hydraulic line from the master cylinder.

c. Plug the master cylinder.

d. Disconnect the clutch pedal return spring (Figure 44).

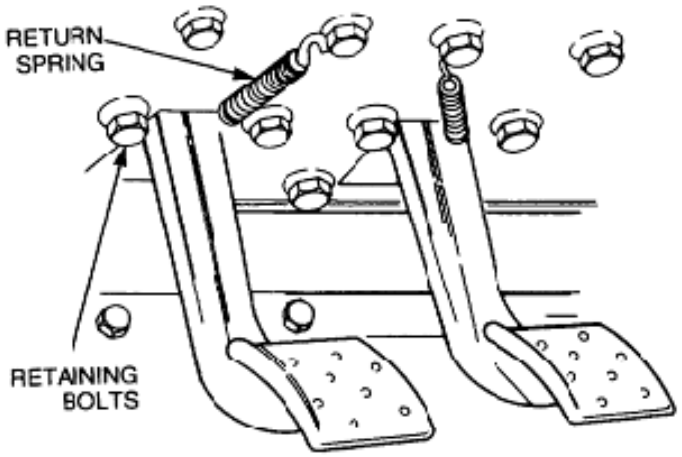


Figure 44 Pedal Bracket and Return Spring Removal

e. Remove the six bolts securing the pedal bracket to the firewall (Figure 44).

f. Remove the pedal and bracket assembly from the vehicle.

g. Remove the six screws securing the top cover and gasket to the pedal bracket (Figure 45).

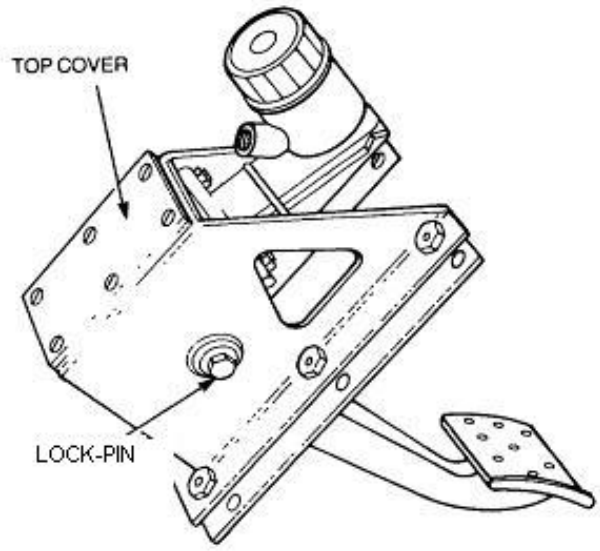


Figure 45 Top Cover Removal

h. Remove the top cover and gasket and discard the gasket.

i. Clean the top cover and pedal bracket.

j. Remove the nut and washer from the end of the master cylinder push rod.

k. Push the rod in and detach the pedal trunnion.

l. Remove the lock-pin from the pedal pivot (Figure 45).

m. Remove the pedal pivot.

n. Remove the pedal from the pedal bracket.

o. Remove the trunnion, distance piece and bushes from the pedal (Figure 46). Discard the bushes.

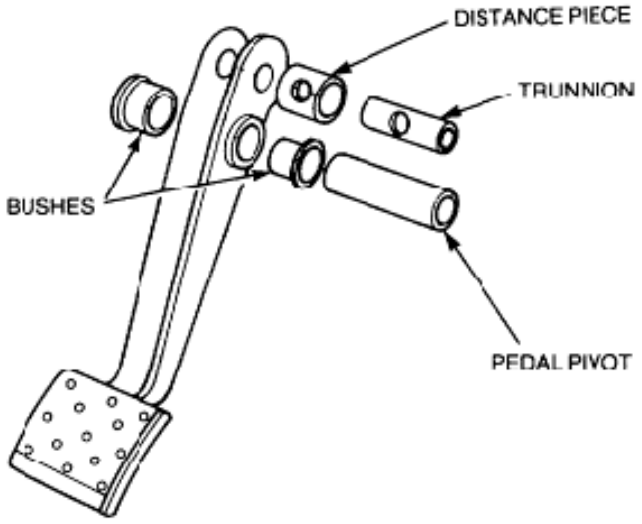


Figure 46 Clutch Pedal Exploded View

77. Installation. Install the clutch pedal as follows:

a. Using a suitable press, install two new bushes in the pedal.

b. Install the pedal pivot (check that the pedal pivot moves freely).

c. Lubricate the trunnion and distance piece with grease and fit them to the pedal.

d. Install the pedal in the pedal bracket ensuring that the clutch master cylinder push rod is inserted into the trunnion.

e. Install the lock-pin on the pedal pivot (Figure 45).

f. Install the nut and washer on the master cylinder push rod, but do not tighten them at this stage.

g. Position the pedal and bracket in the vehicle and secure them with the six retaining bolts (Figure 44).

h. Reconnect the hydraulic line to the master cylinder and tighten it securely.

i. Connect the pedal return spring.

j. Bleed the hydraulic system (Para 83).

k. Adjust the clutch pedal (Para 78).

78. Adjustment. Adjust the clutch pedal as follows:

a. Remove the top cover and gasket (if not already removed). Discard the gasket.

b. Check the distance from the lower edge of the clutch pedal to the floor (Figure 47).

c. Loosen the locknuts on the push rod and adjust the pedal stop as required.

d. Adjust the push rod until there is approximately 1.5 mm (0.062 in) free play between the push rod and the master cylinder piston and tighten the locknuts.

e. Check the clutch pedal and ensure that there is a minimum of 6 mm (0.250 in) free movement of the pedal before pressure is felt.

f. If necessary, readjust the push rod.

g. Install the top cover and a new gasket and tighten the six screws securely.

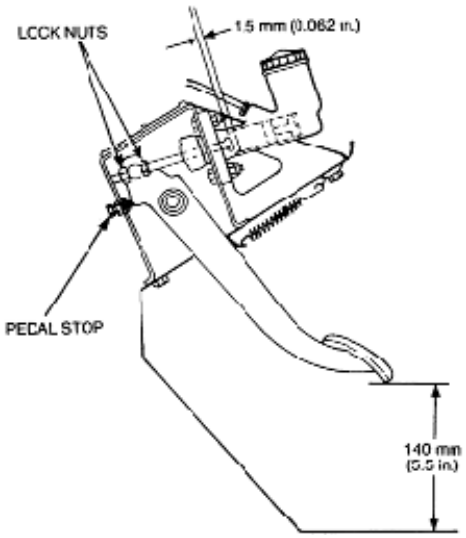


Figure 47 Clutch Pedal Adjustment

Clutch Master Cylinder

79. Removal. Remove the clutch master cylinder as follows:

a. Using a suitable cleaning agent clean the area around the master cylinder and blow it dry with compressed air.

b. Remove the six screws securing the top cover and gasket to the pedal bracket.

c. Remove the top cover and gasket and clean the gasket area. Discard the gasket.

d. Disconnect and plug the hydraulic line from the master cylinder.

e. Remove the nut and washer from the push rod (Figure 48).

f. Remove the two retaining bolts securing the master cylinder to the pedal bracket.

g. Remove the master cylinder from the pedal bracket.

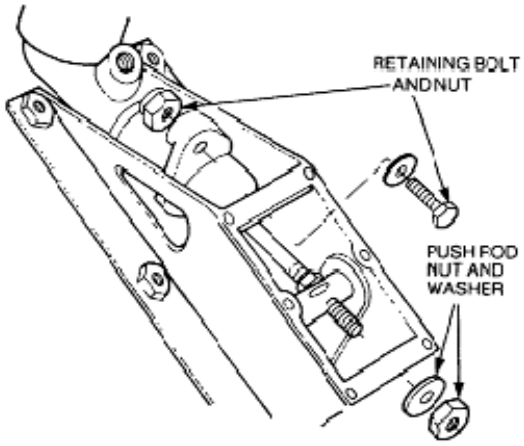


Figure 48 Clutch Master Cylinder Removal

80. Installation. Install the clutch master cylinder as follows:

a. Install the master cylinder onto the pedal bracket and tighten the two retaining bolts securely.

b. Reconnect the hydraulic line to the outlet pipe and tighten it securely.

c. Install the nut and washer on the push rod.

d. Carry out the adjusting and bleeding procedures (Paras 78 and 83).

e. Refit the top cover and a new gasket.

Clutch Slave Cylinder

81. Removal. Remove the clutch slave cylinder as follows:

a. Using a suitable cleaning agent clean the area around the slave cylinder and blow it dry with compressed air.

b. Loosen the bleed screws and drain the hydraulic fluid into a suitable receptacle.

c. Disconnect and plug the hydraulic line from the slave cylinder.

d. Plug the slave cylinder.

e. Remove the two bolts securing the cylinder to the transmission bell housing.

f. Remove the hydraulic line bracket from the starter motor stud.

g. Remove the backing plate.

h. Remove the dustcover (Figure 49).

i. Remove the slave cylinder.

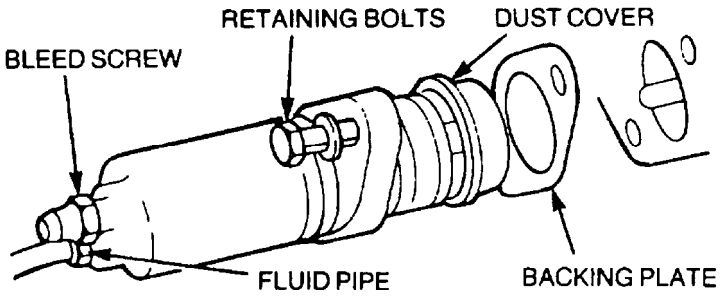


Figure 49 Clutch Slave Cylinder Removal

82. Installation. Install the clutch slave cylinder as follows:

a. Apply a suitable sealer to both sides of the backing plate and install the plate onto the cylinder.

b. Smear the inside of the dust cover with clean hydraulic fluid and install it onto the cylinder.

c. Install the cylinder into the bell housing, ensuring the push rod is inserted into the dust cover and the bleed screw is uppermost (Figure 50).

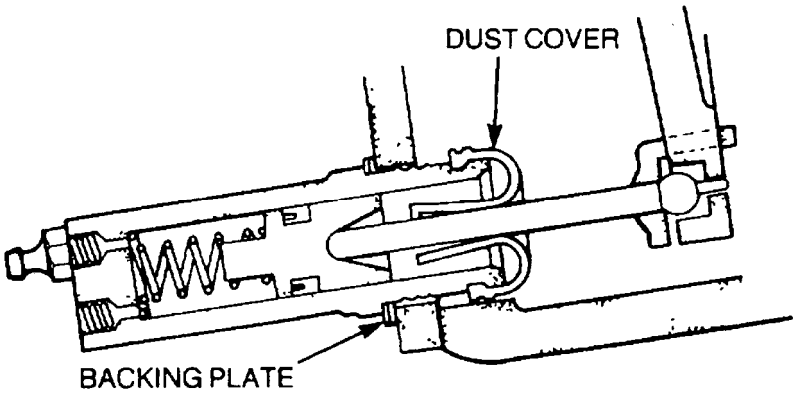


Figure 50 Clutch Slave Cylinder Installation

d. Install the two retaining bolts and washers and tighten them to 27 N.m (20 lbf.ft).

e. Fit the hydraulic line bracket to the starter motor stud and tighten the nut to 40 N.m (30 lbf.ft).

f. Reconnect the hydraulic line and replenish the hydraulic fluid.

g. Carry out the bleeding procedure (Para 83).

h. Check the clutch adjustment (Para 78).

Bleeding the Clutch System

83. Bleed the clutch system as follows:

NOTE

When bleeding the clutch system, keep the fluid reservoir topped up to avoid the introduction of air into the system. Use only the recommended hydraulic fluid.

a. Attach a length of suitable tubing to the slave cylinder bleed screw (Figure 51) and place the free end of the tube in a glass jar containing hydraulic fluid.

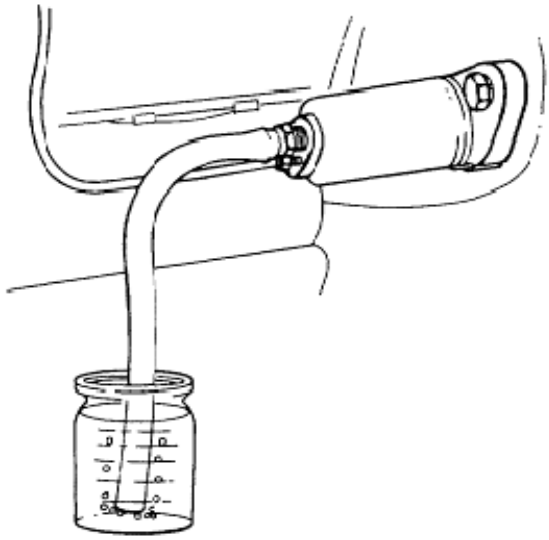


Figure 51 Clutch System Bleeding Procedure

b. Loosen the bleed screw and pump the clutch pedal, pausing at the end of each stroke.

c. Ensuring the tube is below the surface of the fluid, continue pumping until the fluid being pumped from the tube is free of air.

d. Tighten the bleed screw when the pedal has completed a downward stroke.

e. Remove the tube and jar.

Clutch System Specifications

84. The clutch system specifications are detailed in Table 10.

Table 10 Clutch System Specifications

Serial	Specification	Measurement
1	Clutch pedal trunnion bushes internal dimension	19.05 mm ±0.02 mm (0.750 in ±0.002 in)
2	Clutch master cylinder push rodfree play	1.5 mm (0.062 in)
3	Clutch pedal free play	6 mm (0.250 in)
4	Clutch pedal height	140 mm (5.5 in)
5	Clutch slave cylinder tightening torque	27 N.m (20 lbf.ft)
6	Hydraulic pipe bracket tightening torque	40 N.m (30 lbf.ft)
7	Air inlet manifold to cylinder head tightening torque	16–25 N.m (12–19 lbf.ft)

Clutch System Fault Finding

85. The clutch system fault finding is detailed in Table 11.

Table 11 Clutch System Fault Finding

Serial	Symptom	Probable Cause	Action
1	Clutch grabbing	Clutch pedal sticking	Repair or replace
		Oil on friction plate	Report
		Defective friction plate	Report
2	Clutch slipping	Incorrect clutch adjustment	Carry out adjustment procedure
		Oil on friction plate	Report
		Defective friction plate	Report
3	Dragging or spinning clutch	Incorrect clutch adjustment	Carry out adjustment procedure
		Low fluid level	Top up as necessary
		Air in the hydraulic system	Check for leaks and bleed the system
4	Rattling clutch	Broken pedal return spring	Replace
		Defective friction plate	Report
5	Squeaking clutch	Crankshaft spigot bearing fault	Report
6	Clutch shudder	Defective friction plate	Report
		Flywheel loose	Report
		Loose engine mountings	Tighten or replace
		Primary shaft bent	Report
		Worn propeller shaft universal joints	Replace
7	Stiff operation	Pedal faulty	Repair or replace

TRANSMISSION

Gear Lever

86. Removal. Remove the gear lever as follows:

a. Remove the zip clamp securing the rubber boot to the transmission tunnel cover (Figure 52).

b. Remove the knobs from the gear lever and transfer selector lever.

c. Remove the rubber boot and insulating pad from the vehicle.

d. Remove the small rubber boot covering the retaining plate.

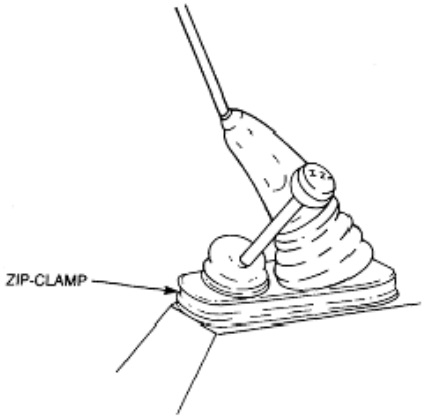


Figure 52 Gear Lever Rubber Boot Removal

e. Remove the three bolts securing the retaining plate to the top cover (Figure 53).

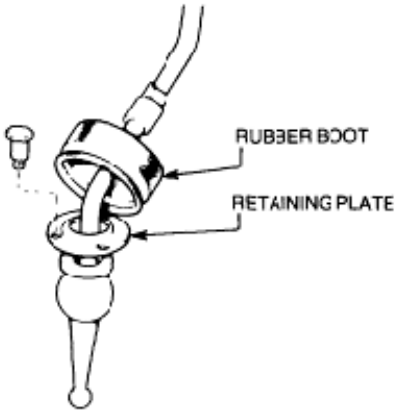


Figure 53 Gear Lever Removal

f. Lift the lever out of the top cover.

87. Installation. Install the gear lever as follows:

a. Smear the ball of the gear lever with suitable graphite grease.

b. Insert the lever into the top cover and selectors; ensure the locating pin is correctly engaged in the slot on the ball.

c. Tighten the three retaining bolts securely.

d. Check the selection of all gears.

e. Stretch the small rubber boot over the top cover.

f. Install the insulating pad in the tunnel cover.

g. Install the rubber boot onto the tunnel cover and secure it with the zip-clamp (Figure 52).

h. Install both the gear lever knob and transfer lever knob.

Transfer Case Selector Lever

88. Removal. Remove the transfer case selector lever as follows:

a. Remove the zip clamp securing the rubber boot to the transmission tunnel cover (Figure 52).

b. Remove the knobs from the gear lever and transfer case selector lever.

c. Remove the rubber boot and insulating pad from the vehicle.

d. Tap out the roll pin securing the transfer case selector lever to the cross shaft (Figure 54).

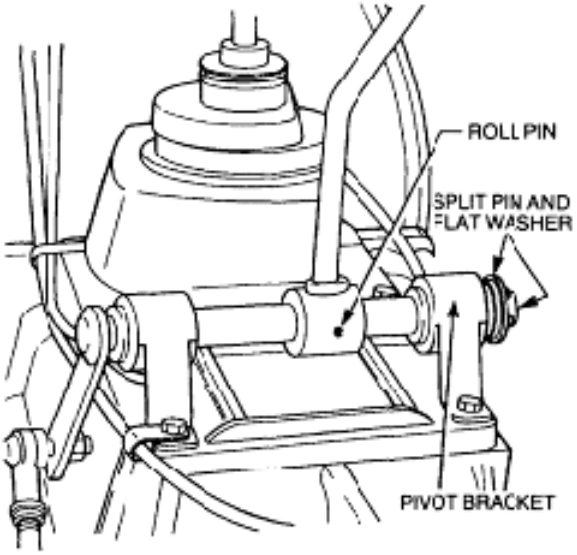


Figure 54 Transfer Case Selector Lever Removal

e. Remove the split pin and flat washer from the end of the cross shaft.

f. Remove the two bolts securing the pivot bracket to the top cover and remove the bracket.

g. Slide the lever along and off the cross shaft.

89. Installation. Install the gear lever as follows:

a. Install the lever on the cross shaft, ensuring that the lever is angled towards the rear of the vehicle.

b. Smear the inside of the pivot bracket bush with grease and install the bracket on the cross shaft.

c. Install the flat washer and secure it in position with a new split pin.

d. Install the two pivot bracket bolts and tighten them securely.

e. Install the roll pin to secure the lever to the cross shaft (Figure 54).

f. Install the insulating pad into the tunnel cover.

g. Install the rubber boot onto the tunnel cover and secure it with a zip clamp (Figure 52).

h. Install both the gear lever knob and transfer case lever knob.

90. Lever Fouling Rectification. To ensure that the transfer case lever is not fouling on the bodywork carry out repairs as follows:

a. Remove the zip clamp, securing the gear lever rubber boot and ease the boot upwards so the transfer case lever movement can be viewed.

b. Select ‘High Range’ and then select ‘Low Range’ to ensure that there is no fouling between the transfer case lever and the foam sound deadening material.

c. If fouling does occur in either position, remove the foam deadening material by cutting and recheck high/low range selection.

d. Resecure the gear lever rubber boot with a zip clamp.

Transfer Case Selector Fork

91. Adjustment. The selector fork adjustment is to be carried out as follows:

WARNING

New gaskets provided by Land Rover do not contain asbestos. Older gaskets still fitted to vehicles may contain asbestos. During this task some parts may contain asbestos; refer and comply with procedures and warnings in the introduction section of this EMEI under paragraph heading: Items Previously Known To Have Contained Asbestos.

a. Chock the vehicle wheels.

b. Remove the centre plastic access tray/rifle butt box.

c. Remove the transfer case top cover plate.

NOTE

Some difficulty may be experienced removing the transfer case top cover plate due to the baffle fitted to the plate.

d. Select neutral on the transfer lever and check that the input gear on the intermediate gear assembly is in the neutral position and the front fork is in contact with the input gear inner member.

e. Adjust the rear fork position on the selector shaft. to allow a clearance of 0.12–0.25 mm (005–010 in), between the front face of the rear fork and the rear face of the input gear inner member.

f. Tighten the pinch bolt securely.

g. Fit a new gasket.

h. Refit the transfer case top cover plate and tighten it securely.

i. Refit the centre plastic access tray/rifle butt box.

PTO Control Cable

92. Removal. Remove the PTO control cable as follows:

a. Remove the split pin from the PTO lever clevis (Figure 55).

b. Discard the split pin.

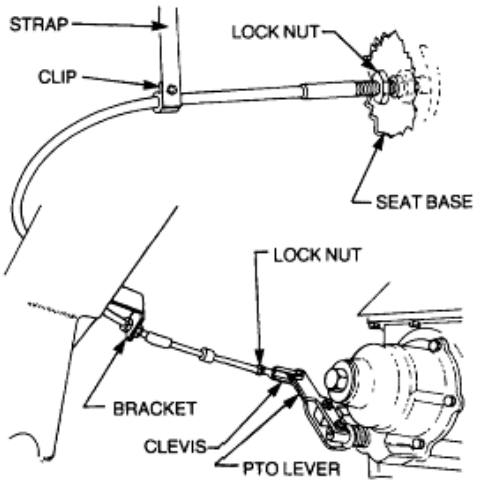


Figure 55 PTO Control Cable Removal

c. Loosen the clevis locknut and remove the clevis and the locknut from the inner cable.

d. Remove the nut securing the outer cable to the body mounting bracket.

e. Remove the cable from the bracket.

f. Remove the clip securing the cable to the strap.

g. Remove the knob from the cable.

h. Remove the locknut securing the cable to the seat base.

i. Remove the cable from behind the seat base.

93. Installation. Install the PTO control cable as follows:

a. Insert the cable through the seat base.

b. Install the locknut on the cable and secure the cable to the seat base (Figure 55).

c. Install the handle.

d. Install the clip and secure the cable to the strap with the nut and bolt.

e. Install a locknut on the outer cable and insert the cable through the body mounting bracket.

f. Fit the remaining locknut on the outer cable, but do not tighten it until the adjustment has been carried out.

g. Install the clevis and locknut on the inner cable, but do not tighten it until the adjustment has been carried out.

94. Adjustment. Adjust the PTO control cable as follows:

a. Push the cable handle in towards the seat base.

b. Push the PTO lever to the disengaged position (to the front of the vehicle).

c. Adjust the clevis and nut along the inner cable to the end of the threaded portion.

d. Adjust the two locknuts on the outer cable, situated at the body mounting bracket, until the hole in the clevis aligns with the hole in the PTO lever.

e. Insert the pin and secure it with a new split pin.

f. Tighten the clevis locknut and the two outer cable locknuts.

g. Check the operation of the PTO and readjust if necessary.

Transmission Filter and Magnetic Plug

95. Removal. Remove the transmission filter and magnetic plug as follows:

WARNING

New gaskets provided by Land Rover do not contain asbestos. Older gaskets still fitted to vehicles may contain asbestos. During this task some parts may contain asbestos; refer and comply with procedures and warnings in the introduction section of this EMEI under paragraph heading: Items Previously Known To Have Contained Asbestos.

a. Remove the filler/level plug from the left-hand side of the transmission (Figure 56).

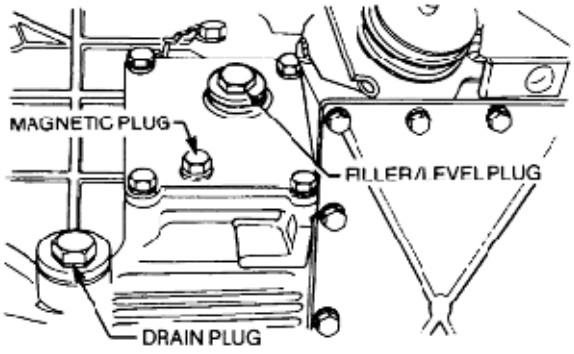


Figure 56 Transmission Filter Removal

b. Remove the drain plug and drain the oil into a suitable receptacle.

c. Remove the filter located behind the drain plug.

d. Remove the magnetic plug.

96. Cleaning and Inspection. Clean and inspect transmission filter as follows:

a. Inspect the transmission filter for damage and any large metal particles that may be present. Wash the filter in a suitable solvent.

b. Inspect the magnetic plug for any large metal particles that may be present. Wash the magnetic plug in a suitable solvent.

97. Installation. Install transmission filter and magnetic plug as follows:

a. Insert the filter into the transmission and using a new sealing washer, install the drain plug and tighten it securely.

b. Using a new sealing washer, install the magnetic plug and tighten it securely.

c. Fill the transmission with oil until oil begins to flow from the filler/level hole (approximately 2.7 litres).

d. Using a new sealing washer, install the filler/level plug and tighten it securely.

Output Shaft Cover Oil Seal – Front

98. Removal. Remove the output shaft cover oil seal (front) as follows:

a. Using a suitable cleaning agent, clean the area around the front output shaft and blow it dry with compressed air.

b. Remove the four nuts securing the front propeller shaft to the front output shaft coupling flange.

c. Remove the propeller shaft.

d. Remove the locknut and the flat washer (Figure 57). Discard the locknut.

e. Remove the flange.

f. Remove the mud shield.

g. Remove and discard the oil seal using a suitable lever.

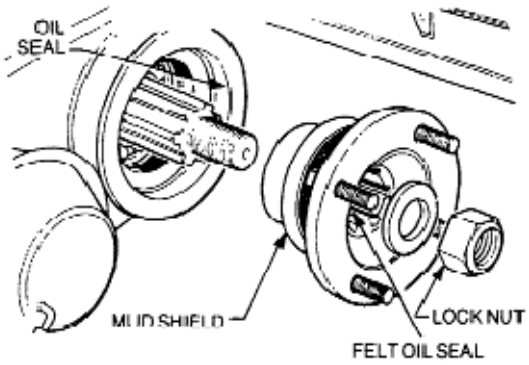


Figure 57 Output Shaft Cover Oils Seal Removal (Front)

99. Installation. Install the output shaft cover oil seal (front) as follows:

a. Press in the new oil seal with the sealing lip towards the bearing.

b. Apply a smear of clean SAE Grade 40 (OMD-115) oil around the lip of the seal.

c. Install the mud shield.

d. Install the flange.

e. Apply Loctite 242 or equivalent to the output shaft threads.

f. Install the flat washer and new locknut. Tighten the nut to 146–180 N.m (108–132 lbf.ft).

g. Position the front propeller shaft on the coupling flange.

h. Install the four nuts and tighten them securely.

i. Check the transfer case oil level and top up if necessary.

Output Shaft Cover Oil Seal – Rear

100. Removal. Remove the output shaft cover oil seal (rear) as follows:

a. Clean the area around the rear output shaft using a suitable cleaning agent and blow it dry with compressed air.

b. Remove the locknuts and bolts securing the rear propeller shaft. Discard the locknuts.

c. Remove the propeller shaft.

d. Remove the locknut and flat washer (Figure 58). Discard the locknut.

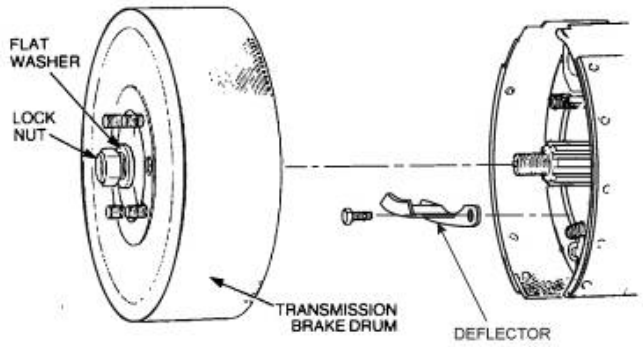


Figure 58 Output Shaft Cover Oils Seal Removal (Rear)

WARNING

Under no circumstances is compressed air to be used to remove dust from the hand brake drum or brake linings. Dust from the brake linings can be a health risk if inhaled.

e. Remove the transmission brake drum complete with the rear coupling flange.

f. Remove the two bolts securing the deflector.

g. Remove the deflector.

h. Remove the retainer packing.

i. Remove the oil seal using a suitable lever.

101. Installation. Install the output shaft cover oil seal (rear)as follows:

a. Press in a new oil seal, sealing lip first, until the seal plain face just clears the chamfer on the seal housing bore.

b. Install the retainer packing.

c. Apply a smear of Bostik Compound 772 (or equivalent) to seal the deflector against the brake back-plate.

d. Install the two bolts and tighten them securely.

e. Apply a smear of clean SAE Grade 40 (OMD-115) oil around the lip of the seal.

f. Install the transmission brake drum and rear coupling flange.

g. Insert a new felt oil seal into the coupling flange.

h. Install the flat washer and new locknut. Tighten the locknut to 146–180 N.m (108–132 lbf.ft).

i. Install the propeller shaft.

CAUTION

When fitting new locknuts ensure the correct nuts are used in the correct locations as they are different in height for the differential end and transmission end of the propeller shaft.

j. Install new locknuts and bolts and tighten them securely.

k. Check the transfer case oil level and top up if necessary.

Bottom Cover

102. Removal. Remove the bottom cover as follows:

WARNING

New gaskets provided by Land Rover do not contain asbestos. Older gaskets still fitted to vehicles may contain asbestos. During this task some parts may contain asbestos; refer and comply with procedures and warnings in the introduction section of this EMEI under paragraph heading: Items Previously Known To Have Contained Asbestos.

a. Using a suitable cleaning agent, clean the area around the bottom cover and blow it dry with compressed air.

b. Remove the drain plug and drain the oil from the transfer case into a suitable receptacle.

c. Re-install the drain plug.

d. Remove the fourteen bolts that secure the bottom cover to the transfer case.

e. Remove the cover and the gasket. Discard the gasket.

f. Remove all traces of gasket material from the transfer case and cover.

103. Installation. Install the bottom cover as follows:

a. Install the bottom cover with a new gasket and secure them the fourteen bolts.

b. Evenly tighten the bolts to 30 N.m (22 lbf.ft).

c. Fill the transfer case with oil.

Top Cover.

WARNING

New gaskets provided by Land Rover do not contain asbestos. Older gaskets still fitted to vehicles may contain asbestos. During this task some parts may contain asbestos; refer and comply with procedures and warnings in the introduction section of this EMEI under paragraph heading: Items Previously Known To Have Contained Asbestos.

104. Removal. Remove the top cover as follows:

a. Remove the zip-clamp securing the rubber boot to the transmission tunnel cover (Figure 59).

b. Remove the knobs from the gear lever and transfer selector lever.

c. Remove the two knurled nuts and the fuse cover.

d. Remove the rubber boot and insulating pad from the vehicle.

e. Carefully remove the rubber transmission cover and both floor mats.

f. Remove the sixteen screws securing the tunnel cover to the floor plates and seat base.

g. Remove the tunnel cover from the vehicle.

h. Using a suitable cleaning agent, clean the area around the top cover and blow it dry with compressed air.

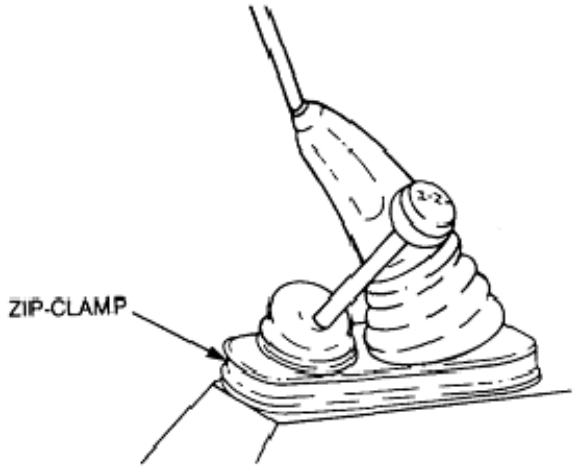


Figure 59 Gear Lever Rubber Boot Removal

i. Disconnect the two wires from the reverse switch (Figure 60) and remove the switch.

j. Remove and plug the breather tube installed on the selector cover.

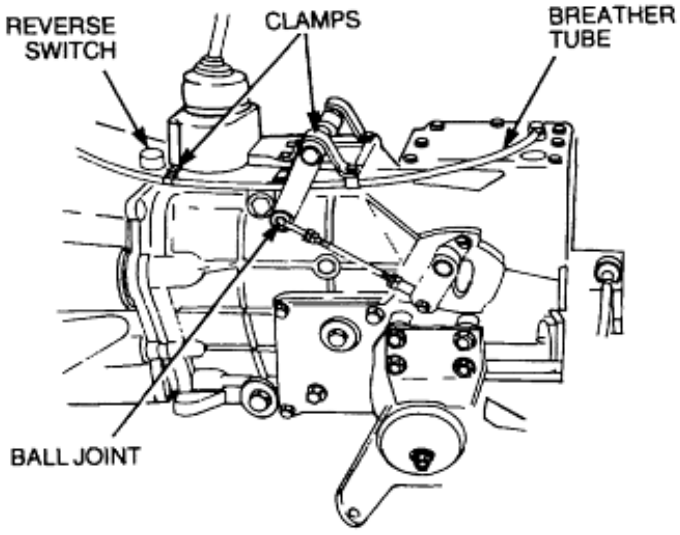


Figure 60 Top Cover Removal

k. Disconnect the upper ball joint installed on the transfer lever cross-shaft.

l. Select 'NEUTRAL' and remove the eight bolts securing the top cover and transfer lever cross-shaft brackets.

m. Lift off the cross-shaft and top cover assembly taking care not to lose the detent springs.

NOTE

The reverse-gear detent spring (yellow) is not interchangeable with other detent springs.

n. Remove and discard the gasket.

o. Remove all trace of gasket material from the top cover and main casing.

105. Installation. Install the top cover as follows:

a. Position a new gasket on the main casing.

b. Install the top cover assembly ensuring that the gear lever is located in the selectors.

c. Install the transfer-selector lever cross-shaft to the top cover and install the eight bolts.

d. Tighten the bolts securely.

e. Install the reverse switch (Para 106).

f. Fit the upper ball joint to the cross-shaft.

g. Connect the breather tube to the top cover and tighten the banjo bolt securely.

h. Install the tunnel cover and sixteen screws and tighten them securely.

i. Carefully install the rubber transmission cover and floor mats.

j. Install the rubber boot and secure it with a new zip-clamp.

k. Install both the gear lever knob and transfer selector lever knob.

Reverse Switch

106. Replacement. Replace the reverse switch as follows:

a. Remove the rubber boot (Para 86 sub-paras a to d).

b. Using a suitable cleaning agent, clean the area around the reverse switch and blow it dry it with compressed air.

c. Disconnect the two electrical wires from the reverse switch.

d. Remove the reverse stop screw.

e. Unscrew the reverse light switch (Figure 61).

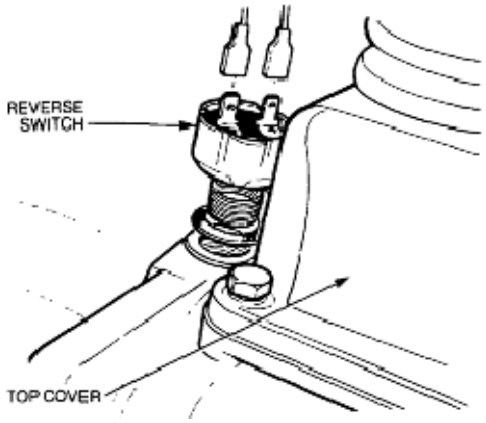


Figure 61 Reverse Switch Removal

f. Screw in the new reverse switch a few turns.

g. Connect the two electrical wires to the reverse switch.

h. Install the reverse stop screw.

i. Engage reverse gear.

j. Adjust the reverse stop screw to lightly contact the selector (Figure 62).

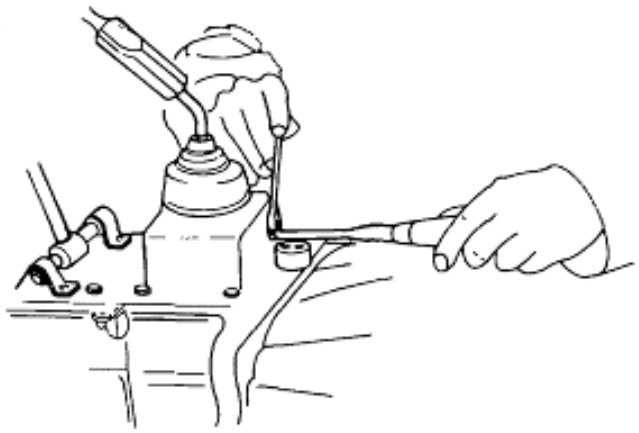


Figure 62 Reverse Stop Screw Adjustment

k. Unscrew the reverse stop screw half a turn, apply Loctite 242 or similar and tighten the locknut.

l. With an assistant sitting in the driver's seat, engage the clutch and start the engine.

m. With reverse gear selected, screw in the switch until the reverse light is illuminated.

n. Screw the switch in a further half a turn and tighten it to 20–24 N.m (15–17 lbf.ft).

o. Switch off the engine.

p. Install the rubber boot (Para 86.f sub-paras f to h).

Breather Hoses and Differential Lock Actuating Lines

107. Replacement. Replace the breather hoses and differential lock actuating lines as follows:

a. Remove the rubber boot and tunnel cover (Para 104 sub-paras a to g)

b. Remove the six screws securing the center plastic access tray/rifle butt box and remove the tray.

c. Loosen the four bolts securing the transfer lever cross-shaft pivot brackets to the top corner.

d. Remove the two banjo bolts and sealing washers securing the breather hoses to the top cover and transfer case cover (Figure 63).

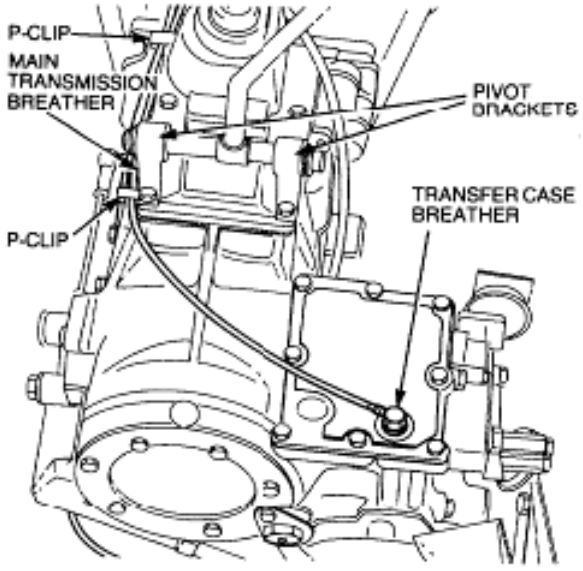


Figure 63 Breather Hose Removal From Transmission

e. Remove the bolts securing the two P-clips to the top cover.

f. Remove the clamp securing the two hoses to the firewall (Figure 64).

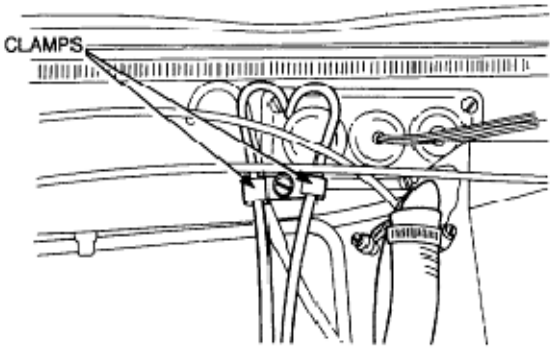


Figure 64 Breather Hose Removal From Firewall

g. Remove the hoses from the vehicle.

h. Connect the new breather hoses to the transmission.

i. Using new sealing washers on the banjo bolts, tighten the bolts securely.

j. Install the two P-clips on the top cover and tighten the two bolts securely.

k. Install the transfer lever cross-shaft pivot brackets on the top cover and tighten the four bolts securely.

l. Position the breather hoses on the firewall, install the clamp and tighten the screw securely.

m. Carefully install the rubber boot and tunnel cover (Para 105 sub-paras h to k).

n. Install the centre plastic access tray/rifle butt box and tighten the six screws.

NOTE

The differential control-actuating lines are an interference fit on the vacuum chamber and a compression type fitting on the control switch (Para 278.a).

Differential Lock Engagement Switch

108. Replacement. Replace the differential lock engagement switch as follows:

a. Using a suitable cleaning agent, clean the area around the switch and blow it dry with compressed air.

b. Disconnect the two electrical wires and unscrew the switch complete with the shims (Figure 65).

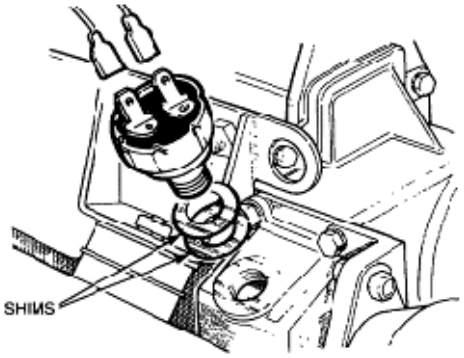


Figure 65 Differential Lock Engagement Switch Removal

c. Screw the new switch without the shims in a few turns.

d. Connect the two electrical wires to the switch.

e. Start the engine and engage the differential lock vacuum control valve.

f. Screw the switch in until the warning light is illuminated. Screw the switch in another one-half a turn.

g. Using feeler gauges, measure and note the clearance between the switch lower face and the transmission
(Figure 66).

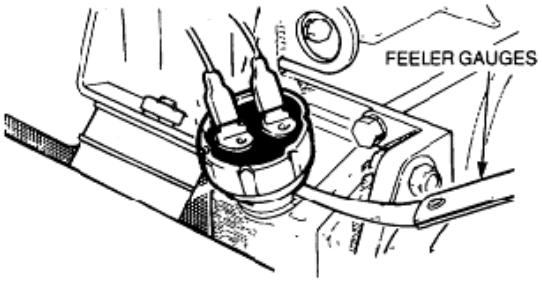


Figure 66 Differential Lock Engagement Switch Adjustment

NOTE

Available shim thicknesses are 0.5 mm (0.020 in) and 0.127 mm (0.005 in).

h. Disengage the differential lock vacuum control valve.

i. Switch the engine off and disconnect the two electrical wires and remove the switch.

j. Install the selected shims (Sub-para g) and the switch to the transmission. Tighten the switch to 20–24 N.m (15–17 lbf.ft).

k. Reconnect the two electrical wires.

Differential Lock Vacuum Chamber

109. Removal. Remove the differential lock vacuum chamber as follows:

WARNING

New gaskets provided by Land Rover do not contain asbestos. Older gaskets still fitted to vehicles may contain asbestos. During this task some parts may contain asbestos; refer and comply with procedures and warnings in the introduction section of this EMEI under paragraph heading: Items Previously Known To Have Contained Asbestos.

a. Using a suitable cleaning agent, clean the area around the selector housing and blow it dry with compressed air.

b. Drain the oil from the transfer case into a suitable receptacle and replace the drain plug.

c. Disconnect the two electrical wires from the differential lock engagement switch.

d. Disconnect and tag the two vacuum hoses from the chamber.

e. Remove the four bolts securing the vacuum chamber selector housing to the transmission (Figure 67).

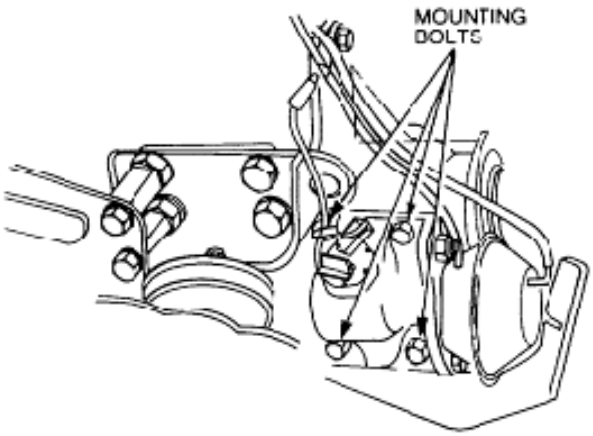


Figure 67 Vacuum Chamber Selector Housing Removal

f. Remove the housing from the transmission. Remove and discard the housing-to-transmission gasket.

g. Remove the detent spring and the ball from the housing (Figure 68).

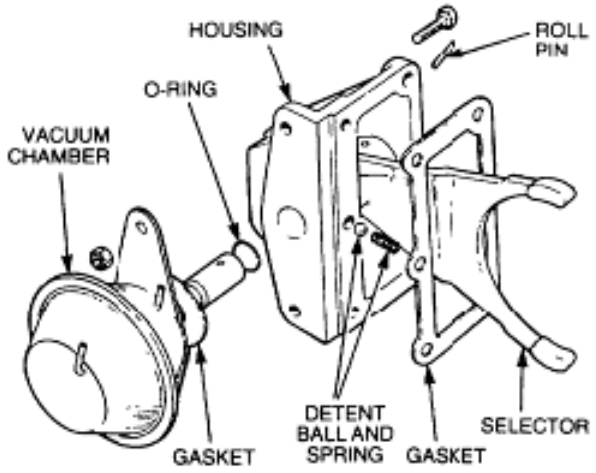


Figure 68 Vacuum Chamber Selector Disassembly

h. Remove the differential lock engagement switch and the shims from the housing.

i. Using a suitable pin punch, tap out the roll pin securing the selector fork to the vacuum chamber shaft.

j. Remove the two bolts and nuts securing the vacuum chamber to the housing.

k. Remove the vacuum chamber from the housing. Remove and discard the O ring and gasket.

l. Taking care not to score or damage any surface, clean all gasket material from all the surfaces.

110. Installation. Install the differential lock vacuum chamber as follows:

a. Install a new O ring to the vacuum chamber shaft.

b. Lightly smear a suitable sealant on both sides of the new gasket.

c. Position the gasket on the vacuum chamber.

d. Position the chamber on the housing ensuring that the shaft locates into the selector.

e. Install the two bolts and nuts and tighten them securely.

f. Insert a new roll pin to secure the selector to the shaft.

g. Lightly smear a suitable sealant on both sides of the housing-to-transmission gasket.

h. Install the vacuum chamber housing on the transmission ensuring the selector fork engages with the dog clutch.

i. Install the four bolts with lock-washers and tighten them to 30 N.m (22 lbf.ft).

j. Fill the transfer case to the correct level with clean oil.

k. Connect the two vacuum pipes on the vacuum chamber.

l. Carry out the adjustment procedure (Para 108).

Speedometer Cable and Spindle

111. Removal. Remove the speedometer cable and spindle as follows (Figure 69 and 70):

CAUTION

There are different coloured spindles used on different Land Rover models. The spindles are not interchangeable due to differing gearing ratios. Ensure that the new spindle is the same colour as the one removed.

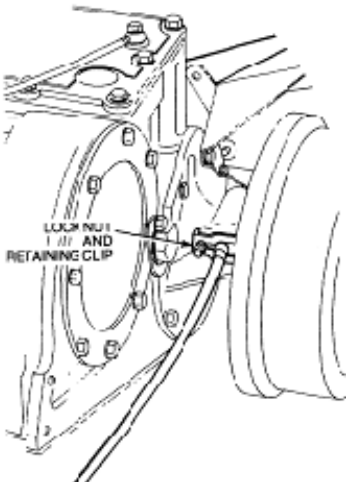


Figure 69 Speedometer Cable Locknut and Retaining Clip

a. Disconnect the battery.

b. Remove the locknut, washer and retaining clip securing the cable and spindle housing. Discard the locknut.

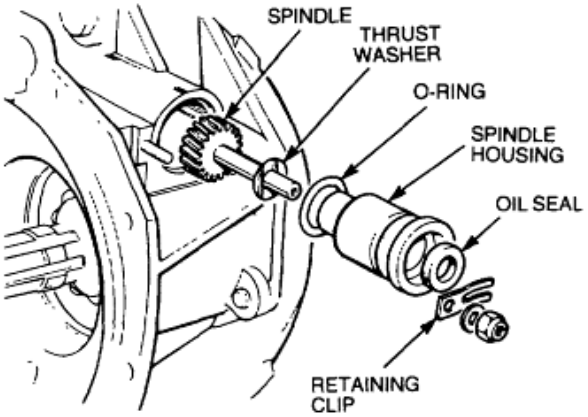


Figure 70 Speedometer Spindle Housing Exploded View

c. Remove the speedometer cable from the spindle housing.

d. Using a suitable screwdriver, carefully remove the spindle housing.

e. Remove and discard the O ring and inner oil seal.

f. Lift out the spindle and thrust washer.

g. Remove the four screws securing the instrument panel to the fascia.

h. Carefully lift the panel off and move it to one side.

i. Depress the clip retaining the speedometer cable to the speedometer and withdraw the cable (Figure 71).

j. Withdraw the cable through the firewall into the engine compartment.

k. Remove the inner cable from the outer cable.

l. Detach the outer cable and grommets from the retaining clips at the engine flywheel housing, chassis side member and transfer case.

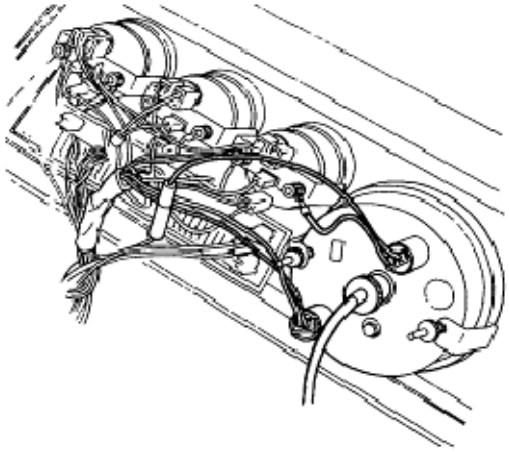


Figure 71 Speedometer Cable Removal

112. Installation. Install the speedometer cable and drive as follows :

a. Insert the outer cable through the firewall.

b. Smear the inner cable with grease and insert it into the outer cable.

c. Fit the cable on the speedometer ensuring the drive end is engaged and the retaining clip is secure (Figure 71).

d. Check that all electrical connections are secure.

e. Position the instrument panel on the fascia ensuring that the wiring harness is free from restrictions.

f. Install the retaining screws and tighten them securely.

g. Fit a new O ring to the spindle housing and insert a new inner oil seal (Figure 69 and 70).

h. Smear the spindle with clean oil.

i. Install the thrust washer on the spindle and insert the spindle into the spindle housing.

j. Lightly smear clean oil around the O ring.

k. Insert the spindle housing into the rear output shaft cover ensuring that the spindle engages with the spindle drive gear.

l. Fit the speedometer cable to the spindle housing ensuring the inner cable engages with the spindle.

m. Install the retaining clip, washer and new locknut and tighten the nut to 16 N.m (12 lbf.ft).

n. Secure the speedometer cable and grommets to the clips on the flywheel housing and chassis side member.

o. Connect the battery.

Transmission System Specifications

113. The transmission system specifications are detailed in Table 12.

Table 12 Transmission System Specifications

Serial	Specification	Measurement
1	Front and rear output coupling flange nuts	28–31 N.m (21–23 lbf.ft)
2	Transmission bottom cover bolts	16 N.m (12 lbf.ft)
3	Switch and differential lock engagement switches	20–24 N.m (15–17 lbf.ft)
4	Differential lock vacuum chamber	30 N.m (22 lbf.ft)

Transmission Fault Finding

114. The transmission fault finding is detailed in Table 13.

Table 13 Transmission Fault Finding

Serial	Symptom	Probable Cause	Action
1	Transmission noisy in neutral	Insufficient oil in transmission	Top up as necessary
		Incorrect oil grade	Drain and refill
		Primary pinion bearing worn	Report
		Constant mesh gears worn	Report
		Countershaft bearings worn	Report
2	Transmission noisy in all gears except top	Countershaft, mainshaft or primary pinion bearings worn	Report
		Constant mesh gears worn	Report
		Transmission oil pump and/or relief valve faulty	Report
3	Transmission noisy in one gear only	Worn or damaged gears or bearings	Report
4	Transmission noisy in all gears	Worn bearings on primary pinion, mainshaft or countershaft	Report
		Transmission oil pump and/or relief valve faulty	Report
5	Oil leaks from transmission	Transmission over filled	Rectify oil level with vehicle on level ground
		Loose or damaged drain or level plugs	Tighten plugs. If damaged, fit new plugs and joint washer as required
		Blocked breathers	Clean pipes and fittings
		Gaskets damaged, incorrectly fitted or missing	Report
		Oil seals damaged or incorrectly fitted	Replace
		Cracked or broken gearbox casings	Report
6	Difficulty in engaging forward gears	Weak springs or worn parts in synchro units	Report
		Worn selector forks and/or interlock pins	Report
		Faulty clutch operation or clutch fluid leaks	Check clutch master and slave cylinders. Report/replace as necessary
		Reverse detent spring installed in forward positions	Report
7	Difficulty in engaging reverse gear	Reverse gear bearings worn or damaged	Report
		Faulty clutch operation or clutch fluid leaks	Check clutch master and slave cylinders. Report/Replace as necessary.
8	Difficulty in disengaging forward gears	Damaged gears or worn synchro cones	Report
		Distorted or damaged splines	Report
		Reverse detent spring installed in forward positions	Report
9	Difficulty in disengaging reverse gear	Reverse gear seized on shaft	Report
10	Gear lever going into reverse too easily and not into top	Weak or broken reverse stop plate tension spring	Report
11	Transfer of oil between transmission and transfer case	Faulty O ring on reverse idler shaft	Report
		Faulty mainshaft oil seal	Report
		Blocked transmission breather	Clean breather
12	Oil leakage to bell housing	Crankshaft rear seal leaking	Report
		Primary shaft oil seal faulty	Report

Table 13 Transmission Fault-finding (Continued)

Serial	Symptom	Probable Cause	Action
13	Transfer case noisy.	Insufficient oil in transfer case	Top up as necessary
		Incorrect oil grade	Drain and refill
		Excessive end-float on intermediate gears	Report
		Worn transmission differential	Report
		Worn intermediate gearshaft bearing	Report
14	Differential lock warning light not working	Faulty globe	Replace.
		Faulty switch or wiring	Check and replace as necessary
		Switch adjustment incorrect	Carry out adjustment procedure
		Faulty vacuum hoses	Check for leaks, replace as necessary
		Faulty vacuum chamber	Replace
15	Reverse lights not working	Faulty globes	Replace globes
		Faulty switch or wiring	Check and replace as necessary

PROPELLER SHAFTS

Front Propeller Shaft

115. Removal. Remove the front propeller shaft by removing the eight locknuts securing the propeller shaft flanges to the front differential and the transmission front output flange. Discard the locknuts.

116. Universal Joint Phasing. The front propeller shaft is assembled with the universal joints phased out of alignment by 39.2° to 43.2° refer to Figure 72. This is explained as when the propeller shaft is rotated in a clockwise direction from the short (transmission or front) end to the long (axel or rear) end the universal joint of the long end is ahead of the universal joint at the short end.

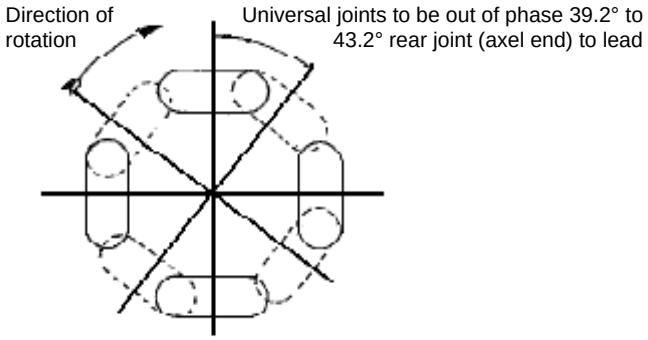


Figure 72 Diagrammatic View Of Universal Joints

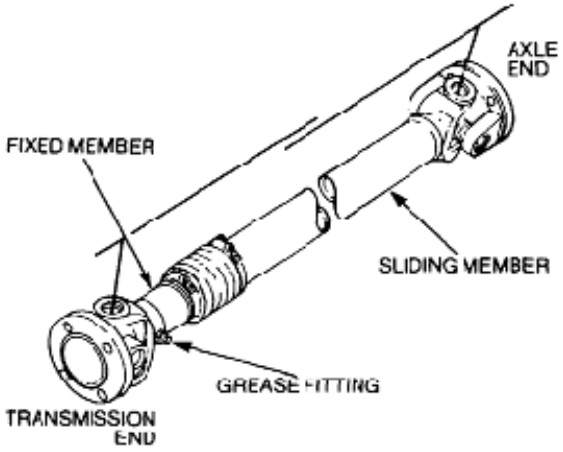


Figure 73 Front Propeller Shaft Alignment

117. Installation. Install the front propeller shaft as follows:

118. Ensuring the propeller shaft is correctly aligned (Figure 73), install the shaft on the front differential with the sliding member to the front of the vehicle and onto the transmission front output flange.

CAUTION

When fitting new locknuts ensure the correct nuts are used in the correct locations as they are different in height for the differential end and transmission end of the propeller shaft.

CAUTION

Ensure propeller shaft flange retaining bolt length is 1-1/8" (approximately 29 mm) in length. If bolt length is shorter there will be insufficient thread for the Nyloc to grip on. No less than two bolt threads must protrude from the Nyloc.

a. Fit eight new locknuts and tighten them to 41–52 N.m (30–38 lbf.ft).

(1) 3/8" (approximately 10 mm) high locknuts are used at the front and rear axel ends.

(2) 31/64" (approximately 13 mm) high locknuts are used at the transmission ends.

b. Lubricate the propeller shaft with grease.

Propeller Shaft Dust Boot

119. Replacement. Replace the propeller shaft dust boot as follows:

a. Remove the front propeller shaft flanges (Para 115).

b. Loosen the two hose clamps securing the rubber boot and slide the boot and clamps away from the splines.

c. Unscrew the dust cap and remove the sliding member.

d. Remove the dust boot.

NOTE

The repair of propeller shafts for worn splines is not authorised.

e. Clean and inspect the splines for wear. Replace the propeller shaft if wear is excessive.

f. Slide on the new propeller shaft dust boot and smear the splines with grease.

NOTE

The front propeller shaft is assembled with the yokes phased out of alignment. Ensure that the alignment marks on both halves of the shaft are correctly aligned.

The rear propeller shafts are assembled with the yokes in phase. Ensure the yokes are correctly aligned.

g. Insert the sliding member splines into the fixed member ensuring the match marks are aligned (Figure 74).

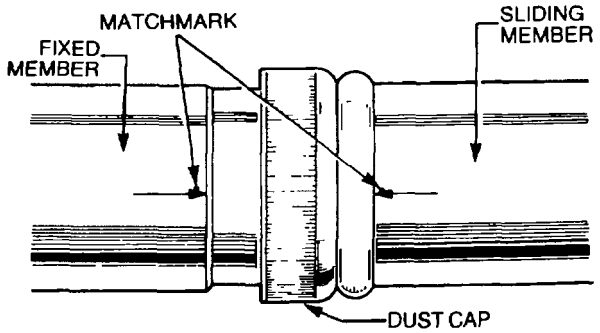


Figure 74 Front Propeller Shaft Matchmark

h. Tighten the dust cap.

i. Slide the propeller shaft dust boot along over the splines.

j. Move the sliding member to the centre of travel and tighten both hose clamps ensuring they are positioned at 180 degrees to each other (Figure 75).

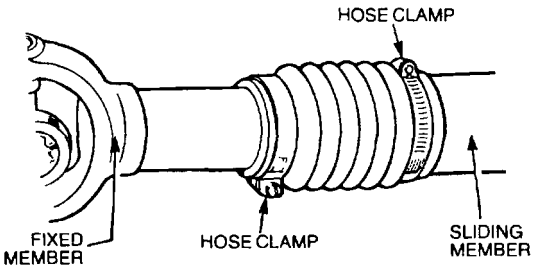


Figure 75 Hose Clamp Positions

k. Install the propeller shaft (Para 116).

Rear Propeller Shaft

120. Removal. Remove the rear propeller shaft as follows:

a. Remove and discard the eight locknuts securing the propeller shaft flanges to the rear differential and the transmission rear output flange.

b. Remove the rear propeller shaft.

121. Inspection of the Rear Propeller Shaft Front Securing Bolts. Inspect the rear propeller shaft front securing bolts for wear, damaged threads and security (replace as necessary) (Para 122).

122. Replacement of the Rear Propeller Shaft Front Securing Bolts. Replace the rear propeller shaft front securing bolts as follows:

WARNING

Under no circumstances is compressed air to be used to remove dust from the hand brake drum or brake linings. Dust from the brake linings can be a health risk if inhaled.

a. Remove the transfer case rear output flange securing nut (handbrake drum flange).

b. Remove the rear output flange and separate the handbrake drum from the flange.

c. Remove the faulty bolts and tack weld the heads of the replacement bolts using an electronic welder (Figure 76).

d. Remove the rear output shaft oil seal (Para 100 sub-paras f to i).

e. Install the rear output shaft oil seal (Para 101 sub-paras a to d).

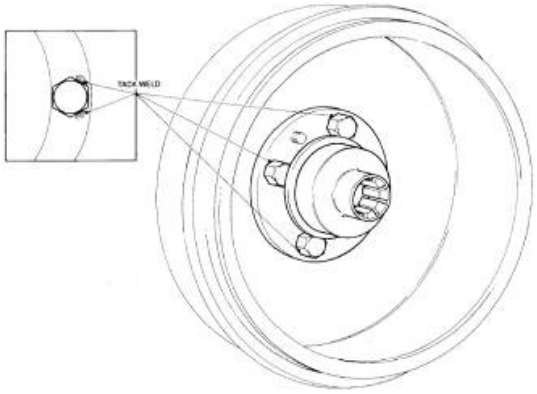


Figure 76 Welding Points For Propeller Shaft Bolts

f. Refit the handbrake drum to the transfer case flange (apply Loctite 242 or similar to the screws).

g. Apply a smear of clean SAE Grade 40 (OMD-115) oil around the lip of the seal and install the flange and handbrake assembly to the transfer case output shaft (apply Loctite 242 or similar to the output shaft threads).

h. Fit a new felt seal and locknut and tighten the nut to 146–180 N.m (108–132 lbf.ft).

123. Installation. Install the rear propeller shaft as follows:

NOTE

The rear propeller shaft is assembled with the yokes in phase. Ensure the yokes are correctly aligned.

a. Ensuring the propeller shaft is correctly aligned; install the shaft on the rear differential with the sliding member to the rear of the vehicle and onto the transmission rear output flange.

CAUTION

When fitting new locknuts ensure the correct nuts are used in the correct locations as they are different in height for the differential end and transmission end of the propeller shaft.

CAUTION

Ensure propeller shaft flange retaining bolt length is 1-1/8" (approximately 29 mm) in length. If bolt length is shorter there will be insufficient thread for the Nyloc to grip on. No lees than two bolt threads must protrude from the Nyloc.

b. Fit eight new locknuts and tighten them to 41–52 N.m (30–38 lbf.ft).

(1) 3/8" (approximately 10 mm) high locknuts are used at the front and rear axel ends.

(2) 31/64" (approximately 13 mm) high locknuts are used at the transmission ends.

c. Lubricate the propeller shaft with grease.

Universal Joints

124. Removal. Remove the universal joints as follows:

a. Clean the area around the universal joint and remove the circlips (Figure 77).

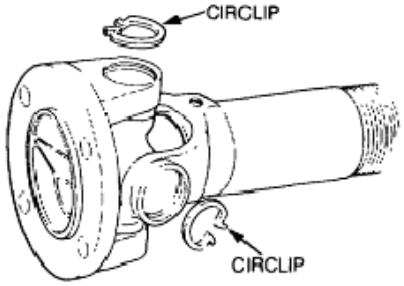


Figure 77 Circlip Removal

b. Tap the yokes to eject the bearing cups (Figure 78).

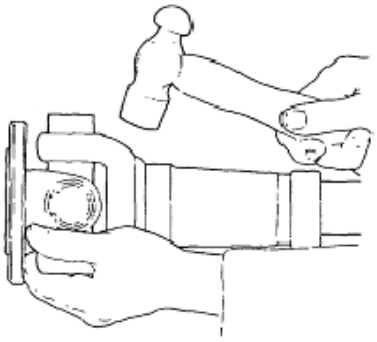


Figure 78 Bearing Cup Removal

c. Remove and discard the bearing cups and the spider.

d. Thoroughly clean the yokes and bearing cup seats.

125. Installation. Install the universal joints as follows:

NOTE

Replacement universal joints are supplied with grease nipples.

A small amount of material may need to be removed from one side of the yoke assembly to allow the fitting of the spider.

Install the spider with the hole for the grease nipple facing away from the flange.

Grease the universal joint prior to fitting it to the vehicle.

a. Remove the bearing cups from the new spider and check that all the needle rollers are correctly positioned in the cup.

b. Ensure the bearing cups are one-third full of clean grease.

c. Install the spider complete with the seals into the yokes.

d. Partially insert one bearing cup into one yoke and insert the spider into the cup taking care not to dislodge the needle rollers.

e. Insert the opposite bearing cup into the opposite yoke.

f. Using a vice, carefully press both cups into place taking care not to dislodge the needle rollers as the spider engages the cup ensuring that the spider is free to rotate in the yoke.

g. Remove the flange and spider from the vice.

h. Using a suitable mandrel of slightly smaller diameter than the bearing cup, position the yoke in a vice (Figure 79).

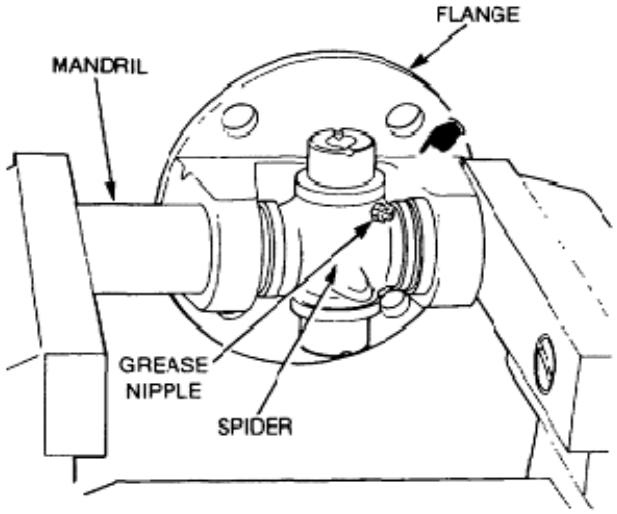


Figure 79 Bearing Cup Installation

CAUTION

Do not press the cups further than the circlip groove or damage to the cups and seals will result.

i. Carefully press each cup until they reach the lower edge of the circlip groove.

j. Remove the flange from the vice and fit the circlips.

k. Check that the flange moves smoothly in all directions.

Propeller Shaft Testing

126. Procedure. The procedure for testing the propeller shaft is as follows:

a. Check that the balance weights are secure and if not, replace the propeller shaft.

b. Check that all universal joint circlips are correctly installed.

c. Check that the rubber boot hose clamps (front propeller shaft only) are installed at 180 degrees to each other and are of the same type.

d. With the parking brake applied, grip the propeller shaft and check the lateral and radial movement in the splines (replace the propeller shaft assembly if movement is excessive).

e. Check that the grease nipple functions correctly (replace as necessary).

f. Check that the universal joint grease seals are not damaged (replace as necessary).

g. Check that the propeller shaft is aligned correctly (Figure 73).

h. Using a dial test indicator, check that the radial movement between the sliding shaft and the fixed shaft does not exceed 0.1 mm (0.004 in) at the slip-joint splines.

i. Replace the propeller shaft assembly if movement exceeds specifications (Table 14).

Propeller Shaft System Specifications

127. The propeller shaft system specifications are detailed in Table 14.

Table 14 Propeller Shaft System Specifications

Serial	Specification	Measurement
1	Front and rear propeller shaft flange locknuts	4–52 N.m (30–38 lbf.ft)
2	Maximum radial movement at slip-joint	0.1 mm (0.004 in)

REAR AXLE

Differential Cover Gasket

128. Removal. Remove the differential cover gasket as follows:

WARNING

New gaskets provided by Land Rover do not contain asbestos. Older gaskets still fitted to vehicles may contain asbestos. During this task some parts may contain asbestos; refer and comply with procedures and warnings in the introduction section of this EMEI under paragraph heading: Items Previously Known To Have Contained Asbestos.

a. Using a recommended cleaning agent, clean the area around the differential cover and blow it dry with compressed air.

b. Remove the fill plug from the differential.

c. Remove the drain plug and drain the oil into a suitable receptacle.

d. Refit the drain plug.

e. Note the position of the support strip.

f. Remove the bolts and lock-washers securing the cover and brake pipe bracket to the axle casing. Discard the lock-washers.

g. Remove the cover and discard the gasket.

h. Remove all trace of gasket material from the cover and the axle casing.

i. Wash the cover in a suitable cleaning agent.

129. Installation. Install the differential cover gasket as follows:

a. Smear a suitable sealant on both sides of the new gasket.

b. Fit the cover and the gasket to the axle casing.

c. Install the bolts and new lock-washers ensuring that the securing strip is fitted to the lower bolts.

d. Tighten the bolts to 27–34 N.m (20–25lbf.ft).

e. Fill the axle casing with clean gear oil until oil flows from the lower edge of the fill plug hole.

f. Insert the fill plug ensuring the gasket is fitted and in good condition.

Differential Pinion Oil Seal

130. Removal. Remove the differential pinion oil seal as follows:

a. Using a recommended cleaning agent, clean the area around the differential pinion and blow it dry with compressed air.

b. Remove and discard the four locknuts securing the rear propeller shaft to the rear differential flange.

CAUTION

To maintain the loading of the collapsible spacer, the pinion shaft, flange and nut must be matchmarked prior to removal.

c. Matchmark the pinion shaft, flange and nut.

d. Using the adjustable wrench (Table 3, Serial 4), to prevent the coupling flange rotating; remove the pinion locknut and washer (Figure 80). Discard the locknut.

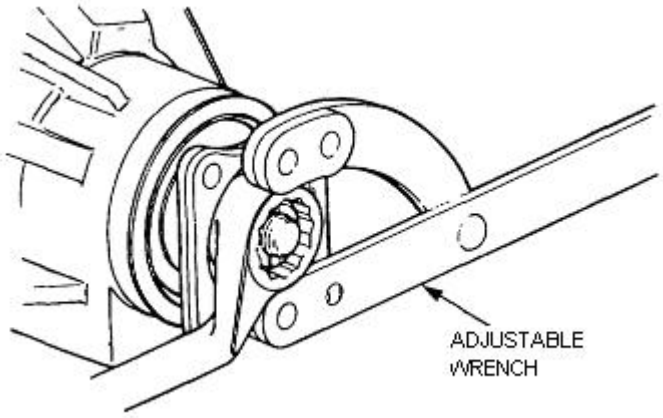


Figure 80 Securing the Differential Pinion Coupling Flange

e. Remove the coupling flange and the oil seal.

f. Discard the oil seal.

131. Installation. Install the differential pinion oil seal as follows:

a. Inspect the outer surface of the coupling flange for roughness or damage, which may cause premature failure of the oil seal (replace as necessary).

b. Using the pinion oil seal replacer drift (Table 3, Serial 5), insert the new oil seal with the seal lips towards the pinion (Figure 81).

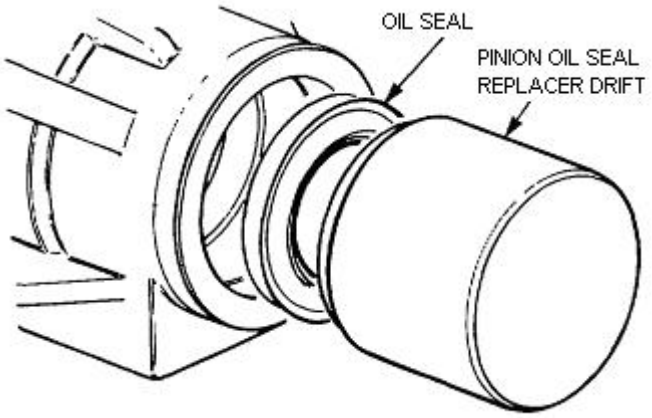


Figure 81 Pinion Oil Seal Installation

c. Lubricate the seal lips with clean gear oil.

CAUTION

Ensure that the coupling flange is installed with the matchmarks aligned and that the locknut is not tightened beyond the marked position.

d. Install the coupling flange, washer and a new locknut ensuring the matchmarks are aligned.

e. Using the adjustable wrench (Table 3, Serial 4) to prevent the flange rotating, torque the locknut to 95–163 N.m (70–120 lbf.ft) (Figure 80).

f. Install the rear propeller shaft on the coupling flange.

g. Fit four new locknuts and tighten them to 41–52 N.m (30–38 lbf.ft).

h. Check the rear axle oil level and top it up if necessary.

Rear Differential Level Plug

132. Installation. Install the rear differential level plug as follows:

a. Ensure that the thread on the plug and in the differential cover plate is clean and free from damage.

NOTE

If the level plug cannot be tightened or protrudes too far into the differential cover plate, the original plug is to be discarded and replaced by a flange type plug and gasket.

b. Fit the level plug and screw it in until it is finger tight.

c. Using a socket bar or differential plug spanner, tighten the level plug a further one-half to three-quarters of a turn.

Axle Shafts

133. Removal. Remove the axle shafts as follows:

a. Using a recommended cleaning agent, clean the area around the hub assembly and blow it dry with compressed air.

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by axle stands. Place the axle stands as close as possible to the raised wheel.

b. Chock the front wheels and engage the transmission differential lock.

c. Using a suitable hydraulic jack, raise the rear of the vehicle and support it on axle stands.

d. Remove the hub cap from the driving hub (if necessary pry it off with a suitable lever).

e. Remove the five bolts and spring washers securing the driving hub to the hub (Figure 82). Discard the spring washers.

f. Remove the driving hub complete with the axle shaft.

g. Remove and discard the gasket.

h. Remove all trace of gasket material from the driving hub and hub.

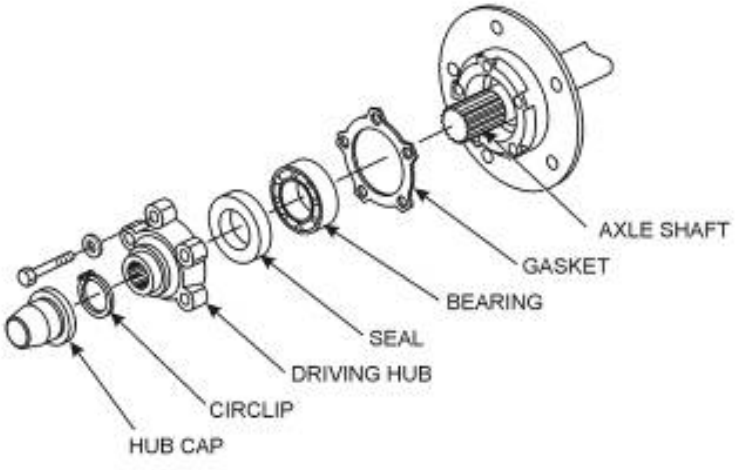


Figure 82 Axle Shaft and Flange Exploded View

134. Installation. Install the axle shafts as follows:

a. Install a new gasket over the axle shaft and insert the driving hub with the axle shaft in the axle case.

b. Turn the driving hub until the shaft engages into the differential and fits flush against the hub.

c. Ensure the driving hub, gasket and hub bolt holes align.

d. Apply Loctite 271, or equivalent, to the bolt threads.

e. Install the bolts and new spring washers. Tighten the bolts to 60–70 N.m (44–52 lbf.ft).

f. Fit the hub cap onto the driving hub ensuring that a tight fit is obtained.

g. Raise the vehicle off the axle stands, remove the stands and lower the vehicle to the ground.

h. Remove the wheel chocks.

i. Disengage the differential lock.

Hub Oil Seal

135. Removal. Remove the hub oil seals as follows:

a. Using a recommended cleaning agent, clean the area around the hub assembly and blow it dry with compressed air.

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by axle stands. Place the axle stands as close as possible to the raised wheel.

b. Loosen the wheel nuts.

c. Chock the front wheels and engage the transmission differential lock.

d. Using a suitable hydraulic jack, raise the rear of the vehicle and support it on axle stands positioned beneath the rear axle.

e. Remove the wheel nuts and wheel.

f. Remove the screw securing the brake drum to the hub and remove the drum (if necessary loosen off the brake adjuster).

g. Check the drum for cracks or scoring (replace if necessary).

h. Remove the hub cap from the driving flange (if necessary pry it off using a suitable lever).

i. Remove the circlip retaining the axle shaft (Figure 82).

j. Remove the five bolts and spring washers securing the driving flange and remove the flange (Figure 82). Discard the spring washers.

k. Remove and discard the gasket.

l. Using special tool hub adjusting spanner (Table 3, Serial 6), remove the locknut (Figure 83).

m. Remove the lock-washer, adjusting nut and seal track (Figure 83). Discard the lock-washer.

n. Remove the hub assembly.

o. Pry out and discard the oil seals, using a suitable lever.

p. Clean off any oil spillage ensuring that the brake linings are not contaminated (replace if necessary).

q. Remove all trace of gasket material from the driving flange and the hub.

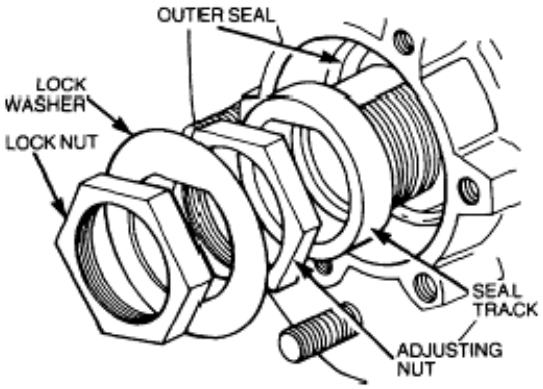


Figure 83 Hub Retaining Nuts

136. Installation. Install the hub oil seal as follows:

a. Smear grease around the seal lips.

b. Using the hub oil seal replacer (Table 3, Serial 7) and the disc brake piston compressor (Table 3, Serial 12), press the new oil seals into the hub with the seal lip towards the hub bearing (Figure 84).

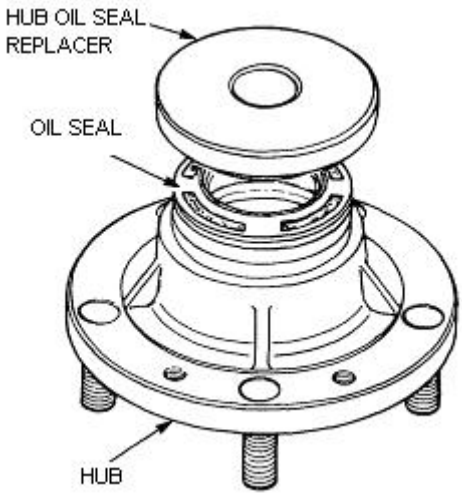


Figure 84 Hub Oil Seal Installation

c. Ensure the hub is half full of grease.

d. Install the hub complete with the bearings.

e. Insert the seal track and adjusting nut.

f. Spin the hub to settle the bearings.

g. Tighten the nut by hand until there is no end float (Figure 85).

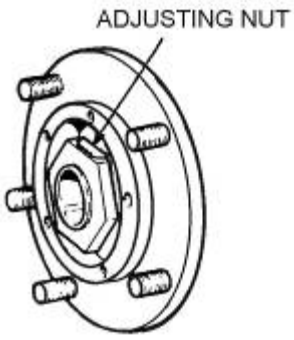


Figure 85 Hub End Float Adjustment

h. Back-off the hub nut 90 degrees and then tighten it to 10 N.m (7 lbf.ft).

i. Fit a new lock-washer.

j. Install the locknut and tighten it to 50 N.m (37 lbf.ft).

k. Tab over the lock-washer.

l. Install the brake drum and secure it with the retaining screw.

m. Install the driving flange and a new gasket ensuring that the splines are aligned with those on the axle shaft.

n. Fit each bolt with a new spring washer.

o. Apply Loctite 271, or equivalent, to the bolt threads.

p. Install the bolts and tighten them to 60–70 N.m (44–52 lbf.ft).

q. Fit the circlip to the axle shaft and install the hub cap securely.

r. Install the wheel and wheel nuts and tighten them.

s. Adjust the rear brakes and ensure both wheels are free to turn.

t. Raise the vehicle off the axle stands, remove the stands and lower the vehicle to the ground.

u. Remove the wheel chocks.

v. Check the axle oil level through the differential fill plug and top up if necessary.

w. Tighten the wheel nuts.

x. Disengage the differential lock.

Wheel Bearings

137. Removal. Remove the wheel bearings as follows:

a. Using a recommended cleaning agent, clean the area around the hub assembly and blow it dry with compressed air.

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by axle stands. Place the axle stands as close as possible to the raised wheel.

b. Loosen the wheel nuts.

c. Chock the front wheels and engage the transmission differential lock.

d. Using a suitable hydraulic jack, raise the rear of the vehicle and support it on axle stands positioned beneath the rear axle.

e. Remove the wheel nuts and the wheel.

f. Remove the screw securing the brake drum to the hub and remove the drum, if necessary loosen the brake adjuster.

g. Remove the hub cap from the driving flange (if necessary pry it off using a suitable lever).

h. Remove the circlip retaining the axle shaft.

i. Remove the five bolts and spring washers securing the driving flange and remove the flange. Discard the spring washers.

j. Remove and discard the gasket.

k. Using the hub adjusting spanner (Table 3, Serial 6) remove the locknut.

l. Remove the lock-washer, adjusting nut and seal track.

m. Remove the hub assembly and the outer bearing cone.

n. Pry out the oil seals, using a suitable lever and remove the inner bearing cone.

o. Remove the bearing cups, using a suitable drift or press.

p. Remove all trace of gasket material from the hub and driving flange.

q. Using a suitable cleaning agent, wash all trace of grease from the hub.

r. Inspect the hub for cracks and damaged wheel studs (replace as necessary).

s. Inspect the seal track around the outer running surface (replace if worn).

138. Installation. Install the wheel bearings as follows:

a. Using a suitable drift or press, install the bearing cups ensuring that the wide sides are towards each other (Figure 86).

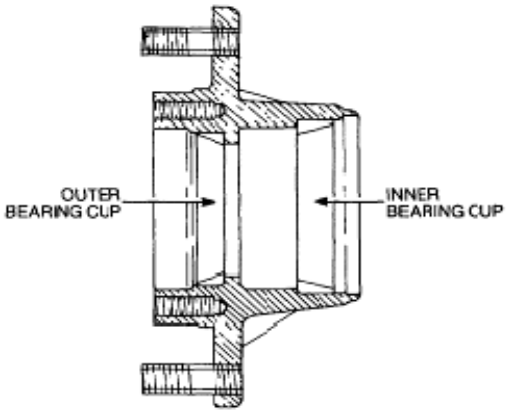


Figure 86 Bearing Cup Installation

b. Pack the inner and outer bearing cones with grease.

c. Insert cones into the hub and half-fill the hub with grease.

d. Using the hub oil seal replacer (Table 3, Serial 7) and the disc brake piston compressor (Table 3, Serial 12), press the new oil seal into the hub with the seal lip towards the hub bearing (Figure 84).

e. Smear grease around the seal lip.

f. Install the hub on the axle casing.

g. Insert the seal track and adjusting nut.

h. Spin the hub to settle the bearings.

i. Tighten the nut by hand until there is no end float.

j. Back-off the hub nut 90 degrees and then tighten it to 10 N.m.

k. Fit a new lock-washer and install the locknut.

l. Tighten the locknut to 50 N.m and tab over the lock-washer.

m. Install the brake drum and secure it with the retaining screw.

n. Install the driving flange and a new gasket ensuring that the splines are aligned with those on the axle shaft.

o. Fit each bolt with a new spring washer.

p. Apply Loctite 271, or equivalent, to the bolt threads.

q. Install the bolts and tighten them to 60–70 N.m (44–52 lbf.ft).

r. Fit the circlip to the axle shaft and install the hub cap securely.

s. Install the wheel and the wheel nuts. Tighten the wheel nuts.

t. Adjust the rear brakes and ensure both wheels are free to turn.

u. Raise the vehicle off the axle stands, remove the stands and lower the vehicle to the ground.

v. Remove the wheel chocks.

w. Check the axle oil level through the differential fill plug (top up if necessary).

x. Tighten the wheel nuts.

y. Disengage the transmission differential lock.

Breather Hose

139. Replacement. Replace the breather hose as follows:

a. Using a recommended cleaning agent, clean the area around the banjo bolt and blow it dry with compressed air.

b. Remove the banjo bolt and sealing washers securing the breather hose to the rear axle casing (Figure 87). Discard the sealing washers.

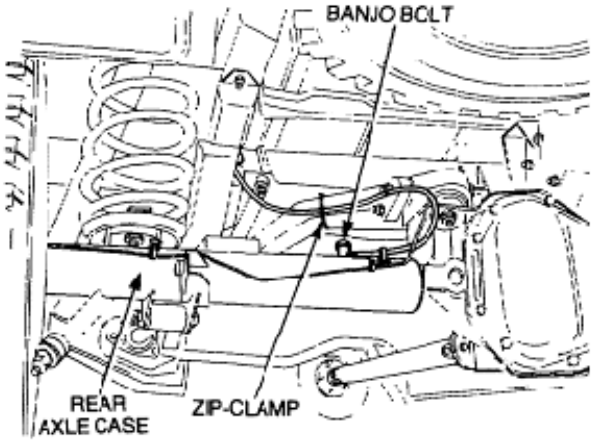


Figure 87 Rear Axle Breather Hose Location

c. Remove the clips securing the hose to the axle case.

d. Remove the hose from the chassis plastic clip.

e. Position the new hose along the axle and up onto the chassis.

f. Using new sealing washers, fit the hose to the axle case and tighten the banjo bolt securely.

g. Install the clips to secure the hose to the axle case.

h. Secure the hose to the chassis with the chassis plastic clip.

Rear Axle System Specifications

140. The rear axle system specifications are detailed in Table 15.

Table 15 Rear Axle System Specifications

Serial	Specification	Measurement
1	Differential cover retaining bolts	27–34 N.m (20–25 lbf.ft)
2	Differential pinion flange	95–163 N.m (70–120 lbf.ft)
3	Propeller shaft retaining nuts	41–52 N.m (30–38 lbf.ft)
4	Hub driving flange retaining bolts	60–70 N.m (44–52 lbf.ft)
5	Hub bearing adjustment hub nut	10 N.m (7 lbf.ft)
6	Hub locknut	50 N.m (37 lbf.ft)

FRONT AXLE

Differential Pinion Oil Seal

141. Removal. Remove the differential pinion oil seal as follows:

a. Using a recommended cleaning agent, clean the area around the pinion and blow it dry with compressed air.

b. Remove and discard the four locknuts securing the front propeller shaft to the front differential flange.

c. Remove and discard the flange nut split pin.

d. Using special tool adjustable wrench (Table 3, Serial 4), to prevent the coupling flange rotating, remove the flange slotted nut (Figure 88).

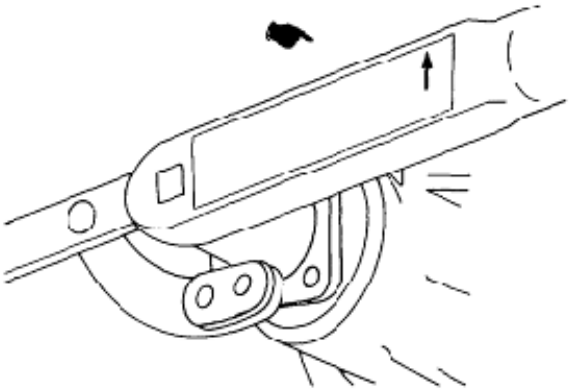


Figure 88 Front Differential Pinion Flange Nut Removal

e. Remove the coupling flange and deflector.

f. Remove and discard the oil seal.

142. Installation. Install the differential pinion oil seal as follows:

a. Smear the outside edge of the oil seal with a suitable sealant.

b. Using the pinion oil seal replacer drift (Table 3, Serial 5), insert the seal with the seal lip towards the pinion (Figure 89).

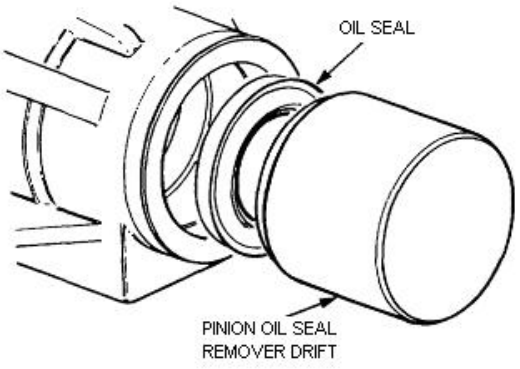


Figure 89 Pinion Oil Seal Installation

c. Lubricate the seal lip with clean gear oil.

d. Install the deflector.

e. Inspect the outer surface of the coupling flange for roughness or damage which may cause premature failure of the oil seal (replace as necessary).

f. Install the coupling flange, washer and slotted nut.

g. Torque the flange nut to 94–163 N.m (70–120 lbf.ft) and ensure the slotted nut aligns with the split pin hole.

h. Install a new split pin and bend over the tabs.

i. Install the front propeller shaft on the coupling flange.

j. Fit four new locknuts and tighten them to 41–52 N.m (30–38 lbf.ft).

k. Check the front axle oil level (top up if necessary).

Hub Oil Seal

143. Removal. Remove the hub oil seal as follows:

a. Using a recommended cleaning agent, clean the area around the hub assembly and blow it dry with compressed air.

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by axle stands. Place the axle stands as close as possible to the raised wheel.

b. Loosen the wheel nuts.

c. Chock the rear wheels and engage the differential lock.

d. Using a suitable hydraulic jack, raise the front of the vehicle and support it on axle stands positioned beneath the front axle.

e. Remove the wheel nuts and wheel.

f. Loosen the locknut securing the brake hose to the retaining bracket (Figure 90).

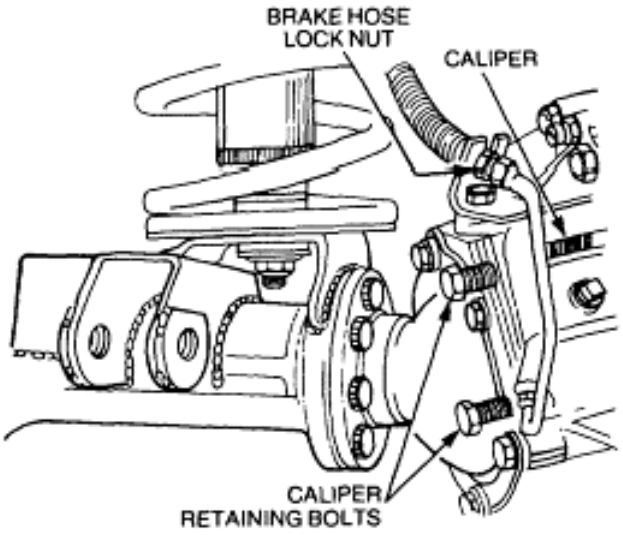


Figure 90 Brake Caliper Removal

g. Disconnect the wear indicator cable at the caliper (left-hand side only).

h. Remove the two bolts securing the caliper to the swivel housing.

i. Move the caliper away from the disc.

j. Ensuring that the brake pipes are not bent, secure the caliper to the road spring with wire or string.

k. Using a suitable lever, pry off the hub cap.

l. Remove the circlip from the drive shaft and remove the shim (Figure 91).

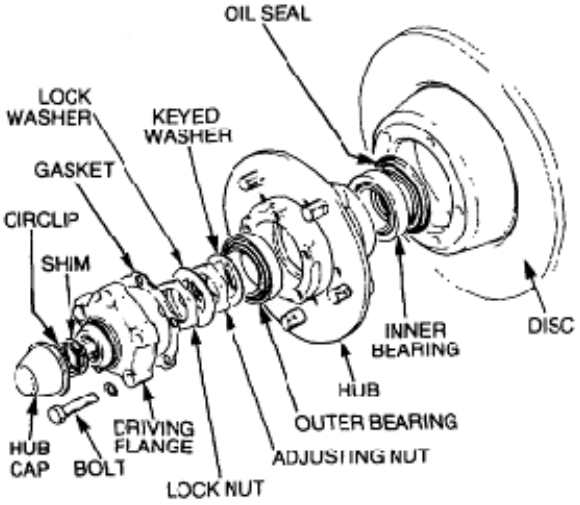


Figure 91 Front Hub and Disc Exploded View

m. Remove the five bolts and spring washers securing the driving flange to the hub and remove the driving flange. Discard the spring washers.

n. Remove and discard the gasket.

o. Clean away all traces of gasket material.

p. Using special tool hub adjusting spanner (Table 3, Serial 6), remove the locknut then the lock-washer, adjusting nut and the keyed washer. Discard the lock-washer.

q. Remove the hub assembly.

r. Using a suitable lever, pry out the oil seal. Discard the oil seal.

s. Clean off any oil spillage.

t. Ensure the brake disc is clean and free from cracks (replace as necessary).

144. Installation. Install the hub oil seal as follows:

a. Using the hub oil seal replacer (Table 3, Serial 7) and the bearing and oil seal replacer (Table 3, Serial 11), press the new oil seal into the hub with the seal lip towards the hub bearings.

b. Smear grease around the seal lip.

c. Ensure that the hub is half-full of grease.

d. Install the hub complete with bearings.

e. Install the keyed washer and adjusting nut.

f. Spin the hub to settle the bearings and tighten the adjusting nut by hand until there is no end float (Figure 92).

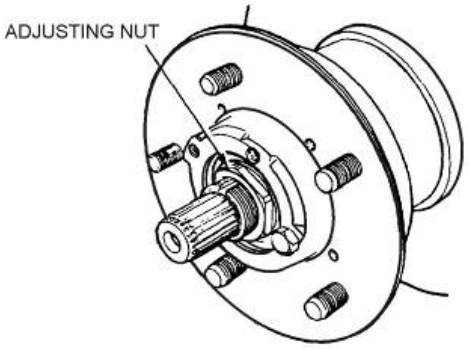


Figure 92 Hub Bearing Adjustment

g. Back-off the hub nut 90 degrees and then tighten it to 10 N.m (7 lbf.ft).

h. Fit a new lock-washer.

i. Install the locknut, tighten it to 50 N.m (37 lbf.ft) and tab over the lock-washer.

j. Install the driving flange and a new gasket ensuring the splines are aligned with those on the drive shaft.

k. Fit each bolt with a new spring washer and apply Loctite 271, or equivalent, to the bolt threads.

l. Install the bolts and tighten them to 60–70 N.m (44–52 lbf.ft).

m. Install the drive shaft shim and secure it with the circlip.

n. Install the hub cap securely.

o. Ensure that the brake disc is free from oil and grease.

p. Install the caliper, smear Loctite 271 or equivalent on the bolt threads and install the retaining bolts with new spring washers.

q. Tighten the bolts to 82 N.m (60 lbf.ft).

r. Fit the brake hose on the retaining bracket and tighten the locknut.

s. Connect the wear indicator cable (left-hand side only).

t. Install the road wheel and tighten the wheel nuts.

u. Raise the vehicle off the axle stands, remove the stands and lower the vehicle to the ground.

v. Remove the wheel chocks.

w. Check the oil level in the swivel housings (top up if necessary).

x. Tighten the wheel nuts.

y. Operate the brake pedal several times to centralise the brake pads.

z. Disengage the differential lock.

Wheel Bearings

145. Removal. Remove the wheel bearings as follows:

a. Clean the area around the hub assembly using a recommended cleaning agent and blow it dry with compressed air.

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by axle stands. Place the axle stands as close as possible to the raised wheel.

b. Loosen the wheel nuts.

c. Chock the rear wheels and engage the differential lock.

d. Using a suitable hydraulic jack, raise the front of the vehicle and support it on axle stands positioned beneath the front axle.

e. Remove the wheel nuts and the wheel.

f. Remove the differential drain plug and drain the oil into a suitable receptacle. Re-install the differential drain plug.

g. Loosen the nut securing the brake hose to the retaining bracket (Figure 93).

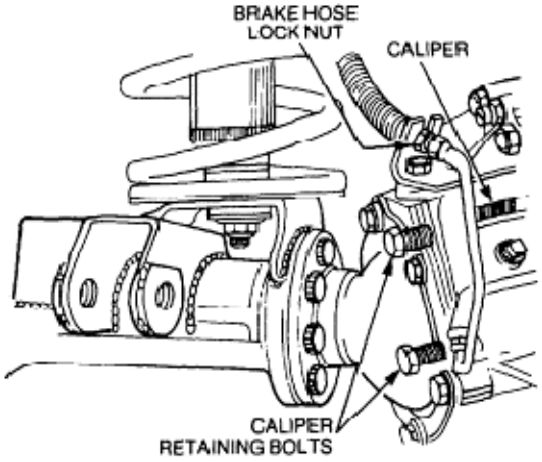


Figure 93 Brake Caliper Removal

h. Disconnect the wear indicator cable at the caliper (left-hand side only).

i. Remove the two bolts securing the caliper to the swivel housing.

j. Move the caliper away from the disc.

k. Ensuring that the brake pipes are not bent, secure the caliper to the road spring with wire or string.

l. Using a suitable lever, pry off the hub cap.

m. Remove the circlip from the drive shaft (Figure 94) and remove the shim.

n. Remove the five bolts and spring washers securing the driving flange to the hub. Discard the spring washers.

o. Remove the driving flange.

p. Remove and discard the gasket.

q. Clean away all trace of gasket material.

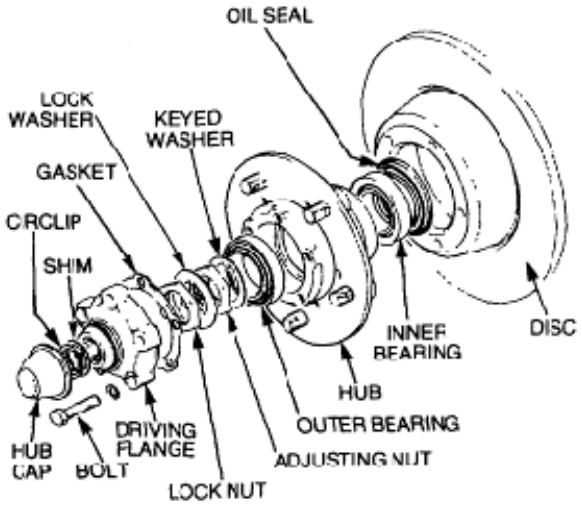


Figure 94 Front Hub and Disk Exploded View

r. Using the hub adjusting spanner (Table 3, Serial 6), remove the locknut, lock-washer, adjusting nut and keyed washer.

s. Remove the hub assembly.

t. Using a suitable lever, pry out the oil seal and remove the inner and outer bearing cones. Discard the oil seal.

u. Remove the bearing cups using a suitable drift or press (Figure 95).

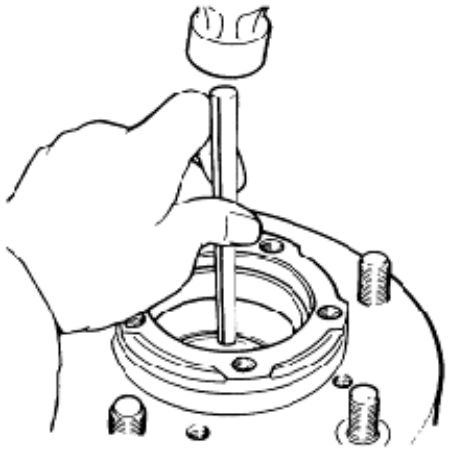


Figure 95 Bearing Cup Removal

v. Clean and degrease the hub in a suitable cleaning agent.

w. Check the disc for cracks or scoring.

x. Replace the disc if it is worn below 13 mm (0.51 in) thickness.

NOTE

The thickness of the new disc is 13.97–14.22 mm (0.55–0.56 in).

146. Installation. Install the wheel bearings as follows:

a. Install the bearing cups using a suitable drift or press, ensuring that the wide sides are towards each other (Figure 96).

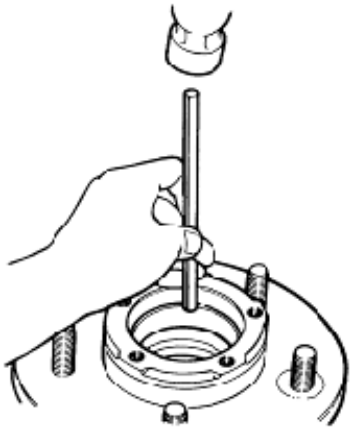


Figure 96 Bearing Cup Installation

b. Pack the inner and outer bearing cones with grease and insert them into the hub.

c. Half-fill the hub with grease.

d. Using the hub oil seal replacer (Table 3, Serial 7) and the bearing and oil seal replacer (Table 3, Serial 11), press the new oil seal into the hub with the seal lip towards the hub bearing (Figure 97).

e. Smear grease around the seal lip.

f. Fit the hub on the stub axle.

g. Install the keyed washer and the adjusting nut.

h. Spin the hub to settle the bearings.

i. Tighten the nut by hand until there is no end float.

j. Back off the hub nut 90 degrees and then tighten it to 10 N.m (7 lbf.ft.).

k. Fit a new lock-washer and install the locknut.

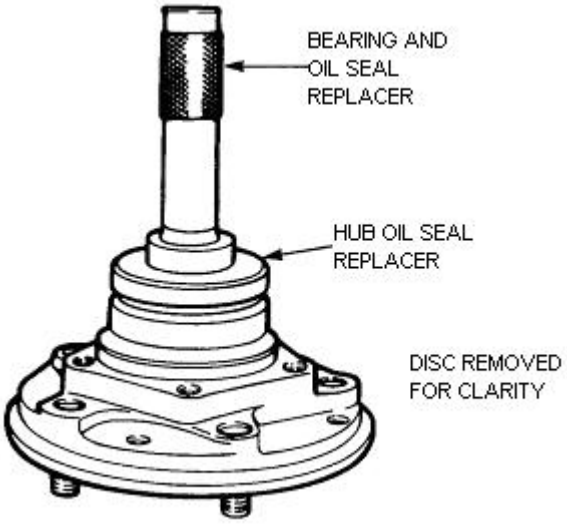


Figure 97 Hub Seal Installation

l. Tighten the locknut to 50 N.m (37 lbf.ft) and tab over the lock-washer.

m. Install the driving flange and a new gasket ensuring the splines are aligned with those on the drive shaft.

n. Fit each bolt with a new spring washer then apply Loctite 271, or equivalent, to the bolt threads.

o. Install the bolts and tighten them to 60–70 N.m (44–52 lbf.ft).

p. Install the drive shaft shim and secure it with the circlip.

q. Install the hub cap securely.

r. Ensure that the brake disc is free from oil and grease and install the caliper.

s. Apply Loctite 271, or equivalent, to the bolt threads.

t. Install the bolts and new lock-washers. Tighten the bolts to 82 N.m (60 lbf.ft).

u. Fit the brake hose on the retaining bracket and tighten the locknut.

v. Connect the wear indicator cable (left-hand side only).

w. Install the road wheel and tighten the wheel nuts.

x. Raise the vehicle off the axle stands, remove the stands and lower the vehicle to the ground.

y. Recheck the wheel nuts.

z. Remove the wheel chocks.

aa. Fill the differential case with oil, up to the lower edge of the fill plug hole.

bb. Install and tighten the plug.

cc. Check the oil level in the swivel housings (top up if necessary).

dd. Operate the brake pedal several times to centralise the brake pads.

Swivel Pin Housing

147. Removal. Remove the swivel pin housing as follows:

a. Remove the front hub assembly (Para 143).

b. Using the ball joint separator (Table 3, Serial 13), disconnect the tie rod and drag link (left side only) ball joints from the swivel housing steering arms.

c. Remove the six bolts and locking plate, retaining the hub stub axle to the swivel housing (Figure 98).

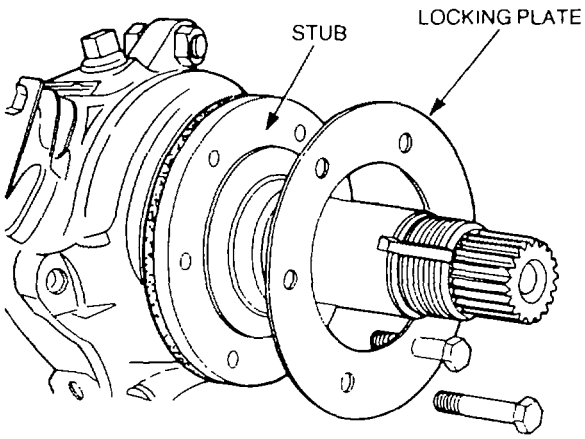


Figure 98 Stub Axle Removal

d. Remove the stub axle and gasket from the swivel housing.

e. Withdraw the drive shaft assembly from the axle.

f. Remove the two bolts and washers retaining the upper swivel pin, hose retaining bracket and shims (Figure 99).

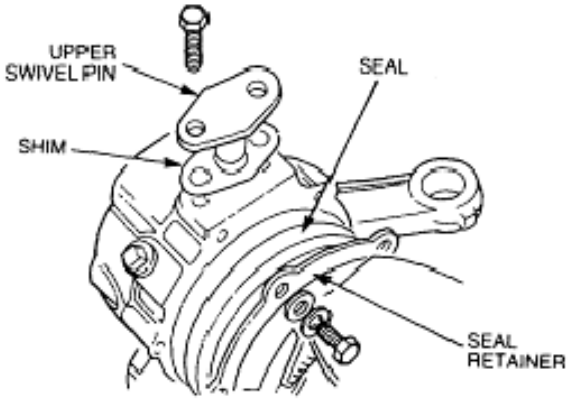


Figure 99 Swivel Housing Oil Seal Removal

g. Remove the bolt securing the backing plate to the lower retaining bracket.

h. Remove the two bolts and washers retaining the lower swivel pin and shims.

i. Remove the swivel pin housing.

j. Remove the seven bolts retaining the bearing housing to the axle case (Figure 100) and remove the bearing housing.

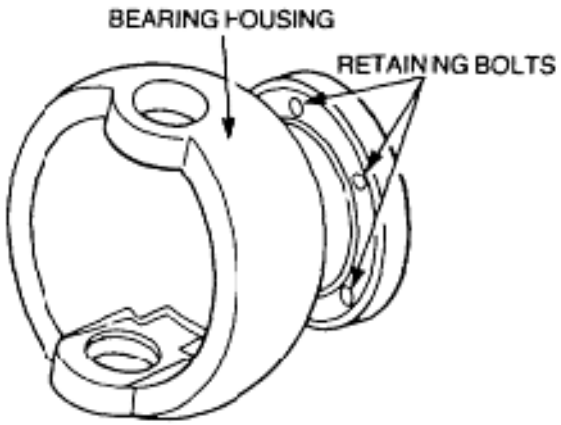


Figure 100 Bearing Housing Removal

148. Disassembly. Disassemble the bearing housing as follows:

a. Remove the oil seal from the bearing housing (Figure 101).

b. Using a suitable press, remove the lower bearing cup and upper bush housing.

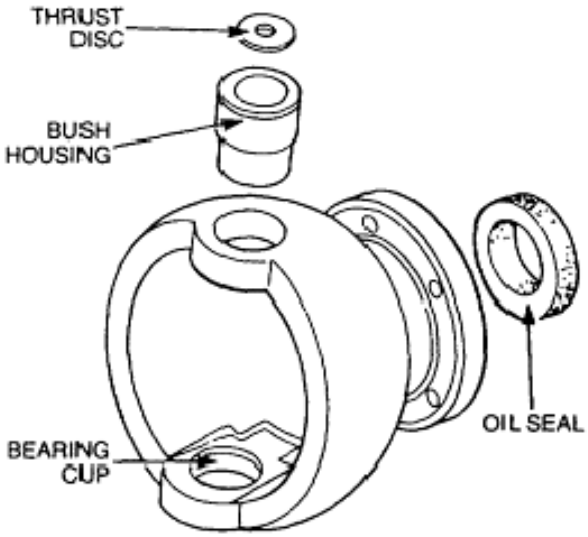


Figure 101 Bearing Housing Disassembly

c. Using the adaptor (Table 3, Serial 9) and the impulse extractor Table 3 Serial 10), remove the oil seal and bronze bush from the stub axle (Figure 102). Discard the oil seal.

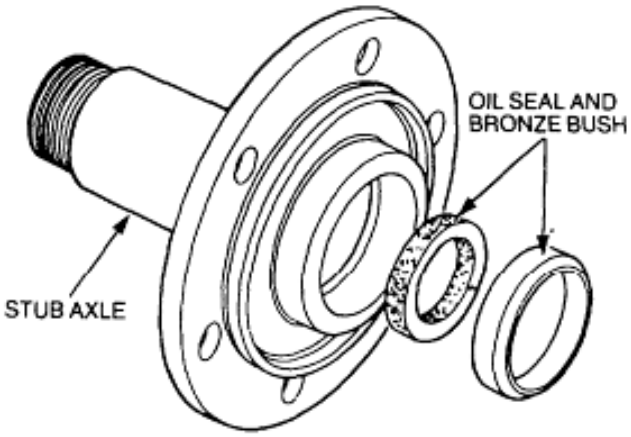


Figure 102 Stub Axle Oil Seal

149. Cleaning and Inspection. Clean and inspect the bearing housing as follows:

NOTE

Do not clean the upper swivel bush if it is to be used again. This will damage the characteristics of the bush and render it unusable.

a. Using a suitable cleaning agent, clean all other components and blow them dry with compressed air.

b. Inspect the upper bush and housing (replace any parts that are excessively worn or pitted).

c. Ensure that the lower bearing is a push fit on the lower swivel pin.

d. Inspect the bearing for pitting, corrosion or excessive wear (replace if necessary).

e. Clean all traces of gasket material from the stub axle and bearing-housing mating flanges.

150. Reassembly. Reassemble the bearing housing as follows:

a. Using a suitable press, install the oil seal and bronze bush in the stub axle (Figure 102).

NOTE

Ensure that the open face of the seal is towards the bearing.

b. Press the lower bearing cup, wide face first, into the bearing housing.

c. Press in the upper swivel bush, with the machined flat towards the mounting flange.

d. Thoroughly lubricate the bush with clean oil.

e. Press the oil seal into the bearing housing, plain side first (Figure 101).

f. Smear grease around the seal lip.

151. Installation. Install the bearing housing as follows:

a. Fit the swivel housing oil seal and seal retainer over the bearing housing flange.

NOTE

Ensure that the open face of the seal is toward the spherical face of the housing.

b. Install the bearing housing and a new gasket onto the axle casing.

c. Smear Loctite 275 or equivalent on the threads of the bolts.

d. Insert and tighten the bolts to 65–80 N.m (48–59 lbf.ft).

e. Lubricate the lower roller bearing and thrust disc with oil.

f. Install the bearing into the bearing housing cup and the thrust disc into the upper bush.

g. Install the swivel pin housing onto the bearing housing.

h. Insert the lower swivel pin and a new gasket.

i. Secure the swivel pin and the backing plate bracket with the two bolts and new lock-washers.

j. Insert the upper swivel pin and original shims.

k. Secure the pin and brake-hose bracket with the two bolts and new lock-washers.

l. Tighten the upper pin bolts to 60–70 N.m (44–52 lbf.ft) and the lower pin bolts to 22–28 N.m (16–20 lbf.ft).

m. Connect a spring balance to the steering-arm ball-joint eye.

n. Measure the resistance to rotation after the initial movement (Figure 103).

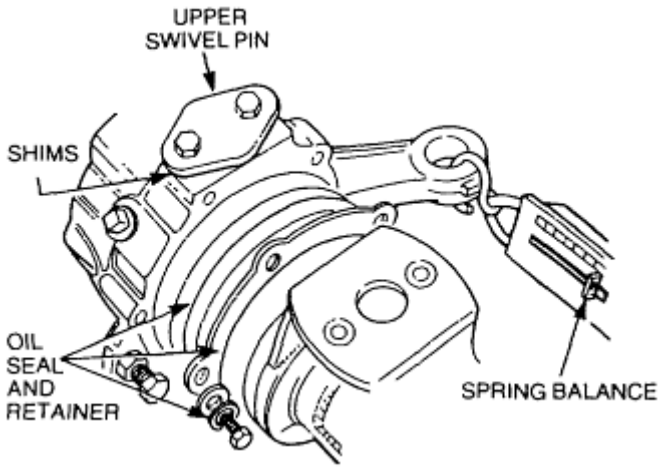


Figure 103 Measuring the Rotating Resistance

o. Adjustment can be achieved by adding or subtracting shims installed under the upper swivel pin.

NOTE

The shims range from 0.076, 0.127, 0.254, 0.762 mm (0.003, 0.005, 0.010, 0.030 in).

p. When the resistance is within specification, remove the upper and lower-pin retaining bolts.

q. Apply Loctite 275 or equivalent to the threads and re-install the bolts.

r. Tighten the upper pin bolts to 60–70 N.m (44–52 lbf.ft) and the lower pin bolts to 22–28 N.m (16–21 lbf.ft).

s. Repeat the rolling resistance check.

t. Smear the swivel housing oil seal with grease and install the seal and seal retaining plate.

u. Install the six bolts and new lock-washers (Figure 103).

v. Tighten the bolts to 7–10 N.m (5–7 lbf.ft).

w. Check that the seal wipes the spherical surface of the bearing housing.

x. Install a new gasket and the stub axle onto the swivel pin housing.

y. Apply Loctite 275 or equivalent to the threads of the bolts.

z. Install the bolts and the locking plate and tighten the bolts to 60–70 N.m (44–52 lbf.ft).

aa. Connect the tie rod to the steering arm.

bb. While applying pressure on the ball joint, tighten the nut securely and lock the nut in position with a new split pin.

cc. Install the hub assembly (Para 144).

dd. Fill the axle with oil to the correct level and grease the swivel pin housings with grease (NSN 9150-99-911-1798).

ee. Carry out the front wheel alignment (Para 235)

Drive Shaft

152. Removal. Remove the drive shaft as follows:

a. Remove the front hub assembly (Para 143).

b. Remove the six bolts and locking plate retaining the hub stub axle to the swivel housing (Figure 104).

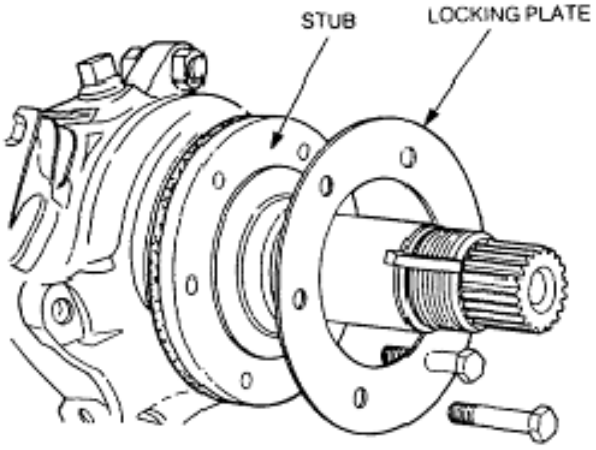


Figure 104 Stub Axle Removal

c. Withdraw the drive shaft from the axle case.

153. Disassembly. Disassemble the drive shaft as follows:

a. Clamp the axle end of the shaft firmly in a vice fitted with soft jawed protectors.

b. Using a soft-faced hammer, remove the constant velocity joint from the shaft.

c. Remove the circlip and collar from the shaft.

d. Match mark the constant velocity joint inner and outer race to the cage.

e. To remove the steel balls, tilt and swivel the cage then the inner race (Figure 105).

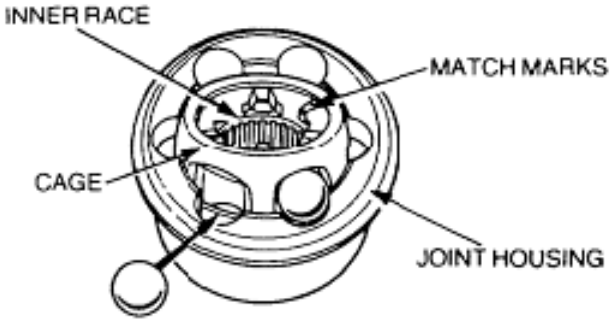


Figure 105 Constant Velocity Joint Steel Ball Removal

f. Swivel the cage to line up with the axis of the constant velocity joint (Figure 106).

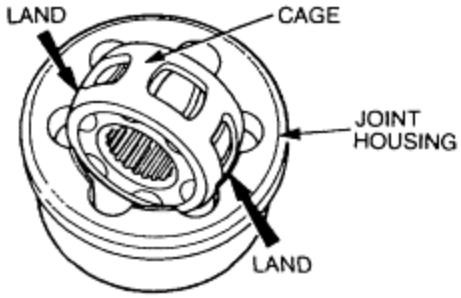


Figure 106 Constant Velocity Joint Cage Removal

g. Turn the cage until two opposite windows line up with two lands of the joint housing.

h. Remove the cage.

i. Turn the inner race at right angles to the cage with two of the lands opposite the cage windows.

j. Remove the race (Figure 107).

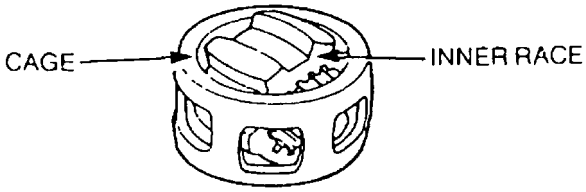


Figure 107 Inner Race Removal

154. Cleaning and Inspection. Clean and inspect the drive shaft as follows:

a. Using a suitable cleaning agent, thoroughly clean all components and blow them dry with compressed air.

b. Inspect all components for wear or cracks.

c. Replace the complete assembly if any part is excessively worn.

155. Reassembly. Reassemble the drive shaft as follows:

NOTE

The maximum permissible end-float on the assembled constant velocity joint is 0.64 mm (0.025 in).

a. Turn the inner race at right angles to the cage with two of the lands opposite the cage windows.

b. Insert the race (Figure 107).

c. Position the cage on the constant velocity joint (Figure 106).

d. Line-up the two opposite windows with the two opposite lands then fit the cage.

e. Align the match marks made on the joint inner and outer race and the cage.

f. Tilt and swivel the cage to allow the steel balls to be inserted (Figure 105).

g. Fit the collar and circlip on the shaft.

h. Using a soft-faced hammer, install the constant velocity joint onto the shaft.

156. Installation. Install the drive shaft as follows:

NOTE

A new circlip must be fitted to the drive shaft when installing the hub assembly.

a. Using a new gasket, install the stub axle and locking plate.

b. Apply Loctite 275 or equivalent to the bolt threads.

c. Install the bolts and tighten them to 60–70 N.m (44–52 lbf.ft).

d. Install the hub assembly (Para 144).

e. Fill the axle with oil to the correct level and grease the swivel pin housings with grease (NSN 9150-99-911-1798).

Swivel Pin to Bush Clearance

157. Inspection and Adjustment. Inspect and adjust the swivel pin to bush clearance in accordance with EMEI Vehicle G 188-1.

Breather Hose

158. Replacement. Replace the breather hose as follows:

a. Using a recommended cleaning agent, clean the area around the breather and blow it dry with compressed air.

b. Remove the banjo bolt and sealing washers securing the breather hose to the front axle casing (Figure 108). Discard the sealing washers.

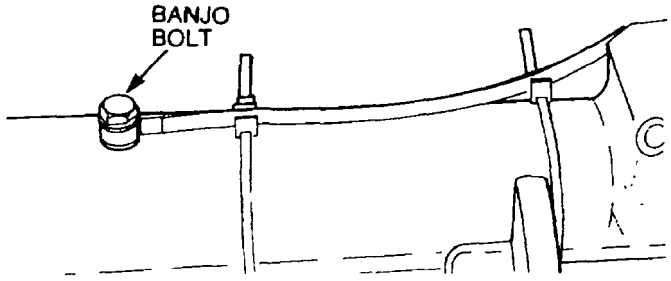


Figure 108 Front Axle Breather Hose Location

c. Disconnect the hose from the securing clips on the left-hand radius arm.

d. Remove the P-clip securing the hose to the chassis.

e. Remove the P-clip securing the hose to the firewall.

f. Remove the hose from the vehicle.

g. Position the new hose along the chassis and up into the firewall.

h. Using new sealing washers, fit the hose to the axle case and tighten the banjo bolt securely.

i. Using the securing clips, secure the hose to the left-hand radius arm.

j. Secure the hose to the chassis and firewall with the P-clips.

Front Axle System Specifications

159. The front axle system specifications are detailed in Table 16.

Table 16 Front Axle System Specifications

Serial	Specification	Measurement
1	Pinion flange nut	94–163 N.m (70–120 lbf.ft)
2	Propeller shaft retaining nuts	41–52 N.m (30–38 lbf.ft)
3	Hub bearing adjustment hub nut	10 N.m (7 lbf.ft)
4	Hub locknut	50 N.m (37 lbf.ft)
5	Hub driving flange retaining bolts	60–70 N.m (44–52 lbf.ft)
6	Rotation resistance	4.5–9 kg (10–20 lb.)
7	Drive shaft end float	0.127–0.254 mm (0.005–0.0 10 in)
8	Front brake caliper retaining bolts	82 N.m (60 lbf.ft)
9	Brake disc wear limit	13 mm (0.51 in.)
10	Brake disc thickness (New)	13.97–14.22 mm (0.55–0.56 in)
11	Brake disc run-out	0.15 mm (0.005 in)
12	Swivel bearing housing	65–80 N.m (48–59 lbf.ft)
13	Swivel pin (lower)	22–28 N.m (16–21 lbf.ft)
14	Swivel pin housing rotation resistance	4.5–9 kg (10–20 lb)
15	Swivel pin housing seal retainer	7–10 N.m (5–7 lbf.ft)
16	Constant velocity joint maximum end-play	0.64 mm (0.025 in)

WHEELS

160. Wheel Balancing. Balance the wheels in accordance with EMEI Vehicle G 189-18.

BRAKE SYSTEM

Master Cylinder

161. Removal. Remove the master cylinder as follows:

a. Using a recommended cleaning agent, clean the area around the master cylinder and blow it dry with compressed air.

b. Remove the clamp securing the expansion tank to the mounting bracket and place the tank on the right-hand mudguard.

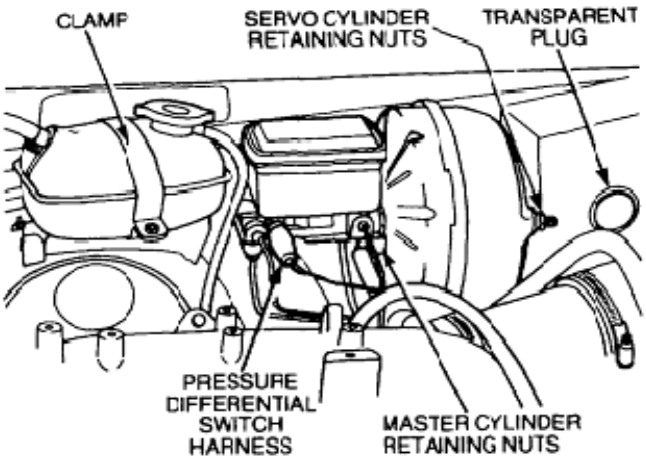


Figure 109 Master Cylinder Removal

c. Disconnect the wiring harness from the pressure differential switch.

d. Remove the brake pipes from the master cylinder and plug the pipes to prevent the ingress of dirt.

e. Remove the two nuts and spring washers securing the master cylinder to the brake servo cylinder. Discard the spring washers.

f. Remove the master cylinder and drain the brake fluid.

162. Installation. Install the master cylinder as follows:

a. Fit the master cylinder on the servo cylinder and install new spring washers.

b. Install the nuts, but do not tighten them.

c. Remove the plugs from the brake pipes and the master cylinder.

NOTE

If necessary, move the master cylinder slightly to enable the connectors to be correctly fitted.

d. Install the brake pipes ensuring that the connectors are not cross-threaded.

e. Tighten the master cylinder retaining nuts securely.

f. Connect the wiring harness to the pressure differential switch.

g. Install the expansion tank and secure the clamp.

h. Remove the lid from the reservoir and fill with clean hydraulic fluid.

i. Bleed the brake system (Para 195).

Servo Cylinder

163. Removal. Remove the servo cylinder as follows:

a. Remove the master cylinder (Para 161).

b. Remove the vacuum hose from the servo cylinder and plug the hose.

c. Remove the transparent plastic plugs from the pedal bracket.

d. From inside the vehicle, remove the split pin securing the clevis to the pedal and discard the split pin.

e. Withdraw the clevis pin through the pedal bracket.

f. Remove the three nuts and washers securing the servo cylinder to the pedal bracket.

g. Remove the servo assembly.

164. Installation. Install the servo cylinder as follows:

NOTE

Ensure that the distance from the centre of the clevis fork to the servo cylinder face is 110 mm for the early pedal box and 120 mm for the late pedal box.

a. Position the servo cylinder in the pedal bracket and install the three nuts and washers.

b. Tighten the nuts securely.

c. Ensuring that the push rod clevis fork is engaged with the brake pedal, insert the clevis pin through the pedal bracket opening.

d. Secure the clevis pin with a new split pin.

e. Apply a smear of grease on the fork and clevis pin.

f. Fit the transparent plastic covers.

g. Connect the vacuum hose to the non-return valve.

h. Secure it with the hose clamp.

i. Install the master cylinder (Para 162).

Front Brake Caliper and Pads

165. Removal. Remove the front brake callipers as follows:

WARNING

Do not use an air line to remove dust from the brake assembly. Dust from the brake linings can be a health risk if inhaled.

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by axle stands. Place the axle stands as close as possible to the raised wheel.

NOTE

Brake disc pads must only be replaced as an axle set not as one side only.

a. Loosen the front wheel nuts.

b. Chock the rear wheels.

c. Using a suitable hydraulic jack, raise the front of the vehicle and place axle stands beneath the front axle.

d. Lower the vehicle on to the stands.

e. Remove the front wheels.

f. Loosen the flexible hose locknut and remove the pipe from the slotted retaining bracket.

g. Remove the disc pad retaining pins and remove the retaining springs and pads (Figure 110).

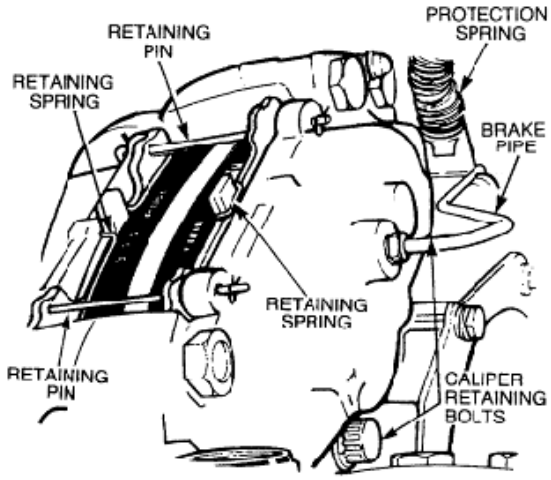


Figure 110 Brake Caliper Removal

h. Remove the two bolts securing the brake caliper to the swivel housing.

i. Remove the caliper from the disc.

166. Disassembly. Disassemble the front brake calipers as follows:

CAUTION

Do not separate the two halves of the caliper. The piston seals can be replaced without splitting the caliper.

a. Thoroughly clean the caliper using a suitable cleaning agent and allow it to dry.

b. Install a disc brake piston compressor (Table 3, Serial 12) to retain both the pistons in the mounting-flange half of the caliper (Figure 111).

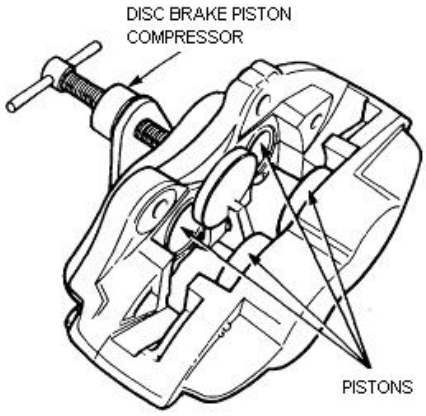


Figure 111 Special Tool Rim Half Disassembly

WARNING

Keep fingers clear when expelling the pistons from the caliper. Pistons are expelled at high speed and will cause injuries to personnel.

c. Apply air pressure to the fluid inlet port to expel the rim half-pistons.

d. Mark the pistons internally to identify them with their respective bores.

e. Remove the wiper seal retainer by inserting a blunt screwdriver between the retainer and the seal.

f. Prise the retainer carefully from the mouth of the bore.

g. Taking care not to damage the seal grooves, remove the wiper seal and fluid seal.

h. Repeat the actions (as detailed in sub-paragraphs c to e), to remove the pistons from the mounting-half of the caliper.

167. Cleaning and Inspection. Clean and inspect the front brake calipers (Figure 112)

a. Using a suitable cleaning agent, thoroughly clean the bores, pistons and particularly the seal grooves and allow them to dry.

b. Check the pistons and caliper bores for corrosion and scoring (replace parts as necessary).

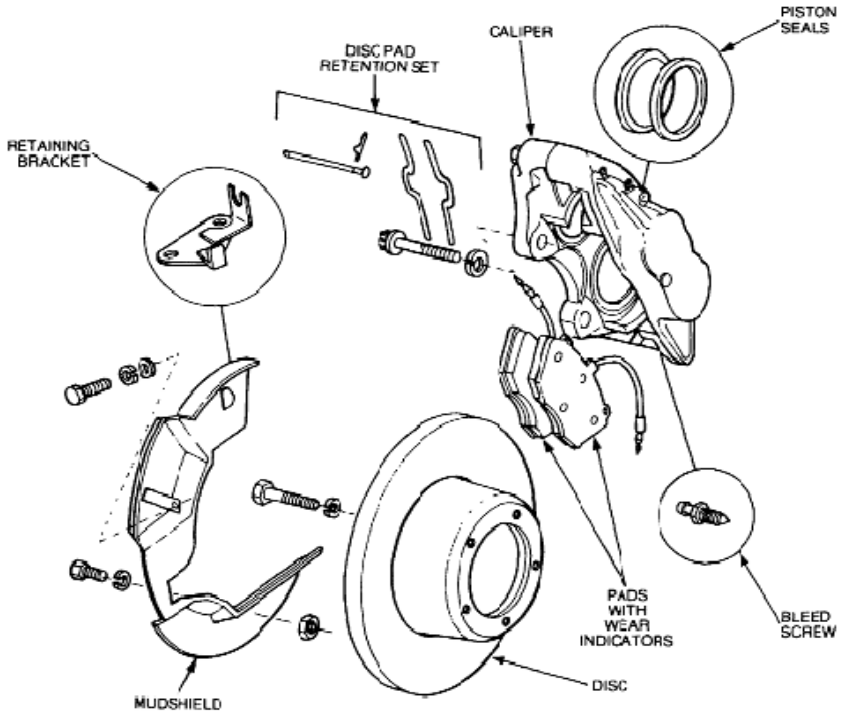


Figure 112 Brake Caliper Exploded View

168. Reassembly. Reassemble the front brake calipers as follows:

NOTE

The fluid seal and groove are not the same in section. This is so the seal feels proud to the touch when it is seated at the edge furthest away from the mouth of the bore.

a. Smear the new fluid seal with Dow Corning 44 Silicone grease, or equivalent.

NOTE

Do not lift the piston during installation. Leave approximately 8 mm (5/16 in) projecting from the bore.

b. Insert the seal into the groove, using fingers only and ensure that the seal is properly seated.

c. Loosen the bleed screw one complete turn.

d. Smear the appropriate piston with Dow Corning 44 Silicone grease, or equivalent.

e. Insert it squarely into the bore by hand only.

f. Smear the new wiper seal with the Dow Corning 44 Silicone grease or equivalent and fit it into a new seal retainer.

g. Slide the assembly, seal-side first, over the protruding piston and into the bore recess.

h. Remove the disc brake piston compressor (Table 3, Serial 12) from the mounting-half of the caliper.

i. Use the compressor to press home the seal retainer and piston.

j. Tighten the bleed screw.

k. To install the pistons in the mounting-half of the caliper, repeat sub-paragraphs a. to d.

l. Install the disc pads into the caliper.

m. Fit the two retaining springs and pins.

169. Installation. Install the front brake caliper as follows:

a. Fit the caliper to the swivel housing.

b. Smear Loctite 271 or equivalent on the bolt threads.

c. Install the bolts and new spring washers and tighten them to 82 N.m (60 lbf.ft).

d. Install the brake pipe to the slotted retaining bracket and tighten the locknut.

e. Bleed the brake system (Para 195).

f. Install the wheels and wheel nuts.

g. Raise the vehicle off the stands. Remove the stands and lower the vehicle to the ground.

h. Tighten the wheel nuts and remove the wheel chocks.

Front Brake Disc

170. Removal. Remove the front brake disc as follows:

WARNING

Do not use an air line to remove dust from the brake assembly. Dust from the brake linings can be a health risk if inhaled.

a. Remove the caliper (Para 165).

b. Remove the hub assembly (Para 143).

c. Matchmark the hub to the disc (if re-using the original disc).

d. Remove the five bolts and separate the hub from the disc.

171. Cleaning and Inspection. Clean and inspect the front brake disc as follows::

a. Using a suitable cleaning agent, thoroughly clean the disc and allow it to dry.

b. Check the disc for corrosion, scoring and cracks (replace as necessary).

c. Measure the thickness of the disc. If it is less than 13 mm (0.51 in), replace the disc.

172. Installation. Install the brake disc as follows:

a. Fit the disc on the hub (align the matchmarks if re-using the original disc).

b. Smear Loctite 271 or equivalent on the bolt threads.

c. Install the bolts with new spring washers.

d. Tighten the bolts to 50 N.m (38 lbf.ft).

e. Install the hub assembly (Para 144).

f. Install the caliper (Para 169).

Rear Brake Drums

173. Removal. Remove the rear brake drum as follows:

WARNING

Under no circumstances is compressed air to be used to remove dust from the brake assembly. Dust from the brake linings can be a health risk if inhaled.

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by axle stands. Place the axle stands as close as possible to the raised wheel.

a. Loosen the wheel nuts.

b. Chock the front wheels and engage the front differential lock.

c. Using a suitable hydraulic jack, raise the rear of the vehicle and support it on axle stands positioned beneath the rear axle.

d. Remove the wheel nuts and wheels.

NOTE

It may be necessary to back-off the brake shoes if the shoes jam on the wear lip of the drum.

e. Remove the screw securing the brake drum to the hub and remove the drum.

f. Check the drums for cracks or scoring (replace if necessary).

174. Installation and Brake Adjustment. Install the brake drum as follows:

a. Ensure that the brake shoes are aligned with the back plate.

NOTE

The brake shoes will have to be backed-off when new shoes are fitted to ensure they do not jam on the wear lip of the drum.

b. Install the brake drum and secure it with the screw.

c. Install the wheels and wheel nuts and tighten them.

d. Adjust the brakes (if necessary as follows):

(1) With the rear of the vehicle supported on axle stands and the parking brake applied, turn each adjuster in turn, until the brake shoe is tight against the brake drum.

(2) Back off the snail cam until the drum turns freely.

e. Raise the vehicle off the axle stands. Remove the stands and lower the vehicle to the ground.

f. Tighten the wheel nuts securely.

g. Remove the wheel chocks and hydraulic jack.

Brake Shoes

175. Removal. Remove the brake shoes as follows:

a. Remove the brake drum (Para 173).

b. Loosen the brake adjuster.

c. Disconnect and plug the brake pipe from the wheel cylinder.

d. Noting the position of the shoe return springs, lever off the brake shoes.

176. Inspection. Inspect the brake shoe linings for wear (replace as necessary).

177. Installation. Install the brake shoes as follows:

a. Install the shoe return springs on the brake shoes (Figure 113).

NOTE

The brake shoes must only be replaced as an axle set, not as one side only.

b. Install the brake shoes on the back plate, ensuring that the shoes locate into the wheel cylinder piston slots.

c. Lever the lower end of the shoes onto the pivot block.

d. Check the adjusters for correct operation.

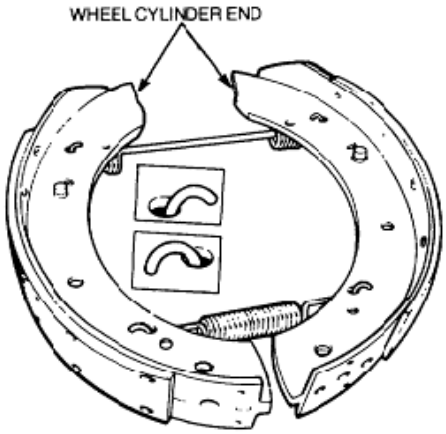


Figure 113 Brake Shoe Return Spring Installation

Wheel Cylinder

178. Removal. Remove the wheel cylinder as follows:

a. Remove the brake shoes (Para 175)

b. Remove the two retaining nuts and spring washers securing the wheel cylinder to the back plate (Figure 114). Discard the spring washers.

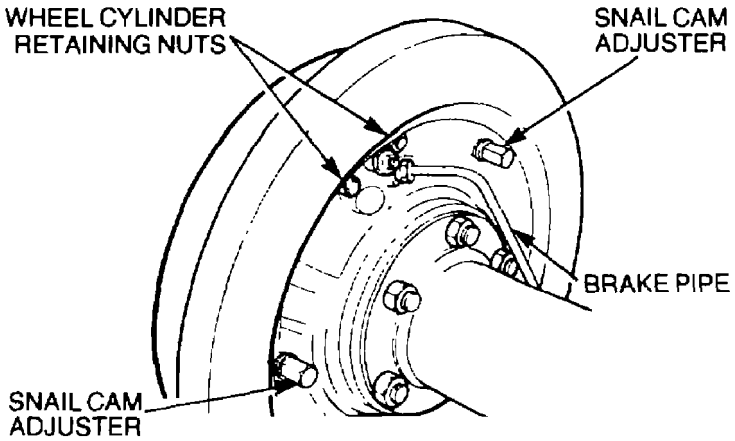


Figure 114 Wheel Cylinder Removal

c. Remove the wheel cylinder.

179. Disassembly. Disassemble the wheel cylinder assembly as follows (Figure 115):

a. Remove the bleed screw.

b. Remove the two dust covers.

c. Remove the pistons and seals. Discard the seals.

d. Remove and discard the wheel cylinder cups.

e. Remove the two seats.

f. Remove the spring.

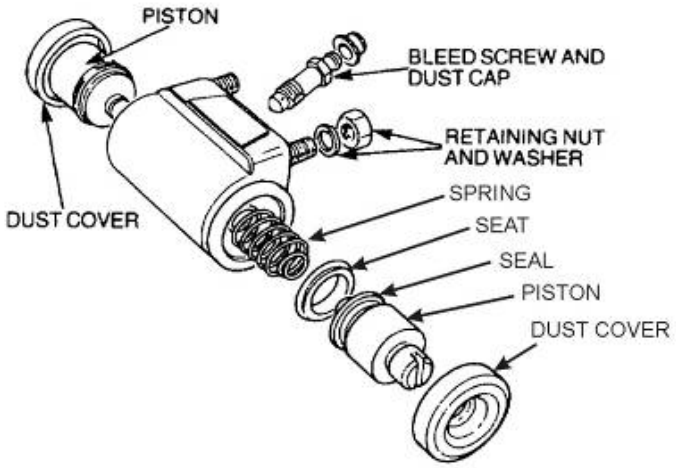


Figure 115 Wheel Cylinder Exploded View

180. Cleaning and Inspection. Clean and inspect the wheel cylinder components and back plate as follows:

a. Using a suitable cleaning agent, thoroughly clean the back plate and wheel cylinder components and allow them to dry.

b. Inspect the back plate and the brake adjusters for damage (replace if necessary).

c. Inspect the wheel cylinder and pistons for corrosion, scores and wear (replace if necessary).

181. Reassembly. Reassemble the cylinder assembly as follows:

a. Fit the spring.

b. Fit the two seats.

c. Fit the new wheel cylinder cups.

d. Fit the pistons and new seals.

e. Install the dust covers.

f. Fit the bleed screw and tighten it.

182. Installation. Install the wheel cylinder as follows:

a. Position the wheel cylinder on the back plate.

b. Install the two nuts and new spring washers and tighten them securely.

c. Connect the brake pipe to the wheel cylinder and tighten it securely.

d. Install the brake shoes (Para 176).

e. Install the brake drum (Para 173.f).

f. Bleed the brake system (Para 195).

Parking Brake Drum

183. Removal. Remove the parking brake drum as follows:

WARNING

New gaskets provided by Land Rover do not contain asbestos. Older gaskets still fitted to vehicles may contain asbestos. During this task some parts may contain asbestos; refer and comply with procedures and warnings in the introduction section of this EMEI under paragraph heading: Items Previously Known To Have Contained Asbestos.

WARNING

Under no circumstances is compressed air to be used to remove dust from the hand brake drum or brake linings. Dust from the brake linings can be a health risk if inhaled.

a. Chock the wheels.

b. Remove the bolts and locknuts securing the propeller shaft. Discard the locknuts.

c. Remove the propeller shaft.

d. Remove the two screws securing the transmission brake drum and remove the drum (Figure 116).

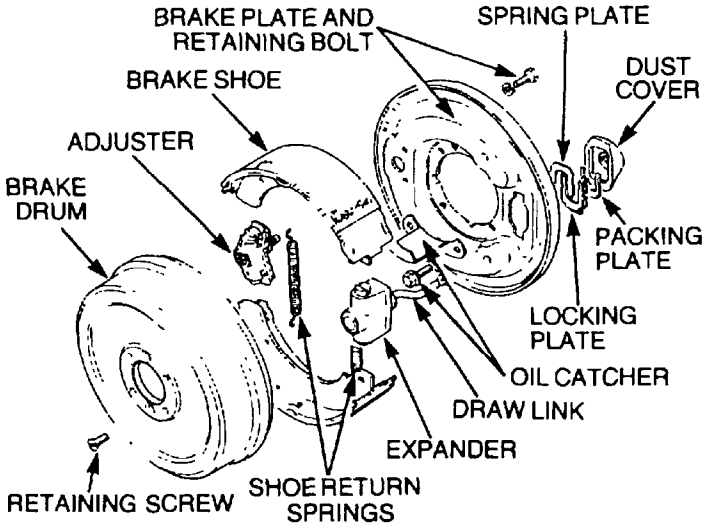


Figure 116 Parking Brake Exploded View

e. Check the drum for cracks or scoring (replace if necessary).

184. Disassembly. Disassemble the parking brake as follows:

a. Remove the brake drum (Para 183).

b. Remove the brake shoes, noting the position of the shoe return springs.

c. Remove the split pin and clevis pin from the draw link. Discard the split pin.

d. Remove the expander unit dust cover and the fixing plates.

e. Remove the expander.

f. Remove the spring clip from the expander and remove the pistons and the rollers.

g. Remove the draw link from the expander.

h. Remove the two bolts and spring washers securing the adjuster to the back plate.

i. Remove the adjuster.

j. Remove the plungers from the adjuster and screw the adjuster cone inwards.

k. Remove the cone from the housing (Figure 117).

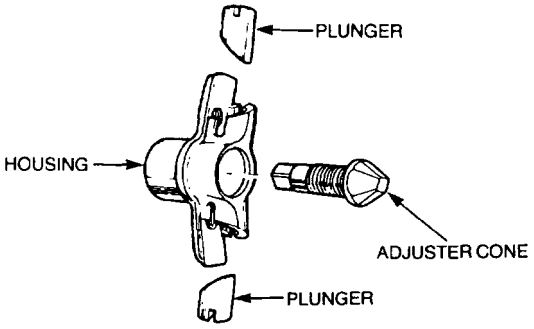


Figure 117 Adjuster Exploded View

185. Cleaning and Inspection. Clean and inspect the parking brake as follows:

a. Using a suitable cleaning agent, thoroughly clean all components and allow them to dry.

b. Inspect all parts for wear (replace if necessary).

c. Inspect the brake shoes for loose, cracked or excessively worn linings and replace if necessary.

186. Reassembly. Reassemble the parking brake as follows:

a. Smear the adjuster cone with grease and screw the adjuster cone fully into the housing.

NOTE

Use an elastic band to prevent the plungers falling out.

b. Smear the plunger with grease and insert it into the adjuster ensuring that the chamfered ends align with the adjuster cone.

c. Smear the expander with grease and insert the draw link into the expander.

d. Smear the plungers and rollers with grease and insert them into the expander ensuring the highest end of the ramp on the plunger is fitted toward the draw link.

e. Install the spring clip.

f. Fit the adjuster to the back plate.

g. Install the two bolts and new spring washers.

h. Install the expander to the back plate and fit the spring, packing and locking plates.

i. Install the dust cover.

j. Connect the draw link clevis and secure it with a new split pin.

187. Installation. Install the parking brake drum as follows:

a. Fit the shoe return springs on the brake shoes.

NOTE

The fully lined end of the lower shoe must be toward the expander housing. The fully lined end of the upper shoe must be toward the adjuster housing.

b. Install the shoes onto the back plate.

c. Install the brake drum and secure it with the two screws.

d. Turn the adjuster in until the shoes are tight against the brake drum.

e. Tighten the adjuster mounting bolts securely.

f. Loosen off the adjuster half a turn and give the parking brake a firm application to centralise the shoes.

g. Release the brake and ensure the drum is free to rotate.

h. Fit the rear propeller shaft flange to the rear output shaft flange, using new locknuts.

i. Torque the locknuts to 43–51 N.m (32–38 lbf.ft).

j. Apply the parking brake and remove the wheel chocks.

Parking Brake Cable

188. Replacement. Replace the parking brake cable as follows:

a. Chock the vehicle wheels.

b. Remove the split pin and clevis pin securing the cable to the pivot under the vehicle (Figure 118). Discard the split pin.

c. Loosen the locknuts securing the brake cable to the transmission bracket.

d. Remove the cable from the transmission bracket.

e. Remove the end nut from the cable and withdraw the cable from the bracket.

f. Remove the screws securing the rubber boot to the seat base.

g. Remove the split pin and clevis pin from the hand brake lever. Discard the split pin.

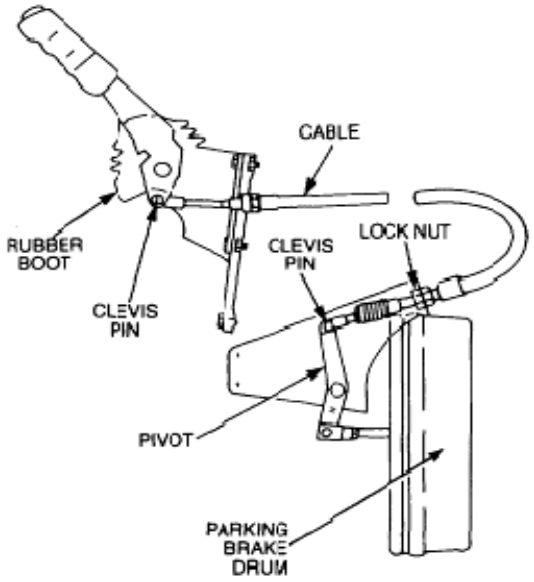


Figure 118 Parking Brake Cable Replacement

h. From under the vehicle, unscrew the cable from the seat base.

i. Remove the cable from the vehicle.

j. Screw in the new cable and tighten it securely.

k. Connect the clevis fork on the parking brake lever.

CAUTION

Ensure that the parking brake cable does not loop right from the handbrake leaver heelboard, subsequently curling over the fuel tank to the transmission bracket. It will rub on fuel lines and may cause a fire.

l. Fit the cable so that it loops left from the handbrake leaver heelboard curling right to the transmission bracket as depicted in Figure119.

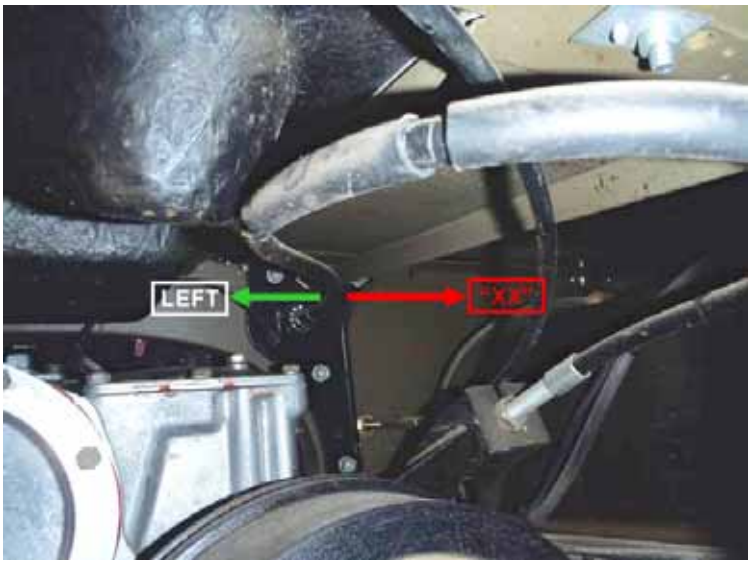


Figure 119 Parking Brake Cable Route

m. Fit the cable on the transmission bracket.

n. Using the two nuts on the cable adjust it until the clevis fork is aligned with the pivot and the clevis pin can be installed.

o. Secure the clevis with a new split pin.

p. Apply the parking brake and remove the wheel chocks.

q. Install the rubber boot and secure it to the seat base.

Parking Brake Adjustment

189. Adjustment. Adjust the parking brake as follows:

a. Chock the vehicle wheels.

b. Apply the parking brake a few times to centralise the brake shoes.

c. Release the parking brake lever.

d. Screw in the adjuster until the brake shoe is tight up against the brake drum (Figure 120).

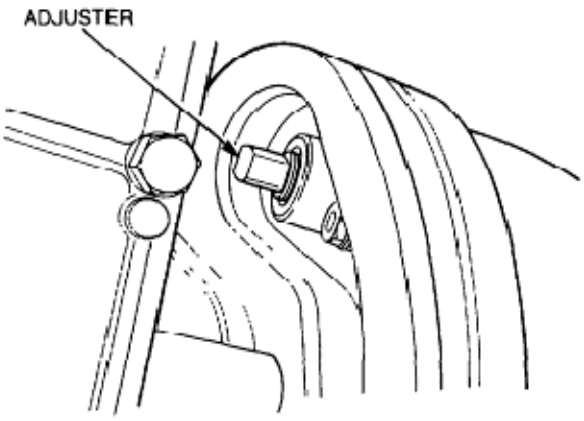


Figure 120 Parking Brake Adjustment

e. Loosen off the adjuster half a turn and ensure the drum is free to rotate. If not, repeat the procedure.

f. Apply the parking brake.

g. Remove the wheel chocks.

Hydraulic Hoses and Pipes

190. Replacement. Replace the hoses and pipes as follows:

a. Using a recommended cleaning agent, clean the area around the brake pipe and allow it to dry.

b. Disconnect the hose or pipe at both connections.

c. Plug both openings to prevent the ingress of dirt.

NOTE

The brake pipe connecting the rear wheel cylinders is secured to the axle by three clips. These clips must be removed to enable the pipe to be removed.

d. Release the pipe from the chassis plastic clips and remove the pipe from the vehicle.

e. Position the new hose or pipe onto the vehicle and secure it with the chassis plastic clips or band clamps.

f. Remove the plugs, connect both connections and tighten them securely.

g. Bleed the brake system (Para 195).

Pedal Free Travel

191. Inspection. Inspect the pedal free travel as follows:

a. Open the bonnet. Tag and remove the wires from the stop light switch, located at the rear of the scuttle.

b. Remove the switch.

c. Depress the brake pedal slightly and position a shim between the pedal and the brake switch box (Figure 121).

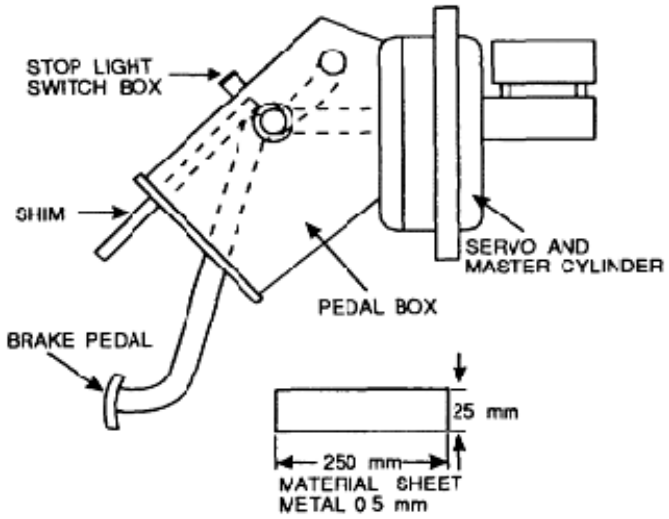


Figure 121 Pedal Free Travel Inspection

d. Holding the shim in position, release the brake pedal and allow it to come to rest against the stop.

NOTE

The stop is inside the servo and cannot be adjusted.

e. Release the shim.

f. If the shim falls out, the brake system is set correctly.

g. If the shim is trapped and has to be pulled out, adjustment is required (Para 192).

h. If the system is correctly set, refit the stop light switch and tighten the locknut.

i. Reconnect the wires ensuring that only the green and green/purple wires are connected to the switch.

j. Check the brake light operation.

k. Close the bonnet.

192. Adjustment. Adjust pedal free travel as follows:

a. Open the bonnet and remove the two plastic plugs on the sides of the pedal box.

b. Remove and discard the split pin from the clevis pin.

c. Remove the clevis pin from the yoke.

d. Remove the clamp securing the radiator expansion tank to the mounting bracket.

e. Place the tank on the right-hand mudguard.

NOTE

It is not necessary to remove any brake pipes from the master cylinder.

f. Remove the two nuts and washers securing the master cylinder to the servo.

g. Remove the brake pipes from the plastic clip on the scuttle.

h. Withdraw the master cylinder until it clears the servo cylinder.

i. Remove the three nuts and washers securing the servo cylinder to the pedal box.

j. Remove the servo cylinder.

k. Loosen the yoke locknut.

NOTE

This dimension is measured from the servo mounting face and not the recess at the base of the push rod guide.

l. Measure and set the brake servo rod length to the required dimensions (Figure 122) and tighten the yoke locknut.

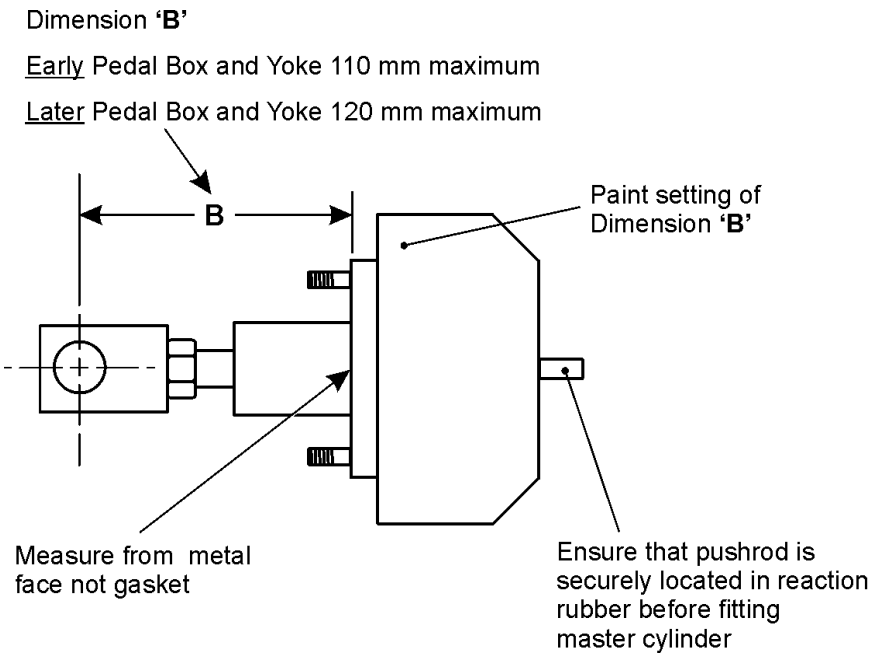


Figure 122 Brake Servo Rod Length

m. Position the servo cylinder at the pedal box and secure it with the three nuts and washers.

n. Position the master cylinder at the servo cylinder and secure it with the two washers and nuts.

o. Secure the brake pipes in the plastic clip at the scuttle.

p. Install the clevis pin and secure it with a new split pin.

q. Install the two plastic plugs to the side of the pedal box.

r. Install the expansion tank and secure it with the clamp.

s. Check the brake pedal free travel (Para 191).

t. Check the brake operation and the operation of the stop lights.

NOTE

After resetting the brake servo rod there will be some spring pre-load between the master cylinder and the servo cylinder. No attempt should be made to place shims between the master cylinder and the servo cylinder.

Pushrod Adjustment to Rectify Excess Brake Pedal Travel

193. Procedure. Adjust the brake servo rod as follows:

NOTE

An early model brake servo rod with a length of 24 mm or a late model brake servo rod with a length of 30 mm may be fitted.

a. Disconnect the battery terminals.

b. Remove the bolt securing the brake pressure differential switch to the firewall.

c. Disconnect the brake master cylinder from the brake booster (leave the brake pipes connected).

d. Move the master cylinder to one side and support it.

e. Disconnect the radiator overflow bottle.

f. From inside the cabin, remove the brake pedal box and booster assembly from the vehicle.

g. To gain access to the pedal yoke clevis, remove the grommets in the pedal box.

h. Remove and discard the clevis split pin. Disconnect the brake booster from the pedal box.

CAUTION

The clevis pin must be a free fit in the brake servo rod. The dimensions (Figure 122) are an absolute maximum and if exceeded will cause brake lockup and pedal application problems. If brake lockup occurs with adjustment set at maximum, shorten the brake servo rod in 2 mm increments.

i. Remove the booster and adjust the length of the brake servo rod to the applicable dimensions (Figure 122). Note the length of the brake servo rod at completion of the adjustment.

j. Refit the booster to the pedal box.

k. Reconnect the pedal yoke clevis pin and secure it with a new split pin.

l. Refit the access hole grommets.

m. Refit the pedal box assembly to the vehicle, using the original mounting bolts.

WARNING

Ensure that the booster to master cylinder pushrod is securely located in the reaction rubber because the pushrod can dislodge and fall into the booster causing excess pedal take up movement and inoperative brakes.

n. Refit the brake master cylinder to the booster.

o. Reconnect the battery terminals.

p. Refit the brake pressure differential switch to the firewall mounting bolt.

q. Refit the radiator overflow bottle.

r. Start the engine and check the operation of the brake booster to ensure excess pedal movement has been reduced and that the brake pedal is firm.

s. Paint the actual pedal dimension that the brake servo rod has been adjusted to on the brake booster (Figure 122).

t. Road test the vehicle and ensure that the brakes do not bind.

u. Bleed the brakes, if a spongy pedal is still evident (Para 195).

NOTE

Particular attention should be paid to brake bleeding, to ensure the system is totally free of air. Elevation of the chassis rear, using a jack or ramp, will often assist in the process.

194. Recording Action. On completion of the adjustment:

a. enter the details of the new brake servo rod dimension, in Part 3 of the GM 120 - Record Book for Service Equipment; and

b. ensure the new brake servo rod dimension is painted on the brake booster.

Bleeding the Brake System

195. Bleed the brake system in accordance with EMEI Vehicle A 459-2.

Brake System Specifications

196. The brake system specifications are detailed in Table 17.

Table 17 Brake System Specifications

Serial	Specification	Measurement
1	Brake servo rod	110 mm (early pedal box)
		120 mm (late pedal box)
2	Servo cylinder push rod length	106–108 mm (4.1–4.2 in)
3	Disc to hub retaining bolts	50 N.m (38 lbf.ft)
4	Rear wheel cylinder bleed screw	5–8 N.m (4–6 lbf.ft)
5	Rear propeller shaft flange nuts	43–51 N.m (32–38 lbf.ft)
6	Front brake caliper retaining bolts	82 N.m (60 lbf.ft)
7	Disc pad minimum thickness	3.0 mm (0.125 in)
8	Brake disc wear limit	13 mm (0.51 in)
9	Brake disc thickness (new)	13.97–14.22 mm (0.55–0.56 in)

Brake System Fault Finding

197. The brake system fault finding is detailed in Table 18.

Table 18 Brake System Fault Finding

Serial	Symptom	Probable Cause	Action
1	Brake Fade	Incorrect linings	Replace shoes
		Badly lined shoes	Replace shoes
		Distorted shoes	Replace shoes
		Overloaded vehicle	Check vehicle weight
2	Spongy pedal	Air in system	Bleed hydraulic system
		Badly lined shoes	Replace shoes
		Distorted shoes	Replace shoes
		Faulty drums	Replace drums
		Faulty master cylinder mounting	Check master cylinder mounting
3	Long pedal travel	Faulty callipers	Replace callipers
		Brakes require adjustment	Adjust brakes
		Hydraulic fluid leak	Tighten all connections
		Fluid contamination	Replace hydraulic fluid
		Faulty master cylinder	Replace master cylinder
4	Brakes binding	Incorrect adjustment	Adjust brakes
		Incorrect pedal freeplay	Adjust push rod clevis
		Faulty callipers	Replace callipers
		Faulty servo cylinder	Replace servo
		Faulty master cylinder	Replace master cylinder
		Rear shoe pull-off springs faulty	Replace springs
5	Hard pedal, poor braking	Linings faulty	Replace shoes
		Faulty servo cylinder	Replace servo
		Faulty callipers	Replace caliper
		Faulty shock absorbers	Replace shock absorbers
6	Brakes pulling.	Faulty callipers	Replace callipers
		Faulty wheel cylinders	Replace wheel cylinders
		Faulty linings	Replace shoes
		Faulty drums	Replace drums
		Loose callipers	Tighten callipers
		Tyres faulty	Replace tyres
		Faulty steering linkage	Rectify fault
		Contaminated brake linings	Rectify fault
7	Low fluid level	Worn disc pads	Replace pads
		Fluid leak	Rectify leak
		Faulty servo	Replace servo
8	Disc brakes squeal	Worn retaining pins	Replace pins
		Worn discs	Replace discs
9	Uneven or excessive pad wear	Faulty disc	Replace disc
		Faulty pads	Replace pads
		Incorrect hub end-float	Rectify

Front Shock Absorbers

NOTE

Shock absorbers are to be replaced as an axle set.

198. Removal. Remove the front shock absorbers as follows:

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by axle stands. Place the axle stands as close as possible to the raised wheel.

a. Loosen the front wheel nuts.

b. Chock the rear wheels.

c. Using a suitable hydraulic jack, raise the front of the vehicle and support it on axle stands positioned beneath the front axle.

d. Remove the wheel nuts and wheels.

e. Remove the nut securing the shock absorber to the axle casing (Figure 123).

f. Remove the lower cup washer, rubber bush and seating washer.

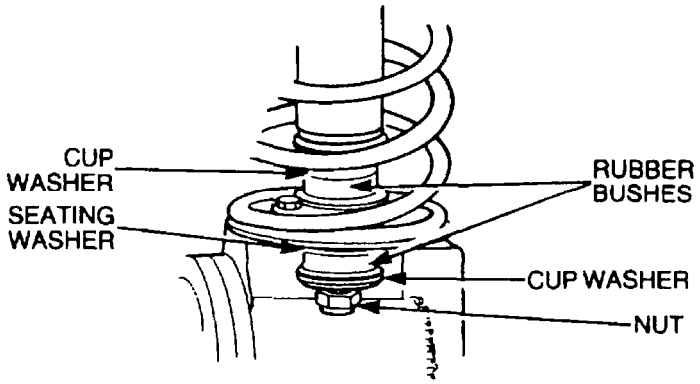


Figure 123 Front Shock Absorber Removal

g. Remove the nuts and lock-washers, securing the shock absorber bracket to the chassis rail Figure 124). Discard the lock-washers.

h. Withdraw the bracket and the shock absorber.

i. Remove the nuts securing the shock absorber to the bracket.

j. Remove the cup washer, the rubber bush and the seating washer.

k. Remove the bracket from the shock absorber and remove the remaining rubber bush and washers.

l. Discard all rubber bushes.

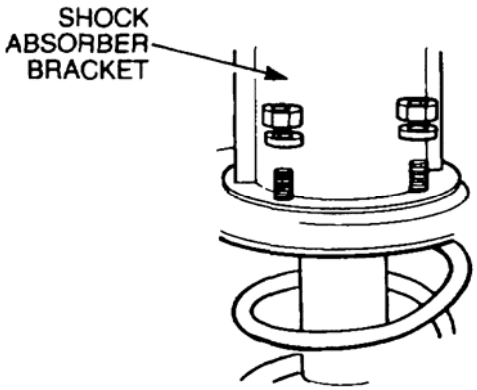


Figure 124 Front Shock Absorber Bracket Removal

199. Installation. Install the front shock absorbers as follows:

a. Fit the new shock absorber into the shock absorber bracket with the widest part uppermost.

b. Install new bushes and the washers (Figure 125).

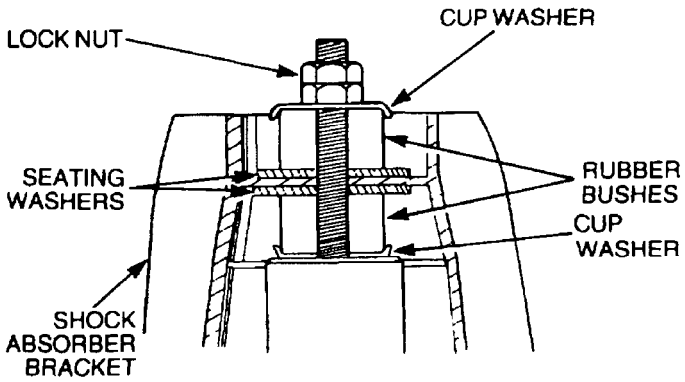


Figure 125 Front Shock Absorber Installation

c. Insert the shock absorber through the front spring and through a cup washer, rubber bush and seating washer.

d. Insert the threaded rod through the axle casing bracket.

e. Fit a seating washer, rubber bush and cup washer and secure them with the nut (Figure 125).

f. Tighten the lower nut securely.

g. Install the nuts and new lock-washers that secure the shock absorber bracket to the chassis rail and tighten them securely (Figure 125).

h. Tighten the upper nut securely. Install and tighten the locknut.

i. Repeat the procedure for the opposite side.

j. Install the front wheels and wheel nuts and raise the vehicle off the axle stands.

k. Remove the stands and lower the vehicle to the ground.

l. Remove the wheel chocks.

m. Tighten the front wheel nuts securely.

Front Bump Stop

200. Removal. Remove the front bump stop as follows:

a. Remove the two bolts, nuts and lock-washers, securing the bump stop and carrier to the chassis rail (Figure 126). Discard the lock-washers.

b. Remove the bump stop.

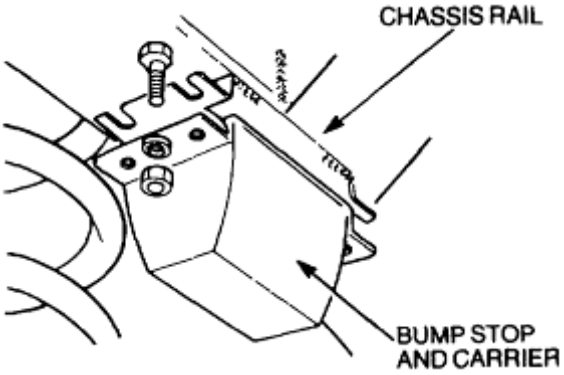


Figure 126 Bump Stop Removal

201. Installation. Install front bump stop as follows:

a. Fit the bump stop and carrier to the chassis rail.

b. Install the two bolts, new lock-washers and nuts.

c. Tighten the nuts securely.

Front Panhard Rod

202. Removal. Remove the front panhard rod as follows:

a. Remove the locknut and bolt securing the rod to the chassis mounting arm (Figure 127).

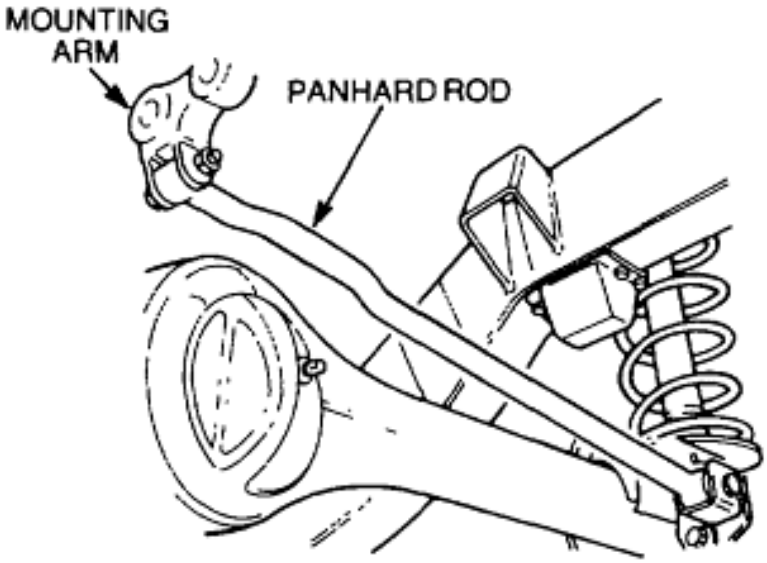


Figure 127 Panhard Rod Removal

b. Remove the locknut and bolt securing the rod to the axle casing and remove the rod from the vehicle.

c. Discard the locknuts.

203. Installation. Install the front panhard rod as follows:

a. Install the rod on the mounting arm and fit the two bolts and new locknuts.

b. Tighten the locknut and bolt securing the panhard rod to the chassis bracket to 176 N.m (130 lbf.ft).

c. Tighten the locknut and bolt securing the rod to the axle case to 176 N.m (130 lbf.ft).

Front Radius Arm

204. Removal. Remove the front radius arm as follows:

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by safety stands. Place the safety stands as close as possible to the raised wheel.

a. Loosen the front wheel nuts.

b. Chock the rear wheels.

c. Using a suitable hydraulic jack, raise the front of the vehicle and support it on safety stands positioned beneath the chassis rails.

d. Remove the front wheel nuts and wheels.

e. Use the jack to support the axle weight.

f. Remove the locknut, washers and rubber bushes from the chassis end of the arm (Figure 128). Discard the locknut.

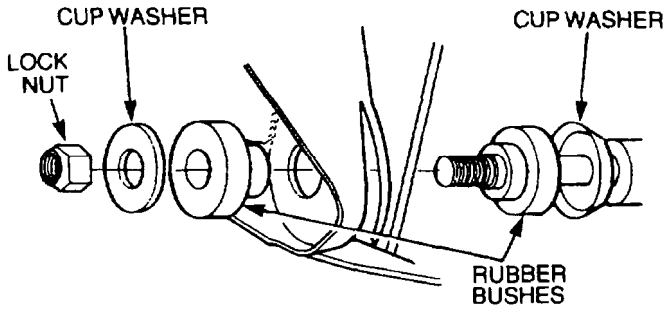


Figure 128 Radius Arm Bush Removal

g. Using the ball joint separator (Table 3, Serial 13), disconnect the tie rod ball joints at the steering arms (Figure 129).

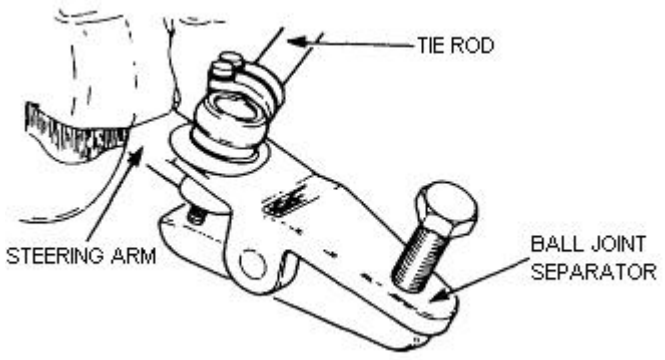


Figure 129 Tie Rod Removal

h. Remove the locknuts and bolts, securing the radius arms to the axle case (Figure 130). Discard the locknuts.

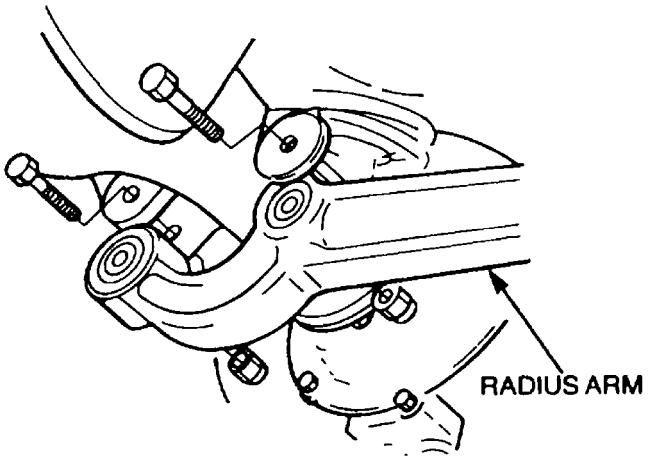


Figure 130 Radius Arm Removal

i. Lower the front end of the radius arms to clear the axle.

j. Withdraw the arms from the chassis brackets.

205. Installation. Install the front radius arm as follows:

a. Install a cup washer and rubber bush on the radius arm and insert it into the chassis bracket.

b. Install the remaining rubber bush and cup washer.

c. Fit the new locknut but do not tighten it.

d. Raise the front end of the radius arm and locate the bushes in the axle casing.

e. Install the two bolts and new locknuts.

f. Install the front wheels and wheel nuts and raise the vehicle off the axle stands.

g. Remove the stands and lower the vehicle to the ground.

h. Remove the wheel chocks.

i. Tighten the front wheel nuts securely.

j. Tighten the nuts and bolts securing the arm to the axle case and chassis bracket to 176 N.m (130 lbf.ft).

k. Install the tie rod and tighten the ball joint nuts to 40 N.m (30 lbf.ft). Secure the nuts with new split pins.

Rear Shock Absorbers

NOTE

Shock absorbers are to be replaced as an axle set.

206. Removal. Remove the rear shock absorbers as follows:

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by axle stands. Place the axle stands as close as possible to the raised wheel.

a. Loosen the rear wheel nuts.

b. Chock the front wheels.

c. Using a suitable hydraulic jack, raise the rear of the vehicle and support it on axle stands positioned beneath the rear axle.

d. Remove the rear wheel nuts and wheels.

e. Remove the nut, cup washer and rubber bush that secures the shock absorber to the axle casing.

f. Remove the nut, cup washer and rubber bush that secures the shock absorber to the chassis bracket.

g. Remove the shock absorber.

h. Discard the bushes.

207. Installation. Install the rear shock absorbers as follows:

a. Ensuring the new rubber bushes are secure in the eye of the shock absorber, install the shock absorber on the chassis bracket.

b. Install, but do not tighten the nut at this stage.

c. Insert the lower end of the shock absorber and the new rubber bushes through the axle casing.

d. Fit the cup washer and nut. Tighten the nut securely.

e. Tighten the upper mounting nut securing the shock absorber to the chassis bracket.

f. Repeat the procedure for the opposite side.

g. Install the rear wheels and wheel nuts and raise the vehicle off the axle stands.

h. Remove the stands and lower the vehicle to the ground.

i. Remove the wheel chocks.

j. Tighten the wheel nuts securely.

Rear Bump Stop

208. Removal. Remove the rear bump stop as follows:

a. Remove the two nuts, lock-washers and bolts securing the rear bump stop to the chassis rail. Discard the lock-washers.

b. Remove the bump stop from the vehicle.

209. Installation. Install the rear bump stop as follows:

a. Fit the bump stop to the chassis rail.

b. Install the two bolts, new lock-washers and nuts. Tighten the nuts securely.

Bottom Link

210. Removal. Remove the bottom link as follows:

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by safety stands. Place the safety stands as close as possible to the raised wheel.

a. Chock the front wheels.

b. Using a suitable hydraulic jack, raise the rear of the vehicle and support it on safety stands positioned beneath the chassis rails.

c. Support the axle weight with the jack.

d. Remove the locknut and bolt securing the bottom link to the axle bracket (Figure 131). Discard the locknut.

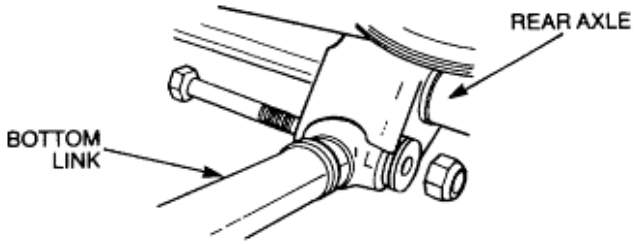


Figure 131 Bottom Link to Axle Bracket Connection

e. Remove the locknut and flat washer, securing the bottom link to the chassis bracket (Figure 132). Discard the locknut.

f. Withdraw the link from the bush.

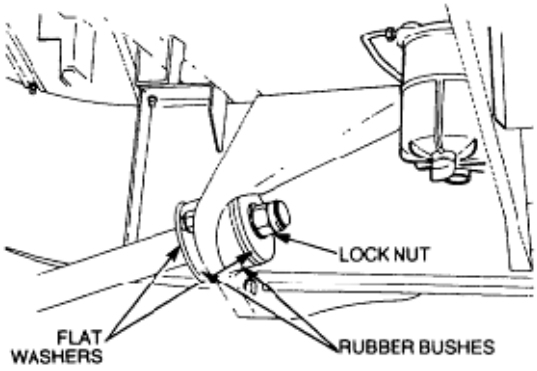


Figure 132 Bottom Link to Chassis Bracket Connection

211. Installation. Install the bottom link as follows:

a. Insert the bottom link in the chassis bracket bush.

b. Install the flat washer and a new locknut but do not tighten it.

c. Position the rear end of the link in the axle bracket.

d. Fit the bolt and a new locknut but do not tighten it.

e. Raise the vehicle off the axle stands, remove the stands and lower the vehicle to the ground.

f. Allow the suspension to settle and tighten the retaining bolt at the axle end of the link to 168–186 N.m (124–137 lbf.ft).

g. Tighten the locknut securing the link to the chassis to 176 N.m (130 lbf.ft).

h. Remove the wheel chocks.

Top Link and Ball Joint

212. Removal. Remove the top link and ball joint as follows:

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by safety stands. Place the safety stands as close as possible to the raised wheel.

a. Chock the front wheels.

b. Using a suitable hydraulic jack, raise the rear of the vehicle and support it on safety stands positioned beneath the chassis rails.

c. Allow the axle to hang.

d. Remove the locknuts and bolts securing the top link to the chassis brackets (Figure 133). Discard the locknuts.

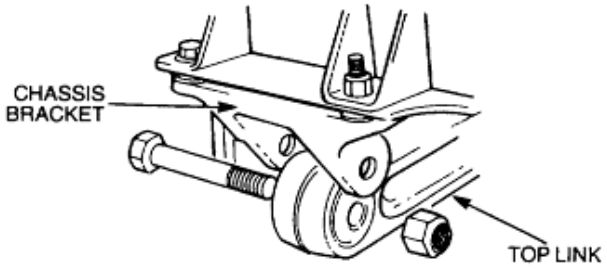


Figure 133 Top Link Removal

e. Secure the top link with a length of rope during the removal of the ball joint from the axle case.

f. Remove the split pin, castellated nut and washer securing the ball joint to the rear axle casing. Discard the split pin.

g. Using the ball joint remover (Table 3, Serial 14), remove the ball joint taking care not to damage the brake pipe (Figure 134).

h. Remove the rope securing the top link and remove the link from the vehicle.

i. Remove the two bolts and spring washers securing the ball joint to the pivot bracket and press the ball joint from the bracket. Discard the spring washers.

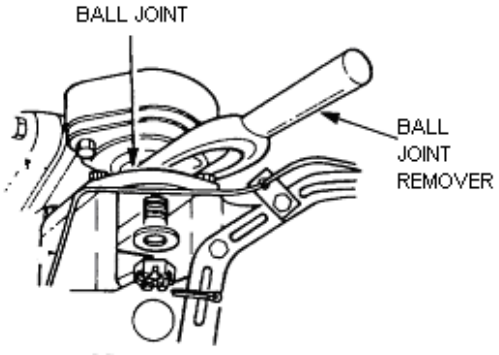


Figure 134 Top Link and Ball Joint Removal

213. Installation. Install the top link and ball joint as follows:

a. Using the two ball joint securing bolts as a guide, press the ball joint fully into the pivot bracket.

b. Using the two bolts and new spring washers, secure the ball joint into position.

c. Add a bead of RTV sealant around the groove at the top of the ball.

d. Position the top link assembly in the chassis brackets.

e. Install the two bolts and new locknuts but do not tighten them at this stage.

f. Insert the ball joint into the axle bracket.

g. Install the washer and the castellated nut.

h. Tighten the nut to 176 N.m (130 lbf.ft) and install a new split pin.

i. Raise the vehicle off the axle stands.

j. Remove the stands and lower the vehicle to the ground.

k. Allow the suspension to settle.

l. Tighten the two nuts and bolts securing the top link to the chassis brackets to 115 N.m (85 lbf.ft).

m. Remove the wheel chocks.

Inspection Procedures

Bushes, mounting bolts and nuts are to be replaced as sets.

214. Panhard Rod Assembly. Inspect the panhard rod assembly in accordance with EMEI Vehicle G 188-1.

215. Radius Arm Assembly. Inspect the radius arm assembly in accordance with EMEI Vehicle G 188-1.

216. Swivel Pin Housing Bushes and Bearings. Inspect the swivel pin housing bushes and bearings in accordance with EMEI Vehicle G 188-1.

217. Rear Lower Link, Front Flexible Mount and Rear Mounting Bush. Inspect the rear lower link, the front flexible mount and the rear mounting bush in accordance with EMEI Vehicle G 188-1.

218. Rear Top Link and Top Link Ball Joint. Inspect the rear top link and top link ball joint in accordance with EMEI Vehicle G 188-1.

219. Front and Rear Shock Absorbers. Inspect front and rear shock absorbers in accordance with EMEI Vehicle G 188-1.

220. Front and Rear Bump Stops. Inspect the front and rear bump stops in accordance with EMEI Vehicle G 188-1.

Suspension System Specifications

221. The suspension system specifications are detailed in Table 19.

Table 19 Suspension System Specifications

Serial	Specification	Measurement
1	Front panhard rod to chassis bracket	176 N.m (130 lbf.ft)
2	Front panhard rod to axle case	176 N.m (130 lbf.ft)
3	Front radius arm to chassis bracket	176 N.m (130 lbf.ft)
4	Steering tie rod ball joint to steering arm	40 N.m (30 lbf.ft)
5	Rear bottom link to chassis bracket	176 N.m (130 lbf.ft)
6	Link retaining bolt (axle end)	168–186 N.m (124–137 lbf.ft)
7	Rear pivot bracket ball joint to axle bracket	176 N.m (130 lbf.ft)
8	Top link to chassis bracket	115 N.m (85 lbf.ft)

STEERING

Steering Wheel

222. Removal. Remove the steering wheel as follows:

a. Remove the screw securing the steering wheel cover.

b. Remove the cover.

c. With the front wheels in the straight ahead position, remove the steering wheel retaining nut and shake proof washer. Discard the washer.

d. Using the adjustable wrench (Table 3, Serial 3), remove the steering wheel from the column.

223. Installation. Install the steering wheel as follows:

NOTE

When installing the steering wheel ensure that the two prongs on the steering wheel hub engage the cut outs in the upper steering column bush. If necessary, rotate the bush to align with the two prongs ensuring that the arrow on the bush faces the indicator switch.

a. Install the steering wheel, a new shake proof washer and the nut. Tighten the nut to 38 N.m (28 lbf.ft).

b. Fit the steering wheel cover and secure it with the screw.

Steering Linkages and Tie Rod Ends

224. Removal. Remove steering linkages and tie rod ends as follows:

CAUTION

A tie rod that is damaged or bent must be replaced. No attempt shall be made to repair or straighten it.

a. Remove the split pin, castellated nut and washer securing the tie rod ends to the steering arms. Discard the split pins.

b. Using the ball joint separator (Table 3, Serial 13), disconnect the tie rod ends from the steering arms (Figure 135) and remove the tie rod from the vehicle.

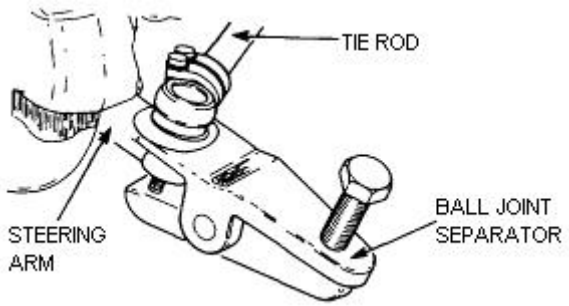


Figure 135 Steering Linkage Removal

NOTE

The tie rod ends are manufactured with either left-hand or right-hand thread for adjustment purposes.

c. Apply a spot of paint on the threads adjacent to the tie rod shoulder to maintain the approximate position of the tie rod end on the tie rod during reassembly.

d. Loosen the clamp bolts securing the tie rod ends to the tie rod.

e. Unscrew the ends from the rod.

225. Installation. Install steering linkages and tie rod ends as follows:

NOTE

When adjusting or renewing a tie rod it is important that the ball joints are assembled in the same angular plane and that the ball joint pins are central in their respective housings (A). Premature wear could result if the pins are inclined to one side (B) (Figure 136).

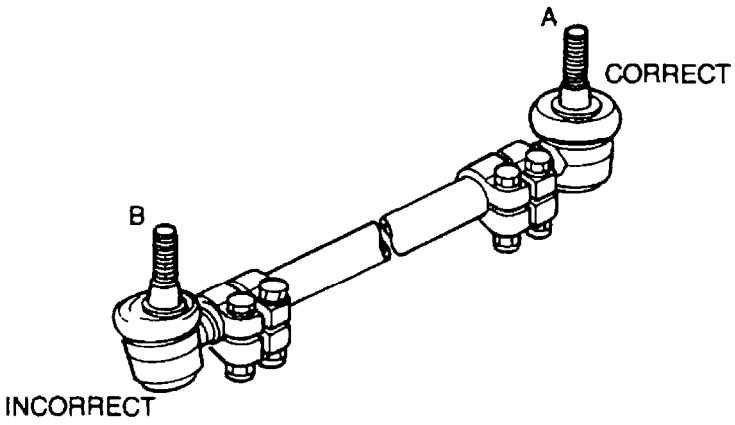


Figure 136 Tie Rod End Installation

a. Screw the tie rod ends on the tie rod until the shoulders align with the spots of paint on the threads.

b. Do not tighten the clamp bolts at this stage.

c. Install the tie rod assembly on the vehicle and fit the washer and castellated nut on both tie rod ends.

d. While applying hand pressure to the ball end of the ball joints, tighten the nuts to 40 N.m (30 lbf.ft).

e. Install new split pins.

f. Carry out the wheel alignment procedure (Para 235).

g. Ensure that the clamps are in the same plane and the bolts are on the split side of the rod.

h. Tighten the bolts to 14 N.m (10 lbf.ft).

Steering Damper

226. Removal. Remove the steering damper as follows:

a. Remove the two nuts securing the steering damper to the chassis bracket and remove the rubber bushes and cup washers (Figure 137).

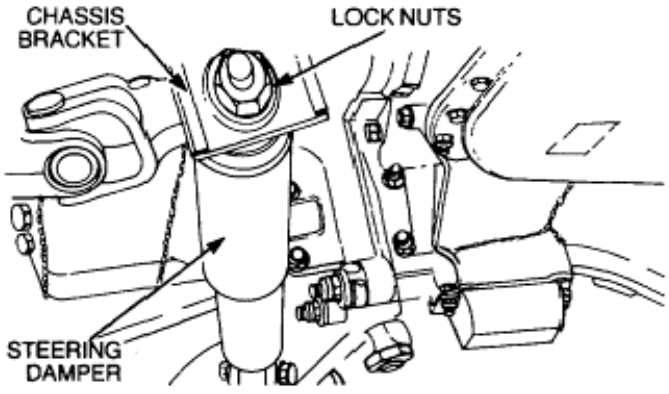


Figure 137 Steering Damper to Chassis Bracket Removal

b. Remove the locknut and bolt securing the steering damper to the drag link (Figure 138). Discard the locknut.

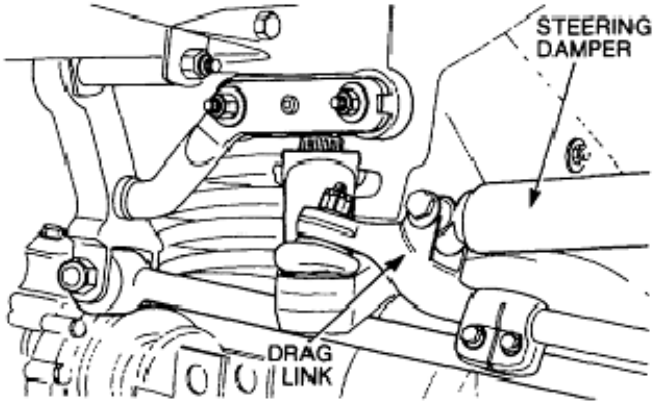


Figure 138 Steering Damper to Drag Link Removal

c. Remove the steering damper.

227. Installation. Install the steering damper as follows:

a. Fit the steering damper to the drag link and install the bolt and a new locknut. Do not tighten the locknut at this stage.

b. Install a cup washer and rubber bush on the steering damper sleeved end and insert the threaded rod through the chassis bracket.

c. Fit the remaining rubber bush and cup washer and secure them with the nuts.

d. Tighten the steering damper securely to the drag link retaining bolt.

Steering Drag Link and Drag Link Ends

228. Removal. Remove the steering drag link and drag link ends as follows:

WARNING

Prior to raising the vehicle, chock the wheels and engage the transmission differential lock to prevent the vehicle from rolling.

Never work under a raised vehicle unless it is supported by safety stands. Place the safety stands as close as possible to the raised wheel.

a. Loosen the left-hand front wheel nuts.

b. Chock the rear wheels.

c. Using a suitable hydraulic jack, raise the front of the vehicle and support it on axle stands positioned beneath the front axle.

d. Remove the left-hand front wheel.

e. Remove the locknut and bolt securing the steering damper to the drag link (Figure 138). Discard the locknut.

f. Remove the split pin, castellated nut and washer securing the drag link to the drop arm ball joint. Discard the split pin.

g. Using the ball joint separator (Table 3, Serial 13), disconnect the drag link (Figure 139).

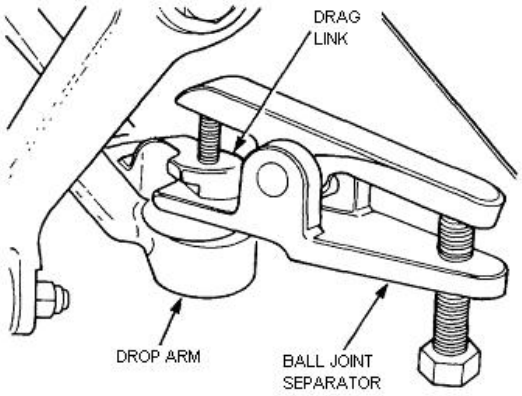


Figure 139 Drop Arm Ball Joint Disconnection

h. Remove the split pin, castellated nut and washer securing the drag link to the steering arm. Discard the split pin.

i. Using the ball joint separator (Table 3, Serial 13), disconnect the drag link.

NOTE

The drag link ends are manufactured with either left-hand or right-hand threads for adjustment purposes.

j. Apply a spot of paint on the threads adjacent to the drag link shoulder to maintain the approximate position of the drag link end on the rod during reassembly.

k. Loosen the clamp bolts, securing the drag link ends to the drag link and unscrew the ends from the rod.

229. Installation. Install the steering drag ink and drag link ends as follows:

CAUTION

When adjusting or renewing a drag link, it is important that the ball joint end and cranked end are assembled in the same angular plane. The ball joint pin and cranked end hole must also be aligned. Premature wear could result if they are inclined to one side.

a. Screw the drag link ends on the drag link until the shoulders align with the spots of paint on the threads ensuring both ends are in the same angular plane and the ball joint pin and the cranked end hole are aligned. Do not tighten the clamp bolts at this stage.

b. Fit the ball joint on the steering arm and install the washer and castellated nut.

c. While applying hand pressure to the ball joint, tighten the castellated nut to 40 N.m (30 lbf.ft) and install a new split pin.

d. Fit the drag link to the steering damper and install the washer and locknut. Tighten the locknut securely.

e. Install the left-hand front wheel and wheel nuts.

f. Raise the vehicle off the axle stands, remove the stands and lower the vehicle to the ground.

g. Remove the wheel chocks.

h. Tighten the front wheel nuts securely.

i. Ensuring that the wheels are on a flat surface and in the straight-ahead position, check that the toe-out dimension is 1.2–2.4 mm (0.045–0.09 in).

j. Adjust the track rod, if necessary, to obtain the correct toe-out.

k. Centralise the steering box ensuring that the steering wheel is correctly aligned.

l. Adjust the drag link length to enable the cranked end hole to align with the drop-arm ball-joint pin.

m. Fit the drag link to the drop arm ball joint and install the washer and castellated nut.

n. While applying hand pressure to the drag link, tighten the castellated nut to 40 N.m (30 lbf.ft) and install a new split pin.

o. Position the clamps in the same plane ensuring that the bolts are on the split side of the rod.

p. Tighten the clamp bolts to 14 N.m (10 lbf.ft).

Manual Steering Box

230. End Float Inspection. Inspect the manual steering box for end float as follows:

a. Sector shaft end float, evident as vertical movement of the sector shaft, is caused by play between the sector shaft adjuster screw and the adjuster screw plug.

b. Rectification of the end float requires the partial disassembly of the steering box.

NOTE

End float should not be confused with steering wheel free play.

231. Steering Wheel Free Play Inspection. Inspect steering wheel free play as follows:

a. Free play is normally caused by worn steering linkage components or by backlash between the worm and sector shafts.

b. Free play can be rectified by replacing worn components or by turning the sector shaft adjusting screw to reduce the backlash.

c. End float is set at zero during assembly of the steering box sector shaft, however, to allow for in service wear, the maximum tolerance is 0.5 mm.

d. End float can be detected in two ways as follows:

(1) grasp the steering box drop arm and lift it up and down, no more than 0.5 mm play should be evident; or

(2) have an assistant turn the steering wheel and observe the lower part of the sector shaft, no more than 0.5 mm play should be evident.

232. Steering Box Removal. Remove the steering box as follows:

a. Ensure the front wheels and steering wheel are in the straight ahead position.

b. Match mark the relationship of the steering column inner shaft to the top universal joint (Figure 140).

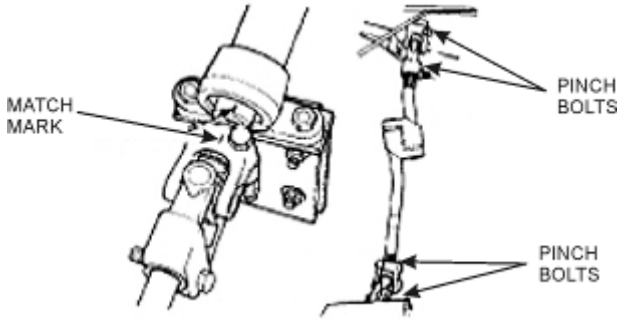


Figure 140 Steering Column Alignment

c. Remove the bolts securing the steering shaft cover to the inner guard and remove the cover.

d. Remove the steering protection plate and disconnect the drop arm ball joint using the ball joint separator (Table 3, Serial 13).

e. Remove the pinch bolt securing the steering box worm shaft to the universal joint.

f. Loosen the pinch bolts securing the upper universal joint and slide the collapsible shaft and lower universal joint off the steering box worm shaft.

g. Loosen the locknut securing the tie bar to the panhard rod mounting arm.

h. Remove the locknuts, washers and bolts securing the tie bar to the steering box and swing the tie bar clear of the steering box.

i. Remove the bolts securing the steering box to the chassis and remove the box from the vehicle.

233. End Float Adjustment. The repair and adjustment procedure to rectify sector shaft end float is an abbreviated one and can be used on all manual steering boxes with the letter 'W' embossed on the top cover as follows:

NOTE

The letter 'W' indicates that the sector shaft has been machined and a hardened washer fitted, hence the sector shaft does not have to be removed or reworked.

a. Remove the adjuster locknut and the four bolts securing the top cover to the steering box housing and remove the top cover.

b. Drain the oil, peen and remove the adjusting screw securing plug.

c. Inspect the hardened washer (replace if necessary).

NOTE

If there is any damage to internal steering box components, the steering box is to be reassembled and a replacement assembly fitted. The old steering box is to be back loaded through normal supply channels for overhaul.

d. Fit the hardened washer, adjuster screw, upper washer and new securing plug.

e. Tighten the threaded plug until the adjusting screw is firmly clamped and back off the plug until the adjusting screw is free to rotate.

NOTE

Ensure there are no tight spots and no detectable axial end float of the adjuster screw.

f. Peen the screwed plug at the adjacent slots in the sector shaft using a hammer to lock the plug in position.

g. Fit a new top housing gasket and screw the top cover onto the adjuster screw until the cover is correctly positioned.

h. Install the four securing bolts and lock-washers. Tighten the bolts to 25–30 N.m (18–22 lbf.ft).

i. With the sector shaft in the straight ahead position, check that the alignment of the drop arm is correct (Figure 141) and that the lower seal is serviceable.

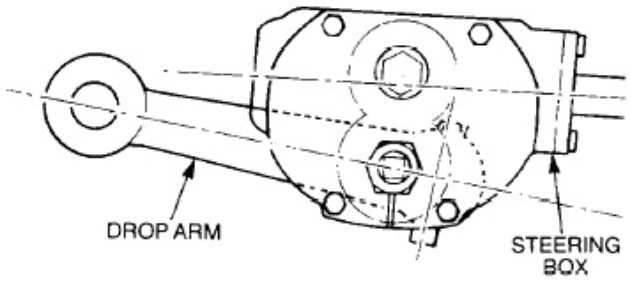


Figure 141 Drop Arm Alignment

j. If necessary, replace the lower seal or align the drop arm and tighten the locknut to 169 N.m (125 lb. ft.).

k. Remove the oil filler plug and add approximately 0.43 litres of clean OEP 220 to 25 mm below the top of the fill hole.

l. Install and tighten the plug.

234. Steering Box Installation. Install the steering box as follows:

a. Install the steering box to the vehicle and tighten the mounting bolts to 80 N.m (60 lb. ft.).

b. Check that the steering wheel is in the straight ahead position and set the steering box to the mid-way lock to lock position.

c. Ensuring that the steering wheel is not moved, fit the collapsible shaft and lower universal joint to the steering box worm shaft.

CAUTION

Over tightening the pinch bolts will result in stripped threads.

d. Fit new locknuts and tighten the pinch bolts to 20–25 N.m. (15–18 lbf.ft).

e. Refit the tie bar to the steering box but do not tighten the locknuts at this stage.

f. Using a new locknut, secure the tie bar to the panhard rod mounting arm.

g. Loosen the tie bar restraining bolts and retighten them securely.

h. Tighten the locknut securing the tie bar to the panhard rod mounting arm to 80 N.m (60 lbf.ft.).

i. Connect the drag link to the drop arm, tighten the nut to 40 N.m (30 lbf.ft) and install a new split pin.

j. Refit the steering protection plate.

k. Fit the steering shaft cover to the inner guard and secure it with the two bolts and washers.

Front Wheel Alignment

235. Alignment. Align the front wheels as follows:

NOTE

No adjustment is provided for caster, camber or swivel pin inclination.

a. With the vehicle on level ground and the front wheels in the straight ahead position, push the vehicle backwards and forwards for a short distance to settle the linkage.

b. Measure the toe-out at the horizontal centre line of the wheels and ensure that a toe-out of 1.2–2.4 mm (0.045–0.09 in) is obtained.

c. Adjust, if necessary, by loosening the tie rod clamp bolts and turning the tie rod anticlockwise to increase the toe-out or clockwise to decrease the toe-out.

d. When the toe-out is within specification, lightly tap the tie rod ends towards the rear of the vehicle to ensure that full unrestricted working travel is obtained.

e. Position the clamps in the same plane ensuring that the bolts are on the split side of the rod.

f. Tighten the bolts to 14 N.m (10 lbf.ft).

Steering Lock Stops

236. Adjustment. Adjust the steering lock stops as follows:

NOTE

The steering lock stop must be adjusted to provide a minimum clearance of 20 mm (0.78 in) between the tyre wall and the radius arm.

a. Loosen the stop bolts locknuts.

b. Turn the bolt clockwise or anticlockwise, to obtain the correct clearance (Figure 142).

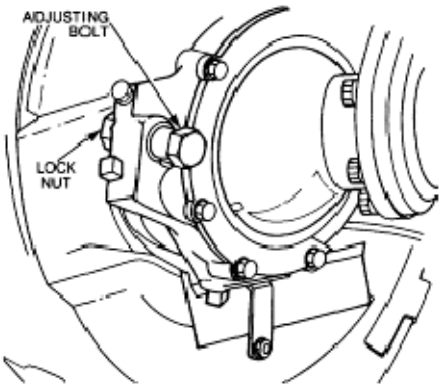


Figure 142 Steering Lock Stop Adjustment

c. Tighten the locknuts and check the wheel positions on full lock.

d. Ensure that the minimum clearance of 20 mm (0.78 in) is obtained.

Steering Protection Plate

237. Removal. Remove the steering protection plate as follows:

NOTE

Check the security of the rear winch mount, prior to removing the fairlead plate (on winch variants).

a. Remove the centre bumper (cargo variants) or the winch fairlead plate (winch variants).

b. Support the protection plate and remove the lower panhard-rod mounting arm to chassis-mounting bolt, washers and nut (Figure 143).

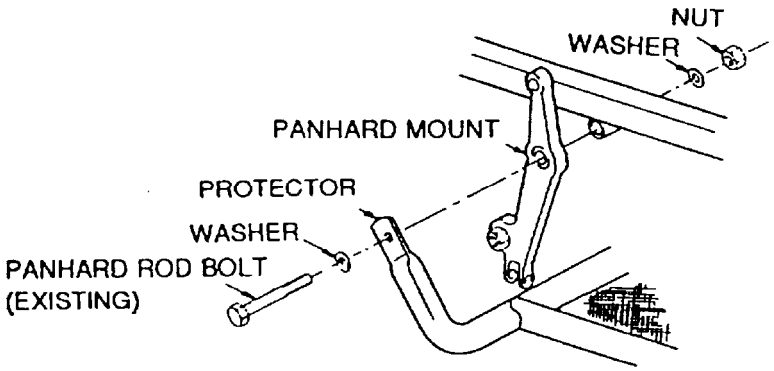


Figure 143 Protection Plate Removal

c. Remove the left-hand rear protector-to-chassis mounting bolt, washers and nut.

d. Remove the bolts, washers and nuts securing the front of the protector to the chassis and remove the protector.

238. Inspection. Inspect the winch fairlead plate winch housing mounting bolt holes. If the threads are damaged, repair them using NSN 5180-66-131-6876 – Tool Kit, Screw Thread, Insert, Metric 4 mm to 12 mm, Oversize.

239. Installation. Install the steering protection plate as follows:

a. Position the protection plate at the chassis and install the lower panhard-rod mounting arm to chassis mounting bolt, washers and nut.

b. Install the left-hand rear protection-plate-to-chassis mounting bolt, washers and nut.

c. Tighten both the rear mounting bolts firmly, allowing the front of the protection plate to be raised to contact the front of the chassis.

d. Secure the front of the protection plate to the chassis with the bolts, washers and nuts.

NOTE

Use Loctite 271 or equivalent on the winch fairlead mounting bolts.

e. On winch variants, install the winch fairlead plate to the winch housing using new mounting bolts.

f. On cargo variants, secure the centre bumper to the chassis mount using new mounting bolts.

g. Tighten all mounting bolts securely.

Steering System Specifications

240. The steering system specifications are detailed in Table 20.

Table 20 Steering System Specifications

Serial	Specification	Measurement
1	Steering linkage, tie rod and drag link ball joint nuts	40 N.m (30 lbf.ft)
2	Steering linkage and drag link clamp bolts	14 N.m (10 lbf.ft)
3	Toe-out setting	1.2–2.4 mm (0.045–0.090 in)
4	Tyre wall to radius arm (steering, lock stop adjustment) minimum clearance	20 mm (0.780 in)
5	Steering wheel retaining nut	38 N.m (28 lbf.ft)
6	Sector shaft end float	0.5 mm (0.020 in)

ELECTRICAL

Battery and Cables

241. Removal. Remove the battery and cables as follows:

a. Remove the passenger seat cushion by lifting the front edge first.

b. Disconnect one end of the operating wire (Figure 144) which is connected between the seat lateral and the locking mechanism.

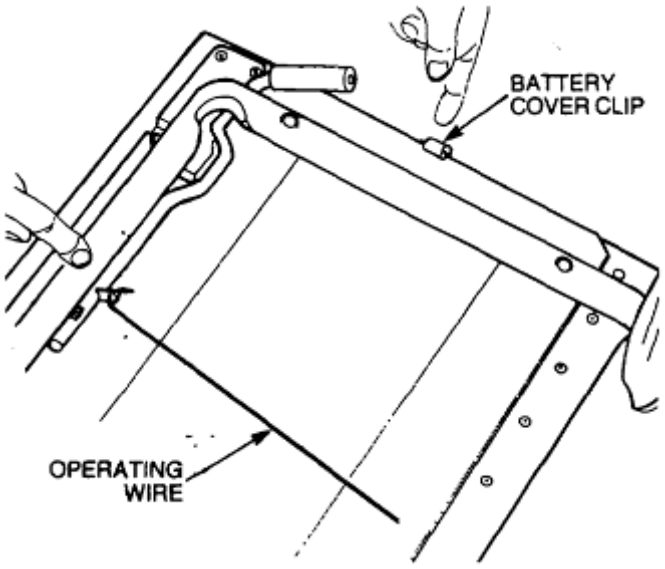


Figure 144 Battery Cover Removal

c. Release the battery cover retaining clip and slide the seat frame forward to allow the cover to be removed.

d. Loosen the negative cable clamp and remove the clamp from the battery post.

e. Loosen the positive cable clamp and remove the clamp from the battery post.

f. Remove the nuts and washers securing the battery retaining bracket and remove the bracket.

g. Lift the battery out of the battery box.

h. Remove the nut, washers and bolt securing the negative (earth) cable to the chassis.

i. Remove the cable through the grommet.

j. Remove the nut and washer securing the positive cable to the starter solenoid.

k. Remove the cable through the grommet.

242. Installation. Install the battery and cables as follows:

a. Install the positive cable on the starter solenoid and secure it with the washer and nut.

b. Insert the cable through the grommet.

c. Fit the negative (earth) cable to the chassis ensuring that the earthing point is clean and free from corrosion.

d. Install the bolt, washers and nut and tighten them securely.

e. Insert the cable through the grommet.

f. Lower the battery into the battery box ensuring that the negative (earth) post is towards the negative cable.

g. Secure the battery with the retaining bracket.

h. Fit the positive cable clamp on the battery post and secure it with the nut and bolt.

i. Ensure that all electrical switches are in the 'OFF' position.

j. Fit the negative cable clamp on the battery post and secure it with the nut and bolt.

k. Install the battery cover and secure it with the retaining clip.

l. Connect the operating wire between the seat lateral and locking mechanism (Figure 144).

m. Install the seat cushion and ensure it locates firmly in the seat frame.

Glow Plugs

243. Removal. Remove the glow plugs as follows:

a. Disconnect the battery.

b. Remove the nuts securing the electrical strip link to the glow plugs and remove the link (Figure 145).

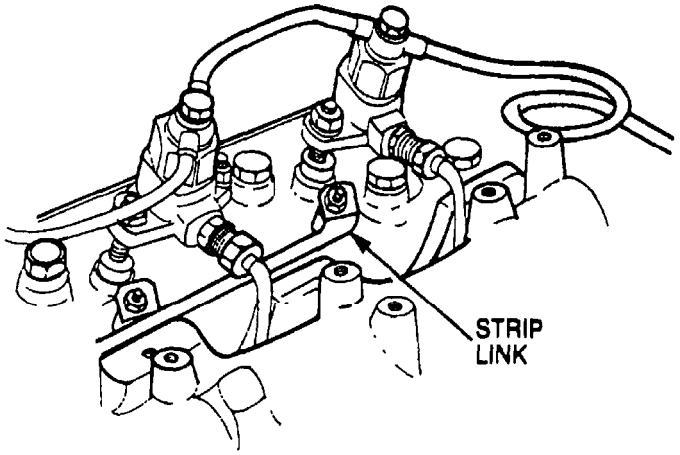


Figure 145 Glow Plug Removal

c. Remove and discard the nut from No. 4 cylinder plug and remove the feed wire.

d. Using a 12 mm deep-socket, remove the glow plugs from the cylinder head.

244. Installation. Install the glow plugs as follows:

a. Install the glow plugs and tighten them to 22–27 N.m (16–20lbf.ft).

b. Position the electrical strip link on the glow plugs and secure it with new nuts at cylinders 1, 2 and 3.

c. Connect the electrical feed wire to cylinder No. 4 glow plug.

d. Secure the feed wire and strip link to the glow plug with a new nut.

e. Connect the battery.

Starter Motor

245. Removal. Remove the starter motor as follows:

a. Disconnect the battery.

b. Remove the nuts and washers securing the cables to the starter motor and solenoid.

c. Tag and remove the cables.

d. Loosen the clamp securing the front exhaust pipe to the bracket.

e. Loosen the locknut securing the clutch slave cylinder flexible hose to the bracket.

f. Remove the bolt and two nuts securing the starter motor to the flywheel housing.

g. Remove the starter motor.

246. Installation. Install the starter motor as follows:

a. Install the starter motor and secure it in position with the bolt and two nuts.

b. Fit the clutch slave cylinder hose and the front exhaust pipe brackets in position.

c. Install the two nuts and new lock-washers.

d. Tighten the bolt and two nuts to 40 N.m (30 lbf.ft).

e. Tighten the exhaust pipe clamp and the hose locknut.

f. Install the cables and washers and tighten the nuts securely.

g. Connect the battery.

Alternator and Vacuum Pump

247. Removal. Remove the alternator and vacuum pump as follows:

a. Disconnect the battery.

b. Loosen the hose clamp securing the hose to the vacuum pump (Figure 146) and plug the hose with a suitable plastic plug.

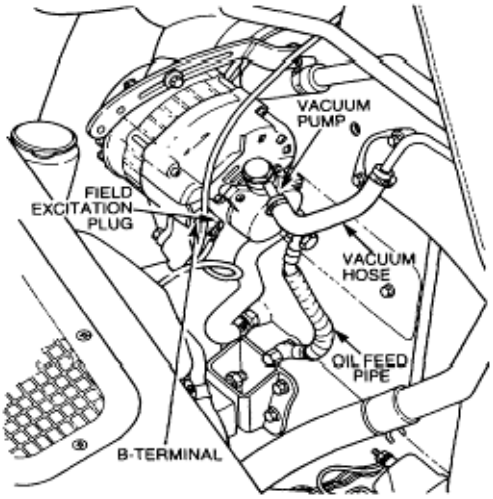


Figure 146 Alternator Removal

c. Remove the banjo bolt and sealing washers securing the oil feed pipe to the vacuum pump. Discard the sealing washers.

d. Plug the pipe with a suitable plastic plug.

e. Loosen the hose clamp securing the oil return hose to the vacuum pump.

f. Remove and plug the hose.

g. Remove the nut and washer securing the cable to the B-terminal of the alternator (Figure 146).

h. Remove the field excitation plug from the alternator.

i. Loosen the alternator mounting bolts and remove the adjusting bolt.

j. Remove the fanbelt from the alternator drive pulley and swing the alternator away from the engine.

k. Remove the mounting bolts and remove the alternator.

248. Installation. Install the alternator and vacuum pump as follows:

NOTE

Prior to installation, apply a few drops of engine oil into the oil feed opening. Rotate the alternator pulley to prevent oil starvation on initial starting.

a. Position the alternator on the mounting bracket and install the two mounting bolts. Do not tighten them at this stage.

b. Move the alternator towards the engine and install the fanbelt.

c. Check the tension of the belt by applying moderate thumb pressure to the longest span of the belt.

d. When a belt deflection of 10–15 mm has been obtained, tighten the adjusting and mounting bolts.

e. Fit the field excitation plug to the alternator socket and the single cable to the alternator B-terminal.

f. Install the oil return hose to the vacuum pump and secure it with the hose clamp.

g. Install the oil feed pipe with new sealing washers and the banjo bolt.

h. Tighten the bolt securely.

i. Install the vacuum hose to the alternator and secure it with the hose clamp.

j. Connect the battery.

Headlight

249. Bulb Replacement. Replace the headlight bulb as follows:

a. Remove the four screws securing the headlight surround and remove the surround.

b. Remove the three screws securing the headlight rim and remove the rim.

c. Disconnect the plug connector from the light unit and remove the light unit.

d. Remove the rubber seal and release the spring clip securing the bulb to the light unit. Remove the bulb.

e. Fit the new bulb in the light unit ensuring that the bulb is seated correctly. Secure it with the spring clip and install the rubber seal.

f. Connect the plug connector to the light unit and install the light unit to the light unit shell.

g. Fit the headlight rim and secure it with the three screws.

h. Install the headlight surround and secure it with the four screws.

i. Adjust the headlights (Para 251).

250. Light Unit Replacement. Replace the light unit as follows:

a. Remove the four screws securing the headlight surround and remove the surround (Figure 147).

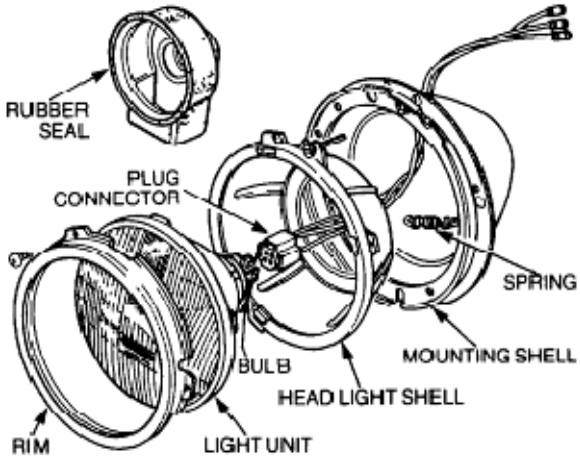


Figure 147 Headlight Unit Exploded View

b. Remove the three screws securing the headlight rim and remove the rim.

c. Disconnect the plug from the light unit and remove the light unit.

d. Disconnect the spring from the headlight shell and remove it by rotating it clear of the slotted location.

e. Tag and disconnect the main wiring harness from the headlight harness.

f. Disconnect any zip-clamps if necessary.

g. Remove the screws securing the mounting shell to the mudguard front panel and remove the shell and the gasket. Discard the gasket.

h. Install a new gasket on the mounting shell and fit the shell on the mudguard.

i. Secure the shell with the screws.

j. Ensure that the wiring harness and grommet are located in the mounting shell.

k. Connect the headlight harness to the main wiring harness and secure it with zip-clamps if necessary.

l. Install the headlight shell into the mounting shell and connect the spring.

m. Ensure that the bulb is correctly installed in the light unit and connect the plug.

n. Fit the light unit to the headlight shell and secure it with the headlight rim.

o. Install the three screws and tighten them securely.

p. Install the headlight surround and secure it with the four screws.

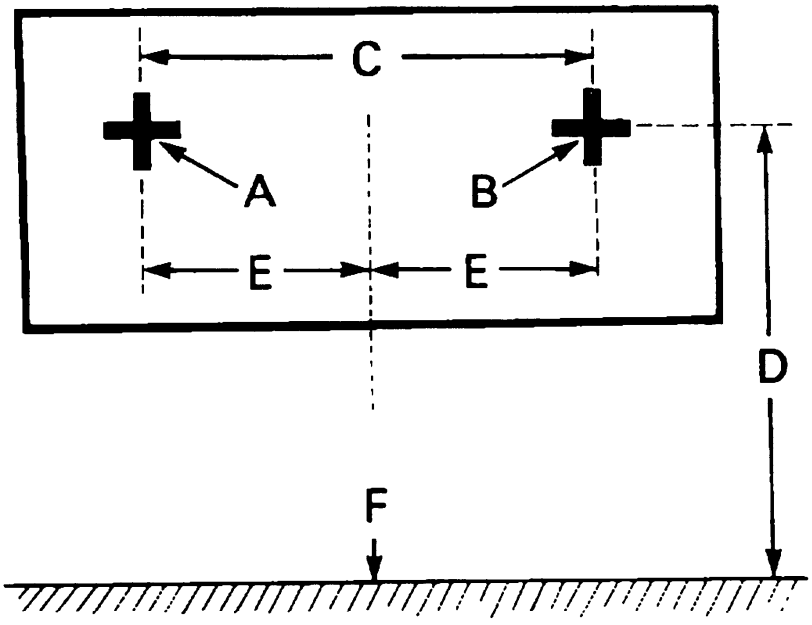
q. Carry out the headlight adjustment procedure (Para 251).

251. Adjustment. Adjust the headlight as follows:

a. Mark the headlight pattern (Figure 148) on a board or wall.

b. Position the vehicle headlights 9.7 metres (32 feet) from the pattern.

c. Ensure that the vehicle centre line is at right angles to the pattern and that the centre line of the pattern is in the same plane as the vehicle centre line.



A — Concentrated area of light — Left hand head light
B — Concentrated area of light — Right hand head light
C — 1070 mm (42 in.)
D — 920 mm (36 in.)
E — 535 mm (21 in.)
F — Ground level

Figure 148 Headlight Unit Adjustment

d. Adjust the lateral and vertical screws (Figure 149), until the area of concentrated light corresponds with the pattern on the board [approximately 76 mm (3 in) below the centre line of the corresponding headlight.

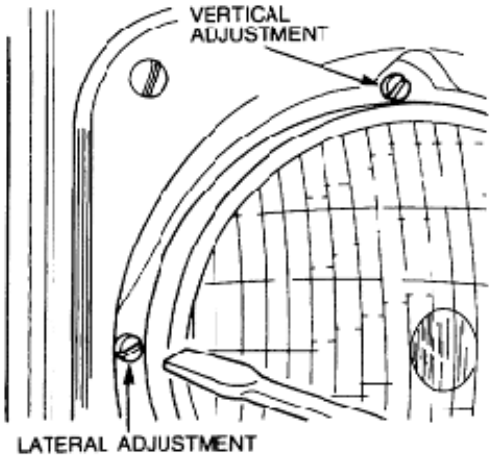


Figure 149 Headlight Beam Adjustment

Park Light

252. Bulb Replacement. Replace the park light bulb as follows:

a. Remove the two screws securing the lens (Figure 150).

b. Remove the lens and remove the bulb.

c. Install the bulb and the lens.

d. Install and tighten the two screws securely.

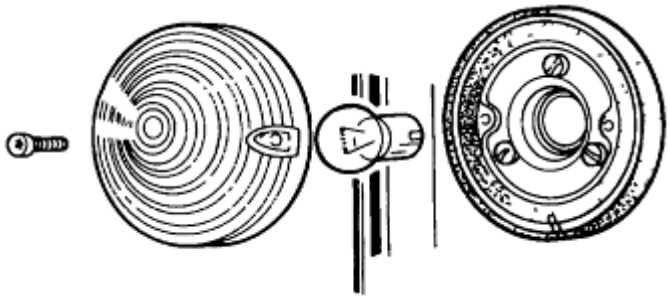


Figure 150 Park Light Exploded View

253. Light Unit Replacement. Replace the light unit as follows:

a. Remove the two screws securing the lens and remove the lens.

b. Tag and disconnect the light harness from the main wiring harness.

c. Disconnect any zip-clamps if necessary.

d. Remove the screws securing the light unit to the mudguard front panel.

e. Remove and discard the light unit.

f. Position the new light unit on the mudguard front panel and secure it with the screws.

g. Insert the bulb and install the lens

h. Install and tighten the two screws securely.

i. Connect the light harness to the wiring harness.

j. Secure the light harness with zip-clamps if necessary.

Turn Indicator Light

254. Bulb Replacement. Replace the turn indicator light bulb as follows:

a. Remove the two screws securing the lens (Figure 151).

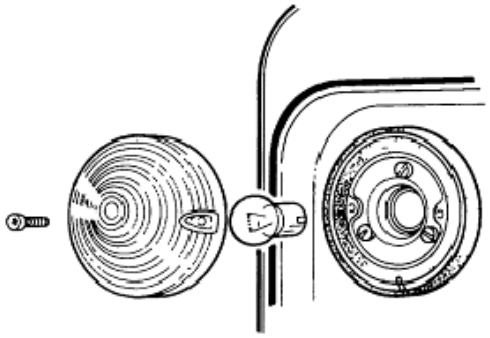


Figure 151 Turn Indicator Light Exploded View

b. Remove the lens and remove the bulb.

c. Install the bulb and the lens.

d. Install and tighten the two screws securely.

255. Light Unit Replacement. Replace the light unit as follows:

a. Remove the two screws securing the lens and remove the lens.

b. Tag and disconnect the light harness from the main wiring harness.

c. Remove the screws securing the light unit to the mudguard front panel.

d. Remove and discard the light unit.

e. Position the new light unit on the mudguard front panel and secure it with the screws.

f. Insert the bulb and install the lens.

g. Install and tighten the two screws securely.

h. Connect the light harness to the wiring harness.

Side Indicator Light

256. Bulb Replacement. Replace the side indicator light as follows:

a. Remove the screw securing the lens to the light unit.

b. Remove the lens and replace the bulb.

c. Ensuring the gasket is serviceable and in position, install the lens and secure it with the screw.

257. Light Unit Replacement. Replace the light unit as follows:

a. Remove the screw securing the lens to the light unit.

b. Remove the lens and remove the bulb (Figure 152).

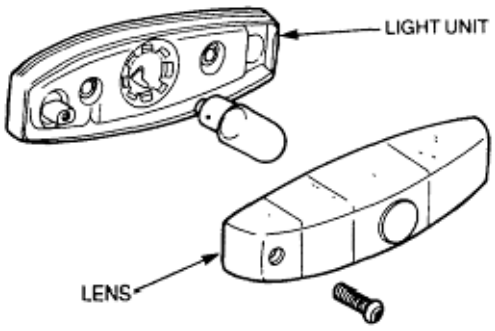


Figure 152 Side Indicator Light Exploded View

c. Remove the two nuts and washers securing the light unit to the mudguard.

d. Tag and disconnect the light harness from the wiring harness.

e. Remove the light unit complete with the rubber seal.

f. Insert the light unit through the mudguard and connect the wiring harness.

g. Ensure that the earth terminal is located on one of the mounting studs and that the lens retaining nut is in position.

h. Install the lock-washers and nuts and tighten them securely.

i. Install the bulb and the lens.

j. Secure the lens with the screw.

Number Plate Light

258. Bulb Replacement. Replace the number plate light as follows:

a. Loosen the cover retaining screw.

b. Remove the cover and the glass (Figure 153).

c. Replace the bulbs as required.

d. Install the cover and glass and tighten the retaining screw.

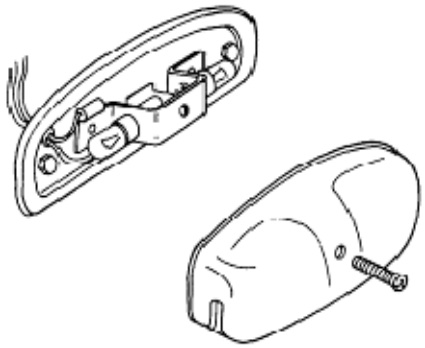


Figure 153 Number Plate Light Exploded View

259. Light Unit Replacement. Replace the light unit as follows:

a. Loosen the cover retaining screw and remove the cover and the glass.

b. Tag and disconnect the two wires connected to the light unit.

c. Remove the two nuts and lock-washers.

d. Remove the light unit from the bracket.

e. Install the light unit on the bracket and secure it with the two lock-washers and nuts.

f. Connect the two wires to the light unit and install the two bulbs.

g. Install the glass and the cover and secure them with the screw.

Stop/Tail, Reversing and Indicator Lights

260. Bulb Replacement. Replace the stop/tail, reversing and indicator light bulb as follows:

a. Remove the two screws securing the lens to the light unit and remove the lens.

b. Replace the bulb as required (Figure 154).

c. Install the lens ensuring the rubber seal is fitted correctly.

d. Secure the lens with the two screws.

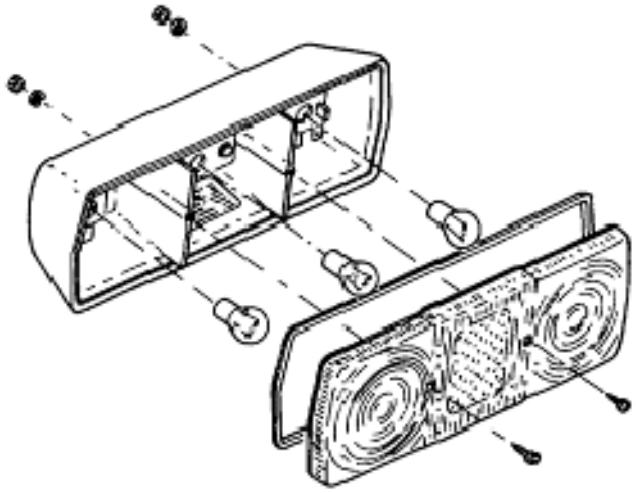


Figure 154 Stop/Tail, Reversing and Indicator Light Exploded View

261. Light Unit Replacement. Replace the light unit as follows:

a. Tag and disconnect the light unit wiring harness from the main wiring harness.

b. Disconnect any zip-clamps if necessary.

c. Remove the two nuts and lock-washers securing the light unit to the rear cross-member and remove the light. Discard the lock-washers.

d. Install the light unit and secure it with two new lock-washers and the nuts.

e. Connect the light unit wiring harness to the main wiring harness and secure it with zip-clamps if necessary.

Reduced Headlight

262. Bulb Replacement. Replace the reduced headlight bulb as follows:

a. Remove the two screws securing the light rim, lens and gasket (Figure 155).

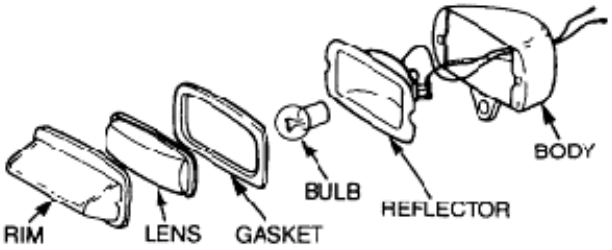


Figure 155 Reduced Headlight Exploded View

b. Replace the bulb.

c. Install the gasket, lens and light rim and secure them with the two screws.

263. Light Unit Replacement. Replace the light unit as follows:

a. Tag and disconnect the light unit wiring harness from the main wiring harness.

b. Disconnect any zip-clamps if necessary.

c. Remove the bolt securing the light unit to the mounting bracket.

d. Withdraw the light unit harness through the grommet in the front panel and remove the light unit.

e. Fit the light unit wiring harness through the front panel grommet.

f. Install the light unit on the mounting bracket and secure it with the bolt.

g. Connect the light unit wiring harness to the main wiring harness and secure with zip-clamps if necessary.

Front Blackout Light

264. Light Unit Replacement. Replace the front blackout light unit as follows:

a. Tag and disconnect the light unit wiring harness from the main wiring harness.

b. Disconnect any zip-clamps if necessary.

c. Remove the two nuts and washers securing the light unit to the front panel (Figure 156).

d. Remove the light.

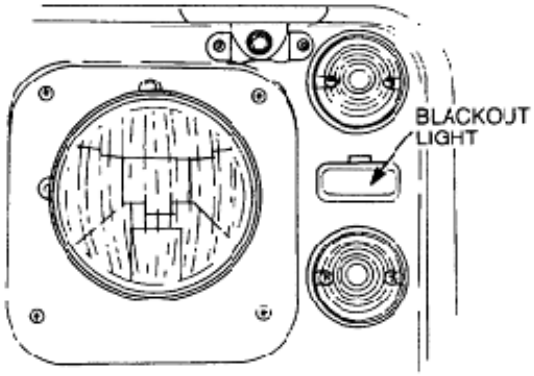


Figure 156 Front Blackout Light Removal

e. Insert the light unit wiring harness through the front panel and fit the light unit.

f. Secure the light unit with the two nuts and washers.

g. Connect the wiring harnesses and secure it with zip-clamps if necessary.

Blackout Stop/Tail Lights

265. Light Unit Replacement. Replace the blackout stop/tail light unit as follows:

a. Tag and disconnect the light unit wiring harness from the main wiring harness.

b. Disconnect any zip-clamps if necessary.

c. Remove the two nuts and washers securing the light unit to the rear cross-member (Figure 157).

d. Remove the light unit.

e. Insert the light unit wiring harness through the rear cross-member and fit the light unit.

f. Secure the light unit with the two nuts and washers.

g. Connect the wiring harnesses and secure with zip-clamps if necessary.

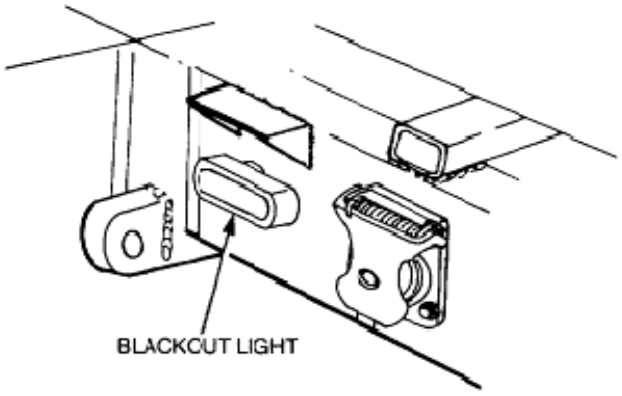


Figure 157 Blackout Stop/Tail Light Removal

Convoy Light

266. Bulb Replacement. Replace the convoy light bulb as follows:

a. Loosen the two screws securing the lens.

b. Remove the lens and the sealing-washers (Figure 158).

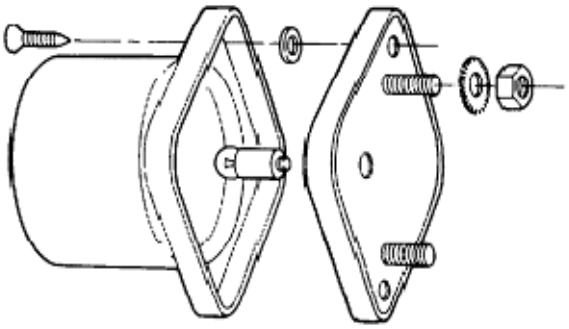


Figure 158 Convoy Light Exploded View

c. Replace the bulb

d. Install the two sealing-washers onto the screws.

e. Install the lens and tighten the screws.

267. Light Unit Replacement. Replace the light unit as follows:

a. Tag and disconnect the light unit harness at the right-hand rear lamp.

b. Disconnect any zip-clamps if necessary.

c. Remove the two nuts, washers and bolts securing the light unit to the chassis bracket.

d. Remove the light.

e. Insert the light unit harness through the chassis bracket and fit the light unit.

f. Secure the light unit with the two nuts, washers and bolts.

g. Connect the wiring harness and secure it with zip-clamps if necessary.

Cab Dome Light

268. Bulb Replacement. Replace the cab dome light bulb as follows:

a. Remove the screw retaining the lens and rim to the light unit (Figure 159).

b. Replace the bulb, fit the lens and secure it with the screw.

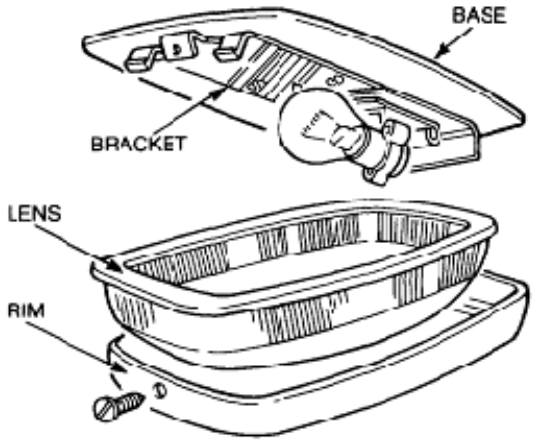


Figure 159 Cab Dome Light Exploded View

269. Light Unit Replacement. Replace the light unit as follows:

a. Remove the screw retaining the lens and rim to the light unit and remove the bulb.

b. Disconnect the wiring harness at the light.

c. Remove the two screws securing the light unit to the windscreen bracket and remove the light unit.

d. Insert the wire through the appropriate hole in the base.

e. Connect the wire to the light unit bracket with the retaining screw.

f. Secure the light unit bracket and base to the windscreen bracket with the two screws.

g. Insert the bulb and secure the lens and rim with the retaining screw.

Map Reading Light

270. Bulb Replacement. Replace the map reading light bulb as follows:

a. Using a small screwdriver, insert the blade into the slot at the side of the lens.

b. Carefully pry the lens away from the body (Figure 160).

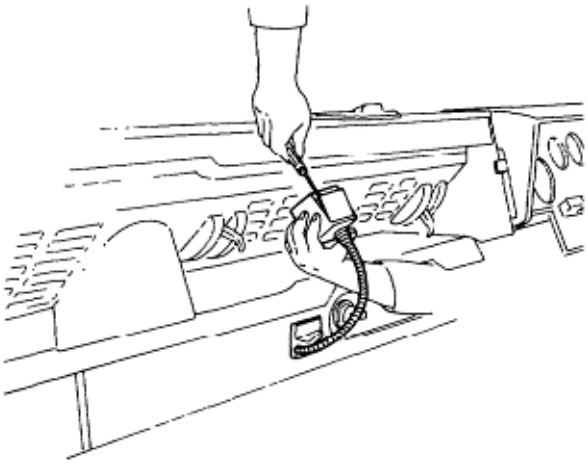


Figure 160 Map Reading Light Lens Removal

c. Replace the bulb and install the lens.

271. Light Unit Replacement. Replace the light unit as follows:

a. Remove the two screws securing the cover to the dash panel (Figure 161).

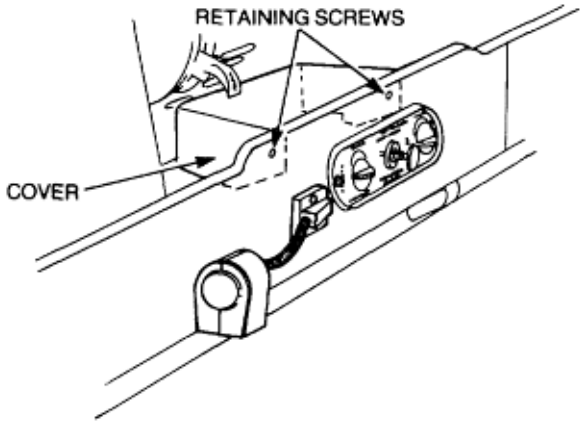


Figure 161 Map Reading Light Removal

b. Carefully remove the cover enough to enable the light unit wiring harness to be disconnected from the quick release terminals.

c. Remove the two nuts and washers securing the light unit to the dash panel and remove the light unit.

d. Insert the wiring harness through the dash panel, fit the light unit and secure it with the nuts and washers.

e. Connect the wiring harness to the quick release terminals.

f. Install the dash cover and secure it with the two screws.

Instrument Panel Lighting

272. Bulb Replacement. Replace the instrument panel light bulb as follows:

a. Disconnect the battery.

b. Remove the four screws securing the instrument panel (Figure 162).

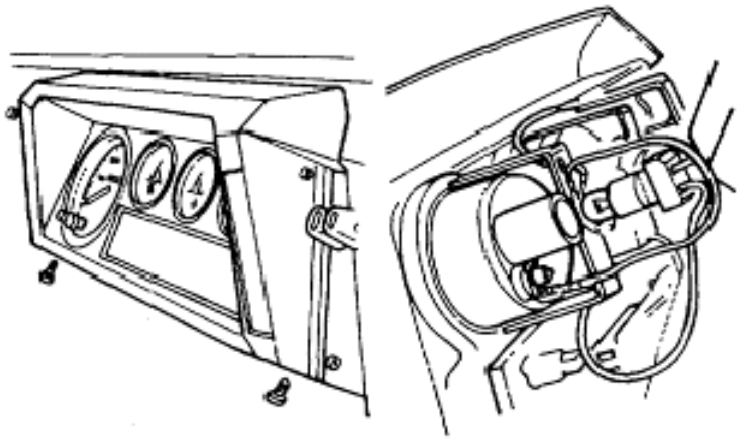


Figure 162 Instrument Panel Light Bulb Replacement

c. Carefully ease the panel away from the surround.

NOTE

If necessary, disconnect the speedometer cable to allow easier access.

d. Remove the bulb holder from the socket with a pull/twist action.

e. Replace the bulb.

f. Insert the bulb holder with a push/twist action.

g. Check that the speedometer cable is connected, install the instrument panel and secure it with the four screws.

h. Connect the battery.

Warning Lights

273. Bulb Replacement. Replace the warning light bulb as follows:

a. Disconnect the battery.

b. Remove the two screws securing the warning light module to the instrument panel (Figure 163).

c. Withdraw the module and the blackout cover. Disconnect the plug.

d. Remove the bulb holder from the socket with a pull/twist action then replace the bulb.

e. Insert the bulb holder with a push/twist action.

f. Connect the plug and install the module on the instrument panel and secure it and the blackout cover with the two screws.

g. Connect the battery.

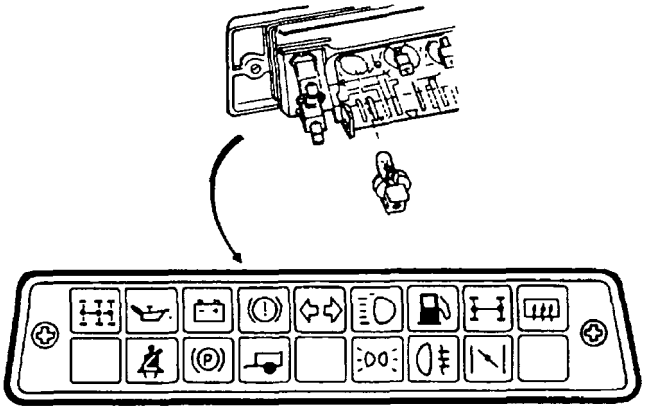


Figure 163 Warning Light Module Removal

Ignition Switch

274. Replacement. Replace the ignition switch as follows:

a. Disconnect the battery.

b. Remove the screw securing the steering wheel cover and remove the cover.

c. With the front wheels in the straight-ahead position, remove the steering wheel retaining nut and the shakeproof washer. Discard the washer.

d. Using the steering wheel puller (Table 3, Serial 3), remove the steering wheel from the column.

e. Remove the seven screws securing the steering column shroud (Figure 164).

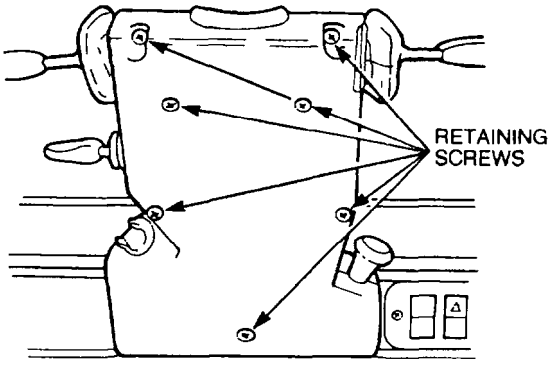


Figure 164 Steering Column Shroud Removal

f. Using a length of 2 mm thick wire, insert the wire in the hole located in the lower part of the switch (Figure 165). Depress the lock barrel plunger and withdraw the lock barrel.

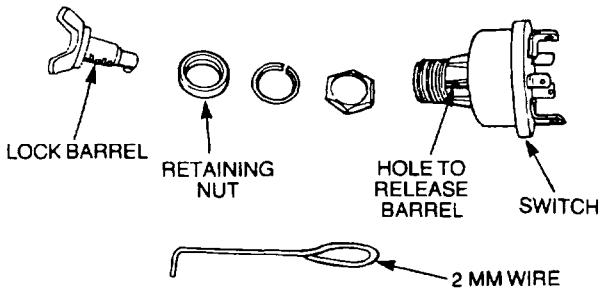


Figure 165 Ignition Switch Exploded View

g. Remove the retaining nut and remove the switch from the mounting bracket.

h. Tag and disconnect the wires from the switch.

i. Connect the wires to the correct terminals and install the switch on the mounting bracket.

j. Secure the switch to the bracket with the retaining nut.

k. Insert the lock barrel.

l. Install the steering column shroud and secure it with the seven screws.

NOTE

When installing the steering wheel, ensure that the two prongs on the steering wheel hub engage the cut outs in the upper steering column bush. If necessary, rotate the bush to align with the two prongs, ensuring that the arrow on the bush faces the indicator switch.

m. Install the steering wheel and secure it with a new shakeproof washer and the nut. Tighten the nut to 38 N.m (28 lbf.ft).

n. Fit the steering wheel cover and secure it with the screw.

o. Connect the battery.

Combination Switch

275. Replacement. Replace the combination switch as follows:

a. Disconnect the battery.

b. Remove the screw securing the steering wheel cover and remove the cover.

c. With the front wheels in the straight-ahead position, remove the steering wheel retaining nut and shakeproof washer. Discard the washer.

d. Using the steering wheel puller (Table 3, Serial 3), remove the steering wheel from the column.

e. Remove the seven screws securing the steering column shroud (Figure 164).

f. Tag and disconnect the light switch harness plug.

g. Loosen the nut securing the switch to the bracket and remove the switch.

h. Tag and disconnect the wiper switch harness plug.

i. Remove the three screws securing the switch to the combination switch bracket (Figure 166).

j. Carefully remove the wiper switch to prevent loss of internal components.

k. Loosen the clamp screw securing the combination switch to the upper steering column.

l. Slide the assembly off the column.

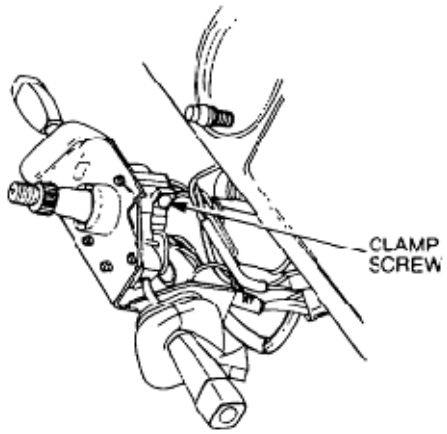


Figure 166 Combination Switch Removal

m. Fit the switch assembly on the column and tighten the clamp screw.

n. Connect the wiring harness.

o. Install the wiper switch to the bracket and secure it with the three screws.

p. Connect the wiring harness.

q. Fit the light switch to the bracket and tighten the retaining nut.

r. Connect the wiring harness.

s. Install the steering column shroud and secure with the seven screws.

NOTE

When installing the steering wheel, ensure that the two prongs on the steering wheel hub engage the cut outs in the upper steering column bush. If necessary, rotate the bush to align with the two prongs, ensuring that the arrow on the bush faces the indicator switch.

t. Install the steering wheel and secure it with a new shakeproof washer and the nut. Tighten the nut to 38 N.m (28 lbf.ft).

u. Fit the steering wheel cover and secure it with the screw.

v. Connect the battery.

Headlight and Park Light Switch

276. Replacement. Replace the headlight and park light switch as follows:

a. Disconnect the battery.

b. Remove the screws securing the steering wheel cover and remove the cover.

c. With the front wheels in the straight-ahead position, remove the steering wheel retaining nut and the shakeproof washer. Discard the washer.

d. Using the steering wheel puller (Table 3, Serial 3), remove the steering wheel from the column.

e. Remove the seven screws securing the steering column shroud (Figure 164).

f. Tag and disconnect the light switch harness plug.

g. Loosen the locknut securing the switch to the bracket and remove the switch.

h. Fit the new light switch to the bracket and tighten the locknut.

i. Connect the wiring harness.

j. Install the steering column shroud and secure it with the seven screws.

NOTE

When installing the steering wheel, ensure that the two prongs on the steering wheel hub engage the cut outs in the upper steering column bush. If necessary, rotate the bush to align with the two prongs, ensuring that the arrow on the bush faces the indicator switch.

k. Install the steering wheel and secure it with a new shakeproof washer and the nut. Tighten the nut to 38 N.m (28 lbf.ft).

l. Fit the steering wheel cover and secure it with the screw.

m. Connect the battery.

Panel Light Dimmer Switch

277. Replacement. Replace the panel light dimmer switch as follows:

a. Disconnect the battery.

b. Remove the two screws securing the top cover to the dash panel (Figure 167).

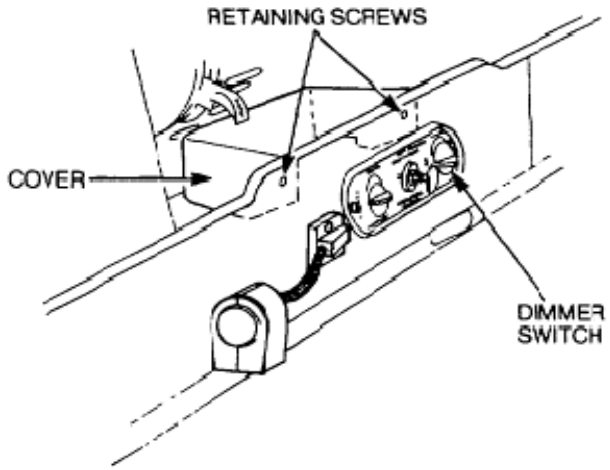


Figure 167 Switch Top Cover Removal

c. Using a small screwdriver, push in the spring-loaded pin to release the knob from the switch.

d. Remove the nut retaining the switch to the mounting bracket.

e. Tag and disconnect the two wires connected to the switch and remove the switch.

f. Insert the switch through the mounting bracket and secure it with the nut.

g. Fit the knob on the switch, ensuring the access hole is adjacent to the spring-loaded pin.

h. Connect the two wires and install the top cover. Secure the cover with the two screws.

i. Connect the battery.

Differential Lock Control Switch

278. Replacement. Replace the differential lock control switch as follows:

a. Disconnect the battery.

b. Remove the two screws securing the top cover to the dash panel (Figure 167).

c. Using a small screwdriver, loosen the screw securing the knob to the blackout switch.

d. Push in the spring-loaded pin to release the knob from the dimmer switch.

e. Using an open-ended spanner, secure the shaft on the differential lock control switch and unscrew the knob.

f. Remove the two screws securing the fascia plate and mounting bracket to the dash panel.

g. Tag and disconnect the three vacuum pipes connected to the differential lock control switch (Figure 168).

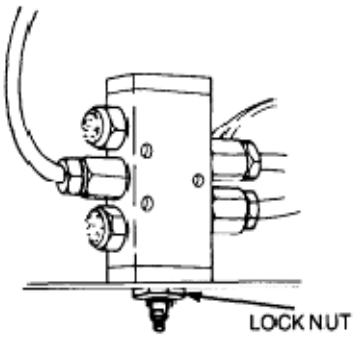


Figure 168 Differential Lock Control Switch Removal

h. Remove the locknut securing the switch to the mounting bracket.

i. Position the control switch in the mounting bracket and secure it with the locknut.

j. Insert the three vacuum pipes and tighten the connectors securely.

k. Position the mounting bracket and fascia plate on the dash panel and secure them with the two screws.

l. Using an open-ended spanner, secure the control switch shaft and install the knob.

m. Push the knob onto the dimmer switch ensuring the access hole is adjacent to the spring-loaded pin.

n. Install the blackout switch knob and tighten the retaining screw.

o. Install the top cover and secure it with the two screws.

p. Connect the battery.

Blackout Light Switch

279. Replacement. Replace the blackout light switch as follows:

a. Disconnect the battery.

b. Remove the two screws securing the top cover to the dash panel (Figure 167).

c. Using a small screwdriver, loosen the screw securing the knob to the blackout switch.

d. Using a small screwdriver, push in the spring-loaded pin to release the knob from the dimmer switch.

e. Using an open-ended spanner, secure the shaft on the differential lock control switch and unscrew the knob.

f. Remove the two screws securing the fascia plate and mounting bracket to the dash panel.

g. Remove the two round-head screws securing the switch to the bracket and remove the switch (Figure 169).

h. Tag and disconnect all the wires from the terminals.

i. Remove the two countersunk screws securing the plate to the switch.

j. Remove the two long nuts and replace the switch.

k. Install the two long nuts, fit the plate and secure it with the two countersunk screws.

l. Connect the wires on the correct terminals as tagged.

m. Fit the switch to the mounting bracket with terminal 3 uppermost and secure it with the two round-head screws.

n. Fit the mounting bracket and fascia plate to the dash panel and secure them with the two screws.

o. Install the blackout switch knob and tighten the retaining screw.

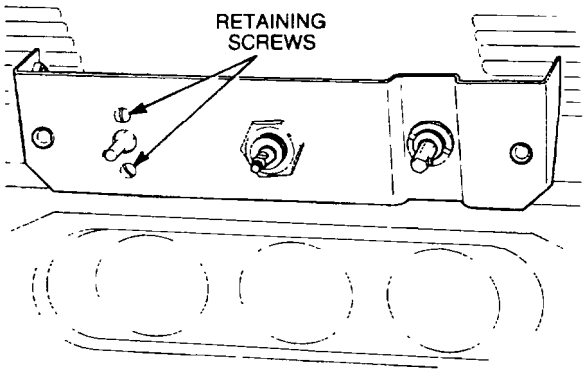


Figure 169 Blackout Lighting Switch Removal

p. Push on the dimmer light switch knob ensuring the access hole is adjacent to the spring-loaded pin.

q. Using an open-ended spanner, secure the shaft on the differential lock control switch and screw the knob back on.

r. Install the top cover and secure it with the two screws.

s. Connect the battery.

Hazard Warning Switch

280. Replacement. Replace the hazard warning switch as follows:

a. Remove the two screws securing the switch panel and remove the panel.

b. Disconnect the plug from the switch.

c. Press the securing clips on the back of the switch and draw the switch out of the panel.

d. Insert the new switch into the switch panel ensuring the securing clips click into place.

e. Connect the plug to the new switch.

f. Install the switch panel and secure it with the two screws.

Dash Instruments

281. Speedometer Replacement. Replace the speedometer as follows:

a. Disconnect the battery.

b. Remove the four screws retaining the instrument panel (Figure 162) and carefully ease the panel away from the surround.

c. Depress the clip securing the speedometer cable to the speedometer and withdraw the cable.

d. Tag and remove the bulb holders from the speedometer sockets.

e. Remove the two knurled nuts securing the speedometer to the instrument panel and remove the speedometer.

f. Insert the new speedometer into the instrument panel and secure it with the two knurled nuts.

g. Install the bulb holders on the speedometer.

h. Fit the speedometer cable on the speedometer ensuring that the clip locks into position.

i. Install the instrument panel and secure it with the four screws.

j. Connect the battery.

k. Record the speedometer replacement in the GM-120 – Record Book for Service Equipment and SDSS in accordance with EMEI Vehicle A 019-1.

282. Fuel Gauge Replacement. Replace the fuel gauge as follows:

a. Disconnect the battery.

b. Remove the four screws retaining the instrument panel (Figure 162) and carefully ease the panel away from the surround.

NOTE

If necessary, disconnect the speedometer cable to allow easier access.

c. Remove the bulb holder from the fuel gauge.

d. Tag and disconnect the electrical connections.

e. Remove the nut securing the gauge to the instrument panel and remove the gauge.

f. Insert the new gauge into the panel and secure it with the nut.

g. Connect the electrical connections as tagged.

h. Install the bulb holder on the fuel gauge.

i. Ensure that the speedometer cable is connected.

j. Install the instrument panel and secure it with the four screws.

k. Connect the battery.

283. Temperature Gauge Replacement. Replace the temperature gauge as follows:

a. Disconnect the battery.

b. Remove the four screws retaining the instrument panel (Figure 162) and carefully ease the panel away from the surround.

NOTE

If necessary, disconnect the speedometer cable to allow easier access.

c. Remove the bulb holder from the temperature gauge.

d. Tag and disconnect the electrical connections.

e. Remove the nut securing the gauge to the instrument panel and remove the gauge.

f. Insert the new gauge into the panel and secure it with the nut.

g. Connect the electrical connections as tagged.

h. Install the bulb holder on the temperature gauge.

i. Ensure that the speedometer cable is connected.

j. Install the instrument panel and secure it with the four screws.

k. Connect the battery.

284. Volt Meter Replacement. Replace the volt meter as follows:

a. Disconnect the battery.

b. Remove the four screws retaining the instrument panel (Figure 162) and carefully ease the panel away from the surround.

NOTE

If necessary, disconnect the speedometer cable to allow easier access.

c. Remove the bulb holder from the volt meter gauge.

d. Tag and disconnect the electrical connections.

e. Remove the nut securing the gauge to the instrument panel and remove the gauge.

f. Insert the new gauge into the panel and secure it with the nut.

g. Connect the electrical connections as tagged.

h. Install the bulb holder on the volt meter gauge.

i. Ensure that the speedometer cable is connected.

j. Install the instrument panel and secure it with the four screws.

k. Connect the battery.

Windscreen Wiper Motor

285. Removal. Remove the windscreen wiper motor as follows:

a. Disconnect the battery.

b. Remove the wiper blades and arms.

c. Using a suitable tool, pry the emblem from the left-side grab handle.

d. Remove the screws securing the handle and wiper motor cover (Figure 170).

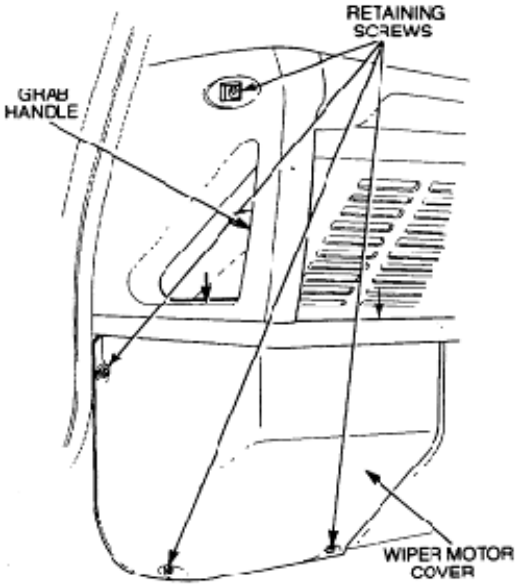


Figure 170 Left-side Grab Handle Removal

e. Remove the cover and handle, noting the two locating pins in the handle.

f. Slide the rubber boot up the drive cable tubing.

g. Loosen the nut securing the tubing to the wiper motor.

h. Disconnect the wiring harness plug from the wiper motor (Figure 171).

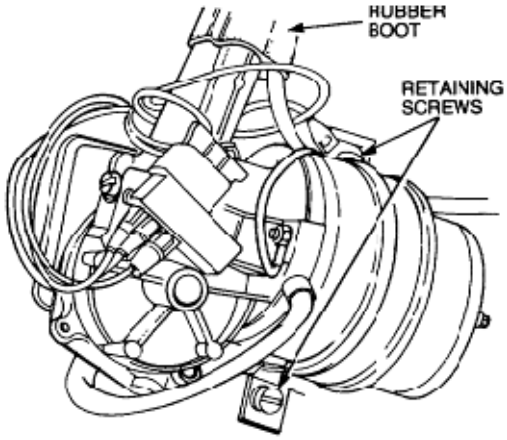


Figure 171 Wiper Motor Removal

CAUTION

The two screws, retaining the wiper motor, also retain a tapped plate on the engine side of the firewall. Do not fully remove the wiper motor retaining screws. If the plate falls away from the mounting position they are difficult to reposition correctly.

i. Loosen the two wiper motor retaining screws.

j. Slide the motor, rubber pad and drive cable out of the clamp.

286. Installation. Install the windscreen wiper motor as follows:

a. Insert the drive cable in the drive cable tubing.

b. Rotate the wheelbox spindles to engage the drive between the cable and gears.

c. Slide the wiper motor into the retaining clamp.

d. Position the rubber pad between the wiper motor and the firewall and tighten the retaining screws securely.

e. Tighten the drive cable tubing nut securely and cover it with the rubber boot.

f. Connect the wiring harness plug.

g. Fit the grab handle to the upper dash panel and insert the top retaining screw.

h. Install the wiper motor cover ensuring that the locating pins are engaged.

i. Secure both the cover and grab handle with the screws and press in the emblem.

j. Install the wiper blades and arms.

k. Connect the battery.

Windscreen Wiper Cable

287. Removal. Remove the windscreen wiper cable as follows:

a. Disconnect the battery.

b. Remove the wiper, blades and arms.

c. Using a suitable tool, pry the emblem from the left-side grab handle.

d. Remove the screws securing the handle and wiper-motor cover (Figure 170).

e. Remove the cover and handle, noting the two locating pins in the handle.

f. Slide the rubber boot up the drive cable tubing.

g. Loosen the nut securing the tubing to the wiper motor.

h. Disconnect the wiring harness plug from the wiper motor (Figure 171).

CAUTION

The two screws, retaining the wiper motor, also retain a tapped plate on the engine side of the firewall. Do not fully remove the wiper motor retaining screws. If the plate falls away from the mounting position they are difficult to reposition correctly.

i. Loosen the two wiper motor retaining screws and slide the motor, rubber pad and drive cable out of the clamp.

j. Remove the four screws securing the motor gearbox cover plate and remove the plate.

k. Remove the circlip and washer securing the connecting rod.

l. Disconnect the drive cable from the rod.

288. Installation. Install the windscreen wiper cable as follows:

a. Connect the drive cable to the connecting rod.

b. Smear grease on the connecting rod and the cable end.

c. Fit the cover plate to the gearbox and secure it with the four screws.

d. Smear the drive cable with grease and insert the cable in the drive cable tubing.

e. Rotate the wheelbox spindles to engage the drive between the cable and gears.

f. Slide the wiper motor into the retaining clamp.

g. Position the rubber pad between the wiper motor and the firewall and tighten the retaining screws securely.

h. Tighten the drive cable tubing nut securely and cover it with the rubber boot.

i. Connect the wiring harness plug.

j. Fit the grab handle to the upper dash panel and insert the top retaining screw.

k. Install the wiper motor cover ensuring that the locating pins are engaged.

l. Secure both the cover and grab handle with the screws and press in the emblem.

m. Install the wiper blades and arms.

n. Connect the battery.

Windscreen Washer Motor

289. Removal. Remove the windscreen washer motor as follows:

a. Remove the supply and delivery pipes from the washer motor (Figure 172) and plug the supply pipe with a suitable plastic plug.

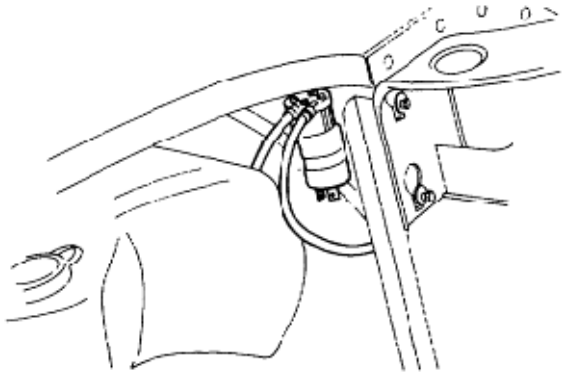


Figure 172 Windscreen Washer Motor Removal

b. Remove the wiring harness plug from the motor.

c. Remove the two screws securing the washer motor.

d. Remove the motor.

290. Installation. Install the windscreen washer motor as follows:

a. Position the washer motor and secure it with the two screws.

b. Push on the wiring harness connector.

c. Connect the supply and delivery pipes on the washer motor.

Horn

291. Removal. Remove the horn as follows:

a. Remove the eight screws securing the front grille and remove the grille.

b. Disconnect the wiring harness plug from the horn.

c. Remove the two bolts securing the horn to the front panel and remove the horn.

292. Installation. Install the horn as follows:

a. Position the horn on the front panel and secure it with the two bolts.

b. Connect the wiring harness plug to the horn.

c. Position the front grille on the vehicle and secure it with the eight screws.

Turn Indicator Flasher Unit

293. Removal. Remove the turn indicator flasher unit as follows:

a. Disconnect the battery.

b. Remove the fuse panel cover.

c. Remove the two screws securing the fuse panel to the firewall (Figure 173) and move the panel away.

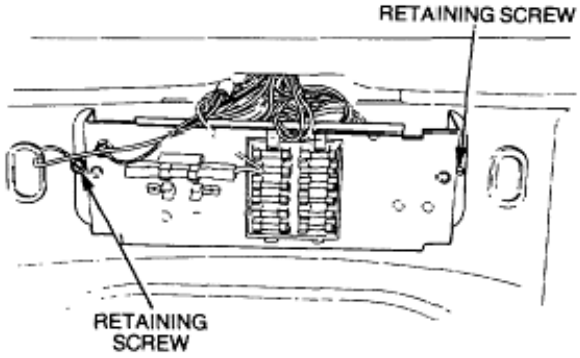


Figure 173 Fuse Panel Removal

d. Remove the flasher unit from the socket (Figure 174).

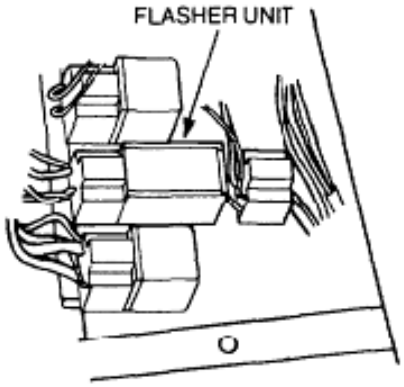


Figure 174 Flasher Unit Removal

294. Installation. Install the turn indicator flasher unit as follows:

a. Align the flasher unit pins with the socket and push the flasher unit into the socket.

b. Position the fuse panel on the firewall and secure it with the two screws.

c. Install the fuse panel cover and secure it with the two knurled knobs.

d. Connect the battery.

NATO Socket

295. Removal. Remove the NATO socket as follows:

a. Disconnect the battery.

b. Tag and disconnect the wiring harness connectors, located behind the right rear tail lamp.

c. Remove the four nuts, washers and bolts securing the socket to the rear cross-member.

d. Remove the three clamps securing the socket wiring harness to the rear cross-member.

e. Remove the socket and harness from the vehicle.

296. Installation. Install the NATO socket as follows:

a. Insert the wiring harness through the rear cross-member and position the socket with the hinge uppermost.

b. Install the four bolts, washers and nuts and tighten them securely.

c. Connect the wiring harness connectors to the main harness; if necessary secure it with zip-clamps.

d. Secure the harness to the rear cross-member with the clamps.

e. Connect the battery.

297. Test Procedure. Test the NATO socket for correct operation as follows:

CAUTION

If bulb replacement is required, all bulbs are accessible from the front panel of the tester. Do not remove the bottom cover.

NOTE

In order to check both earth terminals, all lights except the tail light are earthed through terminal L. The tail light is earthed through terminal D.

a. Plug the NATO tester into the NATO socket.

b. With the vehicle ignition and light switches 'OFF', all lights on the tester except the auxiliary power light should be extinguished.

c. Switch on the left-side indicator and check that the left-side indicator on the tester flashes.

d. Switch on the right-side indicator and check that the right-side indicators on the tester flashes.

e. Apply the foot brake and check that the stop light on the tester illuminates.

f. Switch on the park lights and check that the tail light on the tester illuminates.

g. Switch to the blackout mode.

h. Check that all green blackout and convoy lights on the tester illuminate.

i. Apply the foot brake and check that the red blackout stop light on the tester illuminates.

j. Check that the auxiliary power light on the tester is extinguished in the blackout mode.

Tester Pin Connections

298. A list of terminals to light connections is shown in Table 21.

Table 21 Tester Pin Connections

Serial	Pin	Colour and Function
1	A	Green, blackout and convoy light
2	C	Green, blackout and convoy light
3	H	Green, blackout and convoy light
4	M	Red, left side indicator
5	N	Red, right side indicator
6	B	Red, stop, left side
7	J	Red, stop, right side
8	E	Amber, tail lamp
9	F	Red blackout stop light
10	K	Blue auxiliary power lamp

Fuse Boxes

299. The main change to the fuse box assembly has been the change from barrel to blade fuses, with minor changes to the blade fuse loom components. Details of blade fuses and associated relays are contained in the relevant variant RPS in Group QMA.

300. ARN change points and main loom types for 4x4 is shown in Table 22. The looms can be broken down into four basic types as follows:

a. Group1 – Barrel Fuses;

b. Group 2 – Blade Fuses (no wiper delay);

c. Group 3 – Blade Fuses (headlight override relay removed and link cable fitted as detailed in EMEI Vehicle G 187-1); and

d. Group 4 – Blade Fuses (wiper delay relay fitted).

Table 22 ARN Change Points Barrel/Blade Fuses

Serial	Variant	Group 1 Barrel Fuses	Group 2 Blade Fuses	Group 3 Blade Fuses and Headlight Link Cable	Group 4 Blade Fuses with Wiper Delay Relay
1	Cargo	48008	49601	50057	51425
2	Cargo with Winch	48001	49734	50041	-
3	FFR	48002	49673	49943	50306
4	FFR with Winch	48003	49705	-	-
5	Personnel Carrier	All	-	-	-
6	Survey	All	-	-	-
7	RFSV	-	-	-	All
8	RFSU FFR	-	-	-	All

301. The breakdown of individual components within each type of is shown in Table 23 and is provided to assist parts identification.

Table 23 Loom Component Identification

Serial	Description	Group 1 Barrel Fuses	Group 2 Blade Fuses	Group 3 Blade Fuses and Headlight Link Cable	Group 4 Blade Fuses with Wiper Delay Relay
1	Main harness	6150-66-139-0078	PRC7850	2590-66-128-8456	2590-66-128-8456
2	Control unit – variable delay	-	-	-	2540-99-709-0106
3	Label fuse identification	9905-66-128-4966	9905-66-128-5961	9905-66-128-5961	9905-66-128-5961
4	Fuse relay mounting panel	PRC2243	2590-99-795-1082	2590-99-795-1082	2590-99-795-1082
5	Cable assembly – engine	6150-66-128-4900	6150-66-128-4900	6150-66-128-4900	6150-66-128-4900
6	Harness – front marker lamp	BYG9066	BYG9066	BYG9066	BYG9066
7	Label – blackout light fuses	9905-66-128-4968	-	-	-
8	Fuse box – blackout fuses	PRC3737	-	-	-
9	Chassis harness	AYG9928	6150-66-139-0058	6150-66-139-0058	6150-66-139-0058
10	Fuel tank harness	AYG9971	AYG9971	AYG9971	BYG9184
11	Cable assembly-Santon switch	BYG9357	6150-66-139-0052	6150-66-139-0052	6150-66-139-0052

302. Protection of Wiring Looms. The wiring loom length and routing may vary from vehicle to vehicle, from changes during production or as a result of subsequent repairs. Spiral wrap plastic tubing (Table 24) may be used to enclose the loom to prevent chafing, especially where disassembly and rerouting of the loom is impracticable.

Table 24 Spiral Wrap Details

Serial	NSN	Designation
1	9330-66-057-8399	Tubing, Plastic, Spiral Wrap, Nylon, 12 mm
2	9330-00-733-7799	Tubing, Plastic, Spiral Wrap, 3 mm
3	9330-66-057-8392	Tubing, Plastic, Spiral Wrap, 4 mm
4	9330-66-057-8396	Tubing, Plastic, Spiral Wrap, 6 mm

Wiring Diagram and Loom Replacement

303. A vehicle wiring diagram is shown in Figure 204. In the event that the main loom requires replacement, all looms will continue to be supplied as spare parts by Rover Australia. Early main looms (Para 300) can be upgraded from barrel fuses to blade fuses by fitting the latest loom, NSN 2590-66-128-8456, however the following tasks must also be carried out:

a. **Fuse Panel.** Replace the fuse panel with a new panel, NSN 2590-99-152-4191.

b. **Wiper Switch and Relay.** Replace the wiper switch and relay with an intermittent wiper switch, NSN 2590-99-127-4385.

c. **Fuse Box Label.** Replace the fuse box label with a new label, NSN 9905-66-128-5961.

d. **Headlight Override Relay.** Install the jumper cable, NSN 6150-66-128-5993, in accordance with EMEI Vehicle G 187-1.

304. **Recording Action.** The details of any loom repair/improvements are to be entered in Part 4 of the GM 120, Record Book for Service Equipment.

FRAME

Bumper Brushguard

305. Removal. Remove the bumper brushguard as follows:

a. Loosen the twelve nuts, lock-washers and bolts securing the bumper to the chassis frame (Figure 175).

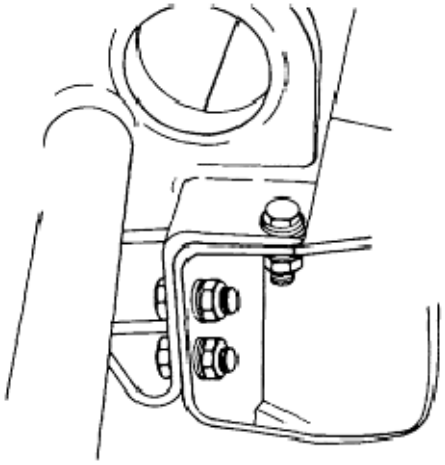


Figure 175 Bumper Brushguard Removal

b. Support the bumper and remove the nuts, lock-washers and bolts. Discard the lock-washers

c. Remove the bumper from the chassis frame.

306. Installation. Install the bumper brushguard as follows:

a. Support the bumper on the chassis frame.

b. Install the twelve bolts, new lock-washers and the nuts and tighten them securely.

Towing Pintle

307. Replacement. Replace the towing pintle as follows:

a. Support the weight of the towing pintle and remove the four locknuts, washers and bolts securing the towing pintle to the rear cross-member. Discard the locknuts.

NOTE

Inspection and repair of the towing pintle, if required, is to be in accordance with EMEI Vehicle G 008-1.

b. Position the new towing pintle on the rear cross-member.

c. Install the four bolts, washers and new locknuts.

d. Tighten the nuts to 61 N.m (44 lbf.ft).

Spare Wheel Carrier

308. Replacement. Replace the spare wheel carrier as follows:

a. Remove the spare wheel from the carrier.

b. Using a suitable pin punch, remove the roll pin securing the shaft to the carrier mechanism.

c. Withdraw the shaft from the coupling (Figure 176).

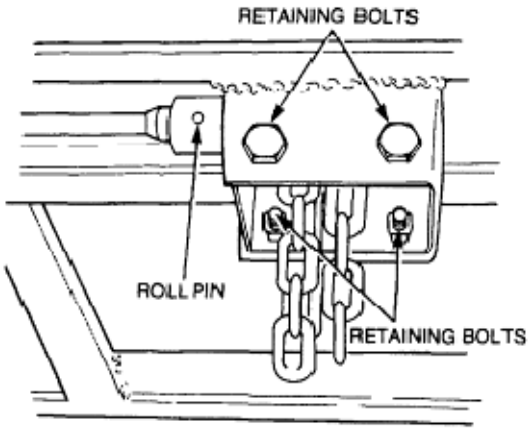


Figure 176 Spare Wheel Carrier Removal

d. Remove the four bolts and lock-washers securing the carrier to the rear subframe. Discard the lock-washers.

e. Position the new carrier in the rear subframe, install the four bolts and new lock-washers and tighten them securely.

f. Insert the shaft in the coupling ensuring that the pin hole aligns and install a new roll pin.

Frame System Specifications

309. The frame system specifications are detailed in Table 25.

Table 25 Frame System Specifications

Serial	Specification	Measurement
1	Towing pintle retaining bolts	61 N.m (44 lbf.ft)

BODY

Cabin Seats

310. Removal. Remove the cabin seats as follows:

a. Remove the seat cushion and slide the seat frame rearwards.

b. Remove the two countersunk screws at the front of the frame (Figure 177).

c. Slide the seat frame forwards and remove the two countersunk screws at the rear of the frame.

d. Lift the seat assembly out of the vehicle.

e. Repeat the procedure for the other seat.

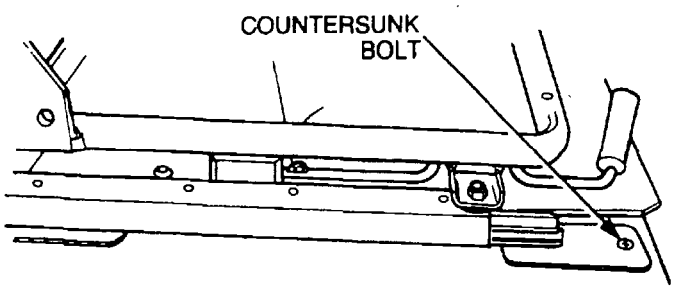


Figure 177 Cabin Seat Removal

311. Installation. Install the cabin seats as follows:

a. Position the seat frame on the seat base and install the four countersunk screws.

b. Tighten the screws securely.

c. Install the seat cushion.

Windscreen Frame

312. Removal. Remove the windscreen frame as follows:

a. Disconnect the battery.

b. Remove the screws securing the sun visors to the windscreen surround and remove the sun visors.

c. Release the four latches and remove the canopy leading edge from between the windscreen and the clamping frame (Figure 178).

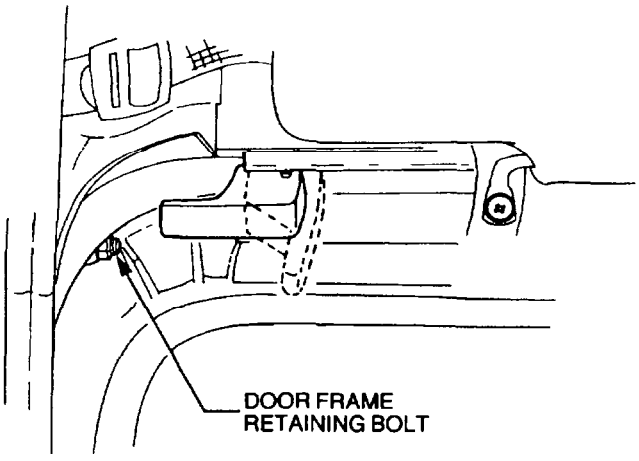


Figure 178 Canopy Removal

d. Remove both wiper blades and arms.

e. Release the two straps attached to the windscreen frame.

f. Remove the interior light lens and disconnect the wiring harness.

g. Remove the harness from the windscreen frame.

h. Remove the bolts securing the mirror and interior light bracket to the frame. Remove the mirror and interior light bracket.

i. Remove the locknuts and washers securing the door frame to the windscreen frame and cut the sealing rubber adjacent to the firewall (Figure 179). Discard the locknuts.

j. Loosen the nuts securing the windscreen clamps.

k. Ease the windscreen forward onto the bonnet support brackets.

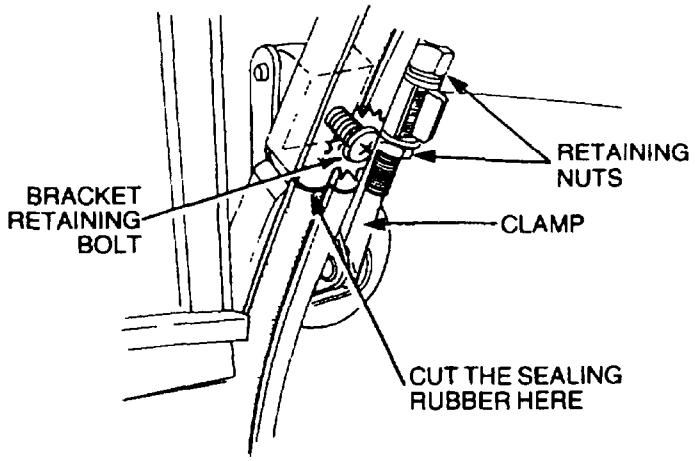


Figure 179 Windscreen Assembly Removal

l. Remove the hinge bracket retaining bolts from both sides of the windscreen frame.

m. Lift the windscreen assembly away from the vehicle.

313. Installation. Install the windscreen frame as follows:

a. Rest the windscreen assembly on the bonnet support.

b. Install a gasket on both hinge brackets and position the windscreen to allow both retaining bolts to be fitted. Fit and tighten the bolts securely.

c. Raise the windscreen assembly to the normal position and install the clamps. Do not tighten the nuts at this stage.

d. Fit the door frames to the windscreen frame and using new locknuts, tighten the locknuts securely.

e. Tighten the two clamp-bolt nuts securely.

f. Install the mirror and interior light bracket and tighten the bolts securely.

g. Position the interior light wiring harness around the windscreen frame and connect the two wires to the light unit.

h. Install the light lens.

NOTE

It may be necessary to loosen all canopy retaining straps to facilitate the installation of the canopy.

i. Ensure the four latches are in the released position.

j. Insert the leading edge of the canopy between the windscreen and the clamping frame and clamp the canopy securely.

k. Fit the two straps to the windscreen frame and tighten them securely.

l. Ensure that all the side straps are secure and the ropes are taut.

m. Install both wiper blades and arms.

n. Install the sun visors.

o. Reconnect the battery.

Grille

314. Replacement. Replace the grille as follows:

a. Remove the eight screws securing the grille to the front panel.

b. Remove the grille.

c. Position the new grille on the front panel and secure it with the eight screws.

Tailgate

315. Replacement. Replace the tailgate as follows:

a. Remove the number plate light cover and the lens.

b. Disconnect the wiring harness and remove the wiring harness from the three plastic clips.

c. Remove the split pins and washers securing the tailgate hinges to the chassis brackets. Discard the split pins.

d. Release the two tailgate latches and the rope securing the canopy to the tailgate.

e. Remove the nuts, washers and bolts securing the left-side hinge to the tailgate and remove the hinge. Discard the washers.

f. Release the two restraint cables from the roll brackets and lower the tailgate.

g. Slide the tailgate to the left to disengage the hinges and remove the tailgate from the vehicle.

h. Fit the new tailgate on the rear cross-member ensuring that the right-side hinge pin engages the bracket and close the tailgate.

i. Install the left-side hinge and secure it with the bolts, nuts and new washers.

j. Secure the tailgate in the raised position with the tailgate latches.

k. Connect the two cables onto the brackets.

l. Install the canopy rope on the tailgate hooks.

m. Install a flat washer and a new split pin on each hinge pin.

n. Insert the wiring harness through the three plastic clips and connect it to the light unit.

o. Install the lens and the lens cover.

Rollover Protection

316. Removal. Remove the rollover protection as follows:

WARNING

The rollover protection assembly is to be replaced should any of the following occur:

1. **the vehicle is involved in a rollover accident;**
2. **where distortion has occurred to the rollover-structure capping rail; or**
3. **weld failure occurs.**

Any of the above replacement triggers significantly reduces the structural integrity of the rollover protection and in an event will not provide adequate protection to the occupants.

a. Remove the four bolts securing the cam net carrier to the front and rear roll tubes.

b. Remove the cam net carrier.

c. Remove the canopy from the rear of the vehicle and fold it forward over the cabin roof.

d. Remove the two horizontal canopy rails connecting the front roll tube to the front and intermediate canopy bows.

e. Remove the seat belts from the front rollover tube or lower mounting point.

f. Remove the bolts securing the rollover protection to the cargo body.

g. Using suitable lifting equipment, remove the rollover protection from the vehicle.

317. Installation. Install the rollover protection as follows:

a. Using suitable lifting equipment, position the rollover protection on the vehicle.

NOTE

Use Loctite 277 or equivalent on all the capping plate bolts.

b. Secure the rollover protection to the vehicle body with the bolts, washers and nuts and tighten them securely.

c. Position the seat belts at the front rollover tube and secure them with the bolts, washers and nuts.

d. Install the two horizontal canopy rails to the front rollover tube and the intermediate and front canopy bows and tighten the bolts securely.

e. Position the canopy over the cargo area and secure it to the vehicle body.

f. Position the cam net carrier on the vehicle and secure it with the bolts, nuts and washers.

Bonnet Release Catch

318. Removal. Remove the bonnet release catch as follows:

a. Raise the bonnet.

b. Remove the insect screen (RFSV only).

c. Remove the plastic grille.

d. Remove the split pin from the clevis pin at the bonnet catch and remove the clevis pin. Discard the split pin.

e. Remove the bolts, nuts and washers securing the pivot plate to the grille panel (Figure 180).

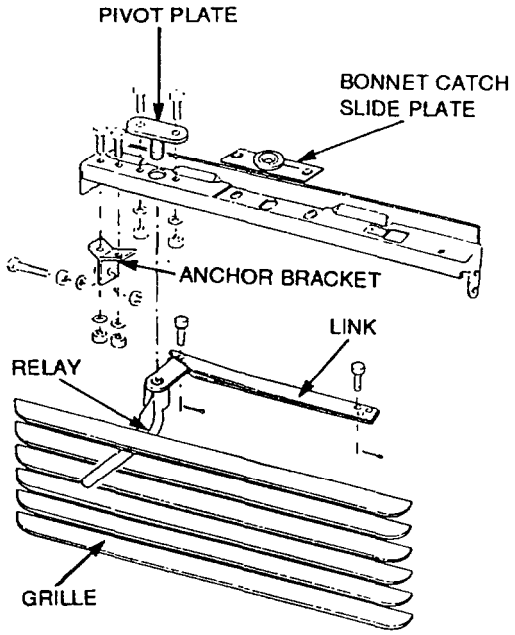


Figure 180 Bonnet Mechanism

f. Hold the relay and unscrew the pivot plate.

g. Remove the split pin and the clevis pin securing the link to the relay. Discard the split pin.

319. Installation. Install the bonnet release catch as follows:

a. Install the link to the relay with the clevis and a new split pin (Figure 180).

NOTE

Lubricate the pivot plate thread with graphite powder or grease XG-291. A gap of approximately 15 mm is required between the top of the pivot plate and the relay.

b. Position the relay below the top grille panel.

c. Screw the pivot plate downwards into the relay through the 16 mm hole.

d. Secure the pivot plate to the grille panel with the bolts, washers and nuts.

NOTE

When the bonnet catch slide plate is fully open, the relay should be at an angle of approximately 85 degrees to the vehicle centreline.

Position the grille at its mounting position. Check that when the relay is in the open position it does not foul the vertical web. If fouling exists select an alternative hole.

e. Connect the link to the bonnet catch with a clevis pin through one of the three holes in the link and secure it with a new split pin.

f. Adjust the anchor stop screw in the closed position so the bonnet lock slide plate travels 5 mm (Figure 181).

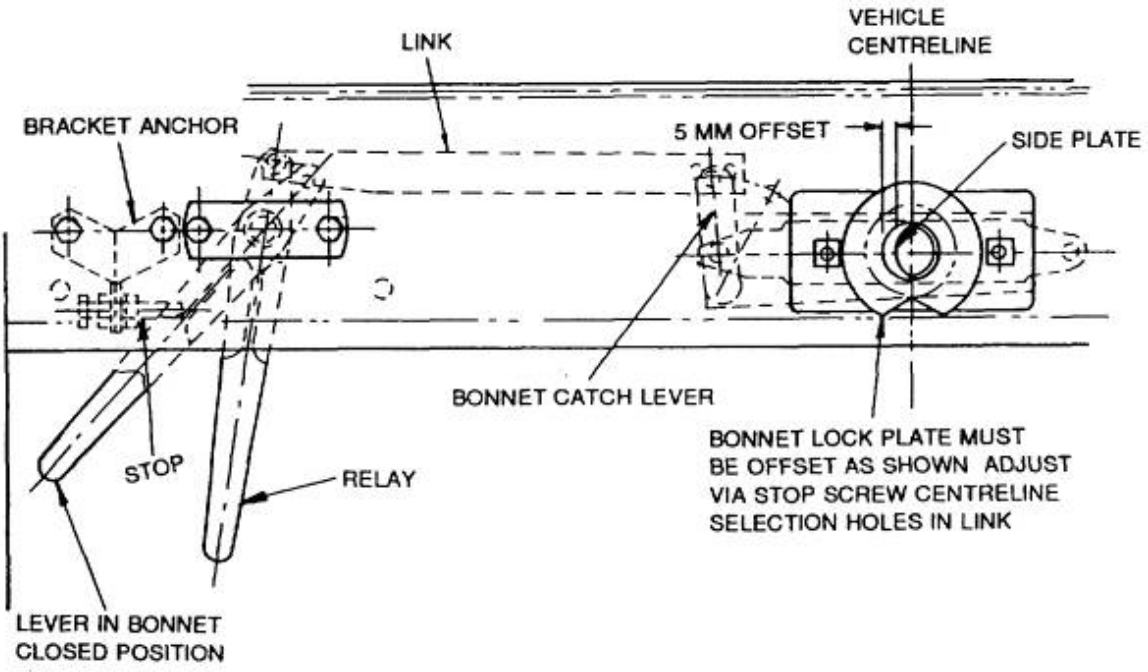


Figure 181 Bonnet Lock Slide Plate

g. Open and close the bonnet a number of times to ensure correct operation.

h. Install the grille.

i. Install the insect screen (RFSV only).

Bonnet

320. Bonnet Adjustment. The bonnet adjustments are to be carried out as follows:

a. Open the bonnet.

b. Visually inspect the bonnet hinges and ensure that the open ended slot of the bush is facing towards the front of the vehicle.

NOTE

Any bush fitted or operating incorrectly are to be removed and inspected. Replace a bush if it is worn. Lubricate the bush when refitting it

c. Check that the bushes pivot in the hinge when the bonnet is raised and lowered.

d. Remove the bonnet buffer rubbers from the adjusting screw heads.

e. Adjust the bonnet striker pin to the correct dimensions (Figure 182).

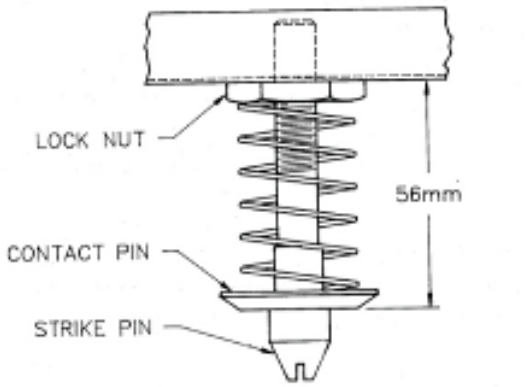


Figure 182 Bonnet Striker Pin

f. Inspect the bonnet safety catch lever to ensure it is aligned (repair or replace as necessary).

g. Adjust the bonnet buffer screws to the correct dimensions (Figure 183) and refit the buffer rubbers.

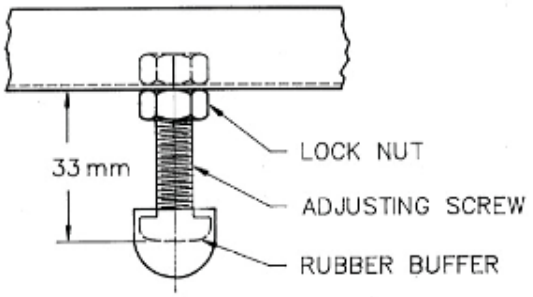


Figure 183 Bonnet Buffer Screw

h. Lubricate the striker mechanism.

Door Window Glass

321. Replacement. Replace the door window glass as follows:

a. Open the door and remove the two nuts and washers securing the sidescreen to the lower door.

b. Remove the sidescreen and lay the door top flat on a work bench.

c. Remove the six screws securing the removable rail to the door frame (Figure 184).

d. Remove the glass and the slide rail assemblies from the doorframe.

e. Carefully remove the sliding and draught seal rails from the glass.

f. Clean away all trace of sealant. Remove and discard the nylon block runners.

NOTE

Position the block runners equidistant along the rail ensuring that a block is within 10 mm from each end of the rail (Figure 185).

g. Insert the new block runners into the slide rails.

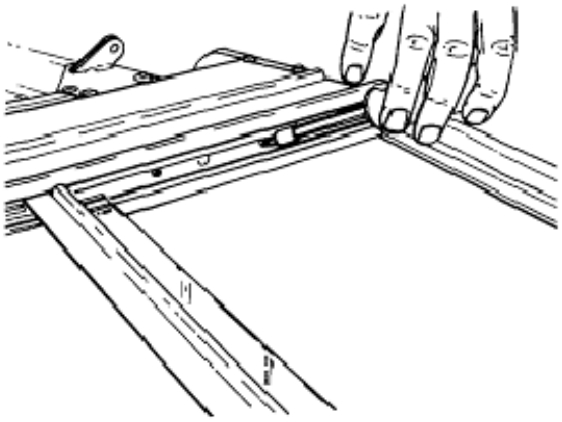


Figure 184 Glass And Rail Removal

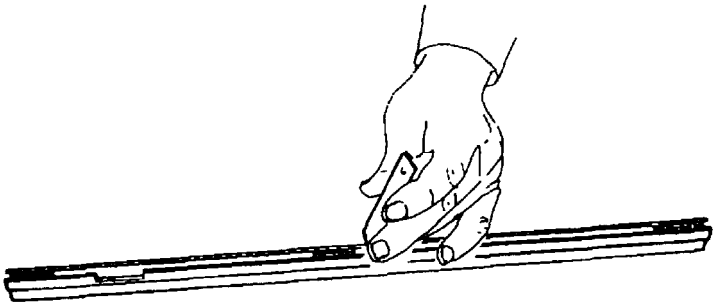


Figure 185 Block Runners Installation

h. To prevent the blocks from moving, peen the edge of the rail slightly.

NOTE

The inner and outer slide rails are not interchangeable. Each rail has an aperture to accept the window lock. Unless the apertures are correctly aligned the window lock will not operate and the leading edge of the window will not seal at the door frame.

i. Align the outer glass (with the hole) in the slide rail. Ensure that the window lock aperture is at the rear and facing towards the interior of the vehicle (Figure 186).

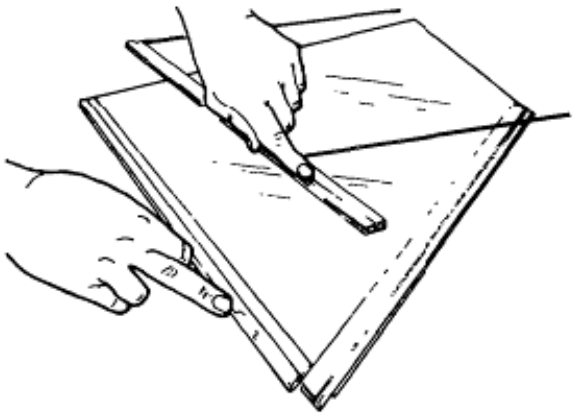


Figure 186 Outer Glass Alignment

j. Place the sealing rubber along the edge of the glass (Figure 187).

k. Using a suitable press, force the glass into the sliding rail. Ensure that when the glass is fully pressed into the rail, the glass protrudes 3–5mm (0.11–0.19 in) beyond the end of the rail on the leading edge.

l. Cut off the excess sealing rubber along the rail.

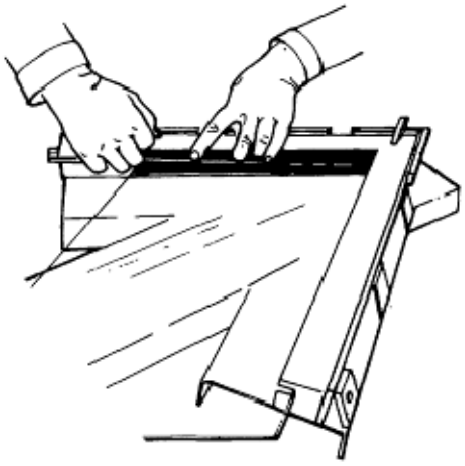


Figure 187 Outer Glass Installation

m. Lubricate the rubber seal with a soapy solution.

n. Align the draught rail, sealing rubber and glass (Figure 188).

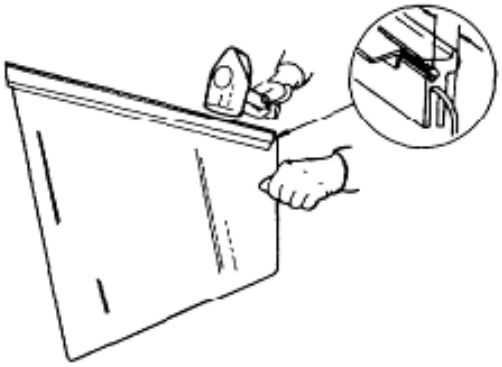


Figure 188 Draught Rail Installation

o. Press the glass into the draught rail.

p. Cut off the excess sealing rubber along the rail.

NOTE

When the draught rail is fully installed, the top edge of the glass must protrude 10 mm (0.39 in) above the end of the frame.

q. Align the inner glass and sealing rubber to the slide rail. Ensure that the window lock aperture is on the same side as the draught rail seal groove.

r. Apply a soapy solution to the rubber and press in the glass fully (Figure 189).

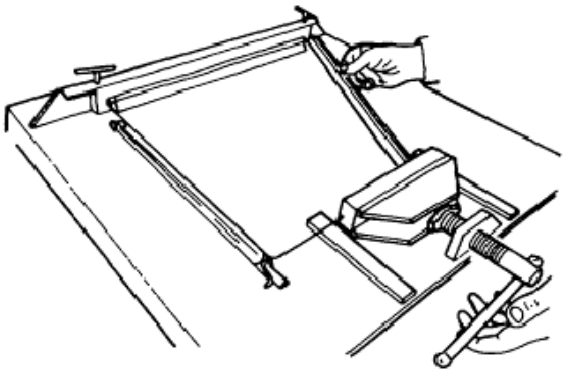


Figure 189 Slide Rail Installation

s. Slide in a new draught seal rubber onto the draught rail (Figure 190).

NOTE

A slight gap between the draught and slide rails is acceptable.

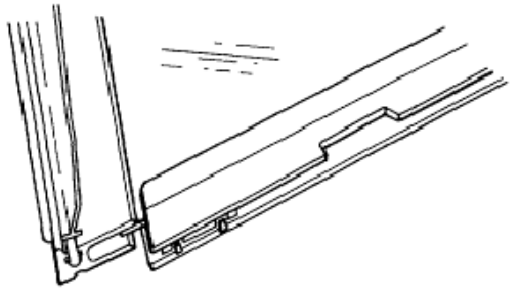


Figure 190 Draught Seal Rubber Installation

t. Lightly lubricate the removable rail with petroleum jelly.

u. Install the inner and outer glasses (Figure 191).

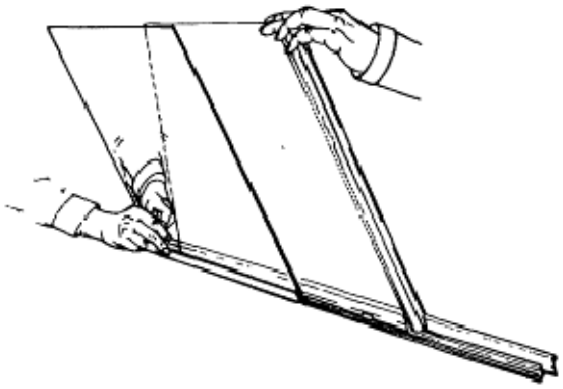


Figure 191 Inner and Outer Glass Installation

v. Install the correct infill along the sidescreen channels and ensure that it is fitted centrally (Figure 192).

NOTE

If the sealing and locking of the window is to be effective, it is essential that all channel in-fills are correctly located and installed.

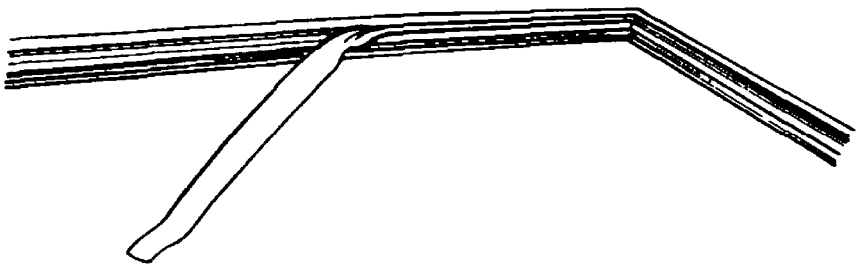


Figure 192 Sidescreen Seal Installation

w. Apply a bead of suitable sealer to the lower frame edge.

x. Fit the glasses complete with the removable rail into the frame (Figure 193). Ensure that the inner and outer glass are located in the correct channels.

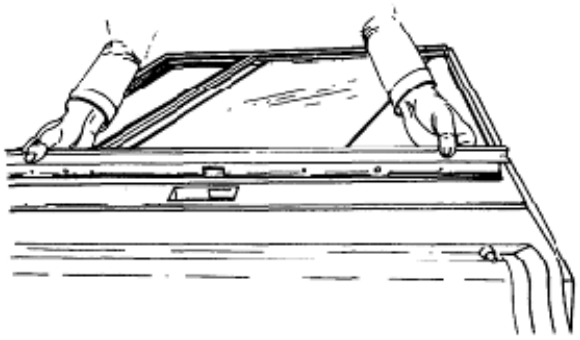


Figure 193 Removable Rail Installation

y. Align the screw holes, install the six screws and tighten them securely.

z. Insert the window lock into the aperture and secure it with the four screws.

aa. Check the operation of the window lock (rectify if necessary).

bb. Position the sidescreen with the lower edge uppermost.

cc. Place the rubber seal on the frame so that the cut-outs are facing the outside of the vehicle (Figure 194).

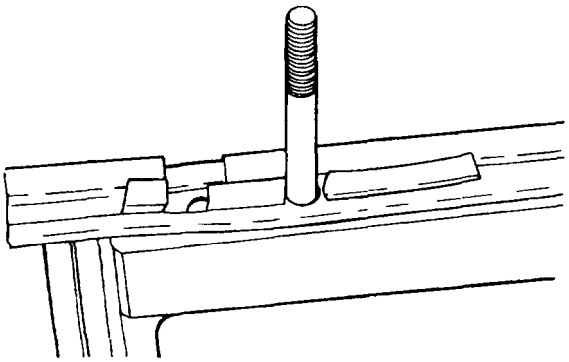


Figure 194 Sidescreen Lower Seal Installation

dd. Using a blunt instrument, force the rubber seal into the formed groove.

NOTE

It may be necessary to remove the studs when installing the rubber seal as they may inhibit seal installation.

CAUTION

Do not over tighten the studs as damage to the threads could result.

ee. If the studs have been removed, install and tighten the studs in the sidescreen.

ff. Position the sidescreen on the lower door.

gg. Install the nuts and washers and tighten them securely.

Wheel Arch Trim

322. Replacement. Replace the wheel arch trim as follows:

a. Using a suitable pin punch, remove the central plastic pin from each plastic rivet securing the trim to the wheel arch.

b. Pry the rivets from the holes and remove the trim from the wheel arch.

NOTE

The wheel arch trims are moulded with attaching holes around the mounting edge. These holes align with pre-drilled holes in the wheel arch.

c. Align the new trim attaching holes with the wheel arch holes and insert the plastic rivets.

d. Press in the central plastic pins to expand the rivets.

Floor Panels

323. Removal. Remove the floor panels as follows:

a. Remove the right and left side floor mats.

b. Loosen the two knurled knobs securing the fuse cover and remove the cover.

c. Carefully remove the rubberised transmission tunnel cover.

d. Unscrew both the gear lever and transfer lever knobs.

e. Release the plastic zip-clamp from around the gear lever rubber boot.

f. Slide the rubber boot off the gear levers.

g. Remove all the screws securing the floor panels and tunnel cover.

h. Remove the tunnel cover and the floor panels.

324. Installation. Install the floor panels as follows:

a. Install the floor panels and the tunnel cover and secure them with the screws.

b. Fit the rubber boot over the gear levers and secure it to the tunnel cover with the plastic zip-clamp.

c. Install the gear knobs.

d. Carefully install the rubberised transmission tunnel cover.

e. Install the fuse cover and secure it with the knurled knobs.

f. Install the floor mats.

Floor Mats

325. Replacement. Replace the floor mats as follows:

a. Remove the floor mats.

b. Using the existing mats as a template, lay the floor mat on the rubber mat, NSN5905-66-065-3220 and mark out the lower section from the fold of the mat downwards (Figure 195).

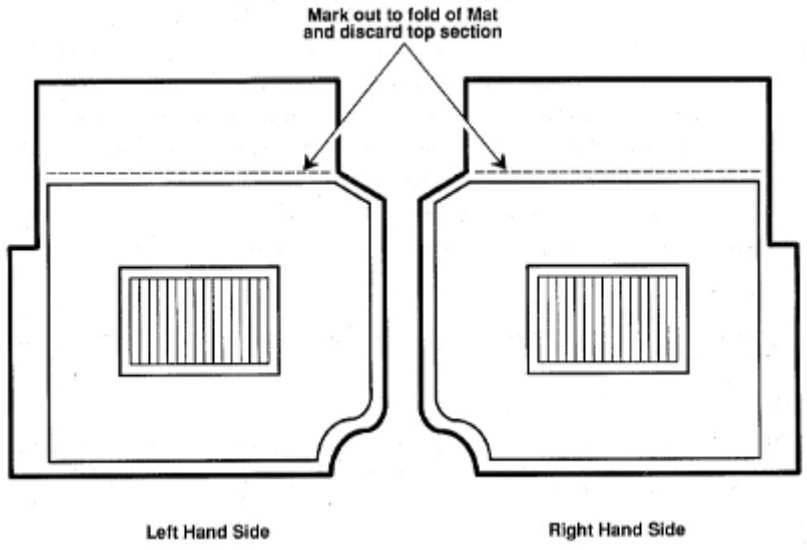


Figure 195 Floor Mats

c. Cut out the new mat, minus the top folded section.

d. Fit the new mats into the vehicle.

NOTE

At this stage, you may have to trim the edges of the new mat, to ensure a good fit.

e. Remove the two Phillips head screws on the outside edge of the floor.

f. Mark the rubber mats in relation to the screw holes and drill holes in the mats where marked.

g. Secure the floor mats to the floor using the Phillip head screws previously removed.

CAB HEATING/COOLING

Heater Assembly

326. Removal. Remove the heater assembly as follows:

a. Using a suitable container, drain the engine cooling system. Open the heater controls to allow the heater to be completely drained.

b. Remove the seven screws securing the ducting and grille to the left-front mudguard and remove the ducting.

c. Disconnect the securing clip and cable from the air directional control lever (Figure 196).

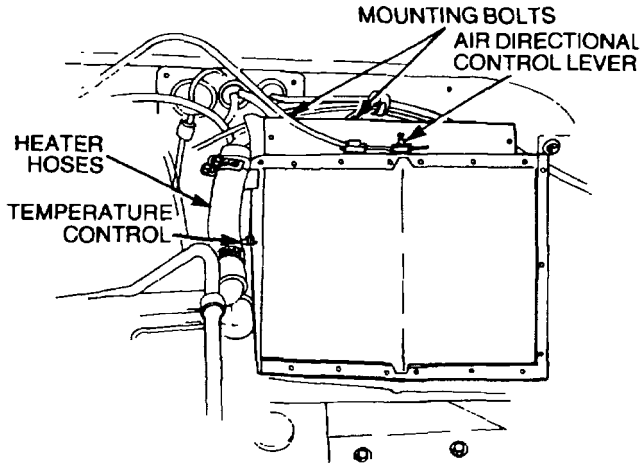


Figure 196 Heater Assembly Removal

d. Loosen the hose clamps securing the inlet and outlet hoses to the pipes and disconnect the hoses.

e. Disconnect the securing clip and cable from the temperature control lever.

f. Remove the two bolts securing the top of the heater assembly to the firewall.

g. Disconnect the wiring harness at the three-pin connector.

h. Remove the two bolts securing the lower mounting bracket to the firewall.

i. Remove the heater assembly.

327. Installation. Install the heater assembly as follows:

a. Position the heater assembly on the firewall.

b. Install the four mounting bolts and tighten them securely.

c. Install both the temperature and air directional cables and secure them with the clip and grub screw.

d. Ensure that when the dash mounted levers are operated, full travel is obtained at the heater assembly.

NOTE

Install Flexiform grommet material into the heater box around the heater pipes. Secure it in place with Silastic.

e. Install the inlet and outlet heater hoses and secure them with the hose clamps.

f. Refill the cooling system (Para 39).

g. Install the ducting and the mudguard grille and secure them with the seven screws.

Heater Motor and Fan Assembly

328. Replacement. Replace the heater motor and fan assembly as follows:

a. Remove the heater assembly (Para 326).

b. Remove the three nuts securing the fan housing to the heater box bracket.

c. Remove the four remaining nuts securing the fan assembly to the housing.

d. Remove the motor and fan assembly.

e. Remove the E-clip securing the fan to the motor shaft (Figure 197).

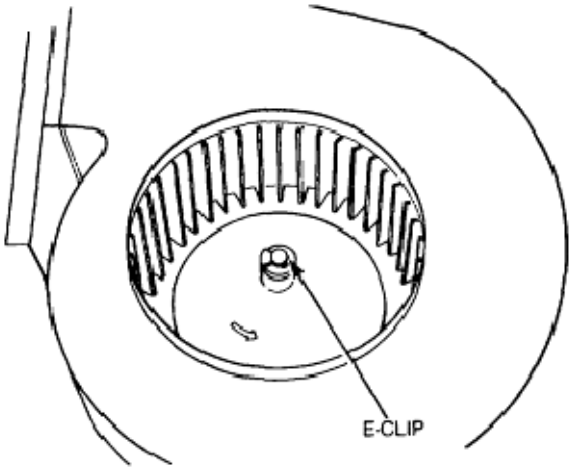


Figure 197 Heater Motor and Fan Removal

f. Withdraw the fan from the motor.

g. Install the new heater motor on the fan housing and install the fan.

h. Secure the fan to the shaft with the E-clip.

i. Install the motor and fan assembly on the housing and secure it with the four nuts.

j. Fit the fan housing to the heater box bracket and secure it with the three nuts.

k. Install the heater assembly (Para 327).

Heater Hoses

329. Replacement. Replace the heater hoses as follows:

a. Using a suitable container, drain the engine cooling system. Open the heater controls to allow the heater to be completely drained.

b. Loosen off the hose clamps and remove the hoses.

c. Install the new hoses and clamps ensuring that there are no twists or kinks in the hoses.

d. Tighten the clamps.

e. Refill the cooling system (Para 39).

Heater Controls

330. Removal. Remove the heater controls as follows:

a. Disconnect the battery.

b. Remove the screws securing the heater control knobs and withdraw the knobs.

c. Remove the four screws securing the instrument panel to the dash panel.

d. Ease the panel towards the steering wheel slightly.

e. Remove the two screws securing the end panel to the fascia.

f. Ease the end panel complete with control levers away from the fascia.

g. Remove the two screws securing the heater control assembly to the end cover and remove the end panel (Figure 198).

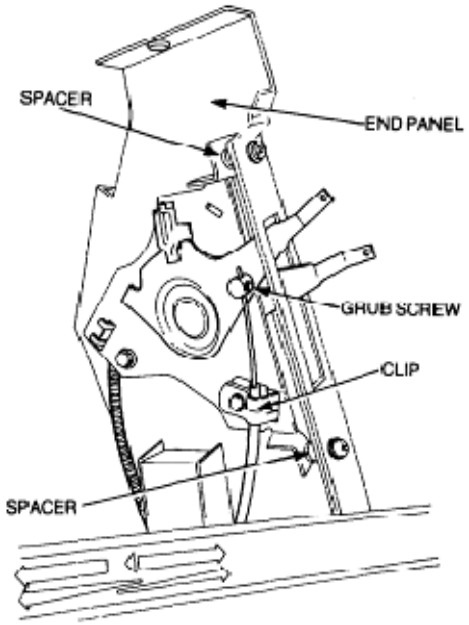


Figure 198 Heater Control Removal

NOTE

There are two spacers installed between the control lever assembly and the end panel.

h. Loosen the grub screws securing the cables to the levers.

i. Tag the cables.

j. Remove the spring clip retaining the outer cables to the control and remove the control.

331. Installation. Install the heater controls as follows:

a. Position the cables on the control ensuring that the temperature control cable is connected to the lever nearest the instruments.

b. Install the spring clips.

c. Insert the inner cables through their respective levers and tighten the grub screws.

d. Operate the levers and check that the levers on the heater assembly operate accordingly.

e. Install the end panel.

f. Ensure that the two spacers are fitted and secure the panel to the control with the two screws.

g. Install the end panel to the fascia and secure it with the two screws.

h. Fit the instrument panel and secure it with the four screws.

i. Install the heater control knobs and secure them with the two screws.

j. Reconnect the battery.

Air Distribution Flaps and Hoses

332. Removal. Remove the air distribution flaps and hoses as follows:

a. Remove the two screws securing the top cover to the dash panel.

b. Remove the two screws securing the fascia plate and switch mounting bracket to the dash panel.

c. Remove the screws securing the lower fascia.

d. Carefully lower the fascia while disconnecting the duct hoses from the grommets.

e. Remove the nineteen screws that secure the distribution flap cover panel to the lower fascia.

f. Disconnect the nipple securing the inner cable to the flap.

g. Remove the flap assembly from the clamp bracket (Figure 199).

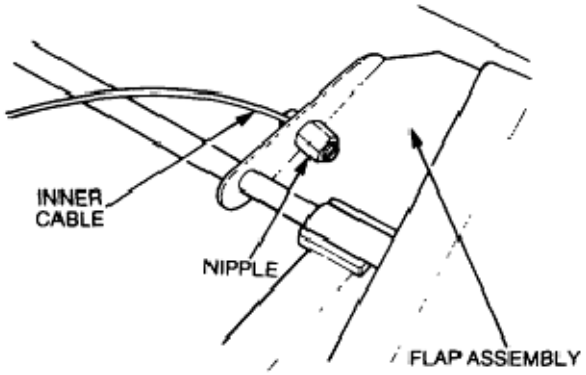


Figure 199 Air Distribution Flap Removal

h. Remove the plastic ducting hoses from the demister ducts.

333. Installation. Install the air distribution flaps and hoses as follows:

a. Install the flap assembly into the clamp bracket.

b. Insert the operating cable through the flap cover panel and into the nipple.

c. Ensure that the flap closes fully and secure the inner cable.

d. Secure the cover panel with the nineteen screws.

e. Install the demister hoses into the grommets.

f. Secure the lower fascia to the firewall and dash panel with the screws.

g. Fit the mounting bracket and the switch fascia plate to the dash panel and secure them with the two screws.

h. Install the switch top cover and secure it with the two screws.

WINCH

Winch Rope

334. Removal. Remove the winch rope as follows:

WARNING

Always wear industrial gloves when handling steel wire rope. When winching, do not use the hands to guide the rope on or off the drum.

a. Place the winch dog-clutch handle in the disengaged (vertical) position.

b. Release the winch rope from the travelling position.

c. Free spool the rope from the winch.

d. Using an Allen key, remove the grub screw securing the end of the rope to the drum.

e. Withdraw the rope from the vehicle.

335. Cleaning and Inspection. Clean and inspect the winch rope as follows:

a. Check the rope for kinks, heavy rust, fraying or excessive wear.

b. Replace the rope if any of these conditions are found.

c. Brush the rope to remove dirt and light rust.

d. Clean thoroughly in accordance with EMEI Vehicle G 109.

336. Installation. Install the winch rope as follows:

a. Feed the end of the rope through the rollers and sheaves and reconnect it to the drum.

CAUTION

Ensure that the rope is securely locked to the drum.

b. Install and tighten the grub screw.

c. Lay the rope out in front of the vehicle.

d. Connect the end to a suitably weighted object which will keep tension on the rope as it is winched in.

e. Start the engine and select neutral on the transfer case lever.

f. Place the winch dog-clutch handle in the engaged position.

g. Rotate the drum by hand until the dog clutch engages.

h. Depress the vehicle clutch.

i. Engage low gear on the main gear lever and pull out the PTO handle.

j. Slowly release the vehicle clutch to take up the slack in the rope.

k. Apply Rocol wire rope lubricant to the rope as it is winched in.

l. Wipe any excess grease from the rollers and sheaves.

m. Ensure that the rope lays on the drum evenly and avoid sharp crossovers.

n. When the rope end nears the rollers, depress the clutch and return the main gear lever to neutral.

o. Push in the PTO handle and select high on the transfer case lever.

p. Switch off the engine and disengage the PTO handle.

q. Secure the rope to the towing eyes with the chain.

Front Fairlead Roller Assembly

337. Removal. Remove the roller assembly as follows:

NOTE

Feed the chain and rope back through the rollers and secure them out of the way. This allows easy access and prevents the rope fouling the fairlead frame while it is being removed.

a. Remove the nuts and washers from the mounting bolts (Figure 200).

b. Remove the bolts that screw into the winch housing.

c. Support the winch by using a suitable axle stand.

d. With the weight of the winch supported on the remaining bolts and axle stand, remove the fairlead frame from the vehicle.

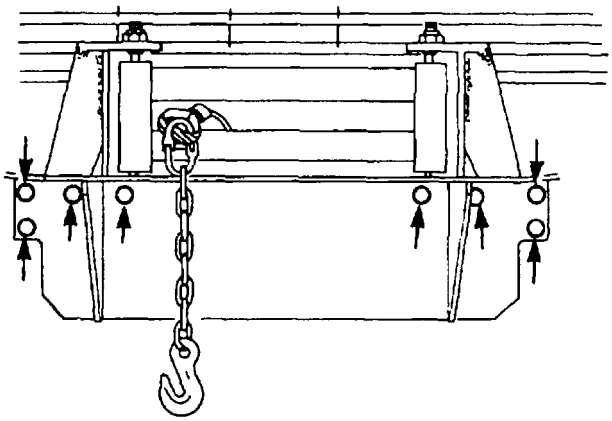


Figure 200 Front Fairlead Removal

338. Disassembly. Disassemble the roller assembly as follows:

a. Using an open-ended spanner, secure the square-headed end of the roller shaft.

b. Remove the nut and flat washer from the opposite end.

c. Withdraw the roller shaft and remove the roller from the frame.

d. Repeat the procedure for the remaining three rollers.

339. Cleaning and Inspection. Clean and inspect the roller assembly as follows:

a. Thoroughly clean the rollers and roller shaft in a suitable cleaning agent to remove all trace of grease and dirt.

b. Inspect the rollers for cracks and signs of binding on the shafts (replace if necessary).

340. Reassembly. Reassemble the roller assembly as follows:

a. Position the rollers in the frame and insert the roller shafts.

b. Install the flat washers and new locknuts. Tighten the locknuts to 190 N.m (140 lbf.ft).

c. Ensure that the rollers revolve freely and without drag.

341. Installation. Install the roller assembly as follows:

a. Position the fairlead frame on the chassis frame.

b. Install the mounting bolts and nuts. Tighten the nuts to 77 N.m (57 lbf.ft).

c. Feed the chain and rope back through the rollers and secure the chain.

Winch Driveline

342. Removal. Remove the winch driveline as follows:

a. Ensure that the winch and PTO are disengaged.

b. Remove the four bolts and lock-washers securing the shaft flange to the PTO (Figure 201). Discard the lock-washers.

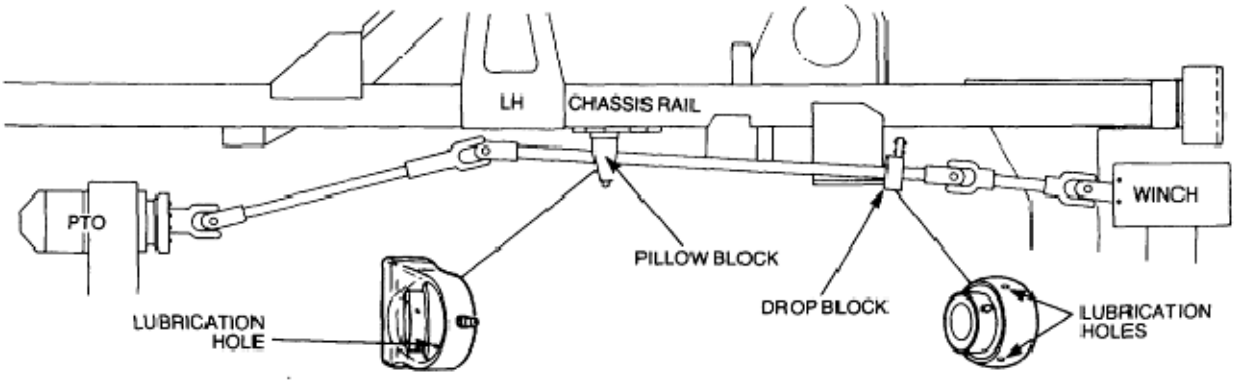


Figure 201 Winch Driveline

c. Remove the two nuts, flat washers and lock washers securing the pillow block to the chassis bracket. Discard the lock-washers.

d. Remove the three bolts and lock-washers securing the drop block to the chassis bracket (Figure 201). Discard the lock-washers.

e. Loosen the Allen screw securing the universal joint yoke to the winch.

NOTE

A soft-faced hammer may be required to tap the universal joint yoke away from the winch input shaft.

f. Remove the winch driveline from the vehicle taking care not to lose the lock-key fitted to the winch input shaft.

343. Installation. Install the winch driveline as follows:

CAUTION

The winch driveline components are not interchangeable between Land Rover 4x4 and 6x6 vehicles.

a. Position the winch driveline over the cross-member and steering damper ensuring that the flanged universal joint is towards the PTO.

b. Ensure that the lock-key is fitted to the winch input shaft.

c. Align the universal joint with the lock-key and push the joint onto the shaft.

d. Tighten the grub screw securely.

e. Fit the flange onto the PTO shaft.

f. Using new lock-washers install the bolts and tighten them to 61 N.m (45 lbf.ft).

NOTE

The drop and pillow bearing block positions may be altered as necessary by loosening the Allen screw on either the blocks or universal joints.

g. Position the drop block on the mounting bracket and install the three bolts and new lock-washers (Figure 202).

h. Install the three nuts and tighten them securely.

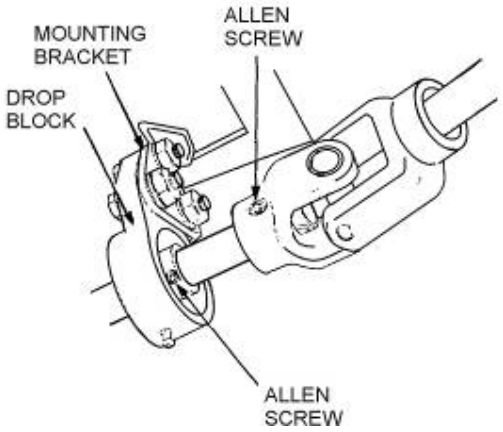


Figure 202 Drop Block Installation

i. Position the pillow block on the mounting bracket bolts (Figure 203).

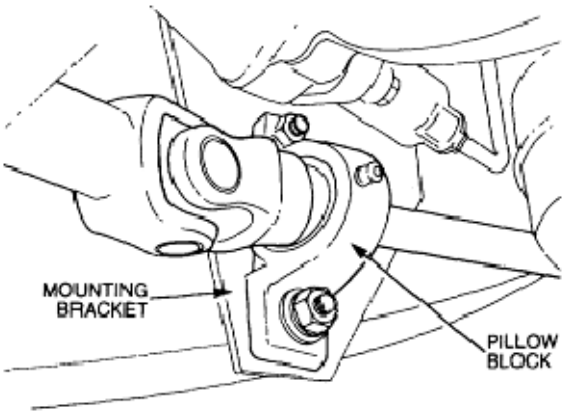


Figure 203 Pillow Block Installation

j. Install the flat washers and new lock-washers.

k. Install the two nuts and tighten them securely.

l. Lubricate the winch driveline with grease.

m. Start the engine, engage the PTO and check that the shafts turn smoothly without vibration.

Winch Driveline Support Bearing

344. Removal. Remove the support bearing as follows:

a. Remove the winch driveline (Para 342).

NOTE

A soft-faced hammer may be required to tap the universal joint away from the centre shaft.

b. Loosen the Allen screws securing the universal joints to the centre shaft.

c. Remove the joints from the shafts taking care not to lose the keys.

d. Loosen the Allen screws securing the drop block or pillow block to the shaft (depending on which block is to be replaced) and withdraw the bearing block.

e. Secure the bearing housing in a vice.

f. Using a suitable screwdriver inserted through the centre of the bearing, turn the bearing through 90 degrees to the housing and remove it from the housing.

345. Installation. Install the support bearing as follows:

a. Secure the bearing housing in a vice and insert the new bearing into the housing ensuring that the two lubrication holes in the bearing outer align with the lubrication groove in the housing (Figure 201).

NOTE

The lubrication holes and the groove are offset from the centre of the bearing and housing. The holes in the bearing must also be positioned equally either side of one of the two grooves in the housing.

b. With the bearing correctly positioned in the housing, rotate the bearing through 90 degrees, ensuring that the bearing is fully installed in the housing.

c. Fit the bearing block on the shaft but do not tighten the Allen screw until the driveline is in position on the vehicle.

d. Install the key.

e. Install the universal joints on the centre shaft and tighten the Allen screws.

f. Install the winch driveline (Para 199)

g. Tighten the pillow and drop block bearing Allen screw securely ensuring there is sufficient clearance between the universal joints and bearings.

h. Lubricate the driveline with grease.

Winch Driveline Inspection

346. Procedure. Inspect the winch driveline as follows:

a. Check that all universal joint circlips are correctly installed.

b. Check that the grease nipple functions correctly (replace as necessary).

c. Check that the universal joint grease seals are not damaged (replace as necessary).

d. Inspect the winch driveline for excessive axial play (replace as necessary).

e. Check all Allen/grub screws are in place and secure.

Winch System Specifications

347. The winch system specifications are detailed in Table 26.

Table 26 Winch System Specifications

Serial	Specification	Measurement
1	Fairlead roller shaft locknuts	190 N.m (140 lbf.ft)
2	Fairlead frame mounting bolts and nuts	77 N.m (57 lbf.ft)
3	Winch driveline flange to PTO	61 N.m (45 lbf.ft)

ROAD TEST

348. Carry out a road test in accordance with EMEI Vehicle G 188.

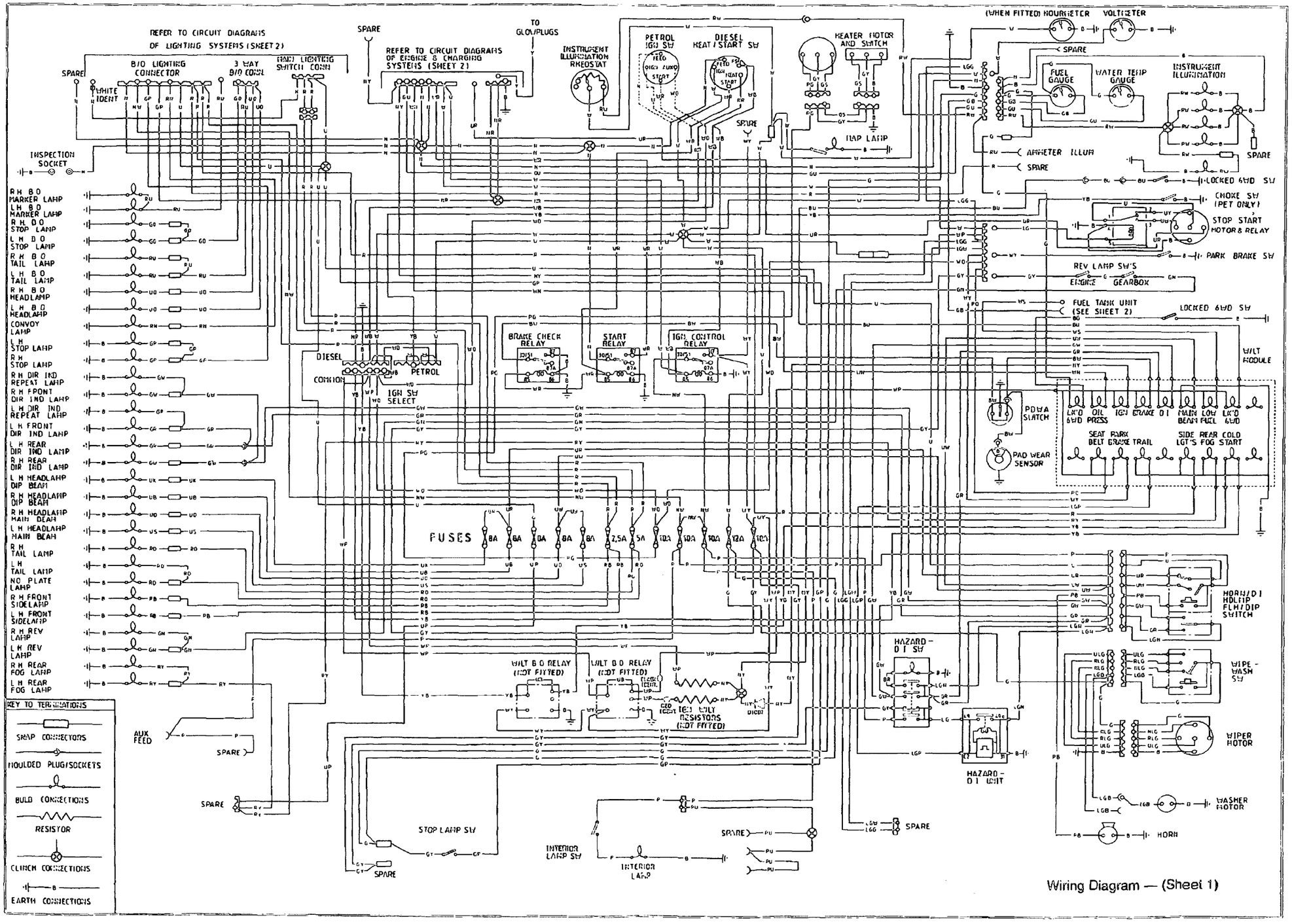


Figure 210 Wiring Diagram (Sheet 1 of 3)

Blank Page

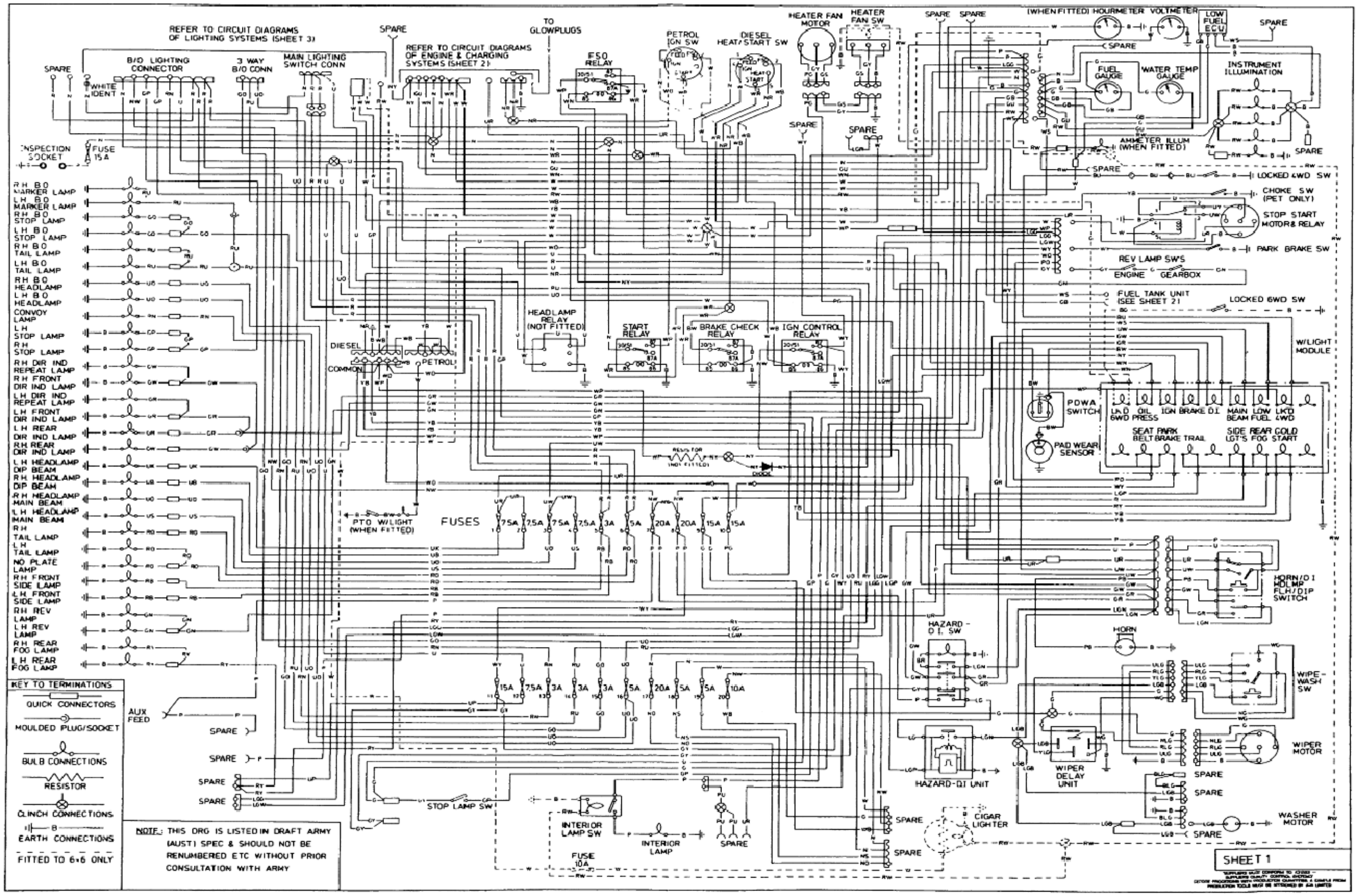


Figure 210 Wiring Diagram (Sheet 2 of 3)

Blank Page

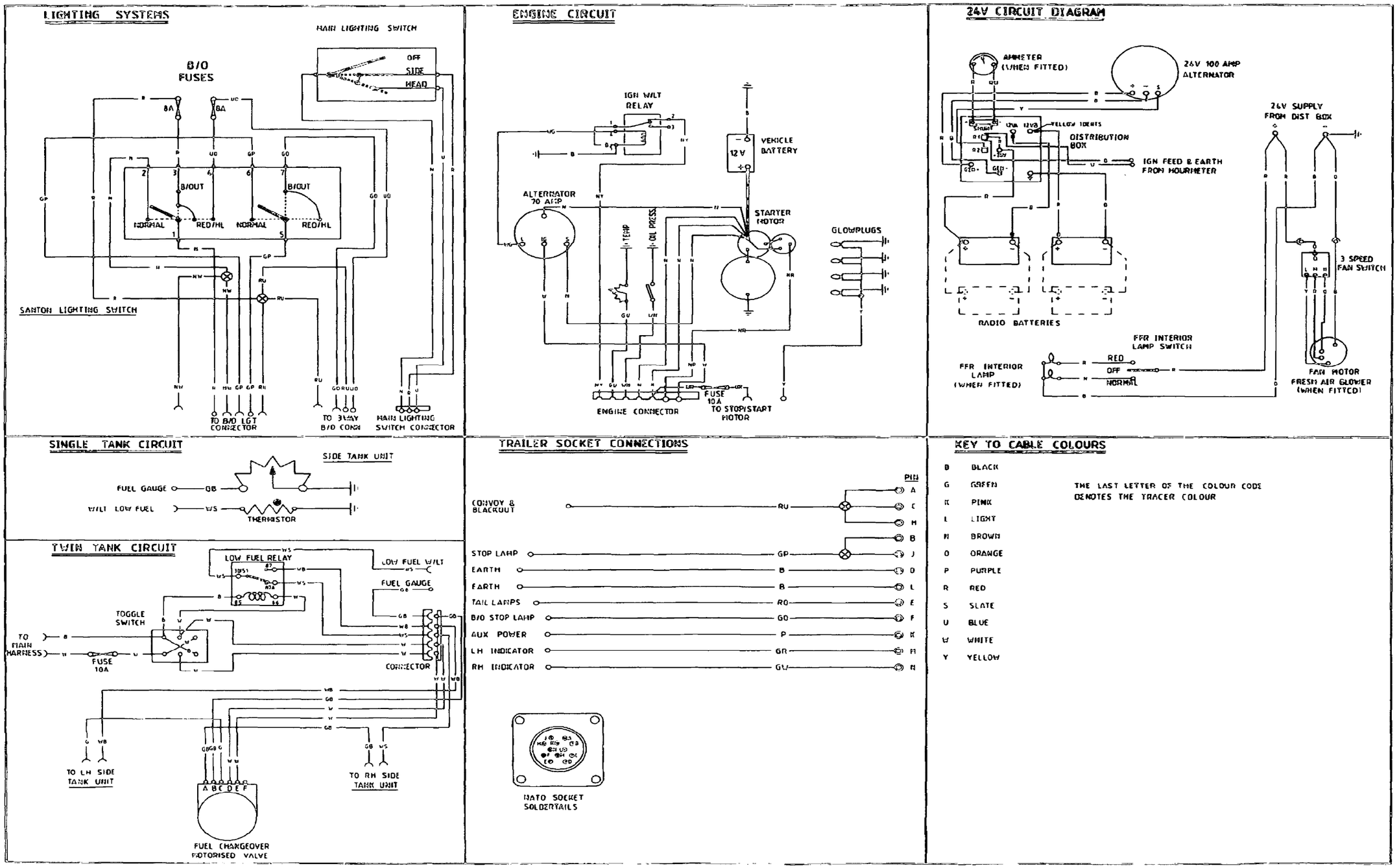


Figure 204 Wiring Diagram (Sheet 3 of 3)

END

Distribution List: **VEH G 16.0 – Code 2** (Maint Level)
(Sponsor: CGSVSPO, Light B Vehicles)
(Authority: EC-006632)