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

HEAVY GRADE REPAIR

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

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INTRODUCTION

1. This EMEI contains procedures for removing, dismantling, repairing, assembling and installing various components of the Truck, Utility, Lightweight including winch variants. Where applicable, instructions for the adjustment, lubrication and minor servicing of these items are included. This EMEI should be read in conjunction with the latest issue of EMEI Vehicle G 103 and EMEI Vehicle G 104-1.

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 gaining slack and avoiding damage to connectors and fittings.

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

5. Use only those fuels and lubricants specified in the latest issue of the Servicing Instruction (EMEI Vehicle G 109), the User Handbook and this instruction when replenishing fuel or lubricants.

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

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

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 parts 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 WHSMnaual, 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. Defence Work Health and Safety Manual (WHSManual);

c. Electronic Supply Chain Manual (ESCM);

d. ChemAlert;

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

f. Complete Equipment Schedules (CES):

(1) SCES 12035 – Truck, Utility, Lightweight, MC2 - Land Rover 110:

(2) SCES 12037 – Truck, Utility, Lightweight, W/Winch, MC2 - Land Rover 110:

g. Block Scale 2406/31 Issue 1 – Special Tools for RAEME – B Vehicles – Truck Utility and Truck Light MC2 (Land Rover Model 110);

h. EMEI Vehicle G 100 Truck, Utility, Lightweight, MC2, Land Rover 110 – Data Summary;

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

j. EMEI Vehicle G 103 Truck, Utility, Lightweight, MC2, Land Rover 110 and Truck, Utility Lightweight, Winch, MC2, Land Rover 110 – Light Grade Repair;

k. EMEI Vehicle G 104-1 Truck, Utility, Lightweight, MC2, Land Rover 110 and Truck, Utility Lightweight, W/Winch, MC2, Land Rover 110 – Medium Grade Repair;

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

m. EMEI Vehicle G 188-1 – Truck, Lightweight and Truck, Light – All Types – Land Rover 110 4x4 and 6x6 – Suspension and Steering Inspection Procedure;

n. EMEI Workshop D 180 – Flaw Detection – Dye Penetrant (Colour Contrast) Testing – General Instruction;

o. EMEI Workshop D 701 – Painting of Army Equipment – Repair Policy for Equipment Painted in Polyurethane Paint – General Instruction;

p. EMEI Workshop E Series – Occupational Health and Safety;

q. Repair Parts Scale 02188;

r. Repair Parts Scale 02189 (W/Winch); and

s. AS/NZS 1554.1, Structural Steel Welding – Welding of Steel Structures. Section 6, Table 6.2.2 (SP).

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. 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 4x4 Cargo – 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 Instrument 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, All Types 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, All Types 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, Lightweight and Truck, Light All Types, Land Rover 110 4x4 and 6x6 – Rewiring Of 28 V 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 and Truck, Light All Types, Land Rover 110 4x4 and 6x6 – Conversion From Oil Filled To Grease Filled Swivel Pin Holdings;

r. EMEI Vehicle G 188 Truck, Lightweight and Truck, Light All Types, Land Rover 110 4x4 and 6x6 – Inspection Guidelines;

s. EMEI Vehicle G 188-1 Truck, Lightweight and Truck, Light All Types, Land Rover 110 4x4 and 6x6 – Suspension and Steering Inspection Procedure;

t. EMEI Vehicle G 189-11 Truck, Lightweight and Truck, Light All Types, Land Rover 110 4x4 and 6x6 – Reclamation Of Panhard Rod, Lower Link and Radius Arm Mounts;

u. EMEI Vehicle G 189-12 Truck, Lightweight and Truck, Light All Types, Land Rover 110 4x4 and 6x6 – Fitting of Speedi-sleeves;

v. EMEI Vehicle G 189-14 Truck, Lightweight and Truck, Light All Types, Land Rover 110 4x4 and 6x6 – Modification of Radius Arm Mounts on Front Axle Housing;

w. EMEI Vehicle G 189-15 Truck, Lightweight and Truck, Light, All Types Land Rover 110 4x4 and 6x6 – Chassis Repairs;

x. EMEI Vehicle G 189-17 Truck, Lightweight and Truck, Light, All Types Land Rover 110 4x4 and 6x6 – Chassis Crack Inspection and Repair;

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

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

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

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

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

dd. 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;

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

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

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

hh. 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;

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

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

kk. EMEI Vehicle G 197-13 Truck, Lightweight, MC2, Land Rover 110 4x4 All Types – Fitting of Coil Spring Retainers;

ll. EMEI Vehicle G 197-14 Truck, Lightweight, MC2, Land Rover 110 4x4 All Types – Repair of Manual Steering Box Sector Shaft End Float; and

mm. EMEI Vehicle G 197-15 Truck, Lightweight, MC2, Land Rover 110 4x4 All Types – Fitting of a Windscreen Washer Nozzle Guard.

Location of Identification Numbers

13. The location of identification numbers on components of the vehicle are listed 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 the axle breather
7	Rear axle number	Adjacent to the axle breather

HEAVY GRADE REPAIR

Special Tools and Gauges

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 and cross-referenced in Figure 1.

NOTE

Items in Table 3 without an NSN were issued to units authorised to conduct Heavy Grade Repairs as part of the vehicle's introduction into service process.

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

Table 3 Special Tools

Serial	Manufacturer's Part No.	NSN	Item Name	Intended Use
1	5884000860		Puller	Removing timing gear
2	9852101410		Remover, Gear	Removing crankshaft gear
3	9852311690		Puller, Mechanical	Removing cylinder liner
4	9852325570		Attachment, Puller, Mechanical	Removing cylinder liner
5	9852325540		Inserter, Cylinder Liner	Installing cylinder liner
6	9852318180		Inserter and Remover	Removing camshaft bearings
7	9852200330	5120-66-128-4313	Inserter, Gear	Installing crankshaft drive gear
8	9852212510		Ring Compressor	Installing piston ring compressor
9	EYA 3737		Tool Kit, Seal Installation	Crankshaft rear oil seal installation
10	LRT-12-001	5120-99-820-6912	Clutch Centraliser	Installing clutch plate
11	18GA092	5120-66-128-4312	Inserter, Seal	Installing timing cover oil seal
12	LRT-12-216		Engine Lifting Sling	Engine lifting
13	9852100970			Water pump impeller removal
14	9852211400			Installing water pump shaft
15	157842-4420			Camshaft coupling tool
16	157944-8720			Mounting bracket base
17	157944-8520			Universal vice
18	157944-7820			Injection pump mounting bracket
19	157916-5420			Coupling spanner
20	157914-0100			Wrench for camshaft coupling nuts
21	157931-2500			Tappet holder
22	157915-0100			Wrench for governor flyweight nuts
23	157910-1120			Lever
24	157926-5110			Extractor for flyweight removal
25	157914-2400			12 mm socket
26	157921-0120		Tool, Compression, Return Spring	Tappet inserter
27	157931-6120			Clamp
28	157921-5620			Inserter
29	157914-0500			Wrench for delivery valve removal
30	105782-4200			Measuring device

Table 3 Special Tools (Continued)

Serial	Manufacturer's Part No.	NSN	Item Name	Intended Use
31	105782-6280			Dial indicator
32	105782-4330			Plunger pre-stroke measuring device
33	157954-3600			
34	105782-6170			Governor adjusting device
35	157976-3100			Control rack locking screw
36	157913-3620			Torque cam wrench
37	157926-5820			Timing device removal
38	LRT-99-002	5120-99-820-8044	Remover, Bearing	Hand press
39	LRT-37-001	5120-99-825-0835	Extractor	Adapter for bearing removal
40	18G1335	5120-99-725-6472	Puller, Mechanical	Reverse gear extractor
41	18G1388	5120-66-128-4344	Remover	Gear and spacer remover
42	LRT-99-004	5120-99-806-9013	Extractor Assembly	Impulse extractor
43	LRT-37-501	5120-99-825-0834	Extractor	Adapter for bearing cup removal
44	LRT-37-507	5120-99-725-6473	Inserter, Seal	Adapter for oil seal installation
45	LRT-99-003	5120-99-874-1715	Replacer, Bearing	Bearing and oil seal remover
46	18G134DG	5120-99-825-0833	Replacement Adapter Ring	Adapter for front cover oil seal
47	205-053	5120-66-128-4300	Wrench, Adjustable	Adjustable flange holding wrench
48	LRT-41-001	5120-99-825-0838	Extractor	Adapter for differential bearing
49	LRT-51-503	5120-99-825-0842	Axle Spreader	Axle casing spreader
50	18G131F	5120-99-825-0843	Adapter, Peg Set	Adapter pins for axle casing spreader
51	LRT-51-502	5120-99-825-1553	Extractor	Pinion bearing cup remover
52	LRT-51-500	5120-99-825-0840	Extractor	Adapter for pinion bearing removal
53	LRT-51-501	5120-99-825-0841	Extractor	Adapter for differential bearing removal
54	LRT-51-504	5120-99-825-0848	Differential Bearing Replacer	Adapter for differential bearing installation
55	LRT-99-502	5120-99-825-0846	Screw Press	Hand press
56	LRT-51-505	5120-99-825-0847	Replace Set	Adapter for pinion bearing installation
57	LRT-99-006	5220-66-128-4306	Gauge, Setting	Dial gauge
58	LRT-51-002	5120-66-128-4301	Replacer, Seal, Pinion	Pinion oil seal installation
59	LRT-54-505	5120-66-128-4325	Extractor, Cup, Pinion Bearing	Extractor for pinion bearing cups
60	LRT-54-502			Pinion head bearing removal
61	205-746			Adapter for pinion bearing cups
62	205-747		Extractor	Adapter for pinion bearing cups
63	LRT-54-503	5120-66-128-4326	Block, Pinion Setting	Pinion setting block
64	LRT-51-001	5120-66-128-4320	Inserter, Seal	Drift for pinion oil seal
65	9852314260		Spring Compressor	Removing valve springs
66	1852200010	5120-66-128-4340	Remover and Installer	Removing valve guides
67	LRT-57-018	5120-66-128-4304	Separator, Ball Joint	Ball joint separator
68	LRT-37-004	5120-99-725-6474	Adaptor, Removal	Adapter for transmission oil seal and oil feed ring removal and stub axle bush and oil feed ring removal
69	LRT-52-012		Remover, Drop arm, Hydraulic	Drop arm removal

Table 3 Special Tools (Continued)

70	LRT-57-017	5120-66-128-4336	Tool, Torque Set	Torque setting tool
71	1852210050	5120-66-128-4341	Inserter, Seal	Installing valve stem oil seals
72	9852100630		Puller	Removing crankshaft pulley

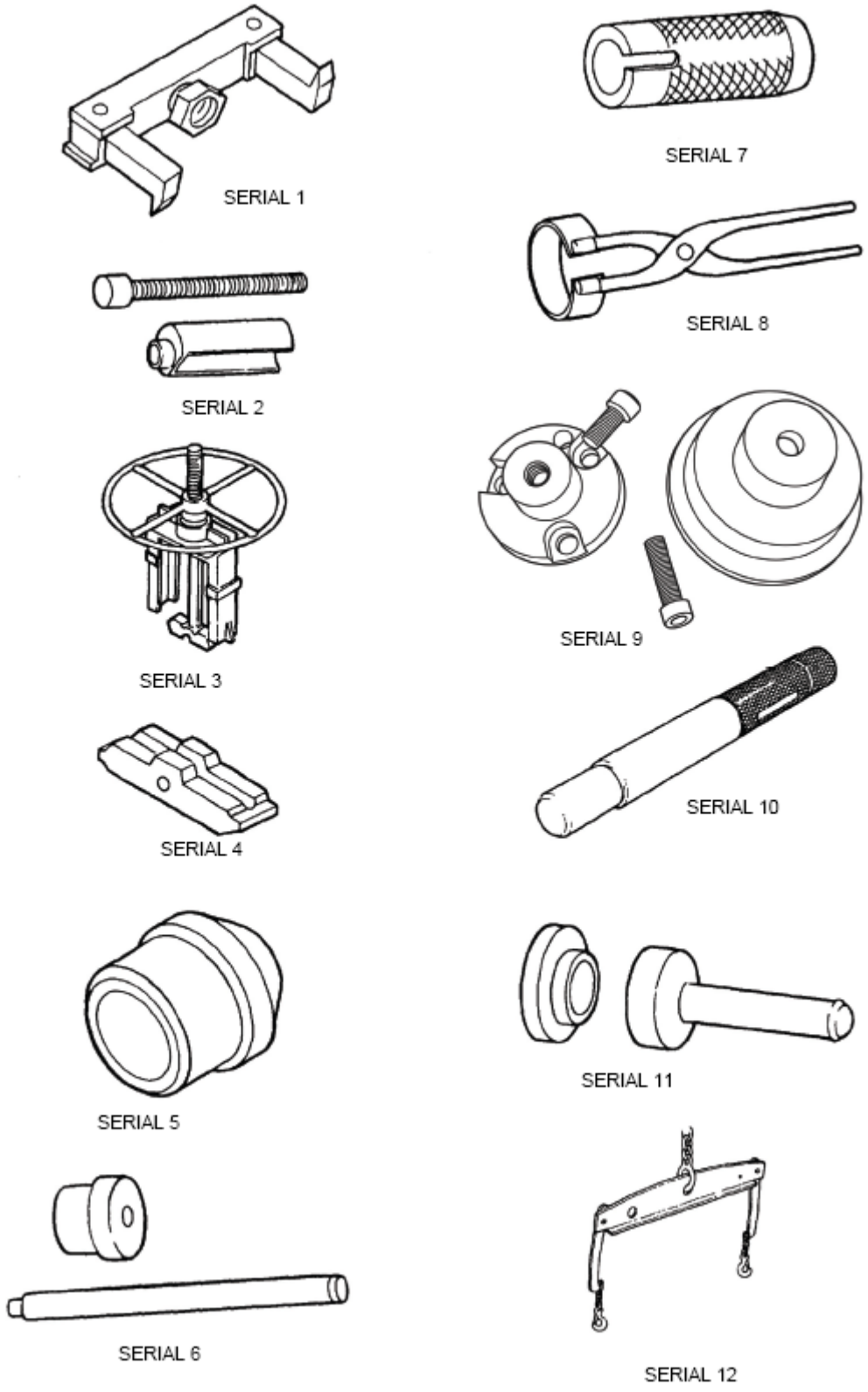
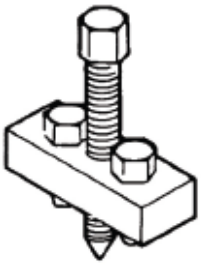


Figure 1 Special Tools (Sheet 1 of 6)



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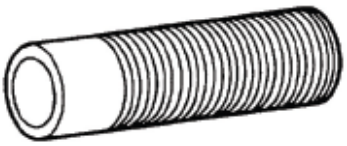

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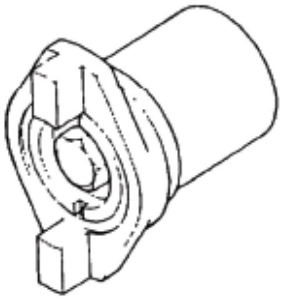

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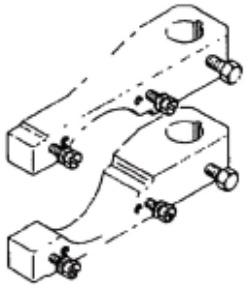

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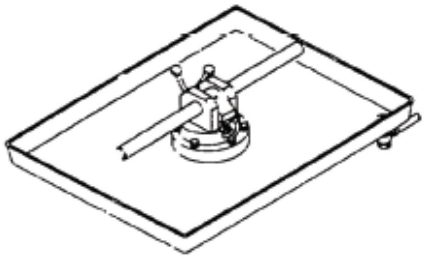

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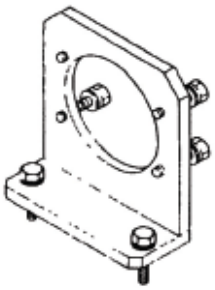

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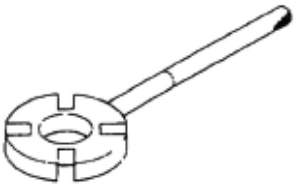

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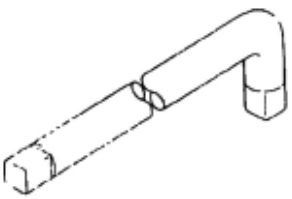

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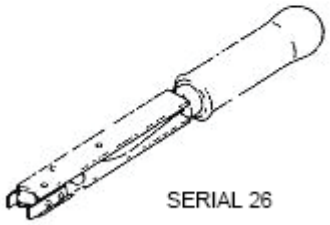
Figure 1 Special Tools (Sheet 2 of 6)

SERIAL 24

SERIAL 25



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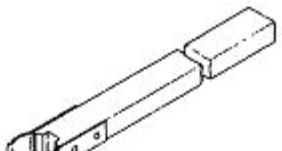

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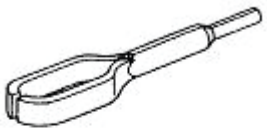

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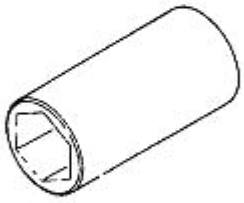

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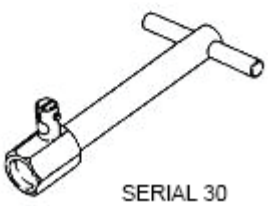

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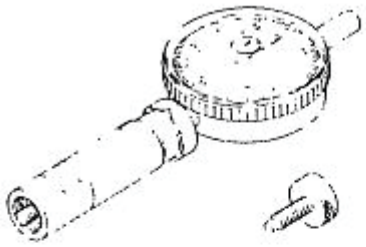

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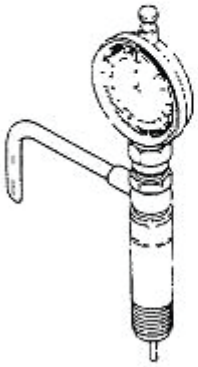

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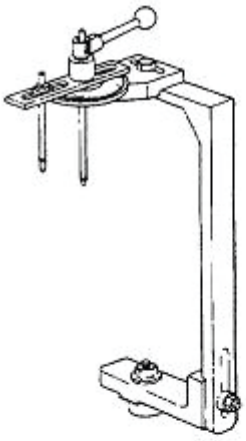

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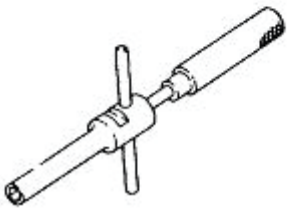

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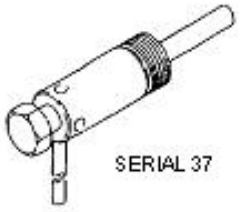
Figure 1 Special Tools (Sheet 3 of 6)



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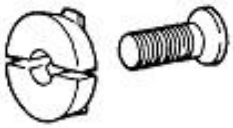

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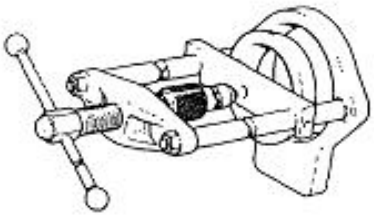

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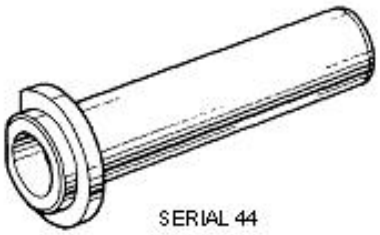

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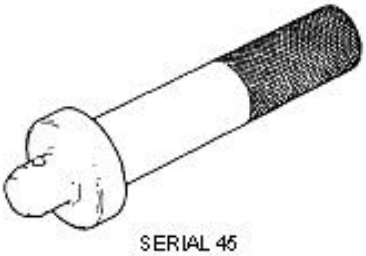

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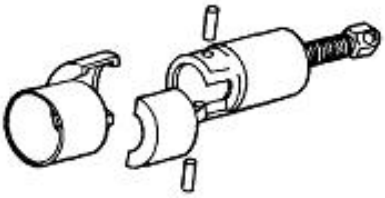

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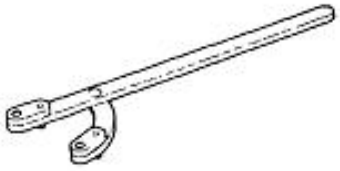

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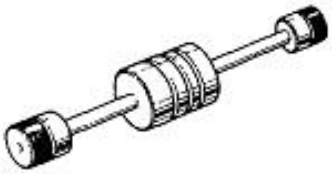

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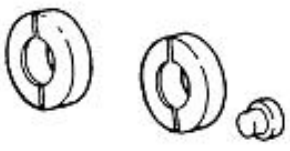
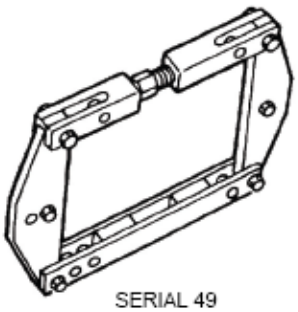


SERIAL 48

Figure 1 Special Tools (Sheet 4 of 6)



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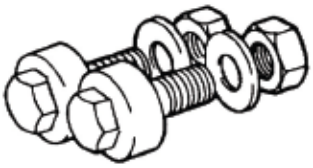

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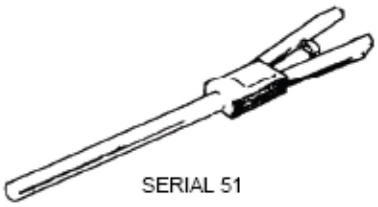

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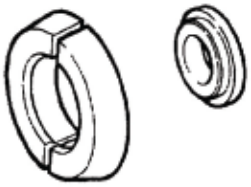

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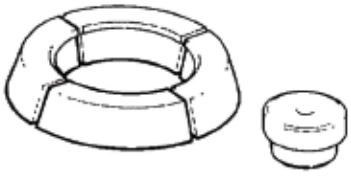

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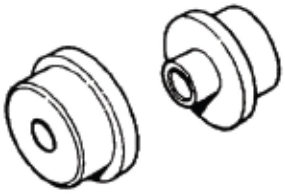

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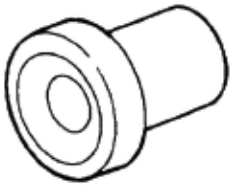

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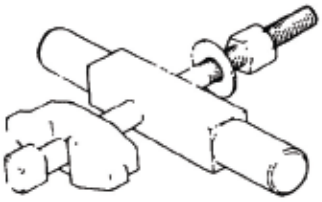

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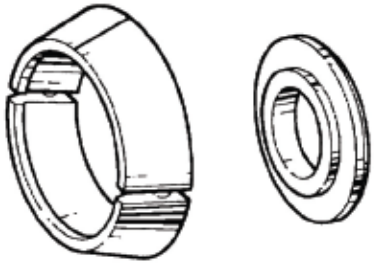
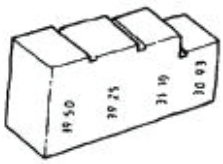


SERIAL 60

Figure 1 Special Tools (Sheet 5 of 6)

SERIAL 61

SERIAL 62



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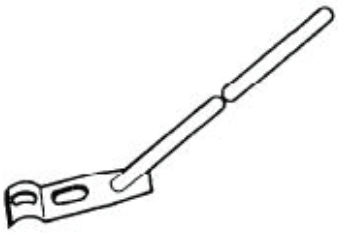

SERIAL 65

SERIAL 66

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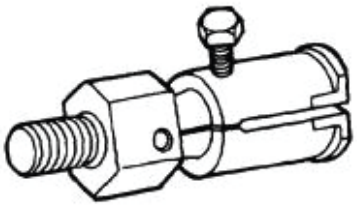

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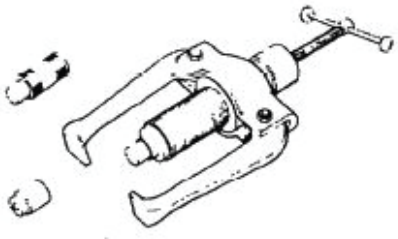

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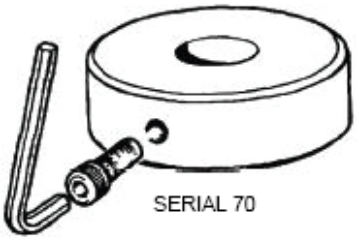

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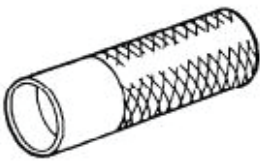

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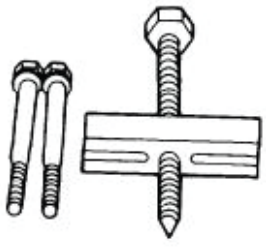

SERIAL 72

Figure 1 Special Tools (Sheet 6 of 6)

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

Table 4 List of Lubricants

Serial	Equipment	Lubricant	Capacity (Litres)
1	Engine (including filters)	SAE Grade 40 (OMD 115)	8.5
2	Transmission	SAE Grade 40 (OMD 115)	2.7
3	Transfer case (without PTO)	SAE Grade 40 (OMD 115)	3.2
4	Transfer case (with PTO)	SAE Grade 40 (OMD 115)	5.8
5	Front differential	OEP-220	1.7
6	Rear differential	OEP-220	2.3
7	Swivel pin housings	Molytex grease	EP00 Sachet
8	Brake master cylinder	OX-8	Fill to level
9	Clutch master cylinder	OX-8	Fill to level
10	Steering box	OEP-220	0.45
11	Wheel bearings	XG-291	As required
12	Winch	OEP-220	1.3
13	Radiator inhibitor	NALCOOL	1:12 Ratio (8% solution)

ENGINE

Cylinder Head

16. Overhaul. Overhaul the cylinder head as follows:

a. Remove the cylinder head in accordance with EMEI Vehicle G 104-1.

b. Install a spring compressor (Table 3, Serial 65) over a valve (Figure 2).

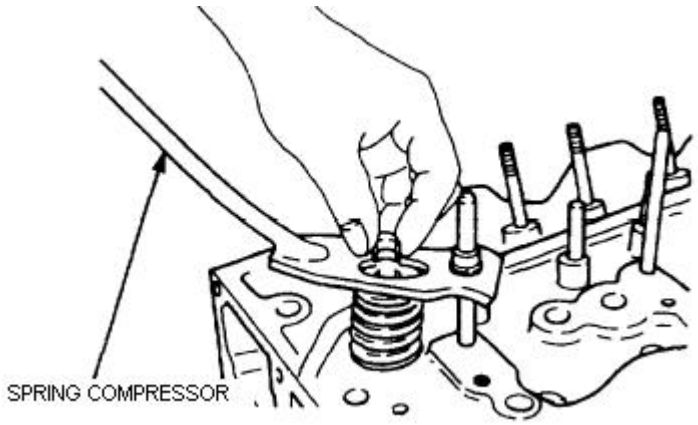

Figure 2 Valve Removal

NOTE

Match mark all components with the cylinder number on removal to ensure that the parts are reinstalled in the same cylinder during the reassembly.

c. Compress the valve springs and remove the two collets.

d. Remove the valve spring compressor.

e. Remove the spring retainer, the valve springs and the valve.

f. Mark the cylinder number on each part after removal to facilitate reassembly.

g. Repeat the procedure detailed in sub-paras b to f for each valve.

h. Clean the surface of the cylinder head with a suitable solvent and dry it.

i. Crack test the cylinder head using dye penetrant techniques as a minimum.

j. Check the cylinder head for distortion using a straight edge and a feeler gauge as shown in Figure 3.

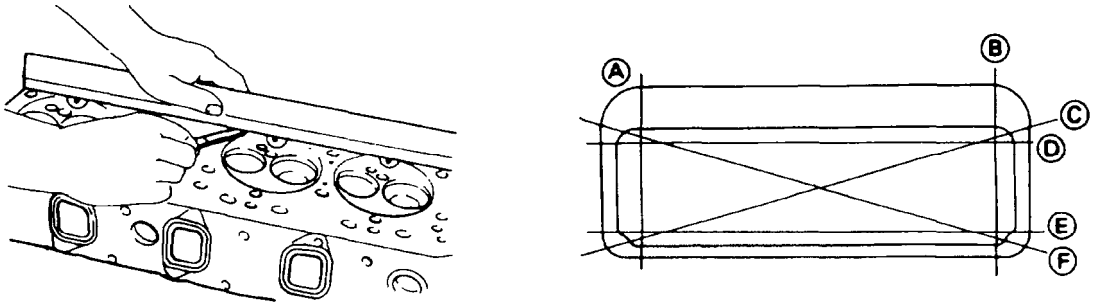

Figure 3 Checking the Cylinder Head Distortion

k. If the distortion exceeds 0.2 mm (0.008 in) the cylinder head will require machining.

l. Prior to machining the cylinder head, measure the thickness of the head with a micrometer. The standard thickness is 89.95 to 90.05 mm (3.541 to 3.545 in). The head may be machined a maximum of 0.3 mm (0.012 in) under the standard minimum thickness, i.e. down to 89.65 mm (3.530 in). If the head cannot be machined true by machining to the minimum thickness of 89.65 (3.530 in), replace the head.

m. Check the condition of all studs, clean the threads with an appropriate die and replace any stud found to be bent or damaged. Run an appropriate tap into all threaded holes to dress the threads.

CAUTION

When using a drill to remove small expansion plugs use care not to damage the cylinder head casting.

n. Remove all the expansion plugs.

NOTE

To replace the expansion plugs, pierce the plug with a sharp instrument, then prise the plug out. If necessary, use a drill ensuring the drill diameter does not exceed the outer diameter of the expansion plug.

o. Install new expansion plugs, ensuring they are correctly seated.

p. Check the valve contact width of the valve seat. If the contact width exceeds the 2.0 mm (0.079 in) limit, insert the valve which was originally positioned in the port, ensuring that the valve head thickness (Figure 4) is not less than 1.0 mm (0.039 in) and measure the amount of depression between the cylinder head surface and the head of the valve (Figure 5). The standard depression limit is 1.0 to 2.5 mm (0.039 to 0.084 in). If the depression is within these limits, carefully grind or cut the valve seat to obtain the correct contact width and recheck the amount of depression. If the depression exceeds 2.5 mm (0.084 in) or if cracks or surface imperfections are evident, replace the valve seat. Repeat this procedure for each valve seat.

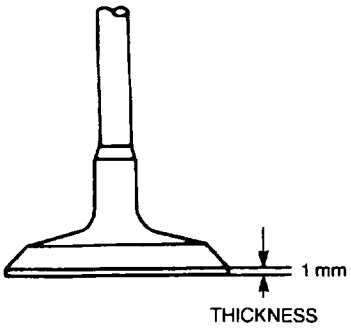

Figure 4 Measuring the Valve Head Thickness

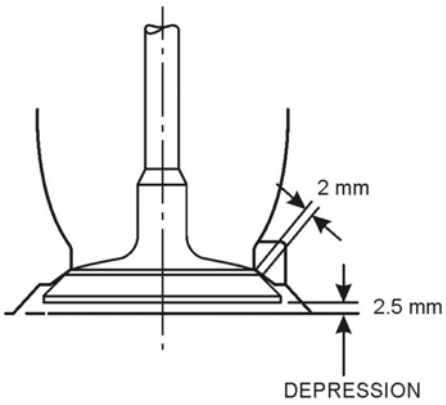

Figure 5 Measuring the Valve Depression

q. If valve seats are to be removed, run a bead of weld on the angled face of the valve seat (Figure 6). As the weld cools, it will cause the valve seat to shrink allowing it to be easily removed.

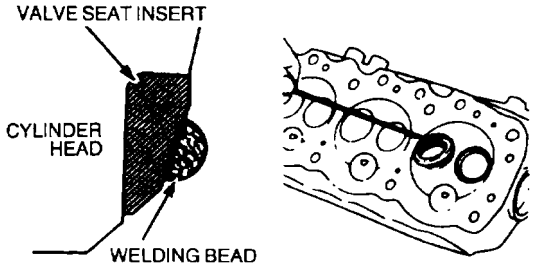

Figure 6 Removing the Valve Seat

NOTE

Chilling the valve seat insert will facilitate installation

r. Ensure that the valve seat insert recess is clean, then position the new valve seat insert over the recess and press it into place using a bench press. To assist with the installation of the valve seat insert, chill the insert.

s. Carefully grind the valve seat to an angle of 45 degrees, ensuring that the contact width of the seating face is 1.5 mm (0.059 in). Repeat this procedure for each valve seat.

t. Check the valve stems for wear by measuring the valve stem diameter in three places using a micrometer (Figure 7). The standard valve stem diameter limits are:

(1) inlet valve, 8.88 to 8.961 mm (0.350 to 0.353 in); and

(2) exhaust valve, 8.88 to 8.936 mm (0.350 to 0.352 in).

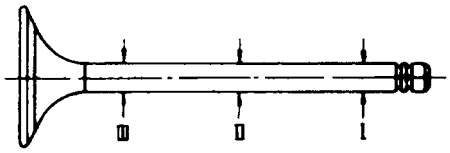

Figure 7 Valve Stem Measuring Points

u. Replace any valve where the stem diameter is worn below 8.88 mm (0.350 in).

v. Check the valve guides for wear by installing the valves in their respective guides (use new valves if the existing valves are unserviceable) and, using a dial indicator (Figure 8), measure the clearance by pushing the valve stem back and forth against the dial indicator plunger. Replace any valve guide if the clearance exceeds the following limits:

(1) inlet valve guides, 0.039 to 0.2 mm (0.0015 to 0.008 in); and

(2) exhaust valve guides, 0.064 to 0.25 mm (0.0025 to 0.010 in).

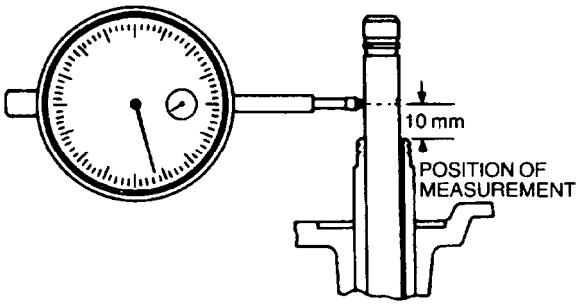

Figure 8 Measuring the Valve Guide Wear

NOTE

To assist with the installation of valve guides, chill the guides.

w. If the valve guides require replacement as determined in sub-para v, remove them using the remover and installer (Table 3, Serial 66) and a hammer. Position the replacement guide on the cylinder head and using the same tools, knock the guide into the head, leaving the guide protruding 13.9 to 14.3 mm (0.547 to 0.563 in) above the cylinder head.

x. Lap the valves to their respective seats, ensuring that both the valve and the seat are lapped in evenly. Remove the valves and wipe all traces of lapping compound from the valves, then clean the cylinder head thoroughly, ensuring that all cuttings and filings are removed and that the water jacket and oil galleries are clear of foreign matter.

y. Position new valve stem seals over the top of each valve guide and use a hammer and the seal inserter (Table 3, Serial 71) to install each seal (Figure 9).

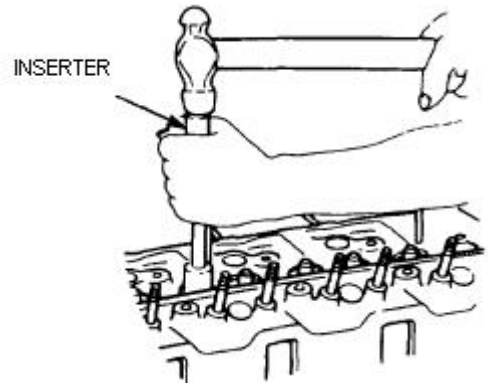

Figure 9 Installing the Valve Stem Oil Seal

z. Liberally coat the valve stems and guides with clean engine oil and install each valve into its respective port.

aa. Before installing the valve spring, check the condition of each spring. Check for cracks or damage and also check the free length, compression and inclination of the spring (Figure 10).

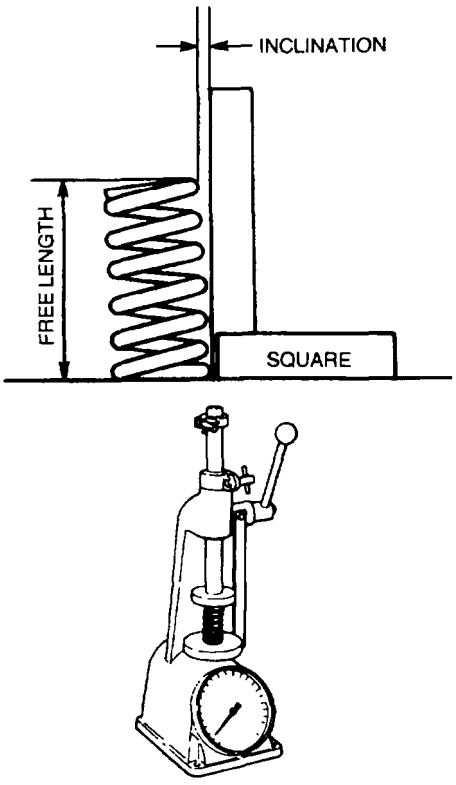

Figure 10 Checking Free Length, Inclination and Compression of the Valve Springs

bb. Replace any spring that is cracked or damaged or is outside the limits listed in Table 5.

Table 5 Valve Spring Tolerances

Free Length and Inclination			
		mm (in)	
Free length	Inner	50.0 to 52.4 (1.970 to 2.063)	
	Outer	50.65 to 53 65 (1.994 to 2.112)	
Inclination	Inner	—	1.0 (0.039)
	Outer	—	1.0 (0.039)
Compression Set Length and Force			
	Set length mm (in)	**kg (lb)**	
Inner	42.0 (1.65)	9.9 to 10.9 (21.83 to 24.03)	
Outer	44.0 (1.73)	20.0 to 23.0 (44.10 to 50.72)	

cc. Position the inner and outer springs over their respective valve with the tighter wound coils towards the cylinder head (Figure 11).

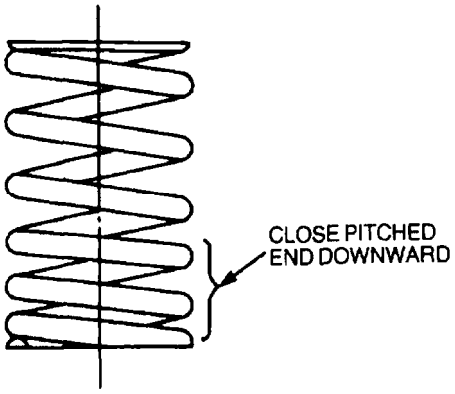

Figure 11 Valve Spring – Installed Position

dd. Install a valve spring retainer over the valve springs, then install a spring compressor (Table 3, Serial 65) and compress the valve springs. Install the two collets, ensuring that they are properly positioned and are correctly seated on the valve stem (Figure 12), then release the spring compressor. Repeat this procedure for each valve and spring assembly.

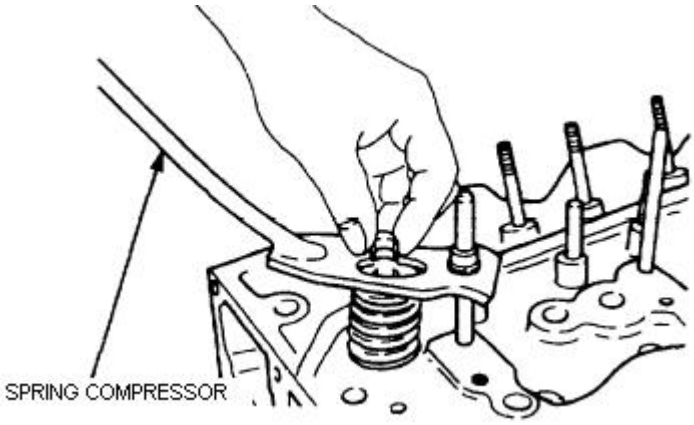

Figure 12 Installing the Valves

ee. Install the cylinder head in accordance with EMEI Vehicle G 104-1.

Engine

17. Disassembly. Disassemble the engine as follows:

WARNING

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a. Remove the engine in accordance with EMEI Vehicle G 104-1 and lower it to a firm horizontal surface with the lifting equipment used to remove the engine still supporting the majority of the engine's weight.

b. Remove the engine mounting brackets, position the engine in a universal engine overhaul stand and secure the engine to the stand. Remove the engine lifting equipment.

c. Inspect the engine mounts and replace them if they are cracked or damaged.

d. Remove the cylinder head in accordance with EMEI Vehicle G 104-1 and place it aside.

e. Position a suitable container beneath the engine, remove the drain plug from the oil pan, drain the oil from the engine and install the drain plug.

f. Position the container under the oil filter adapter, remove the drain plug from the adapter, drain the oil from the oil filter and reinstall the drain plug.

g. Remove the oil filter and the bolts securing the oil feed pipe to the oil cooler.

h. Remove the bolts securing the oil filter adapter to the engine and remove the adapter.

i. Disconnect the oil feed pipe from the injection pump and from the engine block. Plug the oil feed port in the injection pump to prevent the ingress of dust or dirt.

j. Remove the nut and washer securing the injection pump adapter to the rear mounting bracket.

k. Remove the bolts securing the mounting bracket to the engine and remove both the mounting bracket and the oil feed pipe from the engine (Figure 13).

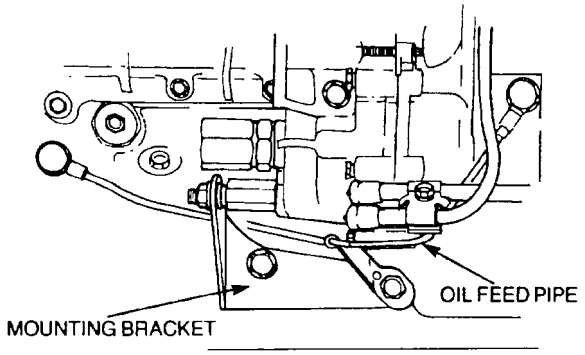

Figure 13 Removing the Injection Pump Rear Mounting Bracket

l. Remove the plug from the timing cover (Figure 14) and remove the bolts (one is accessed from the rear of the timing case below the injection pump) securing the injection pump to the timing case.

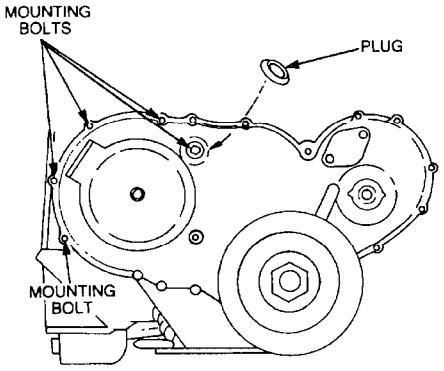

Figure 14 Removing the Injection Pump

m. Remove the injection pump from the engine, place a protective cover over the injection pump and place the pump aside.

n. Disconnect the vacuum pump oil feed and return hoses from the engine block.

o. Disconnect the vacuum hose from the vacuum pump.

p. Remove the alternator adjusting and mounting bolts and remove the alternator and fanbelt.

q. Remove the bolts securing the cooling fan to the water pump drive flange and remove the fan, spacer and drive pulley.

r. Disconnect the heater hose from the water pump.

s. Remove the bolts securing the water pump to the engine block and remove the water pump.

t. Remove the nuts and bolt securing the starter motor to the flywheel housing and remove the starter motor.

WARNING

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

u. Remove the clutch pressure plate and clutch plate by alternately loosening each of the bolts to prevent distortion of the pressure plate housing.

v. Lock the flywheel to prevent it from turning, then loosen the crankshaft pulley retaining nut.

w. Remove the bolts securing the flywheel to the crankshaft and remove the flywheel.

x. Remove the side cover plates from the left-hand side of the engine and discard the gaskets and bolt seals.

y. Remove the bolts securing the oil cooler to the engine block and remove the oil cooler. Remove and discard the gasket.

z. Remove the nut and washer securing the crankshaft pulley to the crankshaft, install the puller (Table 3, Serial 72) and remove the pulley.

aa. Remove the bolts securing the timing cover to the timing case and remove the cover. Remove and discard the oil seal.

bb. Remove all carbon deposits and/or ridging from the top of each cylinder.

cc. Invert the engine and remove the nuts and bolts securing the oil pan to the engine block.

dd. Remove the oil pan, supporting plates and the gaskets. Discard the gaskets.

ee. Return the engine to the upright position.

ff. Remove the bolts securing the oil feed pipe to the engine block.

gg. Remove the bolts securing the oil pump to the engine block and remove the oil pump.

hh. Remove the bolts and washers securing the flywheel housing to the engine block and remove the housing. Pry out and discard the oil seal.

ii. Remove the bearing caps from the connecting rods, ensuring that each bearing cap, connecting rod and piston are match marked with the relevant cylinder number and note the orientation of all items to facilitate correct reassembly.

jj. Remove each piston and connecting rod assembly by pushing the assembly out through the cylinders.

kk. Before further removal of components from the engine, check the following:

(1) Idle Gear End-play. Measure the idle gear end-play with a feeler gauge (Figure 15) and check that is within the standard limits of 0.058 to 0.2 mm (0.002 to 0.008 in).

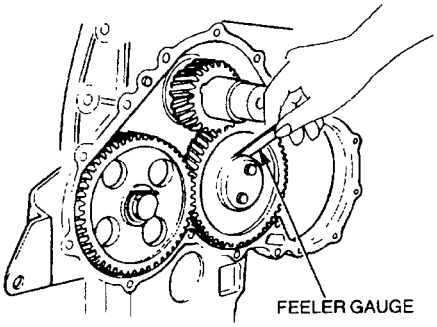

Figure 15 Checking the Idle Gear End-play

(2) Crankshaft, Idle and Camshaft Gear Backlash. Measure the backlash between the crankshaft, idle and camshaft gears using a dial indicator (Figure 16) and check that it is within the standard limits of 0.10 to 0.3 mm (0.004 to 0.012 in).

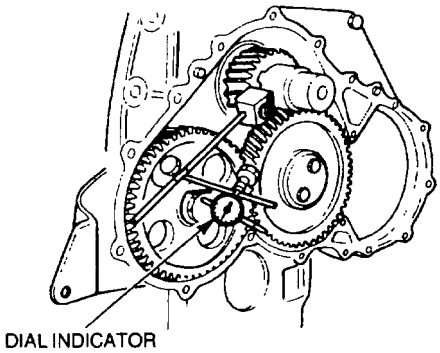

Figure 16 Checking the Timing Gear Backlash

(3) Crankshaft End-play. Measure the crankshaft end-play using a feeler gauge (Figure 17) and check that it is within the standard limits of 0.15 to 0.45mm (0.006 to 0.018 in).

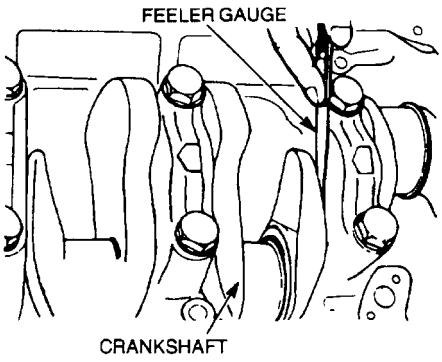

Figure 17 Checking the Crankshaft End-play

ll. Using the sequence shown in Figure 18, remove the crankshaft main bearing bolts, remove the bearing caps, ensuring that each bearing cap is numbered and with the aid of a suitable piece of wire push the thrust bearing out.

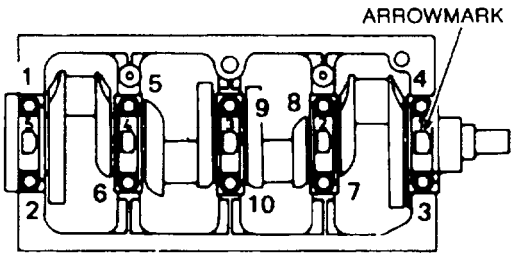

Figure 18 Main Bearing Bolt Removal Sequence

mm. Lift the camshaft followers from the camshaft lobes and support the followers in the raised position with suitable clips or tape, ensuring that there is sufficient clearance beneath them to remove the camshaft.

nn. Remove the oil pump cover from the left-hand side of the engine block and with an Allen key, remove the grub screw locating the thrust bearing.

oo. Remove the thrust bearing and the oil pump drive pinion.

pp. Rotate the camshaft drive gear to allow access to the camshaft thrust plate retaining bolts.

qq. Remove the thrust plate retaining bolts and carefully withdraw the camshaft from the engine block, ensuring that the camshaft lobes do not scratch or damage the camshaft bearings.

NOTE

Take care to prevent the camshaft followers dropping from the engine without restraint.

rr. Match mark or number the camshaft followers, to ensure correct location at installation, remove the device supporting the followers and remove the followers carefully to ensure they are not damaged. The camshaft followers will drop from the engine when the support is removed.

ss. Remove the bolts securing the idle gear thrust collar and shaft to the engine block and remove the idle gear assembly.

tt. Remove the bolts securing the timing case to the engine block and remove the timing case, remove and discard the gaskets and then lift the crankshaft from the engine.

uu. Remove all the expansion plugs and threaded plugs in the engine block.

18. Cleaning and Inspection. Clean and inspect the engine as follows:

WARNING

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a. Thoroughly clean the engine block and engine components with a recommended cleaning agent and blow them dry with compressed air.

b. Ensure all carbon deposits and gasket residues are removed and inspect the engine block for cracks, damage or wear. Repair or replace the engine block as necessary.

c. Inspect the camshaft followers for pitting, cracking or wear (Figure 19). If no fault is evident, measure the diameter of the follower with a micrometer (Figure 20). The standard diameter is 27.92 to 27.98 mm (1.100 to 1.1016 in). Replace any follower which is pitted, cracked or has irregular wear, or if the diameter is worn below 27.92 mm.

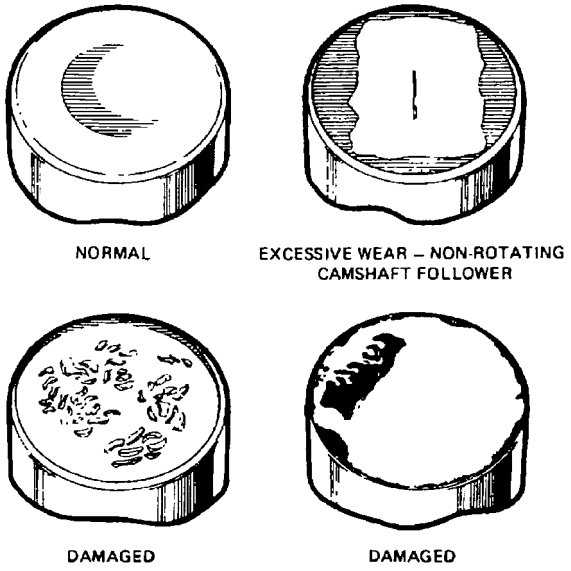


Figure 19 Camshaft Follower Wear Patterns

d. Measure a camshaft follower bore in the engine block with an internal micrometer (Figure 20) and subtract the diameter of the follower, removed from that bore (if the follower is serviceable), from the dimension found. The standard clearance is 0.02 to 0.1 mm (0.0008 to 0.0039 in). Repeat this procedure for each bore and camshaft follower. If camshaft followers need replacement, determine the clearance using a new follower. Replace the engine block if any bore exceeds the clearance limit.

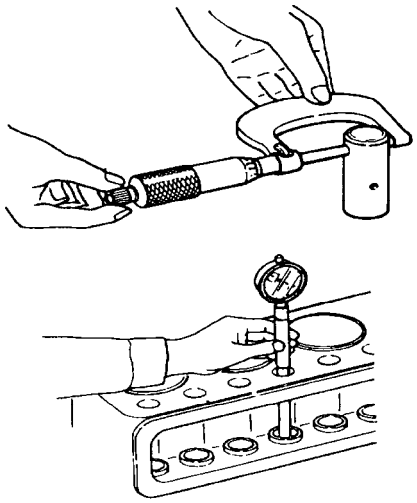


Figure 20 Measuring Camshaft Follower and Bore Wear

NOTE

Each cylinder liner and piston form a matched set and should not be interchanged.

e. Measure the bore of each cylinder liner by inserting an inside diameter micrometer 20 mm down into the cylinder bore. Take a reading from two points approximately 90 degrees apart (Figure 21). The standard bore diameter is 102.021 to 102.2 mm (4.0165 to 4.0236 in). Replace the cylinder liners if they are worn beyond this limit (Paras 19 and 20). Each cylinder liner and piston form a matched set and should not be interchanged. If a cylinder liner replacement is required, the respective piston must also be replaced.

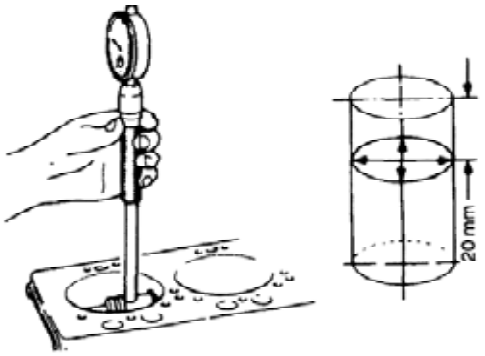


Figure 21 Measuring the Cylinder Bore

f. Position the camshaft in V-blocks, then with a micrometer, measure the diameter of the camshaft bearing journals (Figure 22). The standard diameter is 55.60 to 55.97 mm (2.189 to 2.2035 in). Position a dial indicator on the centre bearing and check the camshaft run-out. If the run-out exceeds 0.1 mm (0.0039 in) or journal wear is below the limit, replace the camshaft.

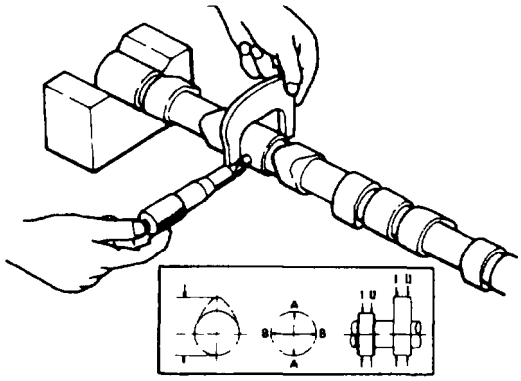


Figure 22 Measuring the Camshaft Bearing Journals

g. Using an internal micrometer, measure the internal diameter of the camshaft bearings (Figure 23). The standard diameter is 56.0 to 56.03 mm (2.2047 to 2.2059 in). If the camshaft is serviceable, subtract the camshaft bearing journal diameters from the internal diameters of the camshaft bearings. The standard clearance is 0.03 to 0.15 mm (0.0012 to 0.0059 in). If the clearance exceeds the limit, replace the camshaft bearings (Para 21 details the camshaft bearing removal procedure).

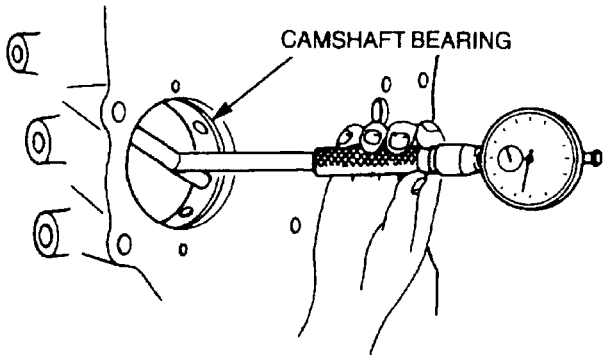


Figure 23 Measuring the Camshaft Bearings

h. Measure the height of the camshaft lobes with the micrometer. The standard height of the lobes is 47.71 mm (1.878 in) and the wear limit is 47.21 mm (1.839 in). Replace the camshaft if the lobes are worn below the limit

i. Check the camshaft oil pump drive gear. If the camshaft oil pump drive gear is cracked, damaged or excessively worn, replace the camshaft.

j. With a feeler gauge, measure the clearance between the camshaft number one bearing journal and the thrust plate. The standard clearance is 0.050 to 0.2 mm (0.002 to 0.0079 in).

k. If the thrust plate wear exceeds the limit or the timing gear backlash is excessive, clamp the camshaft securely in a soft-jawed vice and remove the timing gear retaining bolt. Using the puller (Table 3, Serial 1) remove the timing gear and the thrust plate from the camshaft. Install a new thrust plate and then install the timing gear using a bench press.

l. If the crankshaft gear backlash was excessive, remove the gear from the crankshaft using the gear remover (Table 3, Serial 2) and discard it.

m. Measure the crankshaft bearing journals with an external micrometer (Figure 24). The main bearing journal diameter limits are 79.932 to 79.944 mm (3.1469 to 3.1474 in). The connecting rod bearing journal limits are 63.942 to 63.944 mm (2.5174 to 2.5175 in). Check each journal for taper and/or ovality. Discard the crankshaft if the wear exceeds these limits.

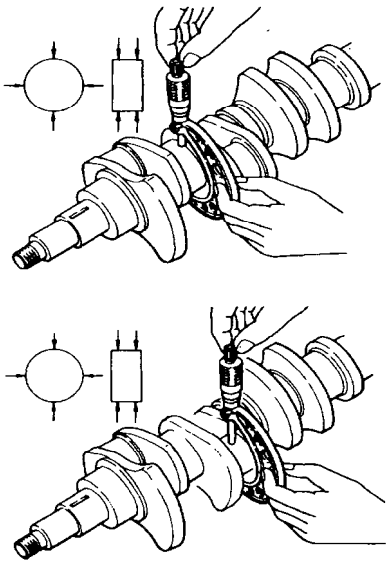


Figure 24 Measuring the Crankshaft Bearing Journals

n. Check the crankshaft for bend or run-out using a dial indicator positioned on the centre main bearing journal with the crankshaft cradled between V-blocks (Figure 25). The crankshaft should be supported on the main bearing journals at each end. Ensure that bearing journal wear is taken into consideration when measuring the run-out. Standard run-out is 0.05 mm (0.002 in) or less and the limit is 0.40 mm (0.016 in). If the run-out exceeds the limit, replace the crankshaft.

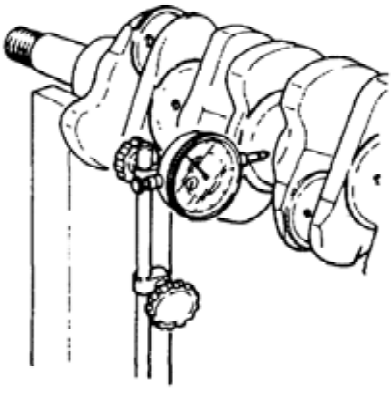


Figure 25 Measuring the Crankshaft Run-out

o. Inspect the crankshaft oil seal journals for any abrasion or scoring which may have been caused by previous oil seals. Carefully remove any burrs or rough areas with emery paper or a fine file. Thoroughly clean the crankshaft of any resulting filings or emery paper dust. If wear is greater than 0.1 mm deep or wide, fill the damaged area with Loctite 3805, per the manufacturer's instructions, to prevent oil seeping under the seal.

p. Before installing new bearings, check the bearing spread (Figure 26). The spread limit for main bearings is 85.0 mm (3.35 in) and for the connecting rod big-end 68.0 mm (2.68 in). Install each half of

each new bearing into its respective position and check that a slight pressure is required to seat the bearing. Replace the set if the bearings are not to specification.

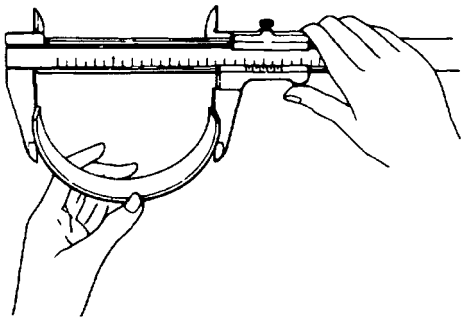


Figure 26 Measuring Bearing Spread

q. Install the main bearing caps, together with the bearings, onto the engine block, ensuring that they are seated squarely and in their correct location. Tighten the retaining bolts to 225 to 245 N.m (166 to 181 lbf.ft). Lubricate the bearing shells with clean engine oil and with an internal micrometer, measure the diameter of the bearings (Figure 27). The nominal diameter is 80.0 mm (3.15 in). Subtract the bearing journal diameter from the diameter of the corresponding bearing and check that the clearance falls within the standard limits of 0.039 to 0.11 mm (0.0015 to 0.0043 in). If the clearance exceeds the limit, replace the crankshaft. Remove the bolts, bearing caps and bearings and set them aside.

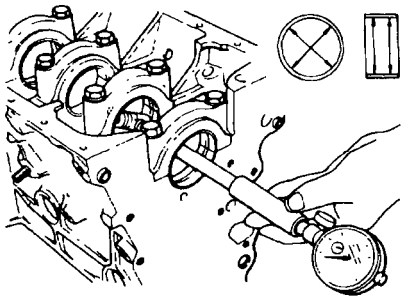


Figure 27 Measuring the Main Bearings

r. Install new bearings into the connecting rod big-end and the big-end cap. Assemble the cap to the connecting rod and tighten the bolts to 39 N.m (29 lbf.ft), then tighten each bolt a further 60 to 90 degrees. With an internal micrometer, measure the inside diameter of the bearing (Figure 28). The nominal diameter is 64 mm. Subtract the crankshaft bearing journal diameter from the diameter of the corresponding bearing to obtain the clearance. The standard clearance limits are 0.073 to 0.10 mm (0.0029 to 0.004 in). If the clearance exceeds the limit, replace the crankshaft. Remove the bolts, big-end caps and bearings and set them aside.

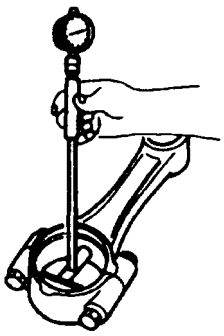


Figure 28 Measuring the Connecting Rod Bearing

s. Remove the piston rings from the pistons, remove the gudgeon (piston) pin retaining snap-rings from each piston and push the gudgeon pin out.

t. Measure the diameter of the gudgeon pin with a micrometer (Figure 29). The standard diameter is 35.0 mm (1.377 in) and the wear limit is 34.95 mm (1.375 in). Replace the gudgeon pin if wear exceeds the limit.

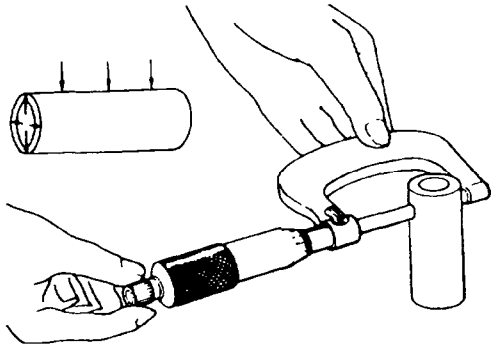


Figure 29 Measuring the Gudgeon Pin

NOTE

Each piston and cylinder liner forms a matched set and should not be interchanged.

u. Measure the diameter of the gudgeon pin bore in the piston using an inside micrometer. Subtract the diameter of the gudgeon pin bore from the diameter of the corresponding gudgeon pin to obtain the interference fit. The interference fit should be no greater than 0.008 mm (0.0003 in). If the gudgeon pin bore of the piston is worn to the extent that an interference fit is no longer possible, replace the piston. Each piston and cylinder liner forms a matched set and should not be interchanged. If a piston replacement is required, the respective cylinder liner must also be replaced.

v. Check the connecting rod for twist and bend using a connecting rod alignment jig. The allowable twist or bend is less than 0.05 mm (0.002 in) per 100 mm of the connecting rod length. Replace the connecting rod if twist or bend exceeds 0.2 mm (0.0079 in).

w. Measure the inside diameter of the connecting rod small-end bush using an inside micrometer. The standard diameter is 35.017 to 35.025 mm (1.3786 to 1.3789 in). Subtract the diameter of the gudgeon pin (sub-para t) from the diameter of the bush to obtain the amount of clearance. The clearance limit is 0.012 to 0.05 mm (0.00047 to 0.002 in). If the clearance limit is exceeded and the gudgeon pin is within the standard diameter, replace the connecting rod small-end bush.

x. If the connecting rod small end bush requires replacement (as determined in sub-paragraph w), remove it and install a new bush with the aid of a press and a suitable adapter and machine the bush out to obtain a clearance of 0.012 to 0.025 mm (0.00047 to 0.00098 in) between the gudgeon pin and the bush.

y. Measure the diameter of the piston using a micrometer. Place the pistons upside down on a work bench, position the micrometer 82 mm up from the crown and at 90 degrees to the centreline of the gudgeon pin bore and measure the diameter (Figure 30). Subtract the diameter of the piston from the inside diameter of the corresponding cylinder liner to obtain the piston to cylinder liner clearance. The clearance limit is 0.057 to 0.075 mm (0.0022 to 0.0030 in). If the clearance exceeds the limits, replace the piston and the cylinder liner as a matched set.

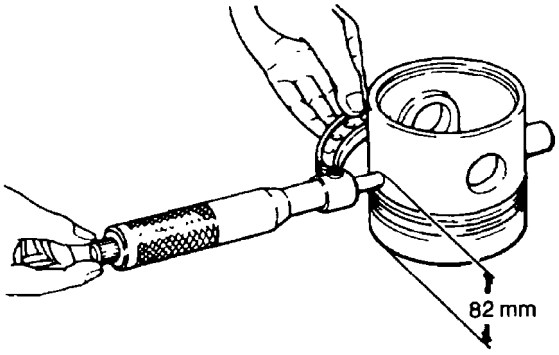


Figure 30 Measuring the Piston Diameter

z. Ensure that all trace of carbon is removed from the piston ring grooves and, with the aid of a set of standard piston rings and feeler gauges, measure the clearance between the piston ring and the ring land (Figure 31). Refer to Table 6 for the standard clearances and limits. Replace any piston where the clearance exceeds the limits. Each piston and cylinder liner forms a matched set. If a piston replacement is required, the respective cylinder liner must also be replaced.

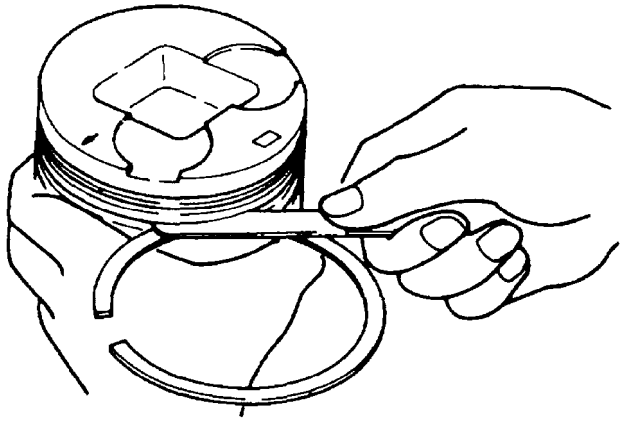


Figure 31 Measuring the Piston Ring Clearance

Table 6 Piston Ring Clearance

Piston Ring	Standard Clearance mm (in)	Maximum Clearance Limit mm (in)
First Compression	0.085 to 0.11 (0.0033 to 0.0043)	0.2 (0.008)
Second Compression	0.030 to 0.055 (0.0012 to 0.0022)	0.15 (0.006)
Oil	0.030 to 0.07 (0.0012 to 0.003)	0.15 (0.006)

aa. Measure the diameter of the idle gear shaft with a micrometer (Figure 32). The limits are 44.94 to 44.97 mm (1.769 to 1.771 in). Replace the idle gear shaft if the wear exceeds the limit.

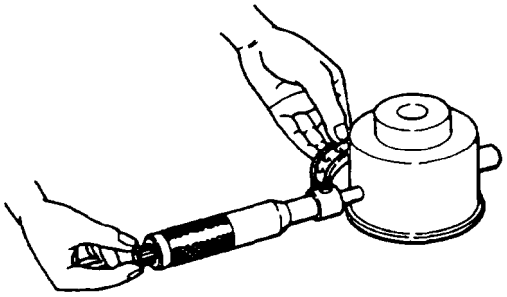


Figure 32 Measuring the Idle Gear Shaft

bb. If the idle gear shaft is within specification, measure the internal diameter of the idle gear (Figure 33). Subtract the shaft diameter from the gear internal diameter to obtain the running clearance. The clearance limit is 0.2 mm (0.008 in). If the running clearance exceeds the limit, or if the gear backlash (measured at Para 17.kk(2)) exceeds the limit, replace the idle gear.

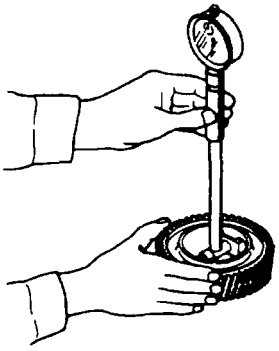


Figure 33 Measuring the Idle Gear

cc. Overhaul the oil pump in accordance with EMEI Vehicle G 104-1.

dd. Overhaul the water pump (Para 25).

Cylinder Liners

19. Cylinder Liner Removal. Remove the cylinder liners as follows:

a. Position the mechanical puller (Table 3, Serial 3) over the defective cylinder liner, ensuring that the tool is seated squarely and firmly supported on the engine block.

b. Install the mechanical puller attachment (Table 3, Serial 4), onto the leg of the mechanical puller, ensuring that the attachment is correctly positioned on the liner.

c. Operate the mechanical puller and withdraw the liner from the engine block (Figure 34).

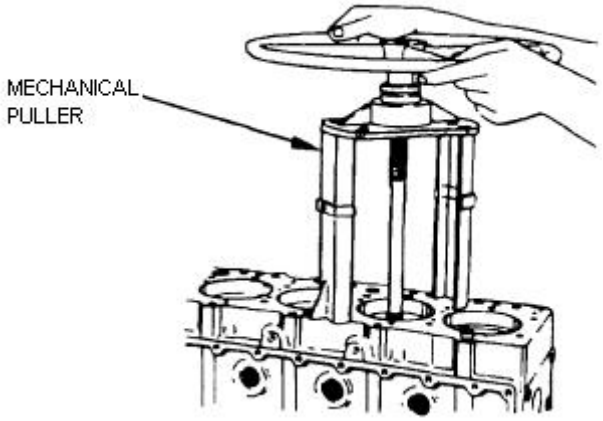


Figure 34 Removing the Cylinder Liners

d. Remove the other cylinder liners as necessary.

e. Check the bores in the engine block for scoring, damage or wear, also check the diameter of the bore. If the bore diameter exceeds the standard dimension of 105.001 to 105.030 mm (4.1339 to 4.1350 in) or if excessive scoring, damage or wear is evident, replace the engine block. Ensure that the bore is machined to allow for an interference fit of up to 0.02 mm (0.0008 in) when the cylinder liner is installed.

f. Check the engine block deck for distortion, using a straight edge and a feeler gauge (Figure 35). If the distortion exceeds 0.2 mm (0.008 in) the engine block deck will require machining; however, the maximum allowable amount of metal that can be removed is 0.3 mm (0.012 in). If distortion cannot be corrected by removing the maximum amount of metal, discard the engine block.

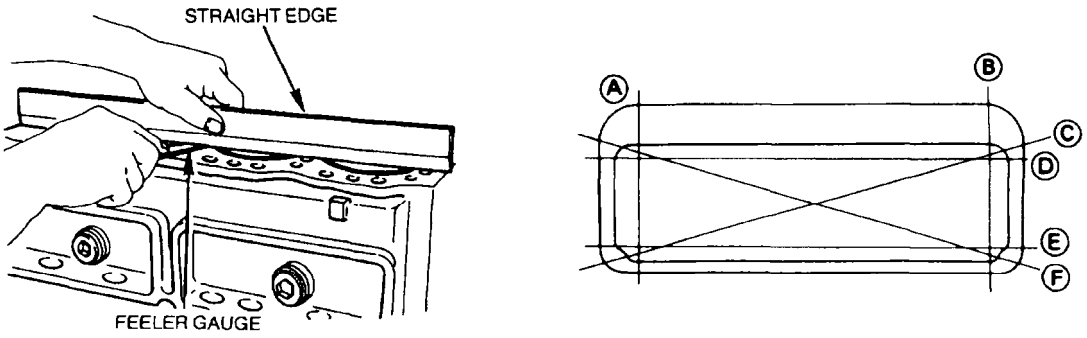


Figure 35 Checking for Engine Block Distortion

g. If the engine block is fully functional after machining, it will be necessary to cut the cylinder liner lip counterbore by the same amount that was removed from the engine block deck to ensure that the protrusion of the cylinder liners (when installed) is between 0.03 to 0.10 mm (0.0012 to 0.0039 in) above the engine block deck.

20. Cylinder Liner Installation. Install the cylinder liners as follows:

a. Thoroughly clean the engine block and ensure that all traces of machine cuttings are removed from each of the cylinder liner bores.

NOTE

Chilling the cylinder liners will facilitate installation.

b. Position the engine block on a hydraulic press and start a new cylinder liner into a bore. To assist with the installation of the cylinder liners, chill the liners.

c. Position the cylinder liner inserter (Table 3, Serial 5) over the cylinder liner (Figure 36). Press the liner into the block by applying an initial load of 500 kg (1 100 lb) and a final load of 2 500 kg (5 500 lb) to ensure that the cylinder liner is properly seated.

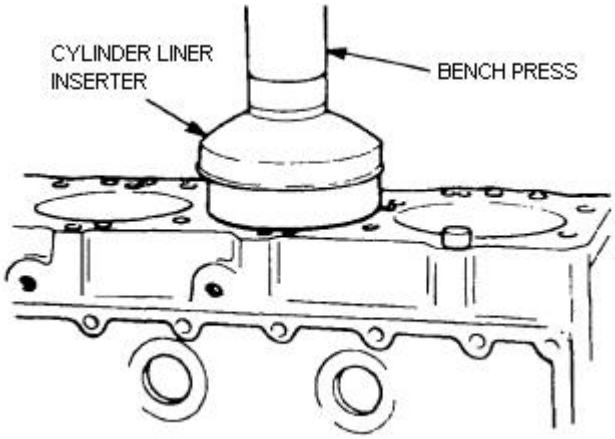


Figure 36 Installing the Cylinder Liners

d. Install other cylinder liners as necessary.

e. After installing the cylinder liners, verify that each liner is protruding 0.03 to 0.10 mm (0.0012 to 0.0039 in) above the engine block deck and that the variation in the amount of protrusion between the cylinder liners is less than 0.03 mm (0.0012 in). Use a straight edge and a feeler gauge to check the amount of protrusion (Figure 37).

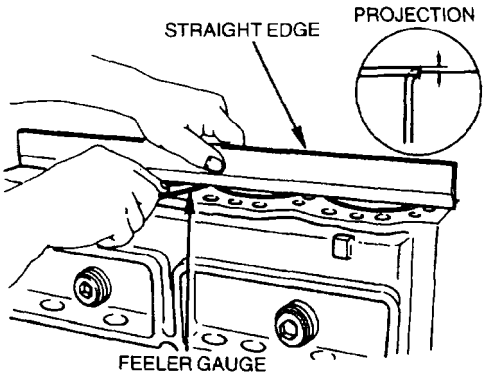


Figure 37 Checking the Cylinder Liner Protrusion

f. If one or more of the cylinder liners exceed the protrusion or variation limit, carefully machine the liners down to the desired dimension.

g. Clean the engine thoroughly to ensure that all metal filings or cuttings are removed.

Camshaft Bearings

21. Camshaft Bearing Removal. Remove the camshaft bearings as follows:

a. Position the inserter and remover (Table 3, Serial 6) over the camshaft bearing and drive the bearing from the engine block (Figure 38). Repeat this procedure for each bearing.

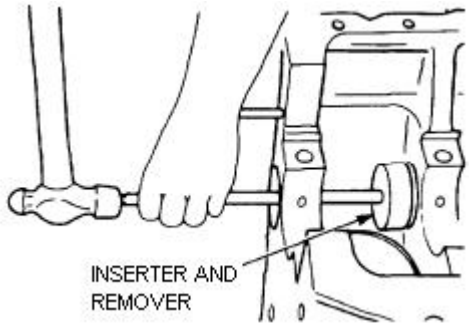


Figure 38 Removing the Camshaft Bearing

b. Check the bearing bores in the engine block for burrs. Remove any burrs with a scraper or fine file and then clean the bores, ensuring that all metal filings are removed.

c. Check the camshaft bearing oil galleries for blockage and clear them as necessary.

CAUTION

Ensure that the number 1 camshaft bearing (timing case end) is correctly identified.

Misalignment of the oil hole(s) in the bearing and the oil gallery port(s) in the engine block will reduce oil flow to engine components and may result in engine failure.

22. Camshaft Bearing Installation. Install the camshaft bearings as follows:

a. Identify the number 1 camshaft bearing (timing case end) as the one having two oil holes, the other bearings, number 2 and 3 (flywheel end) have only one hole.

b. Position the number 3 bearing over the rearmost bearing bore, ensuring that the oil hole in the bearing is fully aligned with the oil gallery hole in the bearing bore. Install the bearing using the inserter and remover (Table 3, Serial 6) and a hammer.

c. Repeat the process for the number 2 bearing over the centre bearing bore and number 1 bearing over the front bearing bore.

23. Engine Reassembly. Reassemble the engine as follows:

a. Position the engine block on a universal engine overhaul stand so that the sump face is uppermost and secure the engine block to the stand.

b. Using the gear inserter (Table 3, Serial 7) and a hammer, install the drive gear onto the crankshaft (Figure 39).

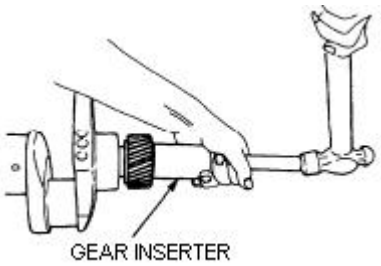


Figure 39 Installing the Drive Gear

c. Install the main bearing shells into the engine block and the main bearing caps.

d. Liberally coat the bearings with clean engine oil and position the crankshaft into the bearings in the engine block.

e. Install a new thrust bearing on the timing case side of the centre main bearing with the oil grooves against the rotating face of the crankshaft.

f. Install the main bearing caps, ensuring that each cap is correctly located in relation to the number placed on the cap during disassembly.

g. Smear the threads, shaft and head of the bearing cap retaining bolts with engine oil.

h. Install and tighten the retaining bolts to 225 to 245 N.m (166 to 181 lbf.ft) in the sequence depicted in Figure 40 while tapping the bearing cap from side to side to centralize and seat the bearing correctly.

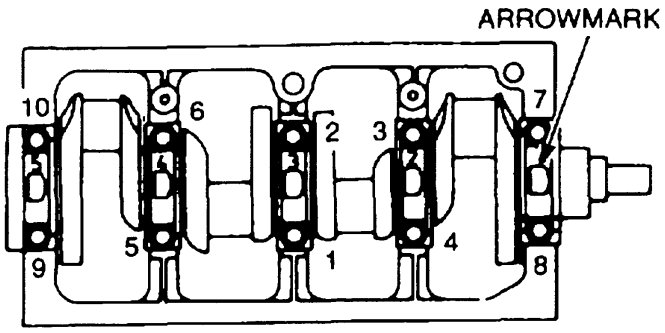


Figure 40 Crankshaft Bearing Bolt Tightening Sequence

i. Ensure that the crankshaft revolves freely without binding.

j. Position the timing case-to-engine block gasket on the back of the timing case and insert two retaining bolts through the timing case to hold the gasket in position.

k. Locate the timing case on the front of the engine block and screw in the two retaining bolts. Install the remaining bolts and tighten all the bolts to 21 to 30 N.m (15 to 22 lbf.ft).

l. Lubricate the camshaft followers and each of the bores with clean engine oil. Position the camshaft followers in their corresponding bores and ensure that each follower moves freely within the bore, then secure each of the followers in the fully raised position, using a suitable clip or tape.

m. Ensure that the camshaft bearings in the engine block are clean and lubricated with a liberal amount of clean engine oil.

n. Carefully install the camshaft, ensuring that the lobes are not dragged across the bearings. Install and tighten the thrust plate retaining bolts (Figure 41) to 21 to 30 N.m (15 to 22 lbf.ft).

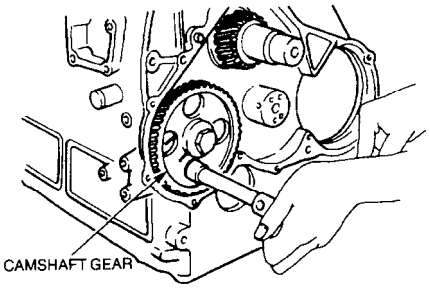


Figure 41 Installing the Camshaft

o. Invert the engine so that the engine block deck is uppermost.

WARNING

Use suitable personal protection equipment and mechanical aids to prevent personal injury when handling pistons heated to 60 degrees C. Burns will result in handling heated pistons without wearing personal protection equipment.

NOTE

Heating the pistons will facilitate installation of the gudgeon pin.

p. Place the pistons in a suitable heating device and heat them to approximately 60 degrees C to facilitate fitting the gudgeon pins.

q. Using suitable personal protection equipment and mechanical aids, position a piston over the small-end of a connecting rod ensuring that both the piston and the connecting rod are matched with their respective cylinder and that each is correctly orientated so that, when installed, the match marks on the connecting rod (Figure 42) are positioned towards the camshaft and the front mark on the piston is positioned toward the front of the engine block (Figure 43).

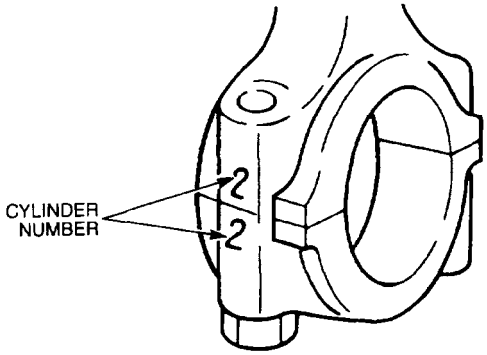


Figure 42 Connecting Rod Match Mark Location

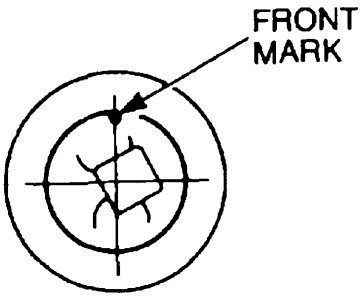


Figure 43 Piston Front Mark Location

r. Coat the outer surface of the gudgeon pin with clean engine oil. Align the gudgeon pin holes in the piston and connecting rod and push the gudgeon pin into position in the piston and connecting rod.

s. Install the gudgeon pin retaining snap-rings into the grooves in the piston (Figure 44) ensuring that they are seated correctly.

t. Set the assembled piston aside to cool prior to installing the piston rings.

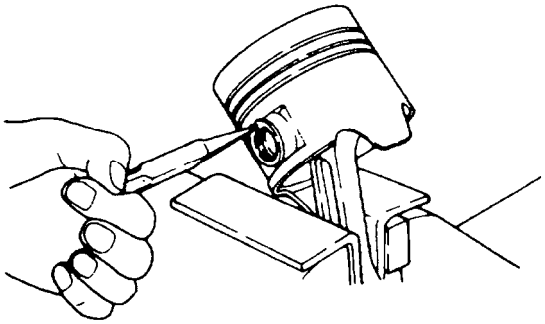


Figure 44 Installing the Snap-rings

u. Repeat the procedure detailed in sub-paragraphs q to t for each piston and connecting rod set.

v. Check the piston ring gap by installing the piston rings in the cylinders and measuring the gap with feeler gauges (Figure 45). Refer to Table 7 for the correct ring gap limits.

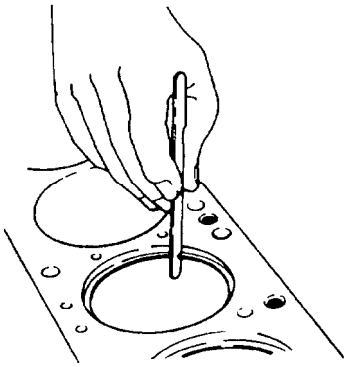


Figure 45 Checking the Piston Ring Gap

Table 7 Piston Ring Gap Tolerances

Serial	Piston Ring	Standard mm (in)	Maximum Limit mm (in)
1	First compression	0.25 to 0.45 (0.010 to 0.018)	1.5 (0.059)
2	Second compression	0.2 to 0.4 (0.008 to 0.016)	1.5 (0.059)
3	Oil	0.2 to 0.4 (0.008 to 0.016)	1.5 (0.059)

w. If the piston ring gap is insufficient, clamp the piston ring securely in a soft-jawed vice and carefully file the end of the ring with a suitable fine file. Ensure that only a small portion of the ring end is protruding above the vice jaws to prevent ring distortion and/or breakage. Check the ring gap regularly to ensure that the limit is not exceeded.

x. When the piston rings are correctly sized, install the rings onto each piston with the aid of a piston ring installer. Ensure that the first and second compression rings are installed with the face marked ‘NPR’ or ‘TOP’ uppermost and the ring gaps positioned as shown in Figure 46.

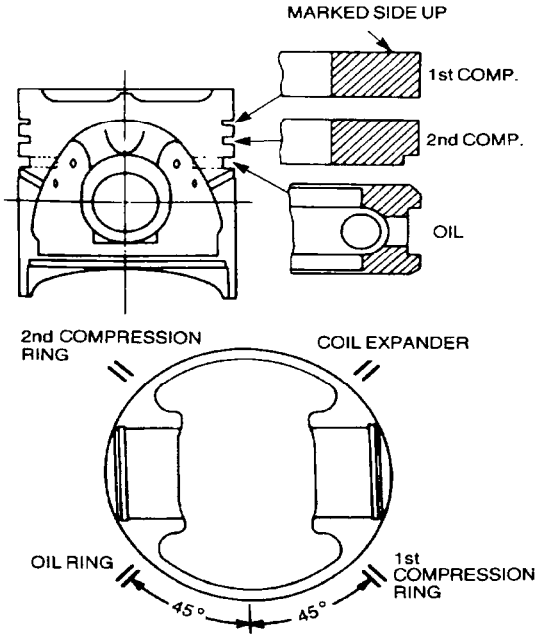


Figure 46 Piston Ring Installation

y. Lubricate the piston rings, piston skirt and the connecting rod big-end bearing with a liberal amount of clean engine oil.

NOTE

Ensure that the piston and connecting rod assembly is correctly orientated.

z. Install a ring compressor (Table 3, Serial 8) over the piston rings. Compress the piston rings and insert the piston and connecting rod assembly into its respective cylinder. Ensure that the front mark on the piston is positioned toward the front of the engine block and the match mark on the connecting rod is toward the camshaft.

aa. Guide the connecting rod big-end bearing over the connecting rod journal on the crankshaft while pushing the piston into the cylinder.

bb. Install the remaining pistons by repeating the procedure detailed in sub-paragraphs y to aa.

cc. Position the engine on its side.

dd. Lubricate a big-end cap bearing with a liberal amount of clean engine oil. Locating the connecting rod on the crank pin journal, install the big-end bearing cap to the appropriate connecting rod and install the retaining bolts.

ee. Tighten the retaining bolts to 39 N.m (29 lbf.ft), while tapping the bearing cap from side to side to centralise and seat the bearings correctly. Tighten the bolts a further 60 to 90 degrees.

ff. Install the remaining big end bearing caps by repeating the procedure detailed in sub-paras dd and ee.

gg. Position the engine with the sump face uppermost.

hh. Install the flywheel housing as follows:

(1) Apply a narrow bead of a suitable sealant to the mounting surface of the flywheel housing and install the housing ensuring that it is properly located over the dowel pins. Install the smaller retaining bolts, together with new lock-washers and tighten them to 21 to 30 N.m (15 to 22 lbf.ft).

(2) Install the large retaining bolts, together with new lock-washers and tighten them to 123 to 152 N.m (90 to 112 lbf.ft).

ii. Install the rear crankshaft oil seal using the seal installation tool kit (Table 3, Serial 9) as follows:

(1) Clean and inspect the crankshaft oil seal journal for any abrasion or scoring which may have been caused by previous oil seals.

(2) Carefully remove any burrs or rough areas with emery paper or a fine file. Thoroughly clean away any resulting filings or emery paper dust. If wear is greater than 0.1 mm deep or wide, fill the damaged area with Loctite 3805 to prevent oil seeping under the seal.

CAUTION

Emery dust or metal filings must not be allowed to enter the engine and must be completely removed before continuing.

(3) Inspect the seal installation, crank plate and push cone and carefully remove any burrs or sharp edges, particularly those on the outer diameter of the crank plate.

CAUTION

Handle the crank plate and push cone carefully during use to avoid causing burrs or sharp edges that may damage the seal during installation and cause early failure.

(4) Fit the crank plate to the crankshaft with one hole positioned at the dowel pin and the other three holes aligned with the flywheel bolt holes (Figure 47). Secure the crank plate with the short screws, ensuring the screws are evenly tightened.

Figure 47 Crank Plate Secured to Crankshaft

NOTE

Before installation, apply only clean engine oil to the outside surface of the new type of seal. Do not apply any type of sealant in an attempt to improve the sealing between the housing and the outer surface of the new seal.

(5) Lubricate the outside surface of the seal with clean engine oil and do not apply any type of sealant in an attempt to improve the sealing between the housing and the outer surface of the seal.

(6) Position the seal over the crank plate so that the part number stamped on the flange of the green inner sleeve is visible. Push the seal, by hand, along the crank guide until it contacts the crankshaft (Figure 48).

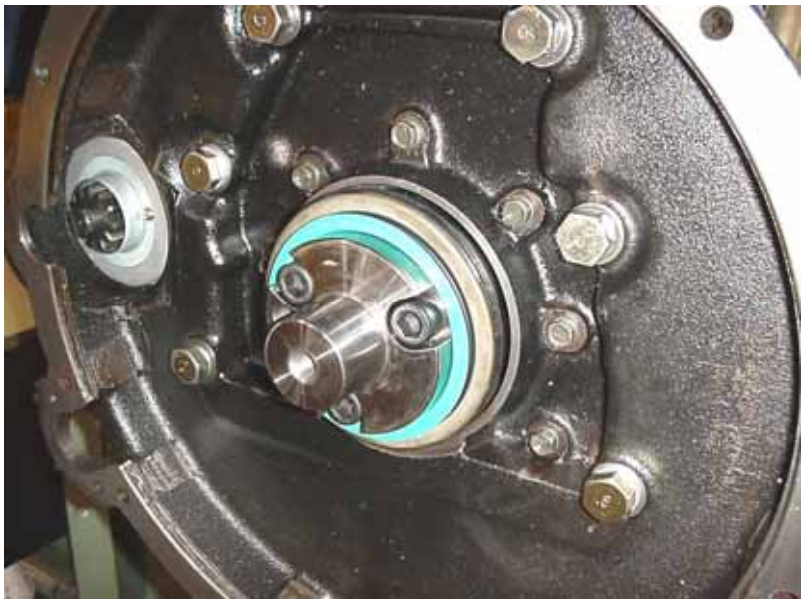


Figure 48 Rear Crankshaft Oil Seal Located on Crank Plate Ready for Installation

(7) Position the push cone over the crank plate, locate it onto the seal and then engage the long screw into the crank plate (Figure 49).

Figure 49 Push Cone Located on Crank Plate and Against Seal

CAUTION

To prevent the rubber seal from creeping back and to ensure the seal remains in the correct position during service, the push cone must be left tight against the seal for at least two minutes.

(8) Rotate the screw to push the seal into its housing, until hard resistance is felt. Leave the push cone in place for at least two minutes before loosening the screw to minimise creep back of the seal rubber and to ensure the seal remains in the correct position during service.

NOTE

The presence of green bore sealant after the seal has been installed does not indicate there is a fault with the newly installed seal.

(9) Remove the push cone and crank guide and use workshop wiping cloths to clean away any green bore sealant that may have been forced from inside the seal.

NOTE

The inner green flange on the seal will stand proud of the housing after installation.

(10) The inner green flange on the seal will stand proud of the housing after installation. This is intentional and no attempt should be made to alter the position of the seal as it is preset by the step on the push cone tool.

(11) Clean away any excess engine oil from the general area.

jj. Install the oil pump drive pinion, together with a new thrust bearing, into the engine block. Install and securely tighten the thrust bearing locating grub screw. Position a new gasket on the cover and install the cover. Install the retaining bolts and tighten them securely.

kk. Pour clean engine oil into the oil pump intake to prime the oil pump. Position the oil pump on the engine block, ensuring that the drive shaft is properly engaged with the drive pinion. Install the oil pump retaining bolts and tighten them to 42 to 62 N.m (31 to 46 lbf.ft).

ll. Install the bolts that secure the oil feed pipe to the engine block and tighten them securely.

mm. Fit new sealing sleeves to the oil pan retaining bolts and studs.

nn. Position a new gasket on the bottom of the engine block and place the oil pan over the gasket.

oo. Position a new gasket and the supporting plates over the rim of the oil pan. Install the retaining bolts and nuts and then tighten them to 10 to 20 N.m (8 to 15 lbf.ft).

pp. Install a new sealing washer onto the oil pan drain plug and install and securely tighten the drain plug.

qq. Invert the engine.

rr. Install new expansion plugs into their appropriate positions on the engine block, eg water jacket and camshaft rear bearing bore.

ss. Install the threaded plugs into the oil galleries, ensuring that the plugs are tightened securely.

tt. Install the crankshaft extension complete with a new spigot bush into the crankshaft.

uu. Install the flywheel locating dowel pin if it was previously removed.

vv. Position the flywheel on the crankshaft, smear the threads of the retaining bolts with engine oil and install the bolts. Lock the flywheel to prevent it from turning and tighten the bolts to 142 to 172 N.m (105 to 127 lbf.ft) in the sequence shown in Figure 50.

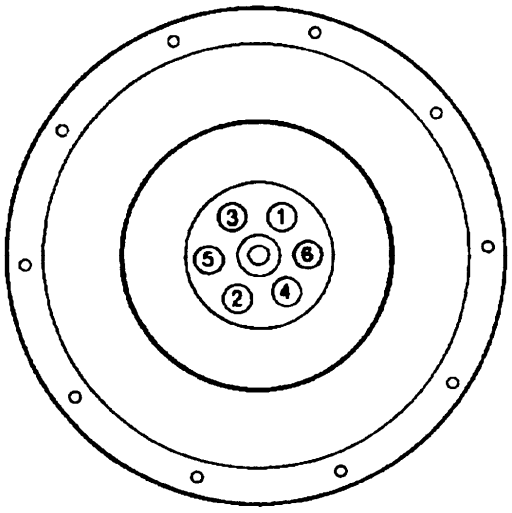


Figure 50 Flywheel Bolt Tightening Sequence

ww. Position the clutch plate onto the clutch centraliser (Table 3, Serial 10) and install the clutch centraliser into the spigot bush to hold the clutch plate in position against the flywheel.

xx. Assemble the pressure plate onto the flywheel ensuring that the dowel pins in the flywheel align with the respective holes in the pressure plate Install the retaining bolts and alternately tighten each of the bolts to 16 N.m (12 lbf.ft). Remove the clutch centraliser and the flywheel locking device.

yy. Install the idle gear shaft, using the thrust collar retaining bolts as a guide and ensure that the oil port is facing toward the camshaft.

zz. Rotate the crankshaft to bring No 1 piston onto Top Dead Centre (TDC), which also brings the timing mark on the gear toward the idle gear shaft (Figure 51).

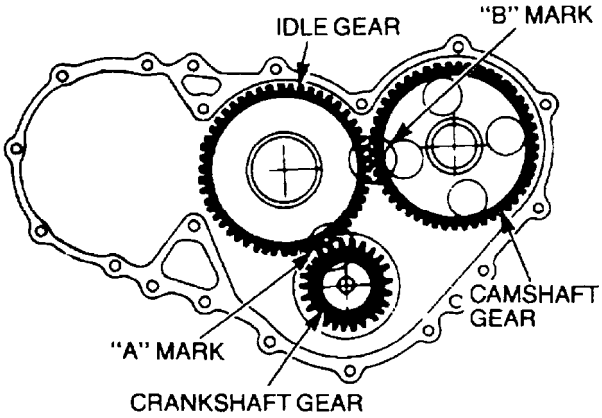


Figure 51 Aligning the Idle Gear Timing Marks

aaa. Rotate the camshaft to bring the timing mark on the gear toward the idle gear shaft (Figure 51).

bbb. Lubricate the idle gear and the idle gear shaft with clean engine oil and install the gear onto the idle shaft aligning the timing marks on the idle gear with the timing marks on both the crankshaft and camshaft gears (Figure 51). If necessary, remove the idle gear and rotate the camshaft to align the timing marks.

ccc. Remove the thrust collar bolts and install the thrust collar with the chamfer away from the gear. Install the thrust collar bolts and tighten them to 42 to 62 N.m (31 to 45 lbf.ft).

ddd. Place a new gasket on the oil cooler cover and locate the oil cooler on the engine block. Install the retaining bolts and tighten them to 21 to 30 N.m (15 to 22 lbf.ft) in the sequence shown in Figure 52.

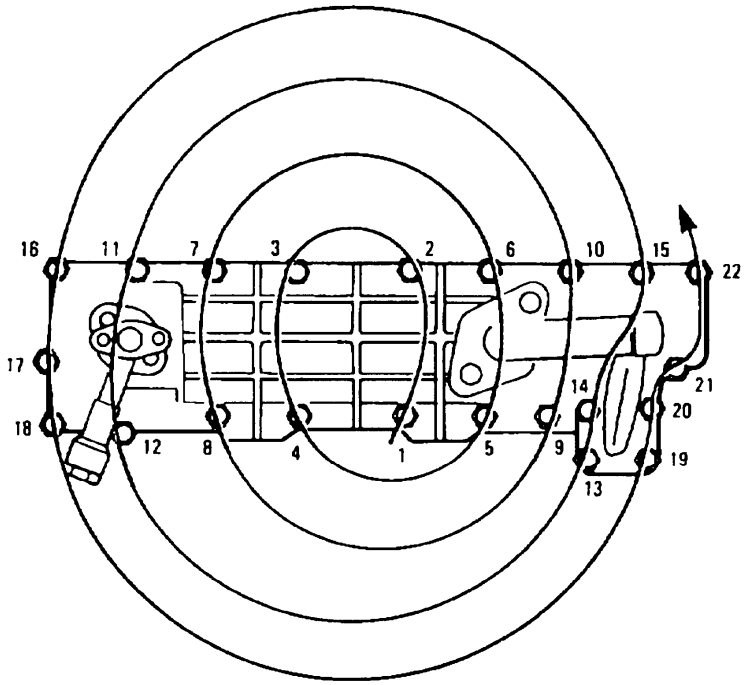


Figure 52 Oil Cooler Tightening Sequence

eee. Place new gaskets on the side cover plates (if necessary use a suitable sealant to hold the gaskets in position). Position the cover plates on the engine block, ensuring that the plate with the engine breather outlet is positioned to the rear of the engine (Figure 53). Install the retaining bolts and tighten them to 16 to 25 N.m (12 to 19 lbf.ft).

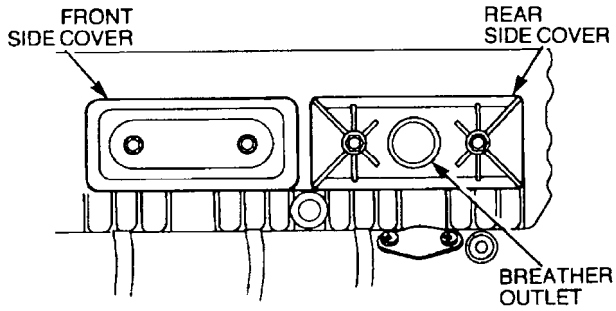


Figure 53 Installing the Side Cover

fff. Position the injection pump on the engine, aligning the timing mark on the pump drive gear with the mark on the idle gear. Install the retaining bolts, together with new lock-washers, but do not tighten them at this stage.

ggg. Install the injection pump rear mounting bracket over the injection pump mounting adapter and onto the engine block. Install the nut and the retaining bolts together with new lock-washers (Figure 54).

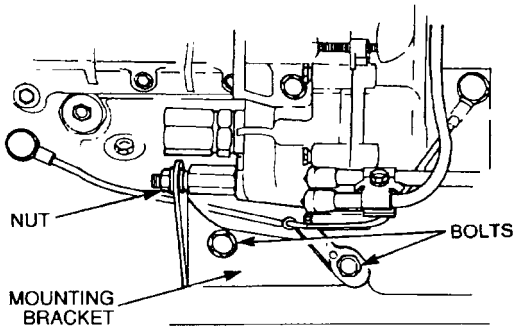


Figure 54 Installing the Injection Pump Rear Mounting Bracket

hhh. Tighten the injection pump-to-timing case retaining bolts to 21 to 30 N.m (15 to 22 lbf.ft)and then tighten the adapter-to-mounting bracket retaining nut and the bracket retaining bolts to 21 to 30 N.m (15 to 22 lbf.ft).

iii. Install the injection pump oil feed pipe adapter onto the engine and tighten it securely. Connect the oil feed pipe to the adapter and tighten the connector securely.

jjj. Ensure that the timing marks are aligned as shown in Figure 55. Lock the flywheel to prevent it from turning and tighten the camshaft drive gear retaining bolt to 123 to 152 N.m (90 to 112 lbf.ft).

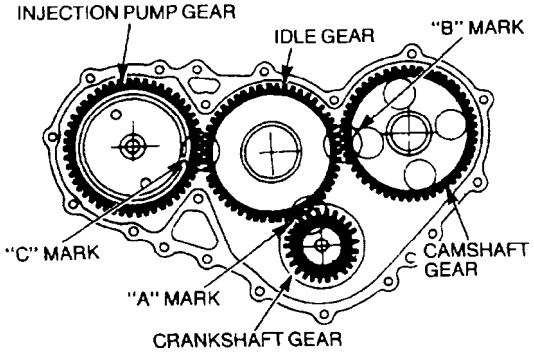


Figure 55 Aligning the Gear Timing Marks

kkk. Install a new oil seal into the timing cover using the seal inserter (Table 3, Serial 11) and a hammer (Figure 56) and smear the sealing lip with rubber grease.

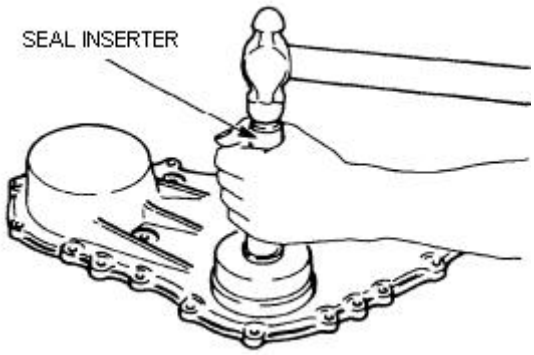


Figure 56 Installing the Timing Case Oil Seal

lll. Position a new gasket on the timing cover, using timing cover retaining bolts to hold the gasket in place.

mmm. Install the timing cover, ensuring that the gasket is correctly aligned and the sealing lip on the seal is not distorted. Install the retaining bolts and tighten them to 21 to 30 N.m (15 to 22 lbf.ft).

nnn. Install the two Woodruff keys into the crankshaft keyways, locate the dust thrower onto the back of the crankshaft pulley and smear the seal rubbing surface on the crankshaft pulley with rubber grease.

ooo. Position the pulley over the end of the crankshaft. Align the keyway with the keys and push the pulley onto the crankshaft. Install the retaining nut and washer and tighten the nut to 382 to 480 N.m (282 to 354 lbf.ft). Remove the flywheel lock.

ppp. Apply suitable sealant to the mating faces of the water pump and engine block. Position the water pump, together with a new gasket, onto the engine block. Install the retaining bolts and tighten them to 42 to 62 N.m (31 to 45 lbf.ft).

qqq. Position the oil filter adapter, together with a new gasket, on the engine block. Install and tighten the four retaining bolts to 42 to 62 N.m (31 to 45 lbf.ft).

rrr. Apply a film of clean engine oil to the rubber seal on the oil filter. Screw the oil filter on to the adaptor until the seal contacts the adapter face and tighten it a further half a turn by hand.

sss. Position the alternator adjusting bracket on the thermostat housing. Install the bolt but do not tighten it at this stage.

ttt. Position the alternator mounting bracket on the engine. Install the retaining bolts and new lock-washers. Tighten the bolts to 42 to 62 N.m (31 to 45 lbf.ft).

uuu. Position the alternator on the mounting bracket and install the two mounting bolts. Align the alternator adjusting bracket with the adjusting bolt hole on the alternator and install the adjusting bolt (Figure 57). Do not tighten the alternator adjusting and mounting bolts at this stage.

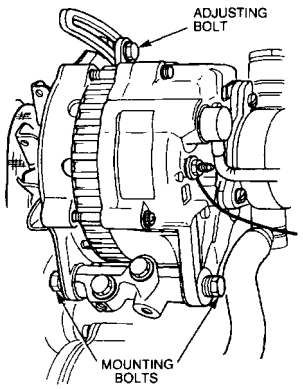


Figure 57 Installing the Alternator and Mounting Bracket

vvv. Install the vacuum pump oil feed and oil return hose and adapters onto the engine block. Connect the oil feed and return hoses (Figure 58) ensuring that the hose connections are secure.

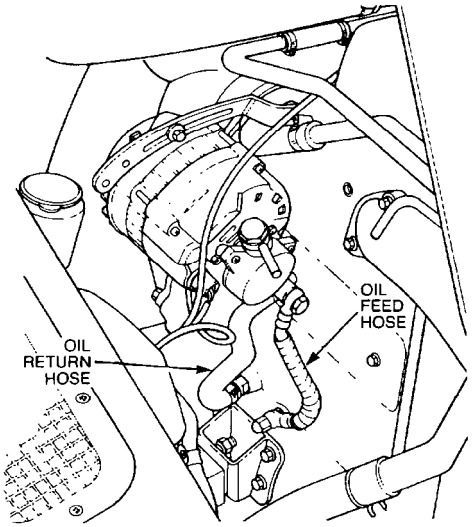


Figure 58 Installing the Vacuum Pump Oil Hoses

www. Position the starter motor on the flywheel housing. Install the retaining bolts and nuts and tighten them securely.

xxx. Install the dipstick tube into position on the engine block.

yyy. Install the cylinder head in accordance with EMEI Vehicle G 104-1.

zzz. Position the drive pulley, spacer and cooling fan on the water pump drive flange. Align the bolt holes, install the retaining bolts and tighten them securely.

aaaa. Position the fanbelt over the pulleys. Adjust the tension of the fanbelt by moving the alternator outward to obtain a belt deflection of 10 to 15 mm between the water pump and alternator pulleys. Securely tighten the alternator adjusting bolt and mounting bolts.

24. Engine Installation. Install the engine as follows:

WARNING

The overhead lifting equipment must have a minimum Safe Working Load (SWL) of 500 kg. Lifting equipment with a lower SWL may fail unexpectedly causing injury to personnel and damage to the equipment.

a. Secure the engine lifting sling (Table 3, Serial 12) to overhead lifting equipment with a minimum safe working load of 500 kg.

b. Position the overhead lifting equipment above the engine (Figure 59), secure the chains to the engine lifting brackets, take up the weight of the engine with the overhead lifting equipment and remove the engine from the overhaul stand.

c. Lower the engine to a firm horizontal surface with the lifting equipment supporting the majority of the engine's weight.

d. Position the engine mounting brackets on the engine, install the retaining nuts and bolts and tighten them securely.

CAUTION

During installation of the engine or transmission, DO NOT use the bell housing bolts to pull the assemblies together, if there is a gap evident. This will cause the transmission input bearing retaining plates to bend and allow excess end-float of the main shaft. If the plates are bent the transmission must be removed and returned for overhaul.

e. Install the engine in accordance with EMEI Vehicle G 104-1.

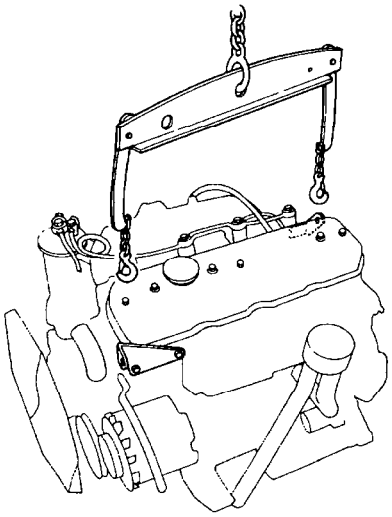


Figure 59 Attaching the Lifting Equipment

Table 8 Engine Group Specifications

Serial	Item	Specification
1	**Engine block**	
2	Distortion	Less than 0.2 mm (0.008 in)
3	Machining limit	0.3 mm (0.012 in)
4	Cylinder liner bore	105.001 to 105.010 mm (4.1339 to 4.1342 in)
5	**Cylinder head**	
6	Distortion	Less than 0.2 mm (0.008 in)
7	Thickness	89.95 to 90.05 mm (3.541 to 3.545 in)
8	Machining limit	89.65 mm (3.530 in)
9	**Valves**	
10	Head to valve depression	1.0 to 2.5 mm (0.039 to 0.098 in)
11	Seat contact width	1.5 to 2.0 mm (0.059 to 0.079 in)
12	Head thickness	Not less than 1.0 mm min. (0.039 in)
13	Seat angle	45 degrees
14	Inlet valve stem diameter	8.88 to 8.961 mm (0.350 to 0.353 in)
15	Exhaust valve stem diameter	8.88 to 8.936 mm (0.350 to 0.352 in)
16	Valve stem diameter wear limit	8.88 mm (0.350 in)
17	Inlet valve clearance	0.039 to 0.2 mm (0.0015 to 0.008 in)
18	Exhaust valve clearance	0.064 to 0.25 mm (0.0025 to 0.010 in)
19	**Valve guides**	
20	Protrusion above cylinder head	13.9 to 14.3 mm (0.547 to 0.563 in)
21	Valve stem to guide clearance	

COOLING SYSTEM

Water Pump

25. Disassembly. Disassemble the water pump as follows:

a. Remove the water pump in accordance with EMEI Vehicle G 103.

b. Remove the screws securing the rear cover to the water pump, remove the cover and discard the gasket.

c. Using the water pump puller (Table 3, Serial 13), remove the impeller from the pump shaft (Figure 60).

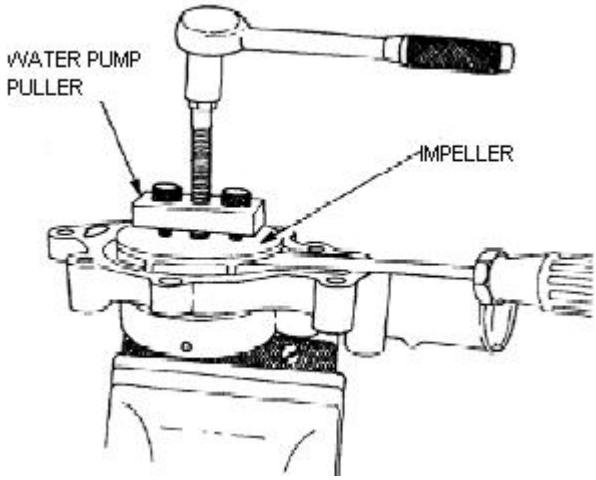


Figure 60 Removing the Water Pump Impeller

d. Position the pump in a suitable press, press the drive flange from the shaft and remove the dust cover (Figure 61).

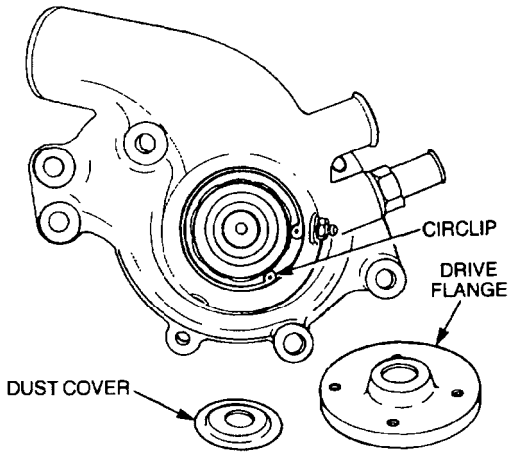


Figure 61 Removing the Drive Flange

e. Remove the circlip (Figure 61) from the front of the water pump housing.

CAUTION

To avoid damaging the water pump housing the shaft must be pressed out from the impeller end of the housing.

f. Using the press, remove the shaft and bearing assembly from the impeller end of the housing.

g. Press out the two seals from the front of the housing and discard the seals.

h. Press the bearings and spacers from the shaft, but do not remove the circlip (Figure 62) unless the circlip is damaged.

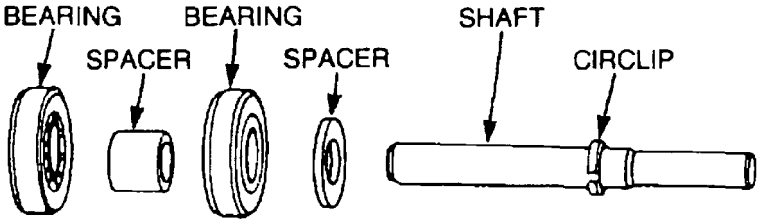


Figure 62 Removing the Bearing and Spacers

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

WARNING

DO NOT spin the bearings with compressed air as personal injury or damage to the bearings may result.

a. Clean all parts with a recommended cleaning agent and blow them dry with compressed air. Do not blow dry the bearings.

b. Remove all traces of gasket material from the water pump housing, rear cover and the engine block.

c. Check the water pump housing and impeller for cracks, damage or excessive corrosion (replace as necessary).

d. Check the bearings for smooth, noiseless operation and replace as necessary.

e. Check the shaft for straightness, excessive wear or damage and replace as necessary.

27. Reassembly. Reassemble the water pump as follows:

a. If the circlip was removed from the shaft during disassembly, fit a new circlip to the shaft.

NOTE

Install the bearings with the sealed sides facing outwards.

b. Pack the bearing with grease and fit the spacers and bearings to the shaft in the sequence shown in Figure 62, using a suitable press for the bearings. When installing the bearings, ensure that the sealed sides of the bearings face outward and that the bearing installing force is applied to the inner ring of the bearing.

c. Apply liquid gasket compound to the contact surfaces of the new seals (Figure 63) and press the seals into the housing.

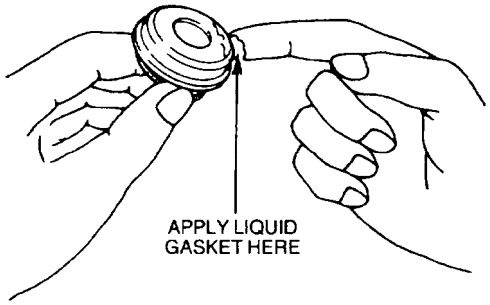


Figure 63 Installing the Water Pump Housing Seals

d. Install the shaft and bearing assembly from the front of the water pump, using a press and the installer (Table 3, Serial 14).

e. Install the circlip in the front of the housing to retain the shaft and bearing assembly in position.

f. Position the dust cover on the shaft and then install the drive flange onto the shaft using a press.

g. Turn the water pump over and position the impeller on the shaft. Press the impeller onto the shaft until the clearance between the impeller and the pump housing (Figure 64) is 0.3 to 0.8 mm (0.012 to 0.031 in).

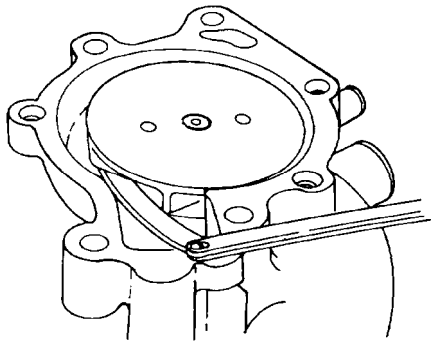


Figure 64 Checking the Impeller Clearance

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

i. Install the water pump in accordance with EMEI Vehicle G 103.

j. Lubricate the water pump with grease through the grease fitting.

FUEL

Fuel Injection Pump

28. Disassembly. Disassemble the fuel injection pump as follows:

CAUTION

All work on fuel injection equipment must be carried out in a clean, dust free location. Dust or dirt could damage the internal components.

a. Remove the injection pump in accordance with EMEI Vehicle G 103 and place it in a clean, dust free location.

b. Lock the injection pump drive gear with a suitable locking device. Remove the nut and washer securing the drive gear and timing device to the injection pump camshaft and remove the drive gear and timing device.

c. Remove the four nuts and washers securing the injection pump-to-timing case mounting adapter to the injection pump. Remove the adapter by tapping the adapter lightly with a soft-faced hammer.

d. Install the camshaft coupling tool (Table 3, Serial 15) on the camshaft and remove the control lever return spring.

NOTE

A suitable soft-jawed vice can be utilized in place of the universal vice and bracket assembly.

e. Install the mounting bracket base (Table 3, Serial 16) onto the universal vice (Table 3, Serial 17), attach the injection pump mounting bracket (Table 3, Serial 18) onto the mounting bracket base and secure it with two bolts (Figure 65).

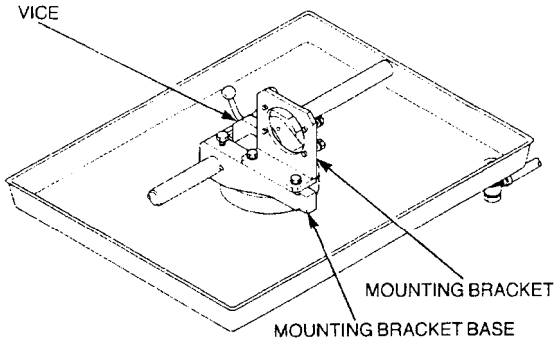


Figure 65 Universal Vice and Bracket Assembly

f. Position the injection pump on the vice and bracket assembly. Attach the pump to the bracket using the four bolts and tighten the bolts securely.

g. Position the coupling spanner (Table 3, Serial 19) onto the camshaft coupling and hold the coupling while tightening the coupling retaining nut with the wrench (Table 3, Serial 20).

h. With the injection pump secured to the vice, remove the nuts securing the fuel transfer pump to the injection pump. Remove the transfer pump. Remove and discard the O ring.

i. Remove the bolts securing the side cover plate to the injection pump and remove the cover plate. Remove and discard the gasket.

WARNING

Ensure that the tappet holders (service pins) are properly installed, otherwise personal injury could result.

NOTE

The drive gear and timing device securing nut can be used in place of the camshaft coupling tool (Table 3, Serial 15) to facilitate the rotation of the camshaft.

j. Using the coupling spanner (Table 3, Serial 19), rotate the camshaft until a plunger return spring is fully compressed (ie. the tappet is at TDC) and install a tappet holder (Table3, Serial 21) into the hole to secure the tappet. Secure the remaining tappets in the same manner.

k. Remove the seven bolts securing the cover to the governor housing and remove the cover by tapping it lightly with a soft-faced hammer. Remove and discard the gasket.

l. Position the coupling spanner (Table 3, Serial 19) on the camshaft coupling to prevent the camshaft from turning and with the wrench (Table 3, Serial 20) and the lever (Table3, Serial 23), remove the flyweight locknut (Figure 66).

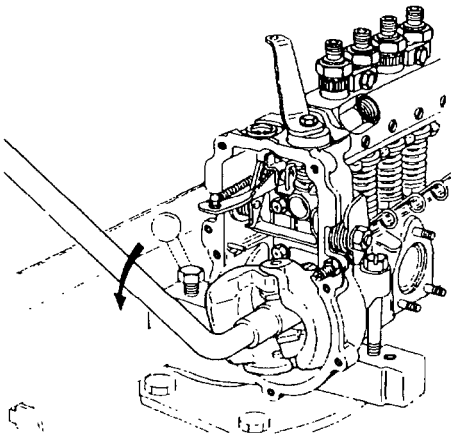


Figure 66 Removing the Flywheel Locknut

m. Position the extractor (Table3, Serial 24) in the flyweights and remove the flyweights from the camshaft (Figure 67).

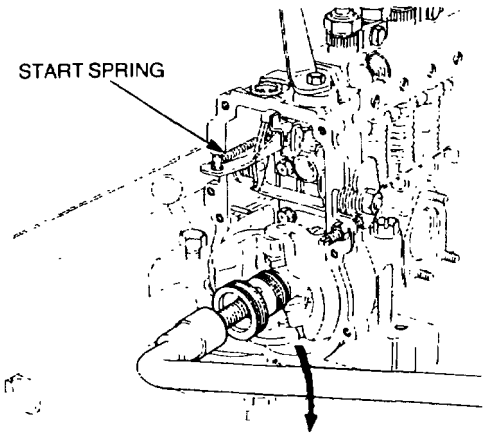


Figure 67 Removing the Flyweights

n. Remove the start spring from the rack connecting link. Use two spanners to remove the nut from the bolt securing the connecting link to the control rack and remove the connecting link complete with the bolt and plate (Figure 68).

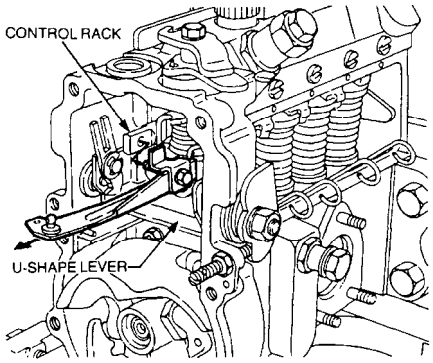


Figure 68 Removing the Connecting Link

o. Remove the nut and spring washer securing the full-load set lever to the U-shape lever and carefully remove the full-load set lever and spring.

p. Remove the U-shape lever pivot plug from the side of the governor housing and remove the U-shape lever complete with the full-load set lever shaft and the sensor lever.

q. Using a Phillips screwdriver and the 12 mm socket (Table3, Serial 25), remove the six bolts securing the governor housing to the injection pump together with the start spring eye. Lightly tap the governor housing with a soft-faced hammer to separate it from the injection pump. Remove and discard the gasket.

r. Turn the injection pump on its side and remove the plugs from the base of the pump using the lever (Table 3, Serial 23).

s. Position the pump upright and remove the coupling from the camshaft using the coupling spanner (Table 3, Serial 19), the wrench (Table 3, Serial 20) and the lever (Table 3, Serial 23).

t. Rotate the injection pump camshaft until the key at the drive end of the camshaft faces upward and remove the key from the camshaft.

u. Remove the four bolts and spring washers securing the front bearing cover to the pump.

v. Tap the governor end of the camshaft with a soft-faced hammer to unseat the bearing cover and using two screwdrivers in the cut-aways provided in the bearing cover, pry off the bearing cover. Remove and discard the gasket.

w. Remove the camshaft from the drive end of the injection pump.

WARNING

Never place fingers inside the injection pump camshaft bore while the plunger return springs are held compressed as personal injury could result.

x. Position the injection pump with the plunger return springs uppermost. Install the return spring compression tool (Table 3, Serial 26) and in turn, compress each spring, remove the tappet holders and slowly release the pressure on the springs (Figure 69).

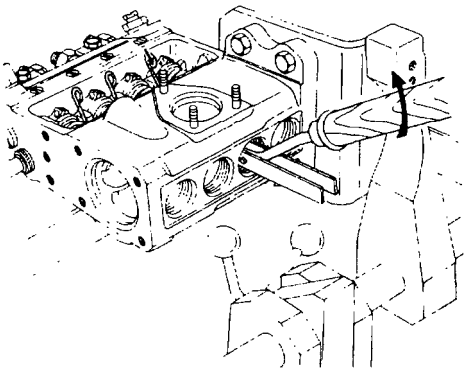


Figure 69 Removing the Tappet Holders

y. Remove the tappet assemblies from the injection pump through the camshaft bore using the clamp (Table 3, Serial 27) (Figure 70).

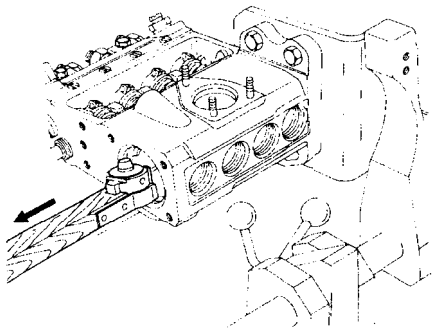


Figure 70 Removing the Tappet Assemblies

z. Remove the lower spring seats and plungers through the holes in the base of the pump using the inserter (Table 3, Serial 28) (Figure 71).

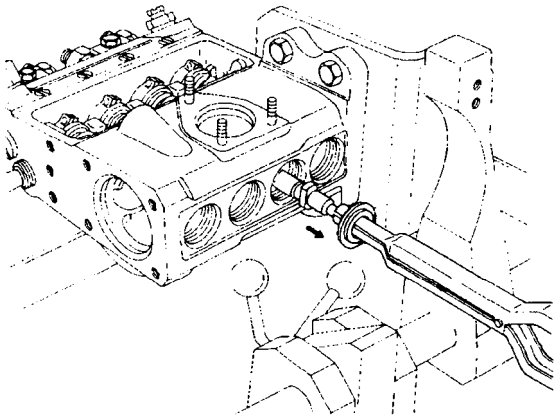


Figure 71 Removing the Spring Seats and Plungers

aa. Remove the plunger return springs and the upper spring seats from the injection pump and then remove the control sleeves from the barrel assemblies (Figure 72).

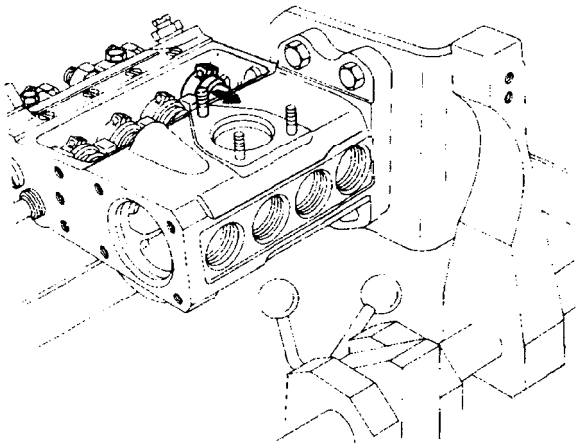


Figure 72 Removing the Control Sleeves

bb. Remove the delivery valve holder locking plates and then loosen the delivery valve holders using the socket wrench (Table 3, Serial 29). Remove the delivery valve holders and the delivery valve springs (Figure 73).

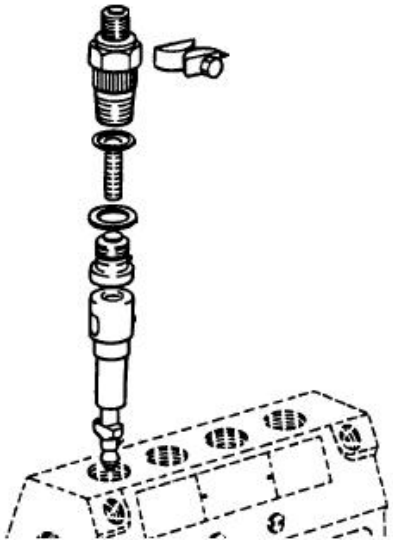


Figure 73 Removing Delivery Valve Holders and Springs

cc. Remove the delivery valve assemblies and gaskets from the top of the injection pump (Figure 74) and place the delivery valve assemblies into clean diesel fuel in their order of removal.

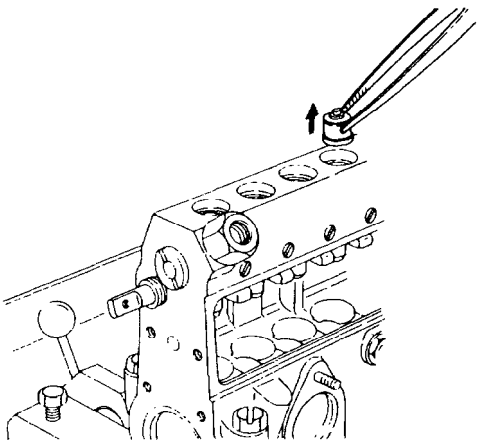


Figure 74 Removing the Delivery Valve Assemblies

CAUTION

The plungers and barrels are a matched pair and shall not be intermixed.

dd. Remove the plunger barrels from the injection pump. Attach them to the corresponding plungers and place the assemblies in the clean diesel fuel aligning them with the corresponding delivery valve assemblies. The plungers and barrels are a matched pair and shall not be intermixed.

ee. Remove the control rack guide screw from the back of the injection pump and carefully withdraw the control rack from the injection pump.

ff. Remove the bearing cones from the camshaft and, with the aid of a suitable puller, remove and retain the shims and spacers.

gg. Remove the bearing cups from the governor housing and the front bearing cover with the aid of a suitable soft drift and a hammer.

29. Cleaning and Inspection. Clean and inspect the fuel injection pump as follows:

NOTE

Do not handle the plungers or barrels excessively during the cleaning and inspection.

a. While cleaning and inspecting the plungers and barrels, avoid handling them excessively as the body heat they absorb can affect the very fine clearances between each barrel and plunger assembly.

b. Wash all parts except the barrel and plunger assemblies, the delivery valve assemblies and bearing assemblies with a suitable cleaning agent and blow them dry with clean moisture-free compressed air.

c. Wash the delivery valve assemblies and the barrel and plunger assemblies in clean diesel fuel ensuring that the matched barrels and plungers are kept together and are aligned with their corresponding delivery valve assembly.

d. Wash the bearing assemblies with a suitable cleaning agent and let them air dry.

e. Remove all trace of gasket material from the mating surfaces of covers and housings. Ensure that the camshaft compartment is thoroughly clean and that the oil feed pipe and connections are clean and free from restrictions.

f. Inspect each plunger and barrel assembly. Ensure that the helix and the inlet/spill port are not damaged, that neither the plunger nor the barrel are discoloured or scored and that the plunger moves smoothly in the barrel.

g. Lubricate each barrel and plunger assembly in clean diesel fuel. Check that each plunger slides smoothly into the barrel under its own weight when the assembly is inclined at 60 degrees (Figure 75). Rotate the plunger slightly several times and check each time that the plunger slides smoothly into the barrel. Replace the barrel and plunger assembly if the plunger fails to slide smoothly into the barrel.

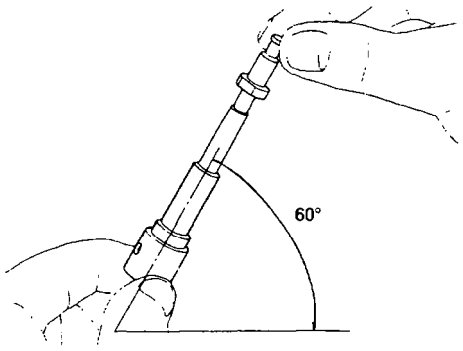


Figure 75 Checking the Plunger for Smooth Operation

h. Inspect the delivery valve and valve seat for nicks, dents or excessive wear. Hold the valve assembly and block off the fuel inlet port with a finger. Push the valve into the valve body and release the valve. Pressure of the air compressed in the bore of the valve body should cause the valve to rise when the

valve is released. Replace the delivery valve assembly if the valve fails to rise when released or if damage or wear is evident.

i. Check the delivery valve return spring for damaged, broken or weakened coils (loss of tension) and replace it as necessary.

j. Inspect the delivery valve holder for cracks or damage and for a scratched or scored sealing face. Replace the delivery valve holder as necessary.

k. Inspect the control rack bushes in the injection pump body for wear and replace the bushes as necessary.

l. Check the control rack for bend, excessive wear on the bush sliding area of the rack and for excessive wear in the gear teeth (when checked with each control pinion). Replace the control rack as necessary.

m. Check the control pinion locking screw for damage (Figure 76) which may prevent the control pinion from being locked in position. Replace worn or damaged parts as necessary.

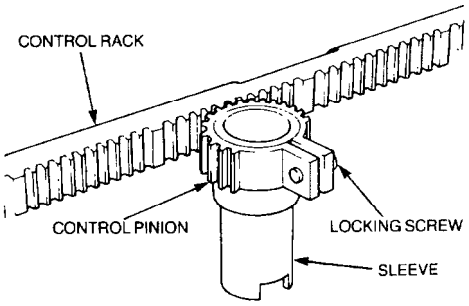


Figure 76 Checking the Control Rack and Control Pinion

n. Check the camshaft for damaged or worn lobes, damaged threads and key slots. Replace the camshaft if damage or wear is evident.

o. Inspect the camshaft roller bearings for scoring, wear or damage. Ensure that the bearings turn smoothly and freely and are a firm (press) fit onto the camshaft. Replace the bearings as necessary.

p. Check the governor housing and the front bearing cover for evidence of bearing cup rotation. Replace the governor housing and/or the front bearing cover as necessary.

q. Inspect the injection pump housing for signs of cracks or damage and check the tappet bores for wear, scoring or damage. Replace the injection pump housing if any of these faults are evident.

r. Check the injection pump housing for damaged gasket (mating) surfaces. If necessary, refinish the surfaces and ensure that they are smooth and flat. Check for damaged threads and loose or damaged studs. If necessary, clean the threads with an appropriate tap and replace any damaged studs.

s. Check the tappet rollers, bushes, guides and pins for excessive wear or damage. If wear or damage is apparent, replace the tappet assembly.

t. Inspect the plunger return springs and the upper and lower spring seats for wear or damage. Replace damaged or worn parts as necessary.

u. Check the control sleeves for damage and worn plunger slots. Replace any damaged or worn parts as necessary.

v. Overhaul the transfer pump (Paras 39 to 42).

30. Reassembly. Reassemble the fuel injection pump as follows:

a. Apply clean engine oil to the control rack and the bushes in the injection pump housing. Install the control rack into the bushes.

b. Centralize the control rack by aligning the setting marks on the outer circumference of each end of the control rack an equal distance from the injection pump housing. Install the control rack guide screw in the back of the injection pump housing and tighten it to 4.9 to 6.9 N.m (43 to 61 lbf.in).

c. Install the plunger barrels into their respective bores. Check that each barrel is properly seated by trying to rotate the barrels by hand. If a barrel can be rotated, the barrel locating pin is not entered far enough into the injection pump housing barrel bore. Remove the affected barrel and carefully drive the

pin into the bore with the aid of a suitable pin punch and hammer until there is a sufficient amount of the pin to effectively locate the barrel. Re-install the barrel.

d. Lubricate the delivery valves with clean diesel fuel and install them into their respective bores together with new copper gaskets ensuring that the gasket is installed as shown in Figure 77.

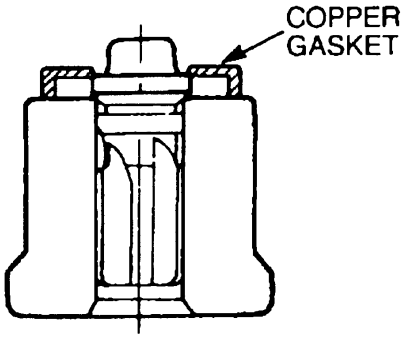


Figure 77 Delivery Valve and Gasket

e. Position the delivery valve springs over the delivery valves and install the delivery valve holders over their respective delivery valve.

f. Tighten the delivery valve holders to 39 N.m (29 lbf.ft). Loosen each holder off and retighten the holders to 39 N.m (29 lbf.ft). Re-loosen each holder and finally tighten each holder to 44 N.m (32 lbf.ft).

g. Install the delivery valve holder locking plates and tighten the retaining bolts to 4.4 to 6.8 N.m (39 to 60 lbf.in).

h. If previously removed, position the control pinions onto the control sleeves with the slit in the control pinion aligned with one of the plunger slots in the control sleeve (Figure 78) and tighten the locking screws to secure the control pinion in position.

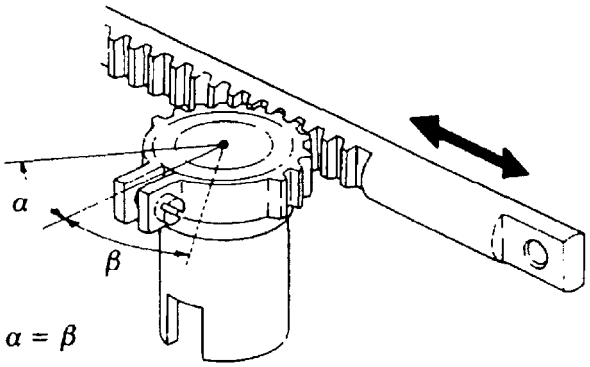


Figure 78 Control Sleeve and Control Pinion Setting Position

i. Lay the injection pump on its side and install the control sleeve assemblies with the slit in the control pinion uppermost.

j. With all control sleeve assemblies installed, move the control rack back and forth and check that the control sleeves rotate equal amounts from the centre position as the control rack is moved in both directions (Figure 78).

k. Using a depth gauge or vernier caliper, check that the full stroke of the control rack is 21 mm from the position where the control rack is pushed fully toward the governor to the position where it is pulled fully toward the drive-end of the injection pump.

l. If the control rack stroke is not 21 mm, reposition the control pinion to obtain the correct stroke.

m. Position the upper spring seats over the control sleeves and install the plunger return springs.

n. Assemble the lower spring seats onto their respective plungers and insert the inserter (Table 3, Serial 28) into the base of the spring seat.

o. Dip each plunger into clean diesel fuel and carefully install each plunger into its respective barrel, ensuring that the plunger helix is facing upward and the identification number is towards the slot in the control sleeve.

p. Lubricate each tappet assembly with clean engine oil and position a new shim of equal thickness to the one removed on each tappet assembly.

q. Using the clamp (Table 3, Serial 27), position the tappet assemblies in their respective bores aligning the tappet guide with the pump housing guide groove.

WARNING

Never place fingers inside the injection pump camshaft bore while the plunger return springs are held compressed as personal injury could result.

r. Using the return spring compression tool (Table 3, Serial 26), slowly compress each plunger return spring while aligning the plunger control arms with the slots in the control sleeve. When each spring is fully compressed, install the tappet holders, ensuring each tappet holder is positively installed into the hole in the tappet and slowly release the compression tool (Figure 79).

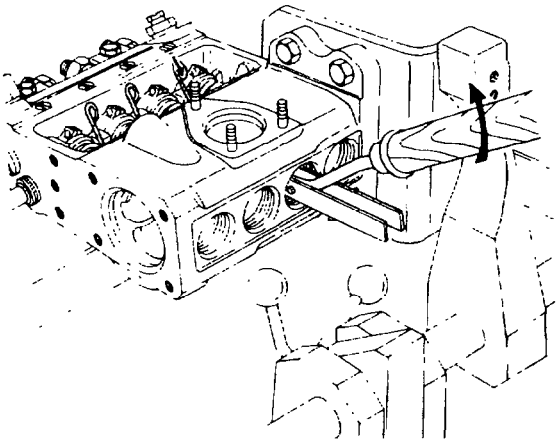


Figure 79 Installing the Tappet Holders

s. Install the spacers and shims onto the camshaft. Using a suitable arbor and press, press the bearings onto the camshaft with the tapers facing toward the ends of the camshaft, ensuring that the bearings butt firmly against the shims (Figure 80).

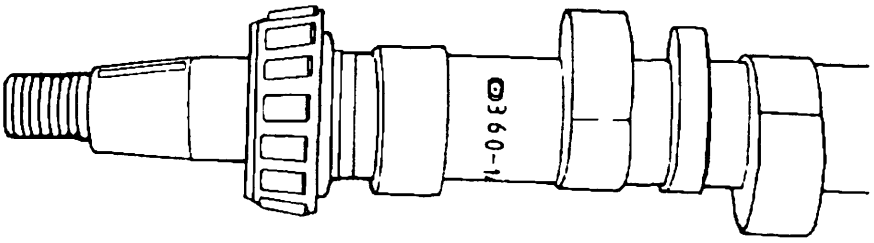


Figure 80 Camshaft Identification Number Location

t. Lubricate the bearings and camshaft lobes with clean engine oil and insert the camshaft into the injection pump housing bore with the identification code on the camshaft toward the front of the injection pump (Figure 80).

u. Press the bearing cups into the governor housing and the front bearing cover.

v. Position the governor housing together with a new gasket onto the injection pump. Install the retaining bolts with new spring washers, ensuring that the start spring eye is correctly positioned. Tighten the bolts to 6.9 to 8.8 N.m (61 to 78 lbf.in).

w. Position the front bearing cover onto the front of the injection pump and install the retaining bolts with new spring washers. Tighten the retaining bolts to 6.9 to 8.8 N.m (61 to 78 lbf.in).

x. Attach a dial indicator to the measuring device (Table 3, Serial 30) and install the measuring device onto the drive end of the camshaft.

y. Pull the camshaft toward the drive end of the injection pump and zero the dial indicator. Push the camshaft toward the governor housing. Check for an end-play reading of 0.3 mm (0.012 in). If the reading is to specification, remove the measuring device and proceed to sub-para aa. If the reading is not to specification, carry out the procedure detailed in sub-para z.

z. Remove the camshaft and remove one of the camshaft bearings and the shims. Increase the thickness of the shims to reduce the camshaft end-play or reduce the thickness of the shims to increase the end-play. Press the bearing onto the camshaft, lubricate the bearing and camshaft lobes and install the camshaft and the bearing cover. Tighten the retaining bolts and recheck the amount of end-play. Repeat this procedure as necessary to obtain the correct end-play. Remove the measuring device.

aa. Install the Woodruff keys onto both ends of the camshaft.

bb. Install the camshaft coupling onto the drive end of the camshaft using the camshaft coupling tool (Table 3, Serial 15).

cc. Rotate the camshaft with the coupling spanner (Table 3, Serial 19) and, as the camshaft lobes contact the tappets and compress the plunger return springs, remove the tappet holders.

dd. Rotate the camshaft several times to ensure that there is no jamming and that the components operate smoothly.

ee. Turn the pump on its side. Apply a thin coating of Loctite 271 to the plug threads, install the four plugs into the injection pump base and tighten them to 54 to 74 N.m (40 to 55 lbf.ft).

ff. Position the U-shape lever in the governor housing. Apply a suitable liquid adhesive to the U-shape lever pivot plug and install the plug into the governor housing, ensuring that it is properly engaged with the U-shape lever. Tighten the plug securely.

gg. Carefully install the full-load set lever and spring onto the full-load set lever shaft. Assemble the nut and spring washer to the shaft and tighten the nut to 10 to 14 N.m (88 to 124 lbf.in).

hh. Install the control rack connecting link complete with bolt and plate onto the control rack. Assemble the retaining nut and tighten it securely using two spanners.

ii. Install the start spring into the spring eye on the governor housing and, with a pair of long-nose pliers, connect the spring to the control rack connecting link (Figure 81).

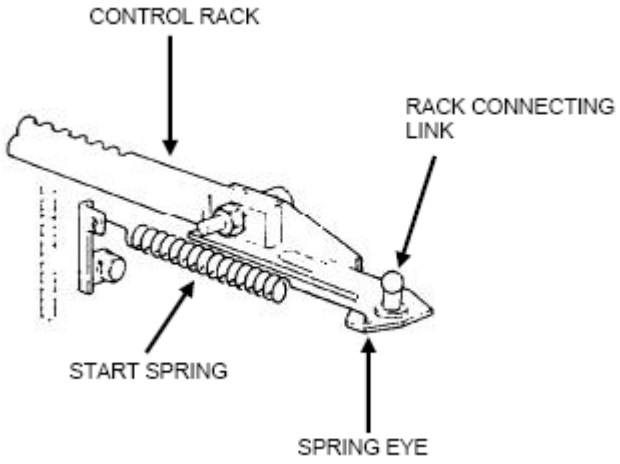


Figure 81 Connecting Link and Start Spring Location

jj. Position the flyweights onto the camshaft in the governor housing and install the flyweight locknut and new spring washer on the camshaft.

kk. Install the coupling spanner (Table 3, Serial 19) onto the camshaft coupling to prevent the camshaft from turning and with the wrench (Table3, Serial 22) and the lever (Table 3, Serial 23), tighten the flyweight locknut to 49 to 59 N.m (36 to 43 lbf.ft).

ll. Position a new gasket on the governor cover and hold the gasket in position with two of the cover retaining bolts.

mm. Turn the free end of the floating lever outward and position the governor cover on the governor housing engaging the free end of the floating lever with the ball joint on the connecting link.

nn. Install the remaining governor cover-to-housing retaining bolts and tighten them to 6.9 to 8.8 N.m (61 to 78 lbf.in).

oo. Install a new O ring onto the transfer pump flange. Locate the transfer pump onto the injection pump housing. Install the retaining nuts and new spring washers. Tighten the nuts to 4.9 to 6.9 N.m (43 to 61 lbf.in).

pp. The injection pump is now ready to be timed, pressure tested and calibrated (Paras 34 to 38).

Governor

31. Disassembly. Disassemble the governor as follows:

CAUTION

All work on fuel injection equipment must be carried out in a clean, dust free location. Dust or dirt could damage the internal components.

a. Remove the injection pump in accordance with EMEI Vehicle G 103 and place it in a clean, dust free location.

b. Access the governor as described in paragraphs 28.b to 28.q.

c. Remove the cap nut and gasket from the governor shaft (Figure 82).

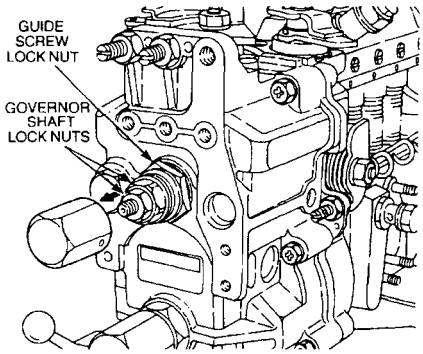


Figure 82 Governor Shaft Cap Nut and Locknuts

d. Remove the two locknuts from the governor shaft.

e. Loosen the guide screw locknut.

f. Remove the 19 mm plug covering the torque cam rod adjuster (Figure 83).

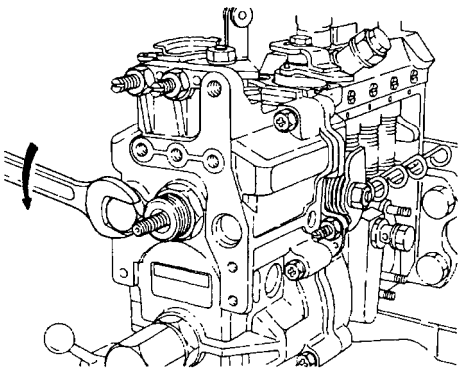


Figure 83 Removing the Torque Cam Rod Adjuster Plug

g. Remove the cap nut from the idling spring capsule, loosen the locknut and remove the idling spring capsule (Figure 84).

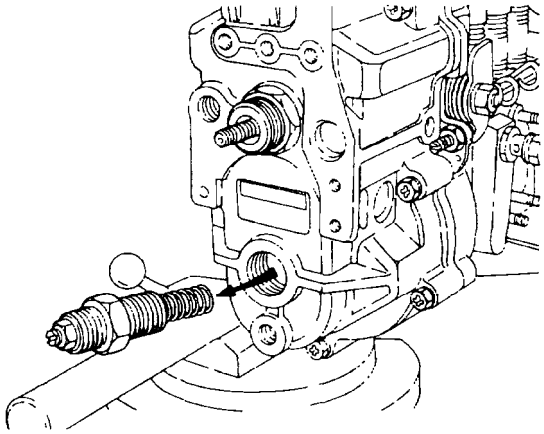


Figure 84 Removing the Idling Spring Capsule

h. Remove the seven bolts securing the cover to the governor housing and remove the cover by tapping the cover lightly with a soft-faced hammer (Figure 85). Remove and discard the gasket.

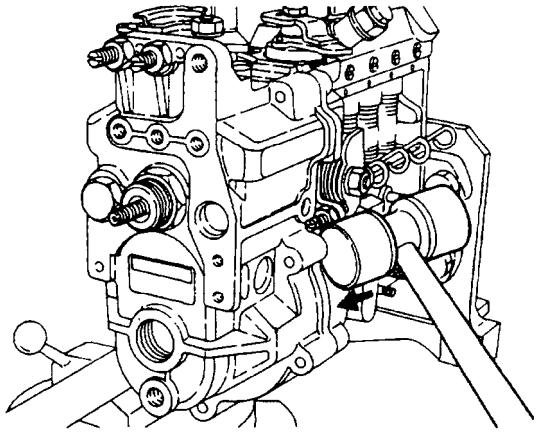


Figure 85 Removing the Governor Cover

i. Remove the governor shaft complete with springs and spring seat from the housing. Disconnect the start spring from the rack connecting link (Figure 86).

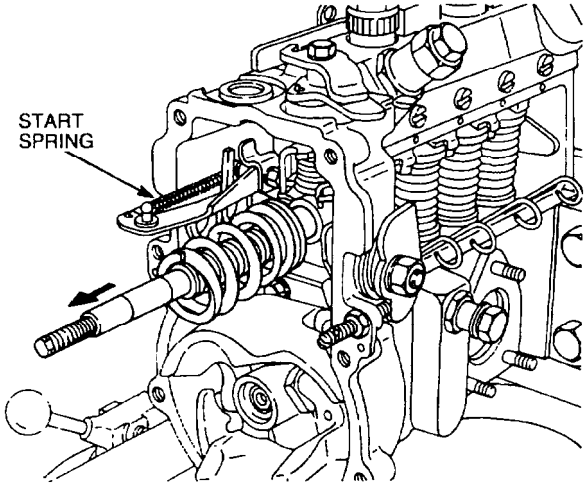


Figure 86 Removing the Governor Shaft and Start Spring

j. Remove the nut securing the connecting link to the control rack and remove the connecting link complete with the bolt and plate (Figure 87).

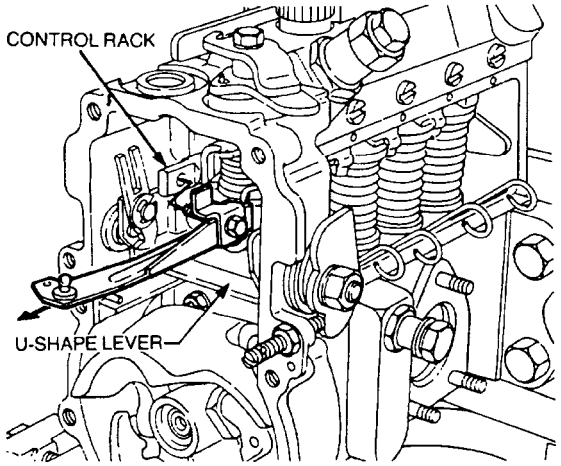


Figure 87 Removing the Connecting Link

k. Remove the snap-ring securing the sensor lever to the U-shaped lever and remove the sensor lever (Figure 88).

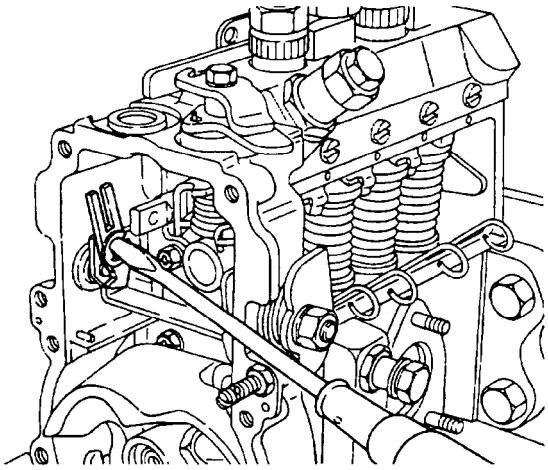


Figure 88 Removing the Sensor Lever

l. Remove the nut securing the full-load setting lever to the U-shaped lever (Figure 89) and remove the full-load setting lever together with the return spring.

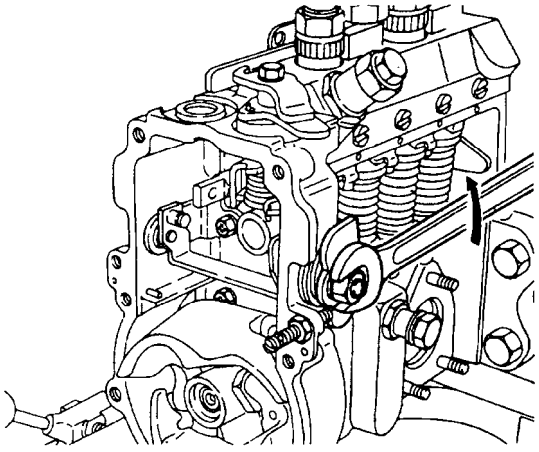


Figure 89 Full-load Setting Lever Retaining Nut Removal

m. Remove the U-shaped lever guide plug from the side of the governor housing and remove the U-shaped lever, full-load setting lever shaft and cancel spring (Figure 90).

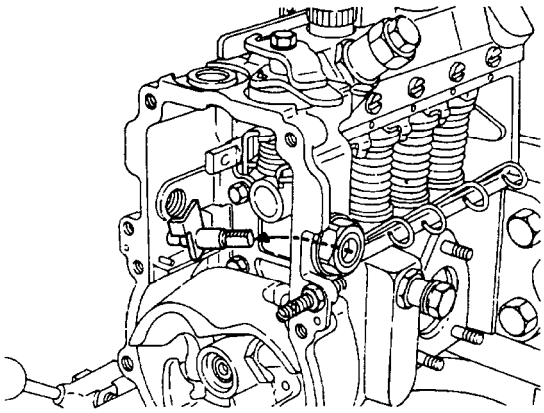


Figure 90 Removing the Full-load Setting Lever Shaft

n. Remove the bolt securing the stop lever to the stop lever shaft and remove the stop lever, cap, return spring, O ring, shim and shaft from the governor housing (Figure 91). Discard the O ring.

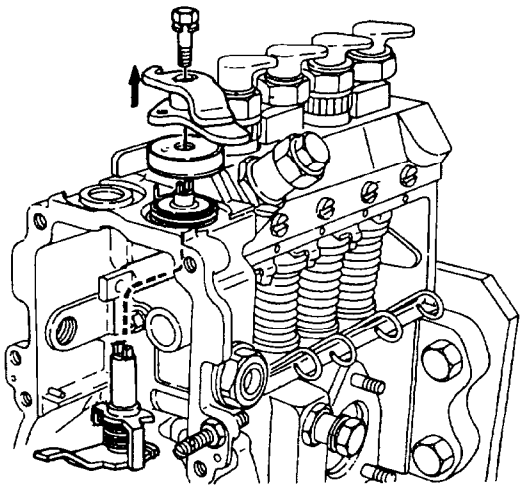


Figure 91 Removing the Stop Lever Assembly

o. Position the coupling spanner (Table 3, Serial 19) on the camshaft coupling to prevent the camshaft from turning and remove the flyweight retaining nut using the wrench (Table 3, Serial 20) and the lever (Table 3, Serial 23). Install the extractor (Table 3, Serial 24) into the flyweights and remove the flyweights (Figure 92).

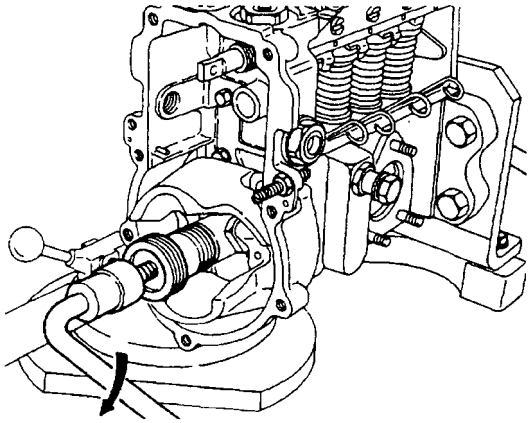


Figure 92 Removing the Flyweights

p. Using a Phillips screwdriver and the socket (Table 3, serial 25) remove the seven bolts and spring eye from the governor housing and lightly tap the housing with a soft-faced hammer to separate it from the injection pump (Figure 93).

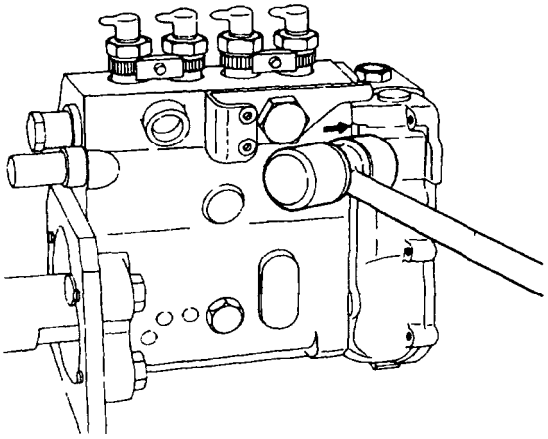


Figure 93 Removing the Governor Housing

q. Remove the governor shaft guide screw and locknut from the governor housing and remove the snap-ring securing the torque cam adjusting rod to the torque cam (Figure 94).

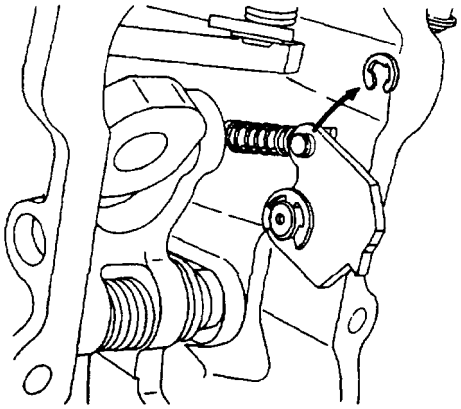


Figure 94 Removing the Snap-ring

r. Remove the two plugs pressed into the sides of the governor housing using a suitable punch.

s. Unhook the cancel spring from the tension lever and push the tension lever pivot shaft out through the hole in the side of the governor housing (Figure 95).

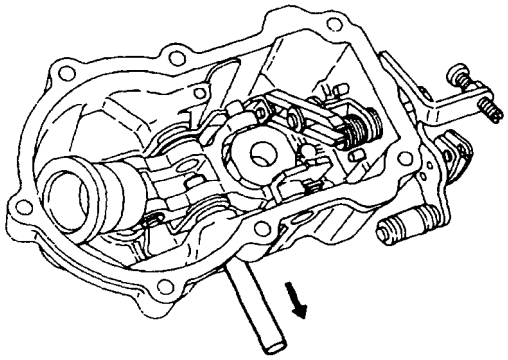


Figure 95 Removing the Tension Lever Pivot Shaft

t. Remove the guide lever, cancel spring and tension lever assembly from the governor cover.

u. Remove the snap-ring securing the torque cam to the pivot pin and remove the torque cam from the governor cover (Figure 96).

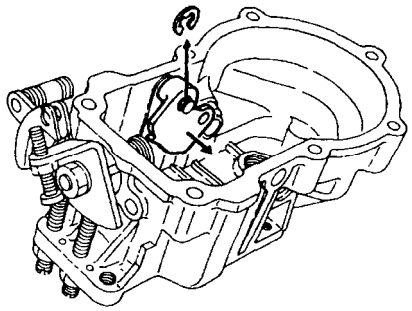


Figure 96 Removing the Torque Cam

v. Remove the nut and spring washer securing the control lever to the control lever shaft and remove the control lever.

w. Remove the control lever shaft and floating lever assembly from the governor cover (Figure 97).

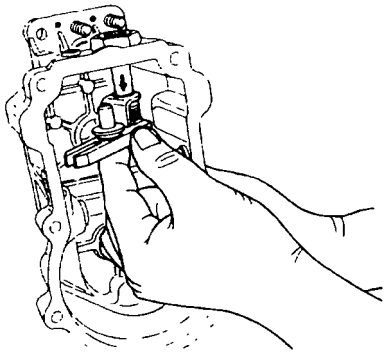


Figure 97 Removing the Control Lever Shaft and Floating Lever Assembly

x. Remove the snap-ring from the pivot pin and remove the pivot pin. Separate the sleeve and shifter assembly from the tension lever (Figure 98).

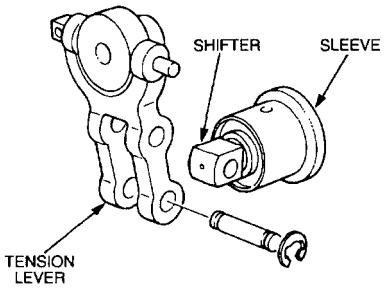


Figure 98 Removing the Snap-ring and Pivot Pin

y. Remove the circlip securing the shifter to the sleeve and remove the shifter and bearing assembly from the sleeve (Figure 99).

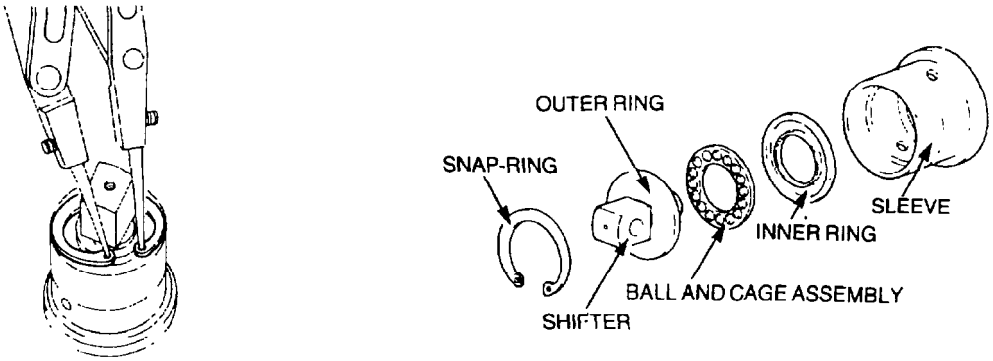


Figure 99 Removing the Shifter and Bearing

32. Cleaning and Inspection. Clean and inspect the governor as follows:

WARNING

DO NOT spin the bearings with compressed air as personal injury or damage to the bearings may result.

a. Clean all components with a suitable cleaning agent and then blow them dry with compressed air.

b. Inspect the governor cover and housing for wear or damage. Check for bent or damaged pivot pins or worn bushes. Replace the governor cover or housing if any of these faults are found. If the governor housing is to be replaced, remove the camshaft outer bearing cup from the housing for further use.

c. Inspect the flyweight assembly. Check for perceivable radial clearance between the flyweight and the pivot pin and the slider and pivot pin. Check for excessive wear on the contact surface of the slider (Figure 100). If any of these faults are found, replace the flyweight assembly.

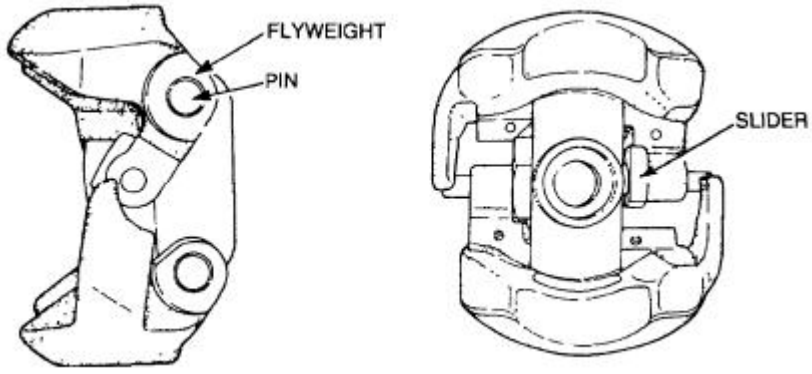


Figure 100 Flyweight Inspection

d. Inspect the pivot pin bores in the tension lever for wear and check for wear on the spring seat and the governor shaft bore in the spring seat. If excessive wear is evident in any of these locations, replace the tension lever.

e. Inspect the shifter for wear in the pivot pin bore and check the sleeve for excessive wear on the slider contact surface. Replace the shifter and/or the sleeve if excessive wear is evident.

f. Inspect the shifter/sleeve bearing for wear, pitting, cracks or damage. If replacement is required, press the bearing outer ring from the shifter as shown in Figure 101.

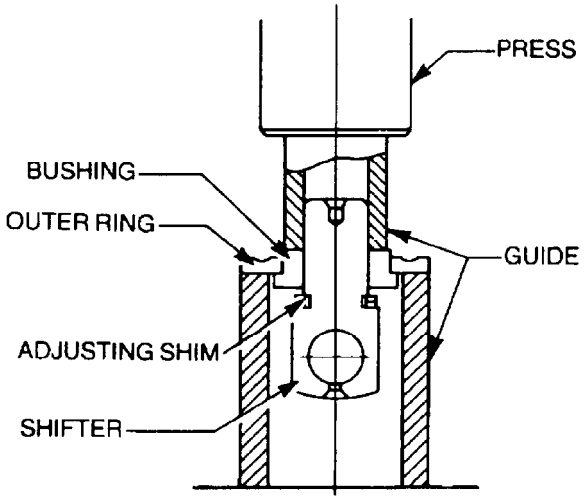


Figure 101 Removing the Bearing Outer Ring From the Shifter

g. Check the sensor lever and the torque cam for wear at the points shown in Figure 102. Replace the sensor lever and/or the torque cam if excessive wear is evident.

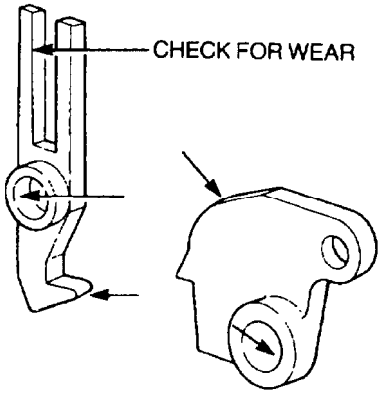


Figure 102 Sensor Lever and Torque Cam Wear Points

h. Inspect the control lever shaft assembly and the control rack connecting link for damage or wear (Figure 103). Replace any part showing excessive wear.

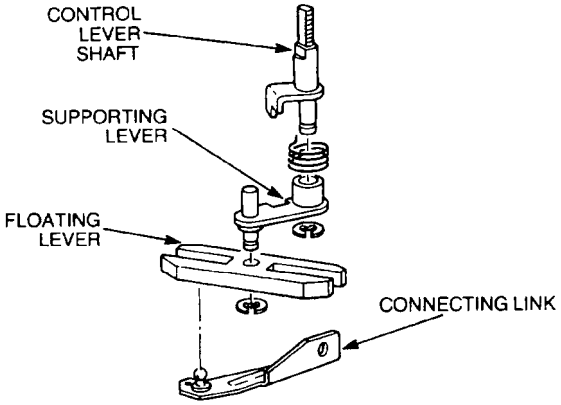


Figure 103 Control Lever Shaft Assembly and Connecting Link

i. Inspect all springs (Figure 104) for distortion, excessive wear, cracks or damage and replace as necessary.

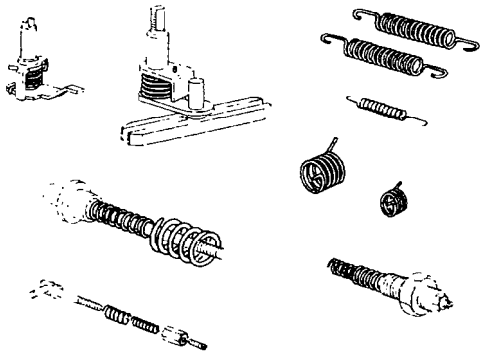


Figure 104 Governor Springs

j. Inspect the governor shaft and replace the shaft if wear or damage is evident.

33. Reassembly. Reassemble the governor as follows:

a. Install a new oil seal into the control lever shaft bore at the top of the governor housing.

b. Install the camshaft bearing outer cup into the governor housing.

c. Position the governor housing together with a new gasket onto the injection pump. Install the retaining bolts with new spring washers, ensuring that the start spring eye is correctly positioned and tighten the bolts to 6.9 to 8.8 N.m (61 to 78 lbf.in).

d. Insert the woodruff key into the camshaft keyway. Align the keyway in the flyweight assembly with the key on the camshaft and locate the flyweight assembly onto the camshaft. Install the flyweight assembly retaining nut together with a new lock-washer.

e. Position the coupling spanner (Table 3, Serial 19) on the camshaft coupling to prevent the camshaft from turning and tighten the flyweight retaining nut 49 to 59 N.m (36 to 43 lbf.ft) using the wrench (Table 3, Serial 20) and the lever (Table 3, Serial 23).

f. If the shifter/sleeve was replaced, press the new bearing outer ring onto the shifter bush ensuring that the bearing running surface is facing away from the bush shoulder and that the bearing butts against the bush shoulder (Figure 101).

g. Smear the ball bearing and cage assembly and both rings with grease. Position the inner ring, ball bearing and cage assembly, outer ring and shifter assembly into the sleeve and install a new circlip, ensuring that it is properly seated in the groove in the sleeve. Ensure that the sleeve rotates smoothly on the shifter.

h. Position the shifter and sleeve assembly in the flyweight assembly, ensuring that the shifter and sleeve assembly contacts the flyweight holder.

i. Hold the shifter and sleeve assembly against the flyweight holder to ensure that the flyweights are in the zero lift position and measure the distance between the governor housing face and the centre of the pivot pin hole in the shifter (Figure 105). The dimension should be 28.8 to 29.2 mm (1.134 to 1.149 in). If the dimension is to specification, proceed to sub-para k. If the dimension is not to specification, carry out the procedures detailed in sub-para j.

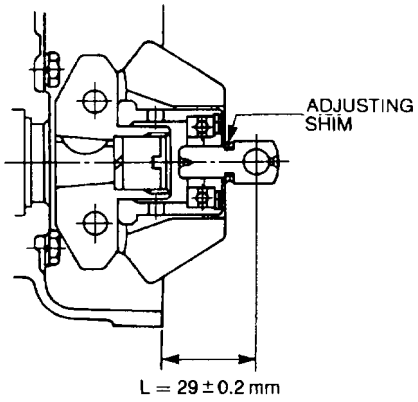


Figure 105 Shifter and Sleeve Assembly Setting Dimension

j. Disassemble the shifter and sleeve assembly and press the bush and bearing outer ring from the shifter to gain access to the adjusting shims. Either increase or decrease the thickness of the shims to obtain the correct dimension. Reassemble the shifter and sleeve assembly and verify that the dimension is correct. If necessary, repeat this procedure until the correct dimension is obtained.

k. Position the tension lever over the shifter. Align the pivot pin holes, install the pivot pin and secure it with new snap-rings (Figure 106).

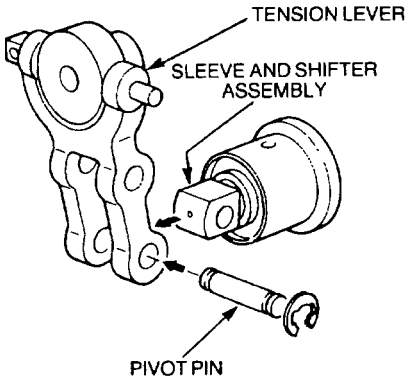


Figure 106 Connecting Sleeve and Shifter Assembly

l. Install the torque cam control rod into the governor seat locating pin on the tension lever and then adjust the nut until 3 to 6 mm of thread protrudes from the nut.

m. Lubricate the sealing lip on the oil seal with grease and carefully install the control lever shaft assembly into the bore at the top of the governor cover (Figure 107).

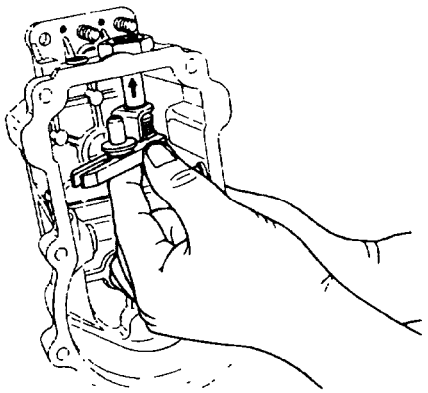


Figure 107 Installing the Control Lever Shaft Assembly

n. Position the control lever over the control lever shaft. Install the retaining nut together with a new spring washer and then tighten the nut securely.

o. Position the torque cam on the pivot pin in the governor cover (Figure 108) and secure the torque cam in place with a new snap-ring.

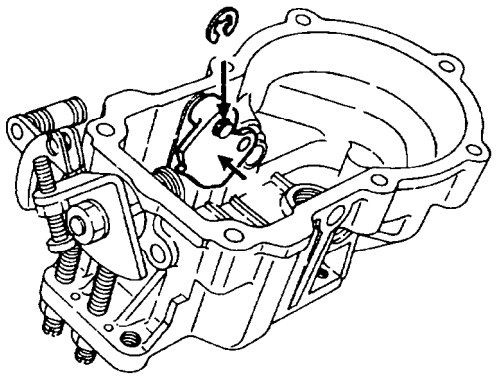


Figure 108 Installing the Torque Cam

p. Install new bushes in the guide lever and position the guide lever in the governor cover ensuring that the ball joint is correctly engaged in the floating arm.

q. Install the tension lever into the governor cover. Position the lever between the bushes on the guide lever, align the tension lever shaft holes in the guide lever and tension lever with those in the governor cover and then start the tension lever shaft into the governor cover, guide lever and tension lever.

r. Install the cancel spring between the tension lever fork legs.

s. Align the bore of the spring with the tension lever shaft and push the shaft in until both ends of the shaft are supported by the governor cover.

t. Install a new expansion plug into the governor cover at both ends of the tension lever shaft (Figure 109). Apply a liquid adhesive to the outside of each plug to prevent oil leakage.

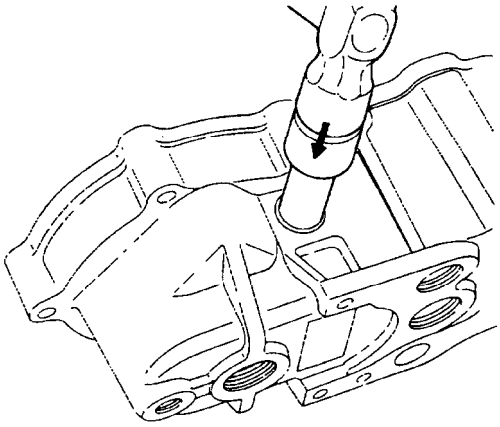


Figure 109 Installing Expansion Plugs

u. Attach the cancel spring to the tension lever (Figure 110).

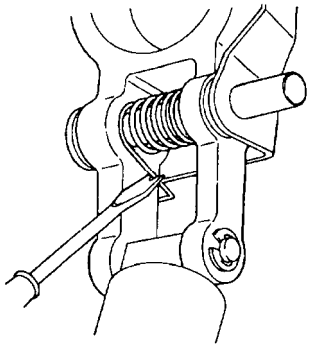


Figure 110 Attaching Cancel Spring to Tension Lever

v. Connect the torque cam control rod to the torque cam and secure it in place with a new snap-ring.

w. Install the stop control lever shaft through the aperture in the top of the governor housing. Position a new O ring, the shims, return spring, cap and stop lever onto the shaft. Install the retaining bolt together with a new spring washer and tighten the bolt to 10 to 14 N.m (7 to 10 lbf.ft).

x. Install the full-load setting lever shaft and cancel spring into the governor housing and position the full-load setting lever over the end of the shaft. Install the retaining nut together with a new spring washer and tighten the nut to 10 to 14 N.m (7 to 10 lbf.ft).

y. Position the U-shaped lever onto the full-load setting lever shaft and then link the end of the cancel spring over the U-shaped lever.

z. Apply a suitable liquid adhesive to the threads of the U-shaped lever guide plug, install the guide plug into the governor housing, ensuring that the U-shaped lever is properly engaged with the guide plug and tighten the guide plug to 20 to 29 N.m (15 to 21 lbf.ft).

aa. Position the sensor lever on the U-shaped lever and secure it in place with a new snap-ring.

bb. Position the control rack connecting link complete with bolt and plate on the control rack with the end of the bolt positioned in the fork of the sensor lever. Install the retaining nut and tighten it securely.

cc. Install one end of the start spring into the spring eye secured to the governor housing and the other end into the control rack connecting link with the aid of long-nose pliers (Figure 111).

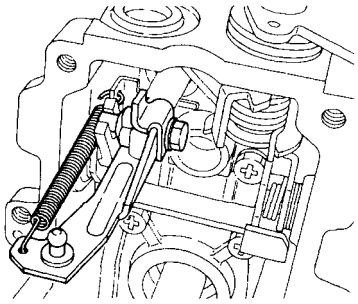


Figure 111 Installing the Start Spring

dd. If previously removed, install the spring seat and springs onto the governor shaft and insert the governor shaft into the bore in the governor housing (Figure 112).

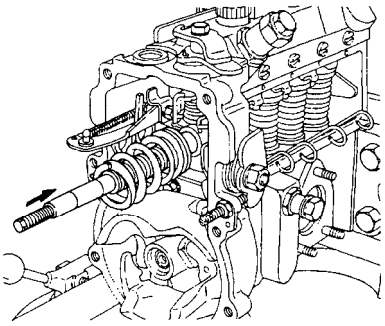


Figure 112 Installing the Governor Shaft

ee. Position a new gasket on the governor housing and install the governor cover, aligning the ball joint on the connecting link with the fork in the floating lever and aligning the shifter and sleeve assembly with the flange on the flyweights. Install the seven retaining bolts and tighten them to 7 to 9 N.m (62 to 80 lbf.in).

ff. Install the governor shaft guide screw complete with locknut. Install the idling spring capsule complete with the idling springs (Figure 113).

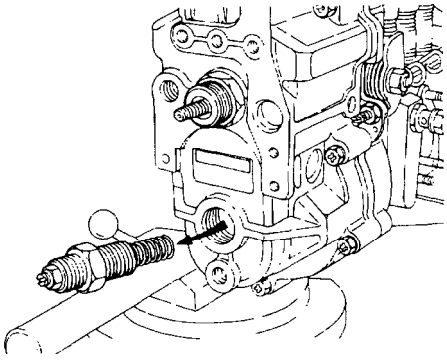


Figure 113 Installing the Idling Spring Capsule

gg. Connect the coupling spanner (Table 3, Serial 19) onto the camshaft coupling and rotate the camshaft until the lobe on number one cylinder raises the tappet and remove the tappet holder installed at Para 28.j. Repeat the procedure for the remaining cylinders.

hh. Remove the injection pump from the overhaul vice and set it aside.

Injection Pump Timing

34. Adjustment. Adjust the injection pump timing as follows:

a. Mount the pump on the calibration stand, add approximately 180 ml of clean engine oil and install a suitable plug into the oil feed hole.

b. Connect the fuel feed hose directly to the injection pump fuel gallery and connect the high pressure fuel lines to the delivery valve holders.

c. Install a dial indicator (Table 3, Serial 31) over the end of the control rack.

d. Fully loosen off the governor shaft locknuts and set the pump rotating in a clockwise direction (as viewed from the drive end of the injection pump) at a speed of 1 000 to 1 200 .

e. Push the governor shaft in until it contacts the wall of the injection pump housing and then set the control rack at the position where the dial indicator reads zero.

f. Stop the injection pump and set the injection pump control lever to the full-load position.

g. Remove the high pressure fuel line from the injection pump number one cylinder and remove the delivery valve holder locking plate, the delivery valve holder, delivery valve return spring and the delivery valve assembly.

h. Install the plunger pre-stroke measuring device (Table3, Items 32 and 33) into the bore of number one cylinder (Figure 114).

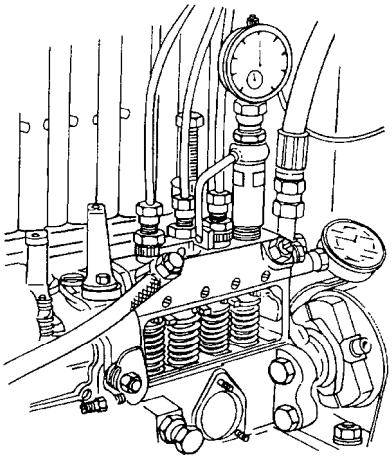


Figure 114 Installing the Pre-stroke Measuring Device

i. Rotate the injection pump camshaft by hand to bring the camshaft lobe on number one cylinder to bottom dead centre (BDC). Zero the dial indicator and then continue rotating the camshaft and check that the reading of the dial indicator varies with the lift of the camshaft lobe.

j. Using suitable calibration oil, set the test stand supply pump to 20 kPa (3 psi), start the supply pump, open the bleed screw on the injection pump to bleed off all the air from the injection pump fuel gallery and then close the bleed screw.

k. With calibration oil flowing from the measuring device on number one cylinder, rotate the camshaft in the clockwise direction until the calibration oil stops flowing and check for a pre-stroke reading of 3.6 +0.05 mm on the dial indicator.

l. If the reading is not to specification, stop the supply pump and rotate the camshaft until number one camshaft lobe is at TDC. Install a return spring compression tool (Table 3, Serial 26) and rotate the camshaft until the tappet is sufficiently clear of the spring seat to enable the shim to be replaced.

WARNING

Do not place fingers near the plunger return spring while the spring is being held in compression otherwise personal injury could result.

m. Remove the shim from the top of the tappet and install a thicker shim to decrease the plunger-lift-to-port-closing or a thinner shim to increase the plunger-lift-to-port-closing. Rotate the camshaft until the number one lobe is at TDC and remove the return spring holding tool.

n. Start the supply pump and measure the pre-stroke again. Replace the shim as necessary to obtain the correct pre-stroke specification.

o. Once the correct setting has been obtained, stop the supply pump and remove the plunger pre-stroke measuring device.

p. Install the delivery valve assembly, the delivery valve return spring and the delivery valve holder together with a new copper gasket into cylinder number one.

q. Tighten the delivery valve holder to 39 N.m (29 lbf.ft), loosen the holder and retighten the delivery valve holder to 39 N.m (29 lbf.ft), loosen the holder again and finally tighten the holder to 44 N.m (32 lbf.ft).

r. Set the test stand flywheel pointer to an arbitrary angle graduation and record the exact number of degrees.

s. Open the bleed-off valve at the number three fuel outlet on the test stand. Start the supply pump and adjust the pressure until a steady stream of calibration oil flows from the bleed-off valve. Rotate the camshaft clockwise by hand until the oil stops flowing. Note the number of degrees on the test stand flywheel. If the rotation, in degrees, is not 90° +30', stop the supply pump and replace the tappet shim as detailed in sub-paras l and m. Repeat the test procedure until the correct number of degrees is obtained. Repeat the procedure for cylinders four and two.

Injection Pump Pressure Test

35. Test Procedure. Test the injection pump pressure as follows:

a. With the injection pump mounted on the test stand, connect the test stand fuel supply hose to the injection pump fuel gallery and tighten the connection securely.

b. Start the test stand fuel supply, bleed all the air from the injection pump fuel gallery and close off the bleed screw.

c. Slowly supply fuel to the injection pump until a pressure of 1 725 kPa (250 psi) is obtained, stop the supply pump and check for fuel leaks. A rapid drop in pressure indicates a fuel leak. A very small leak between the barrel and plunger is permissible.

d. Repair or replace parts as necessary to rectify any leak.

Calibration

36. Preliminary Checks. Carry out the following preliminary checks:

a. Ensure that the pump is aligned, properly connected and secured to the test stand.

b. Check that the fuel supply hoses are correctly connected and secured to the transfer pump and that an overflow valve is installed in place of the blanking plug in the injection pump fuel gallery.

c. Ensure that the fuel supply hoses to the transfer and injection pumps and the fuel return hose from the overflow valve are correctly installed and free from restriction.

d. Check that each test nozzle is functioning correctly. Repair or replace any faulty nozzle as necessary.

e. Ensure that the high pressure fuel lines are in good condition and correctly installed and that each of the injection pump cylinders is connected to its corresponding test nozzle on the calibration stand.

f. Check the temperature of the calibration oil (or test fuel) at the injection pump fuel inlet is 38 to 41 degrees C.

37. Preparation and Run-in. Prepare the injection pump as follows:

a. Ensure that the fuel system is primed. Loosen the overflow valve connection on the injection pump and operate the hand primer plunger on the transfer pump. The system is primed when the calibration oil (or test fuel) flows from the overflow valve in a steady stream and is free from air bubbles.

b. Remove the idling spring capsule assembly from the governor cover; loosen the maximum-speed setting bolt and the full-load setting bolt.

c. Position the governor adjusting device (Table 3, Serial 34) over the control lever, attach the adjusting device support bracket to the test stand and align the mark on the supporting bracket with one of the match marks on the scale plate (Figure 115).

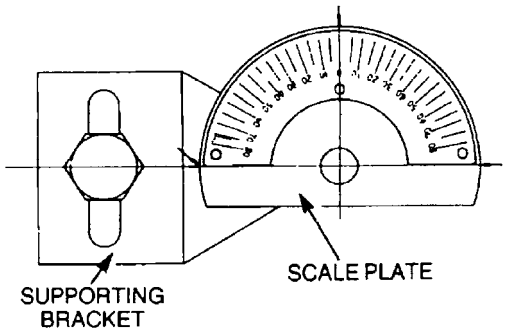


Figure 115 Aligning the Adjusting Device Match Marks

d. Move the support bracket of the adjusting device until pin 'A' is over the centre hole of the control lever shaft (Figure 116), secure the support bracket in place and insert pin 'B' into the hole in the control lever.

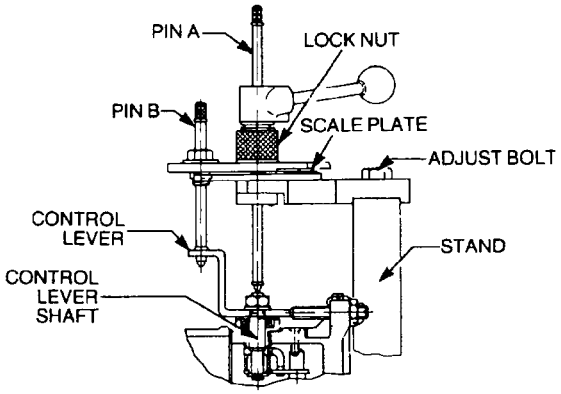


Figure 116 Positioning the Adjusting Device

e. Loosen the adjusting device locking handle and check that the injection pump control lever and pin 'B' move smoothly.

f. Verify that there is approximately 180 ml of clean engine oil in the injection pump and governor assembly.

g. Install the dial indicator (Table 3, Serial 31) onto the end of the control rack.

h. Lock the control lever in the idle position and push the governor shaft into the governor housing until it contacts the injection pump housing.

i. Start the test stand motor and run the pump at 1 000 to 1 200 and check the zero position as indicated on the dial indicator.

38. Calibration Procedure. Calibrate the injection pump as follows:

NOTE

Fuel delivery figures given in this instruction are per 1 000 strokes.

Drain the calibrated containers after each fuel delivery reading.

a. Remove the control rack guide screw from the back of the injection pump and replace it with the control rack locking screw (Table 3, Serial 35) and set the calibration stand to 1 000 strokes.

b. Set the control rack at 11.3 mm using the dial indicator, lock the rack in position with the locking screw and run the pump at 950 . Fuel delivery should be 67.3 to 70.3 ml per cylinder with a maximum variation of ±2.5% between the cylinders.

c. If the fuel injection quantity on any cylinder is not to specification, adjust the cylinder(s) by loosening the clamping screw on the control pinion and, with the aid of a suitable tool inserted into one of the holes in the side of the control sleeve, rotate the sleeve to adjust the quantity of fuel delivered by that cylinder, tighten the clamping screw and remove the adjusting tool. Rotating the control sleeve towards the governor increases the fuel quantity. Repeat the procedure for other cylinders as required.

d. Repeat the testing and adjustment procedures as per sub-paras b and c until the correct delivery quantity is achieved for each cylinder, ensuring the calibrated containers are drained after each test.

e. Loosen the control rack locking screw, set the control rack to 9.6 mm, lock it in position and run the pump at 290 . Fuel delivery should be 6.7 to 9.3 ml per cylinder with a maximum variation of ±14% between the cylinders. Adjust the position of the control sleeves, as described in sub-para c as necessary to achieve the correct fuel delivery. Repeat the test and adjustment procedure until the correct delivery quantity is achieved for each cylinder.

f. Loosen the control rack locking screw and adjust the position of the control rack to 11.3 mm using the control lever, lock the control lever in position and run the pump at 950 . Fuel delivery should be 67.8 to 69.8 ml without variation between cylinders. Adjust cylinders as described in sub-para c as necessary to achieve correct fuel delivery.

g. Using the control lever, adjust the control rack position to 10.95 mm, lock the control lever and run the pump at 1 600 . Fuel delivery should be 67.0 to 70.2 ml without variation between cylinders. Adjust the cylinders as described in sub-paragraph c. as necessary to achieve the correct fuel delivery. Repeat the test and adjustment procedure until the correct delivery quantity is achieved for each cylinder.

h. Move the control lever to bring the control rack to 11.15 mm, lock the control lever and run the pump at 1 300 . Fuel delivery should be 70.9 to 74.1 ml without variation between cylinders. Adjust the cylinders, as described in sub-paragraph c. as necessary to achieve the correct fuel delivery. Repeat the test and adjustment procedure until the correct delivery quantity is achieved for each cylinder.

i. Move the control lever to bring the control rack to 11.05 mm, lock the control lever, run the pump at 650 and check that the fuel delivery is 48.7 to 51.9 ml without variation between cylinders.

j. Move the control lever to bring the control rack to 11.4 mm, lock the control lever, run the pump at 500 and check that the fuel delivery is 49.9 to 53.9 ml without variation between cylinders.

k. After setting the fuel injection quantities, adjust the governor.

l. Hold the control lever in the idling position and increase the pump speed to 500 to 600 , move the control lever to the maximum speed position and adjust the full-load setting bolt to set the control rack 3 mm beyond the maximum speed position.

m. Set the pump speed at 80 to 100 and adjust the idle setting bolt (Figure 117) so that the control rack is at 11.5 mm.

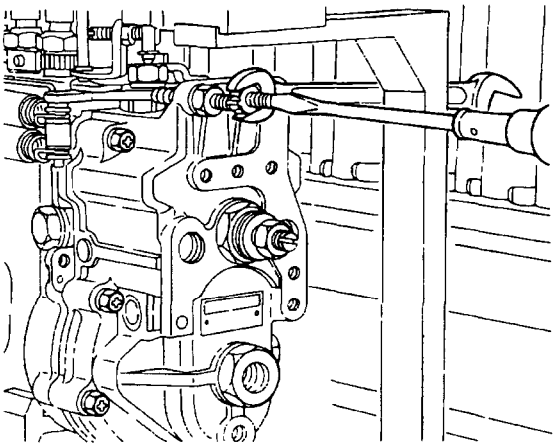


Figure 117 Idle Setting Bolt Adjustment

n. Set the pump speed to 220 , install the idling spring capsule with a new gasket and screw the capsule in (Figure 118) until the control rack is at approximately 9.5 mm. Hold the idling spring capsule in this position and tighten the locknut to 18 to 22 N.m (13 to 16 lbf.ft). The outer idling spring is now set.

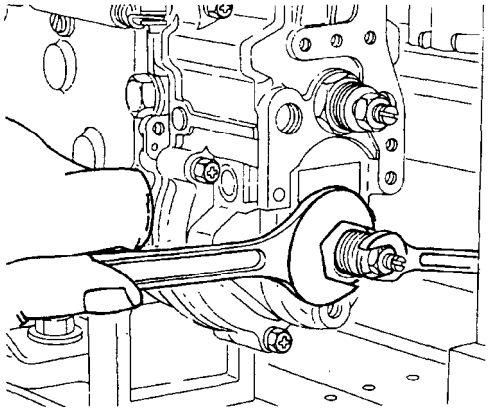


Figure 118 Outer Idling Spring Adjustment

o. Set the pump speed to 240 , adjust the screw on the idling capsule (Figure 119) until the control rack is at 9.5 mm and tighten the locknut securely without moving the screw. The inner idling spring is now set.

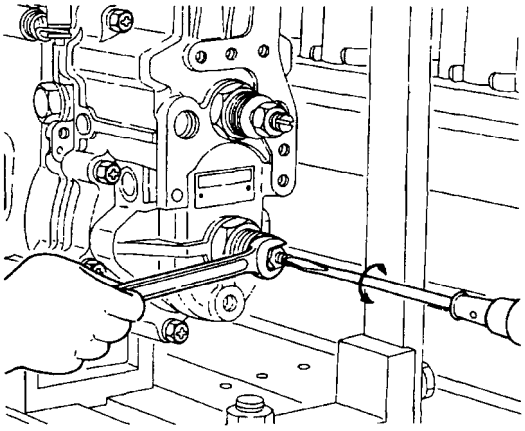


Figure 119 Inner Idling Spring Adjustment

p. Install the cap nut with a new gasket and tighten the cap nut to 16 to 20 N.m (12 to 15 lbf.ft).

q. Check that the governor shaft guide screw protrudes 13.5 to 14.5 mm from the governor cover (Figure 120) and adjust as necessary. Tighten the locknut to 39 to 48 N.m (29 to 36 lbf.ft).

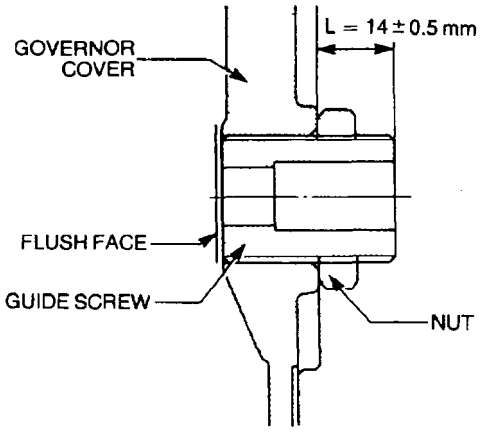


Figure 120 Governor Shaft Guide Screw Adjustment

r. Position and lock the control lever in the idling position, set the pump speed to 630 , turn the adjusting nut on the governor shaft (Figure 121) to bring the control rack to 6.6 mm and tighten the locknut to 10 to 14 N.m (7 to 10 lbf.ft).

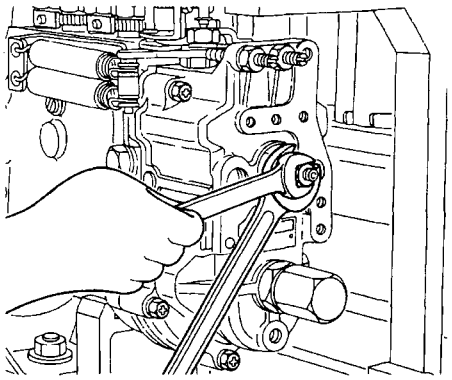


Figure 121 Governor Shaft Spring Adjustment

s. Increase the pump speed to bring the control rack to 3.5 mm and check that the pump speed is 1 100 ±50 .

t. Increase the pump speed until the control rack reaches the zero position on the dial indicator and check that the pump speed is 1 340 . After correct adjustment is made, install the cap nut with a new gasket and tighten the cap nut to 29 to 39 N.m (21 to 29 lbf.ft).

u. Set the pump speed to 240 , adjust the idling setting bolt to bring the control rack to 9.5 mm and tighten the locknut securely.

v. Set the pump speed to 80 to 100 and check that the control rack is at 11.5 mm.

w. Set the pump speed to 1 120 , set the control lever in the position where it makes contact with the maximum speed setting bolt and adjust the maximum speed setting bolt (Figure 122) so that the control rack begins to move in the fuel decrease direction while the pump speed is 1 600 plus 35 or minus 25 . Tighten the locknut on the maximum speed setting bolt.

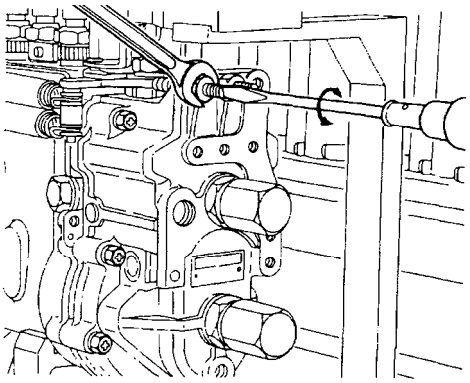


Figure 122 Maximum Speed Setting Bolt Adjustment

x. Set the pump speed to 1 120 , adjust the full-load setting bolt to bring the control rack to 11.3 mm and tighten the locknut (Figure 123).

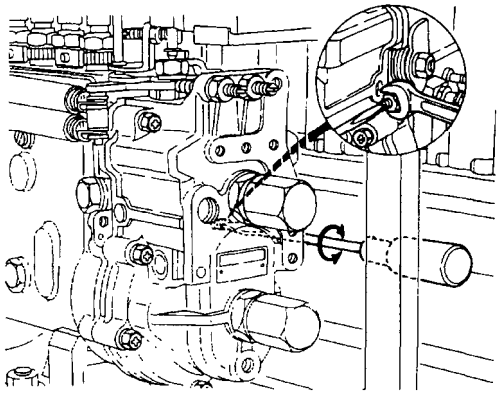


Figure 123 Full-load Setting Bolt Adjustment

y. Set the pump speed to 225 and, using the torque cam wrench (Table 3, Serial 36), adjust the nut on the torque cam control rod (Figure 124) to bring the control rack to 11.15 mm. Once the correct adjustment has been made, lock the adjusting nut with the lock screw.

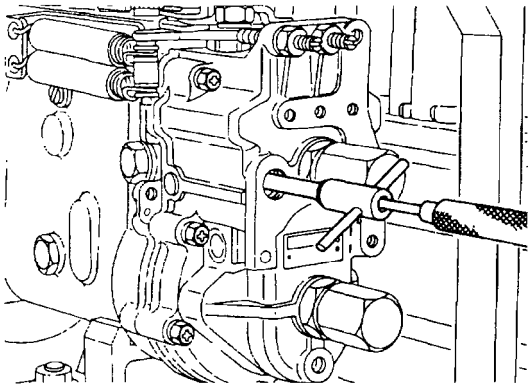


Figure 124 Torque Cam Control Rod Adjustment

z. Decrease the pump speed to 190 , then increase the pump speed to 1 600 plus 35 or minus 25 to ensure that the control rack position is to specification for the corresponding pump speeds. If not, adjust the torque cam control rod to obtain the correct settings. If adjustment cannot be made, replace the torque cam.

aa. Check the fuel injection quantities as specified in sub-paras e to i. If necessary, adjust the full-load setting bolt and the torque cam adjusting nut to bring the quantities to specification.

bb. Set the pump speed to 1 600 plus 35 or minus 25 , move the control lever to maximum speed and lock the control lever when it makes contact with the maximum speed setting bolt. Adjust the maximum speed setting bolt until the control rack begins to move from 1 to 1.3 mm toward fuel decrease and tighten the setting bolt locknut.

cc. Check the speed drop by gradually increasing the pump speed to 1 780 ±50 and confirm that the control rack moves to 9.5 mm. Increase the pump speed further and ensure that the control rack moves to 0 mm.

dd. After the governor adjustments have been made, stop the pump, install the plug with a new gasket into the governor cover of the torque cam adjusting nut and tighten the plug to 20 to 29 N.m (15 to 21 lbf.ft).

ee. Install lock wire and seals between the idle and maximum speed setting bolts, between the governor shaft and idling spring cap nuts and into the full-load setting bolt.

ff. Disconnect the fuel lines from the fuel injection pump and the transfer pump and remove the injection pump from the calibration stand.

gg. Remove the coupling device from the injection pump camshaft, install the automatic timing device and tighten the timing device retaining nut to 49 to 59 N.m (36 to 43 lbf.ft).

hh. Install the fuel injection pump in accordance with EMEI Vehicle G 103.

Transfer Pump

39. Disassembly. Disassemble the transfer pump as follows:

CAUTION

All work on the fuel transfer pump must be performed in a clean, dust free location. Dust or dirt could damage the internal components.

a. Remove the transfer pump in accordance with EMEI Vehicle G 103 and place it in a clean, dust free location. An exploded view of the transfer pump is shown in Figure 125.

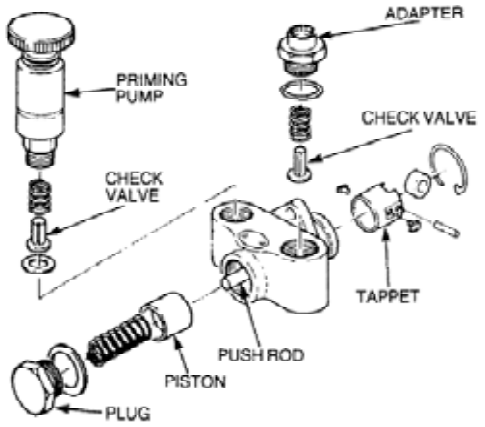


Figure 125 Transfer Pump Exploded View

b. Clamp the pump in a suitable vice, ensuring soft jaw covers are used and remove the priming pump (Figure 126). Discard the O ring.

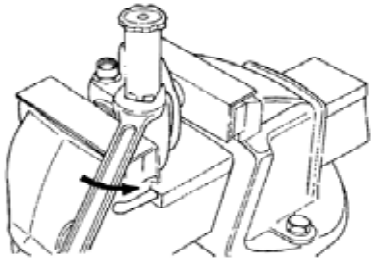


Figure 126 Removing the Priming Pump

c. Remove the adapter and, using long-nose pliers, lift out both check-valves and springs (Figure 127). Remove and discard the O ring.

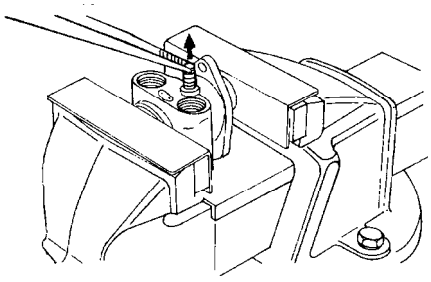


Figure 127 Removing the Check-valve

d. Clamp the pump in the vice so that the plug faces upwards and remove the plug (Figure 128). Remove and discard the gasket.

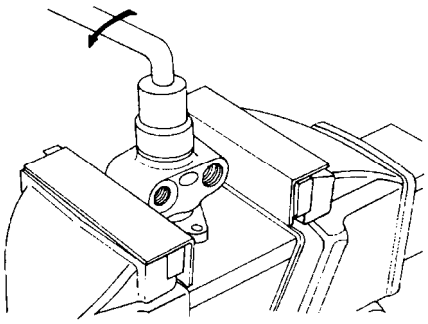


Figure 128 Removing the Plug

e. Lift out the piston spring and, using long-nose pliers, remove the piston (Figure 129).

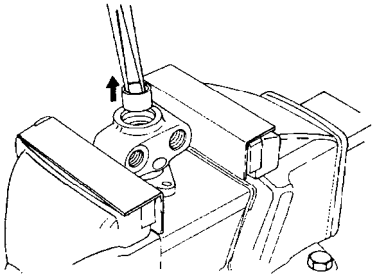


Figure 129 Removing the Piston

f. Clamp the pump in the vice so that the tappet assembly faces upward. Pry off the snap-ring retaining the tappet, remove the tappet assembly and remove the push rod (Figure 130).

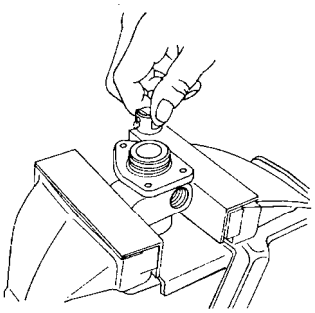


Figure 130 Removing the Tappet

40. Cleaning and Inspection. Thoroughly clean all parts in clean diesel fuel and inspect the valve seats, piston and related parts for wear, cracks and scoring. Replace parts as necessary. Should the push rod or the pump body show any signs of wear, they must be replaced together as they are a matched pair.

41. Reassembly. Reassemble the transfer pump as follows:

a. Clamp the pump in a vice so that the mounting flange faces upwards and insert the tappet into the body.

b. Install the snap-ring.

c. Clamp the pump in a vice so that the tappet assembly faces downwards and insert the push rod, piston and piston spring.

d. Using a new gasket, install the plug and tighten it to 78 to 88 N.m (57 to 64 lbf.ft).

e. Clamp the pump in a vice so that the plug faces downwards and install the two check-valves and springs.

f. Using a new O ring, install the priming pump and tighten it to 40 N.m (29 lbf.ft).

g. Using a new O ring, install the adapter and tighten it to 12 N.m (8 lbf.ft).

42. Testing. Test the transfer pump by plugging the outlet (delivery) port using a plug with a thread of M17 x 1.5 mm and tighten the plug securely. Connect an air supply to the pump inlet port and tighten the connection securely. Immerse the transfer pump assembly in a container of clean diesel fuel. Apply clean moisture free air at a pressure of approximately 200 kPa (29 psi) to the pump. Replace the transfer pump if air leaks are present.

Automatic Timer

43. Removal. Remove the automatic timer as follows:

a. Remove the fuel injection pump in accordance with EMEI Vehicle G 103.

b. Secure the injection pump in a soft-jawed vice, lock the injection pump drive gear with a suitable locking device and remove the nut and washer securing the automatic timer assembly to the injection pump camshaft.

c. Using the timing device remover (Table 3, Serial 37), install the outer piece of the tool in the centre of the automatic timer, insert the centre bolt and tighten it until the timer is withdrawn from the camshaft.

44. Disassembly. Disassemble the automatic timer as follows:

a. Secure the automatic timer in the soft-jawed vice and match mark the drive gear to the timer assembly.

b. Remove the bolts and lock-washers securing the drive gear to the timer assembly and remove the drive gear (Figure 131).

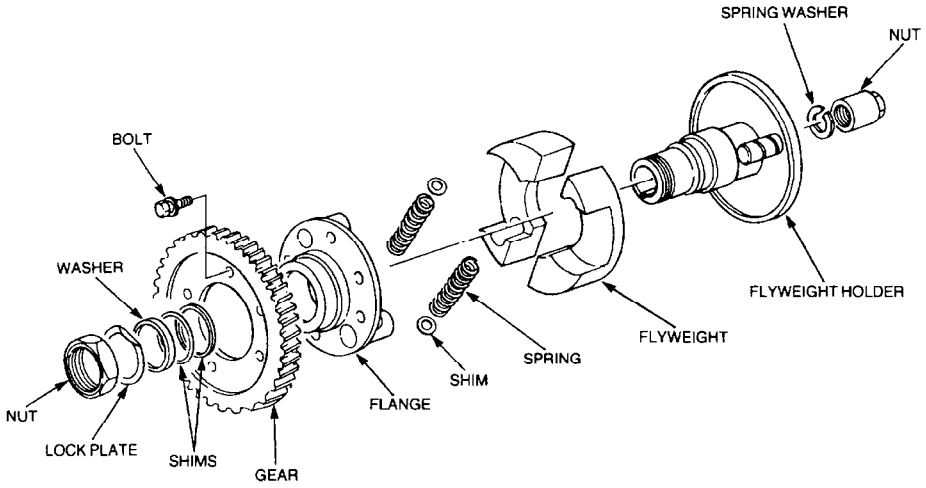


Figure 131 Automatic Timer Exploded View

c. Straighten the lock plate securing the retaining nut, unscrew and remove the nut, lock plate, washer and shims.

d. Place a clean piece of cloth over the timer to prevent the springs from being lost (the springs are under pressure), then using two screwdrivers, remove the timer flange (Figure 132).

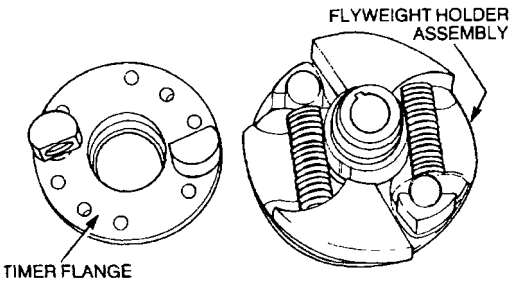


Figure 132 Removing the Timer Flange

e. Note the number and position of the shims fitted to each flyweight pivot as they are to be refitted in their original position and remove the springs, shims and flyweights (Figure 133).

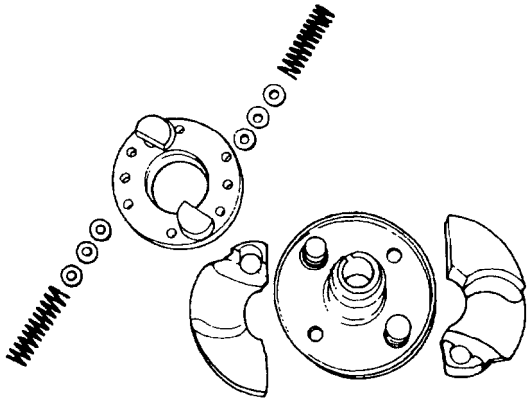


Figure 133 Removing the Flyweights

45. Cleaning and Inspection. Clean and inspect the automatic timer as follows:

a. Thoroughly clean all components in a suitable solvent and blow them dry with compressed air.

b. Inspect all components for excessive wear or damage and replace parts as required.

NOTE

The springs and adjusting shims must always be replaced as a set.

c. Check the free length of the springs against a new spring and replace the set if one is found to be faulty.

d. Using a micrometer, measure the outside diameter of the flyweight pivots (Figure 134) and note the reading.

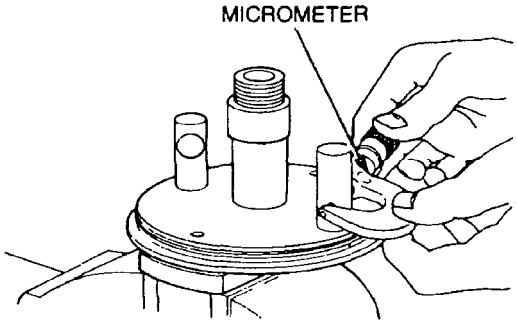


Figure 134 Measuring the Flyweight Pivots

e. Using an internal micrometer, measure the inside diameter of the flyweight pivot bore (Figure 135)and compare the dimension with the flyweight pivot dimension. If perceivable radial clearance exists, replace the automatic timer assembly.

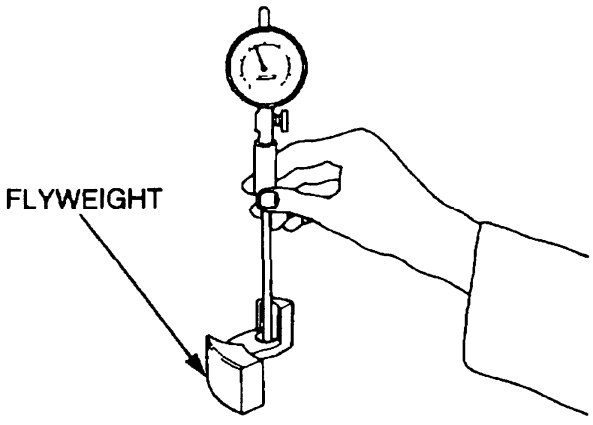


Figure 135 Measuring the Flyweight Pivot Bore

46. Reassembly. Reassemble the automatic timer as follows:

CAUTION

The shims must be installed in their original positions.

a. Install the flyweights on the flyweight pivots, insert the shims in their original position and insert the springs into the recesses in the pivots.

WARNING

Exercise care when installing the timer flange as the springs are compressed and could cause personal injury if they should dislodge.

b. Position the timer flange on the flyweight holder and carefully engage each spring in its respective flange post, rotate the flange against spring pressure until the flange can be pushed fully onto the flyweight holder.

c. Using the shims that were removed when the retaining nut and lock plate were removed, adjust the timer flange end float to between 0.02 and 0.1 mm (0.0008 and 0.0039 in).

d. Install a new lock plate and nut and tighten the nut to 98 N.m (72 lbf.ft). Fold the tab of the lock plate over.

e. Fit the drive gear on the timer flange ensuring the match marks align, insert the retaining bolts and new lock-washers and tighten the bolts to 43 N.m (32 lbf.ft).

47. Installation. Fit the automatic timer to the injection pump camshaft, ensuring that the key and keyway align, install a new lock-washer and round nut and tighten it to 59 to 69 N.m (43 to 51 lbf.ft).

48. Adjustment. Adjust the automatic timer as follows:

a. Install the fuel injection pump on a calibration test stand.

b. Operate the test stand and using a stroboscope check that at a pump speed of 1 250 the advance is not greater than 0.5 degrees, at 1 350 it is not greater than 1.1 degrees, at 1400 it is not greater than 1.6 degrees and at 1 600 it is 4 to 5 degrees.

c. If the advance is not within specification, adjustment can be made by replacing the timer springs and/or the shims.

Fuel Injectors

49. Disassembly. Disassemble the fuel injectors as follows (Figure 136):

CAUTION

All work on the injector assembly must be performed in a clean, dust free location. Dust or dirt could damage the internal components.

a. Remove the fuel injector in accordance with EMEI Vehicle G 103 and place it in a clean, dust free location.

b. Secure the injector body in a soft-jawed vice and remove the end-cap.

c. Remove the adjuster, washer and pressure spring and lift out the push rod.

d. Unscrew the connector and remove and discard the gasket.

e. Invert the injector body in the vice and remove the cap nut and nozzle assembly.

f. Remove the injector body from the vice.

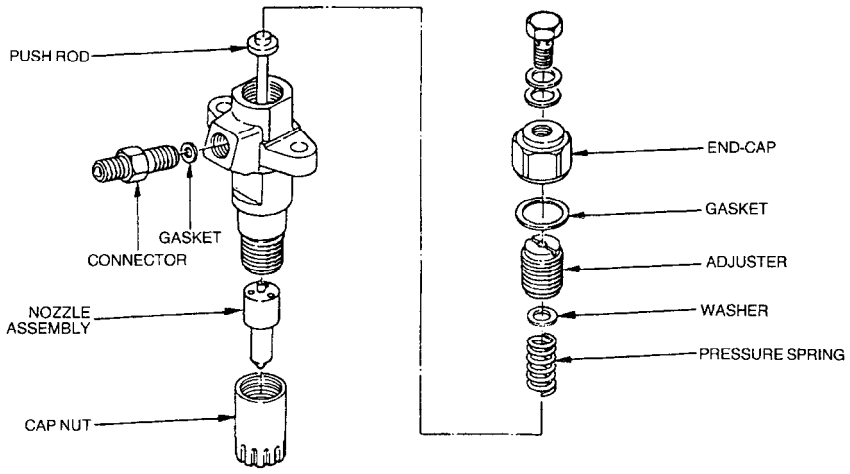


Figure 136 Fuel Injector Exploded View

50. Cleaning and Inspection. Clean and inspect the fuel injectors as follows:

a. Soak all components in a suitable carbon removing and cleaning agent. Wash all external dirt, grease and carbon deposits from the body and cap nut. Use a brass wire brush as necessary to assist with the removal of carbon deposits.

NOTE

When cleaning the needle valve and nozzle, take care not to scratch or score the valve seat.

b. Using a suitable diameter wire or drill, clean the fuel feed passages in the nozzle (Figure 137).

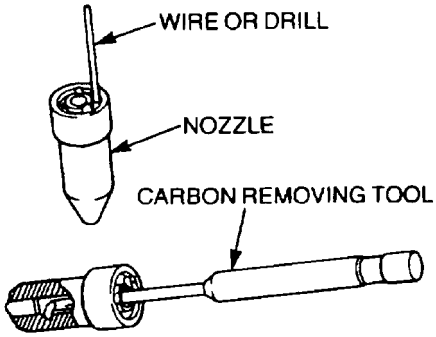


Figure 137 Nozzle Cleaning

c. Using an injector cleaning kit, remove the carbon from the recess in the nozzle.

d. Using the tools provided in the cleaning kit, remove the carbon from the valve seat (Figure 138), then select a suitable probe from the kit to clean the main fuel outlet.

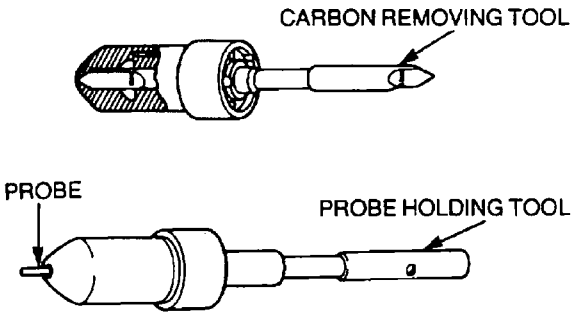


Figure 138 Nozzle Valve Seat Cleaning

e. Using the probe wire, clean out the carbon from the nozzle spray holes (Figure 139), ensuring that no more than 1.5 mm (0.062 in) of wire extends from the holder to prevent the wire bending or breaking in the nozzle.

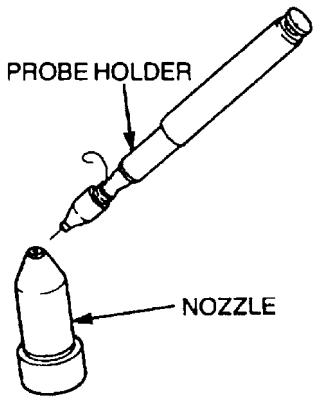


Figure 139 Nozzle Spray Holes Cleaning

f. Clean the needle valve and inspect it for wear or damage. The needle valve is worn if it has a blued or dull appearance. Do not attempt to lap the valve in the nozzle. The valve and nozzle is a matched pair and if any damage or wear is evident they must be replaced as a pair.

g. Inspect the mating faces of the nozzle and the body, these should be smooth and free of scratches or scores (Figure 140). Replace the injector assembly if these components are faulty.

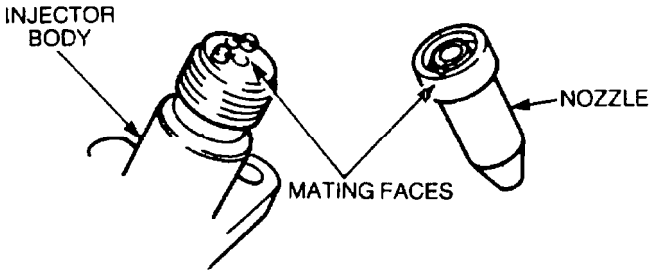


Figure 140 Inspecting the Injector Mating Faces

51. Reassembly. Reassemble the fuel injectors as follows (Figure 136):

NOTE

Do not hold the needle valve for too long as expansion due to body heat transfer will prevent valve installation.

a. Immerse the nozzle and needle valve in clean fuel and insert the valve in the nozzle, ensuring that the valve moves freely. Do not handle the needle valve for too long during reassembly as expansion due to body heat transfer will prevent valve installation.

b. Ensuring that the injector body is clean, fit the nozzle to the body, aligning the locating pegs.

c. Insert the push rod, pressure spring, washer and adjuster.

d. Install the end-cap and tighten it by hand.

e. Secure the injector body in the vice and tighten the end-cap to 59 to 78 N.m (43 to 58 lbf.ft).

f. Install the connecter with a new gasket and tighten it securely.

g. Remove the injector from the vice.

52. Spray Pattern Test. Test the spray pattern of the fuel injectors as followings:

WARNING

Due to the high pressures involved in the spray pattern test and the possibility of a defective injector spraying in any direction, wear appropriate PPE and keep hands away from the injector outlet to prevent personal injury.

CAUTION

Injector spray patterns should be checked by operating the pump lever at a rate of four to six strokes per second. Operating the lever too slowly will not generate sufficient test pressure and will cause the fuel to spray in coarse particles which will not give a true indication of the injector's condition.

a. Install the injector on the test rig ensuring that there is sufficient clean fuel in the reservoir.

b. Close off the fuel supply to the gauge and operate the handle two to three times while observing the spray pattern (Figure 141).

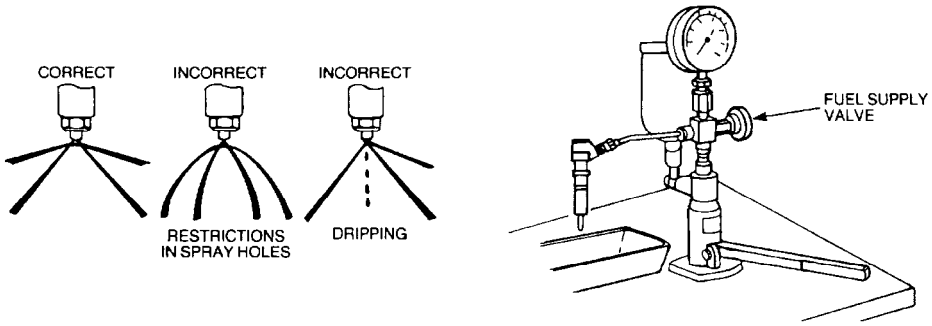


Figure 141 Injector Spray Pattern Test

c. Replace any injector that fails to spray correctly.

d. Open the fuel supply to the gauge and operate the handle to build up pressure, but do not allow the injector to spray. Observe the starting pressure reading on the test rig gauge while holding the pressure with the handle as the injector sprays. The injection starting pressure must be 18 140 kPa (2 630 psi). If not, turn the adjuster with a screwdriver to increase or decrease the starting pressure as required (Figure 142).

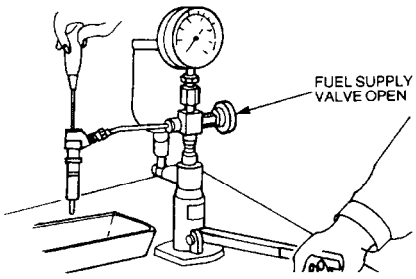


Figure 142 Starting Pressure Adjustment

e. Install the end-cap and tighten it to 58 to 78 N.m (43 to 58 lbf.ft).

f. Check that the starting pressure is correct and the leak-down rate is not less than six seconds from 18 140 kPa (2630 psi) to 10 130 kPa (1470 psi) when the handle is released and the pressure is allowed to fall naturally. If the leak-down rate is less than six seconds, replace the nozzle assembly.

g. Check for leaks at the end-cap, cap nut and connector and rectify as necessary.

h. Replace the injector if it does not conform to specification. Refer to specifications in Table 9

53. Installation. Install the fuel injector in accordance with EMEI Vehicle G 103.

Table 9 Fuel System Specifications

Serial	Item	Specification
1	Control rack guide screw	4.9 to 6.9 N.m (43 to 61 lbf.in)
2	Delivery valve holders	
3	Initial	39 N.m (29 lbf.ft)
4	Final	44 N.m (32 lbf.ft)
5	Delivery valve holder locking plates	4.4 to 6.8 N.m (39 to 60 lbf.in)
6	Governor housing	6.9 to 8.8 N.m (61 to 78 lbf.in)
7	Front bearing cover	
8	Tightening torque	6.9 to 8.8 N.m (61 to 78 lbf.in)
9	Camshaft end-play	0.03 mm (0.001 in)
10	Injection pump base plugs	54 to 74 N.m (40 to 55 lbf.ft)
11	Full-load set lever retaining nut	10 to 14 N.m (88 to 124 lbf.in)
12	Transfer pump	4.9 to 6.9 N.m (43 to 61 lbf.in)
13	Flyweight assembly retaining nut	49 to 59 N.m (36 to 43 lbf.ft)
14	Governor housing face-to-pivot pin hole	28.8 to 29.2 mm (1.134 to 1.149.in)
15	Stop control lever	10 to 14 N.m (7 to 10 lbf.ft)
16	U-shape lever guide plug	20 to 29 N.m (15 to 21 lbf.ft)
17	Injection pump timing	
18	Plunger pre-stroke	3.6 +0.05 mm
19	Pump cylinder port closure	
20	Cylinder 1	0 °
21	Cylinder 3	90 ° +30'
22	Cylinder 4	180 ° +30'
23	Cylinder 2	270 ° +30'
24	Idling capsule locknut	18 to 22 N.m (13 to 16 lbf.ft)
25	Inner idling spring cap nut	16 to 20 N.m (12 to 15 lbf.ft)
26	Governor shaft guide screw protrusion	
27	Protrusion above governor cover	13.5 to 14.5 mm
28	Locknut	39 to 49 N.m (29 to 36 lbf.ft)
29	Governor shaft	
30	Locknut	10 to 14 N.m (7 to 10 lbf.ft)
31	Cap nut	29 to 39 N.m (21 to 29 lbf.ft)
32	Governor cover	20 to 29 N.m (15 to 21 lbf.ft)
33	Automatic timer	49 to 59 N.m (36 to 43 lbf.ft)
34	Transfer pump piston plug	78 to 88 N.m (57 to 64 lbf.ft)
35	Transfer pump	40 N.m (29 lbf.ft)
36	Transfer pump adapter	12 N.m (8 lbf.ft)
37	Automatic timer advance	
38	Pump speed and degrees advance	
39	1 250	Not greater than 0.5 degrees
40	1 350	Not greater than 1.1 degrees
41	1 400	Not greater than 1.6 degrees

Table 9 Fuel System Specifications (Continued)

Serial	Item	Specification
42	1 600	5 degrees +0 –1
43	Automatic timer	
44	Flange end-float	0.02 to 0.1 mm (0.0008 to 0.0039 in)
45	Locknut	98 N.m (72 lbf.ft)
46	Timer flange	43 N.m (32 lbf.ft)
47	Round nut	59 to 69 N.m (43 to 51 lbf.ft)
48	Fuel injectors	
49	Starting pressure	18 140 kPa (2 630 psi)
50	Leak-down rate	Not less than six seconds from 18 140 kPa (2 630 psi) to 10 130 kPa (1469 psi)
51	End-cap	58 to 78 N.m (43 to 58 lbf.ft)

CLUTCH

Master Cylinder

54. Disassembly. Disassemble the master cylinder as follows:

a. Remove the master cylinder in accordance with EMEI Vehicle G 103.

b. Remove the circlip, push rod and retaining washer (Figure 143).

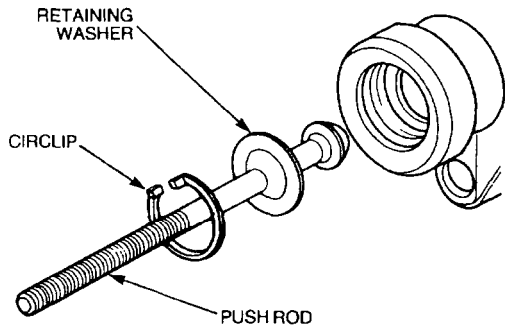


Figure 143 Removing the Push Rod

c. Remove the piston assembly from the master cylinder (Figure 144). If necessary, gradually apply air at low pressure to the outlet port to expel the piston.

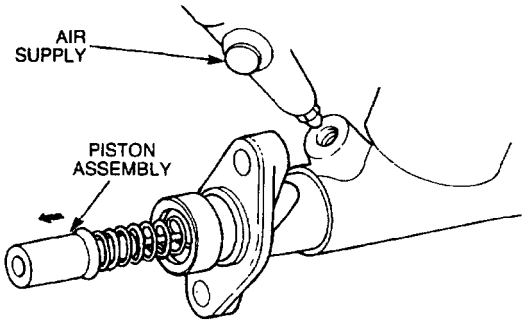


Figure 144 Removing the Piston Assembly

d. Using a small screwdriver, prise the spring retainer locking prong clear of the piston shoulder and withdraw the piston (Figure 145) and the piston seal.

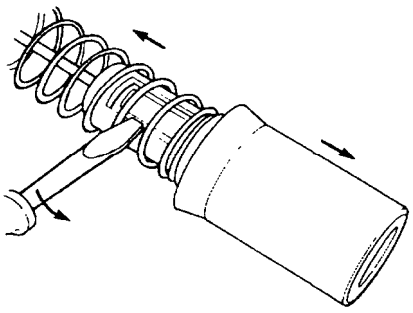


Figure 145 Removing the Piston Seal

e. Compress the spring and position the valve stem to disengage it from the keyhole slot in the spring retainer.

f. Remove the spring, retainer, valve spacer and spring washer from the valve stem. Remove and discard the valve seal (Figure 146).

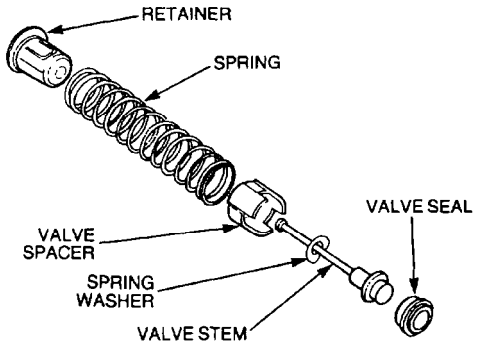


Figure 146 Valve Stem Disassembly

55. Cleaning and Inspection. Clean and inspect the master cylinder as follows:

a. Clean all components in a suitable solvent and allow them to dry.

b. Inspect the cylinder bore and piston and check that they are smooth to touch and show no signs of corrosion, score marks or ridges (replace as necessary).

56. Reassembly. Reassemble the master cylinder as follows:

a. Smear the new seals with suitable rubber grease and the remaining internal components with clean brake fluid.

b. Install the valve seal, with the flat side first, onto the end of the valve stem (Figure 146).

c. Install the spring washer, domed side first, over the small end of the valve stem (Figure 146).

d. Install the valve spacer with the legs entering the valve stem first.

e. Place the spring over the valve stem and insert the retainer into the spring.

f. Compress the spring and engage the valve stem in the keyhole slot provided in the retainer (Figure 147).

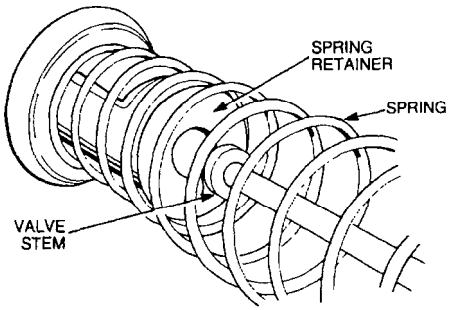


Figure 147 Valve Stem Reassembly

g. Install the piston seal onto the piston (Figure 148).

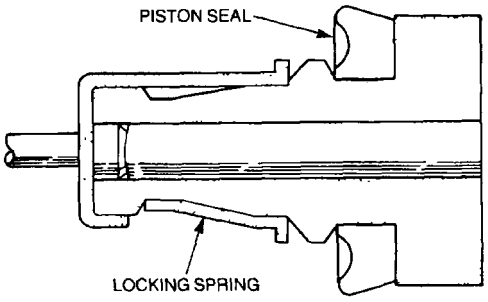


Figure 148 Installing the Piston Seal

h. Insert the piston into the spring retainer and engage the locking spring (Figure 148).

i. Smear the piston with suitable rubber grease and insert the piston assembly, valve end first, into the cylinder.

j. Install the push rod, retaining washer and circlip (Figure 149).

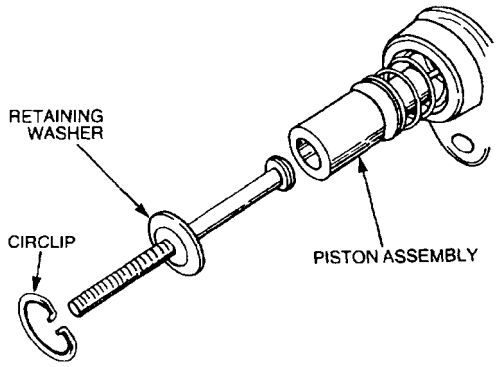


Figure 149 Installing the Piston Assembly

k. Install the master cylinder in accordance with EMEI Vehicle G 103.

Slave Cylinder

57. Disassembly. Disassemble the slave cylinder as follows:

a. Remove the slave cylinder in accordance with EMEI Vehicle G 103.

b. Remove and discard the dust cover from the slave cylinder (Figure 150).

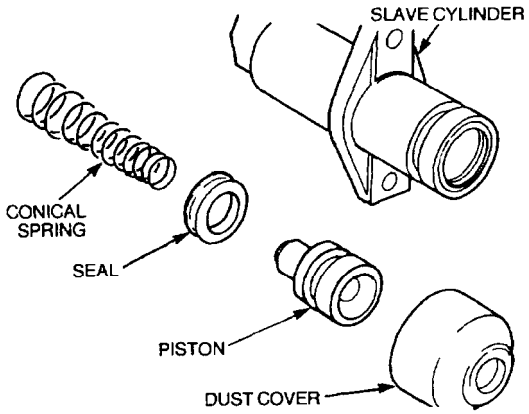


Figure 150 Slave Cylinder Exploded View

c. Remove the piston assembly from the slave cylinder (Figure 150). If necessary, gradually apply low air pressure to the inlet port to expel the piston. Remove the seal from the piston and discard the seal.

d. Remove the conical spring.

58. Cleaning and Inspection. Clean and inspect the slave cylinder as follows:

a. Clean all components in a suitable solvent and allow them to dry.

b. Ensure that the cylinder bore and piston are smooth to touch and show no sign of corrosion, scale marks or ridges. Replace as necessary.

59. Reassembly. Reassemble the slave cylinder as follows:

a. Smear all internal components with clean brake fluid.

b. Assemble the conical spring, a new seal and the piston in the sequence shown in Figure 150.

c. Smear the cylinder bore with clean hydraulic fluid then insert the piston assembly, spring end first, into the cylinder. Fit the dust cover.

d. Install the slave cylinder in accordance with EMEI Vehicle G 103.

TRANSMISSION SYSTEM

Transmission

60. Disassembly. Disassemble the transmission 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 PTO, if fitted and transmission assembly in accordance with EMEI Vehicle G 104-1.

b. Remove the transmission and transfer case drain plugs and drain the oil into a suitable receptacle. Remove and clean the filter.

c. Remove the bolt and clip retaining the release lever to the pivot (Figure 151). Remove the lever and the release bearing.

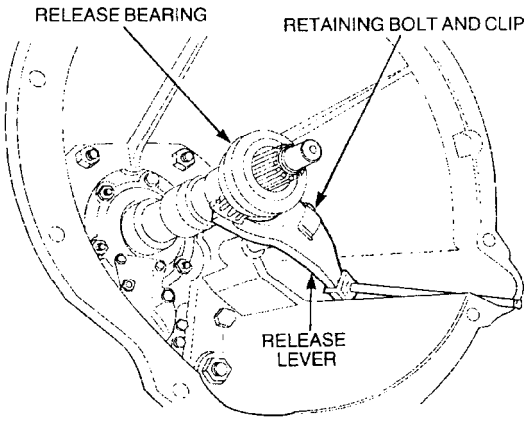


Figure 151 Removing the Release Lever and Bearing

d. Remove the bolts and nuts retaining the bell housing to the transmission. Remove the bell housing.

e. Move the gear and transfer levers to the neutral positions. Remove the reverse light switch.

f. Disconnect the transfer selector linkage at the lower ball joint.

g. Remove the bolts retaining the top cover and transfer lever cross-shaft to the transmission case. Remove the top cover, ensuring that the detent springs do not fall into the case.

h. Remove the detent springs, taking note that the reverse spring is painted yellow (Figure 152). Remove the detent balls by using a small magnet.

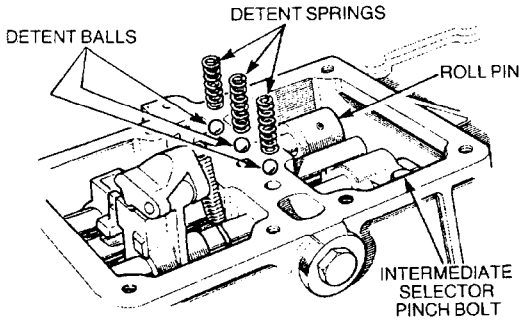


Figure 152 Removing the Detent Spring

i. Loosen the pinch-bolt securing the intermediate selector. Using a suitable pin punch, remove the roll pins retaining the selectors on the shaft.

CAUTION

The selector shafts must be in the neutral position prior to removal to prevent damage to the casing.

j. Ensure the selector shafts are in the neutral position, disconnect the reverse selector spring, remove the selector shafts out through the front bearing plate and remove the selectors and forks.

k. Remove the plug retaining the two interlock plungers in the cross drilling (Figure 153) and remove the plungers.

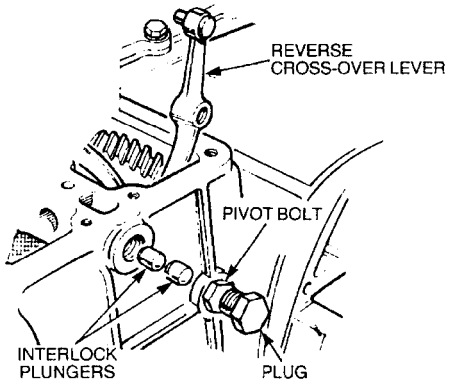


Figure 153 Removing the Interlock Plungers and Reverse Crossover Lever

l. Remove the lock wire and pivot bolt and lift out the reverse crossover lever (Figure 153).

m. Position the transmission with the front end uppermost, remove the bolts, locknuts and washers retaining the front cover and oil pump cover and gears. Remove the oil pump cover and gears (Figure 154).

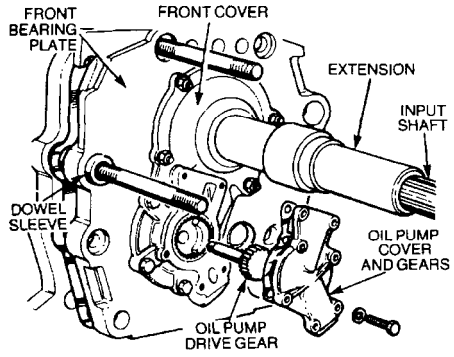


Figure 154 Removing the Oil Pump and Drive Gear

n. Remove the oil pump drive gear (Figure 154).

o. Remove the plug retaining the ball and spring from the relief valve housing located in the front cover.

p. Remove the nuts and washers retaining the input shaft bearing, gently tap the shaft rearwards, remove the studs installed through the bearing plate and ease the plate away from the transmission.

q. Remove the dowel sleeves which locate the bearing plate, then remove the plate complete with the input shaft and countershaft.

r. Remove the countershaft assembly from the bearing plate.

s. Using the bearing remover (Table 3, Serial 38) and the extractor (Table 3, Serial 39), remove and discard the bearing cones from the countershaft (Figure 155).

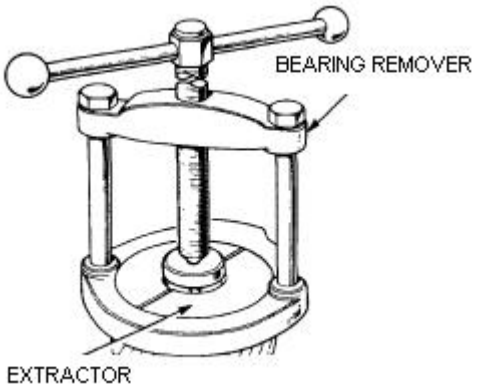


Figure 155 Removing the Countershaft Bearing

t. Remove the bolts and washers retaining the side and bottom cover and remove the covers.

u. Remove the bolt retaining the reverse idler gear shaft in the transmission casing (Figure 156).

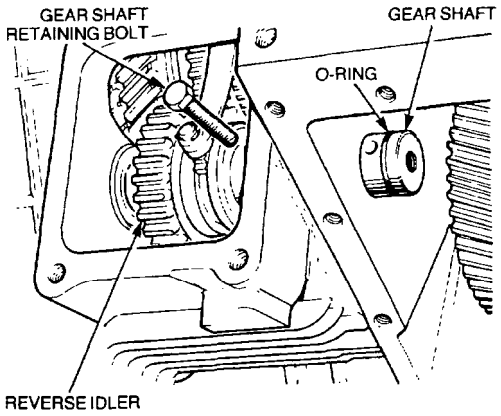


Figure 156 Removing the Reverse Idler Gear and Shaft

v. Using the mechanical puller (Table 3, Serial 40), withdraw the gear shaft, remove and discard the O ring and lift out the reverse idler assembly.

w. Remove the circlips retaining the needle roller bearings in the reverse idler and remove the bearings and washer (Figure 157). Discard the circlips and bearings.

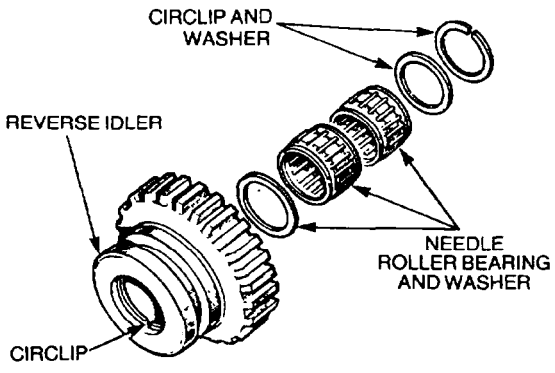


Figure 157 Reverse Idler Exploded View

x. Remove the bolts and washers retaining the mainshaft rear bearing cover and remove the cover complete with the needle roller bearing. Discard the washers, gasket and bearing.

y. Remove the circlip and shim retaining the transfer gear to the mainshaft and discard the circlip (Figure 158).

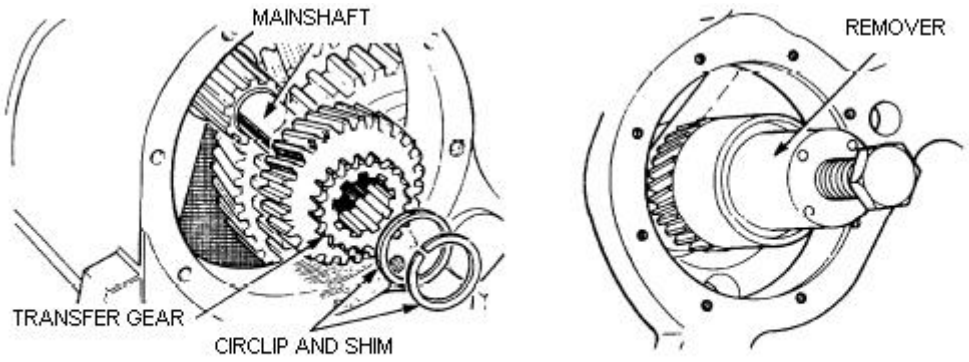


Figure 158 Removing the Transfer Gear

WARNING

The transfer gear is secured to the main shaft with Loctite 275 and requires considerable force to remove it. Ensure that the remover (Table 3, Serial 41) is correctly located on the transfer gear before using it to prevent it dislodging under force and causing injury.

z. Using the remover (Table 3, Serial 41) withdraw the transfer gear from the mainshaft. Ensure the remover is correctly located on the transfer gear before applying force to the transfer gear (Figure 158).

WARNING

The transfer gear spacer is secured to the main shaft with Loctite 275 and requires considerable force to remove it. Ensure that the remover (Table 3, Serial 41) is correctly located on the transfer gear spacer and the extractor pins are securely installed before using it to prevent it dislodging under force and causing injury.

aa. Using the remover (Table 3, Serial 41), withdraw the transfer gear spacer along the mainshaft until the larger diameter on the spacer reaches the transfer gear lever cross-shaft. Ensure the remover is correctly located on the transfer gear spacer and the extractor pins are correctly located before applying force to the transfer gear spacer. Remove the remover when the spacer is loose on the mainshaft.

bb. Carefully remove the mainshaft assembly while simultaneously removing the first speed gear from the shaft (Figure 159). Lift out the first speed gear.

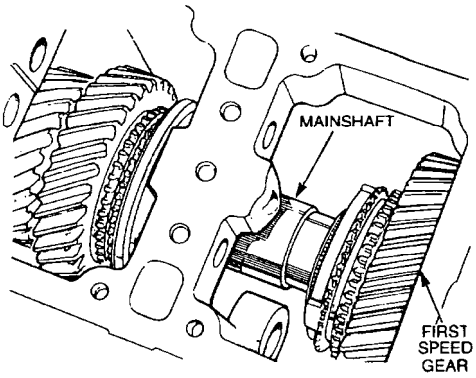


Figure 159 Removing the Mainshaft

cc. Remove the thrust washers and roller bearings from the rear of the mainshaft and remove the circlip and shim from the front of the mainshaft.

dd. Remove the third and fourth gear synchromesh assembly (Figure 160). Discard the circlip and bearing.

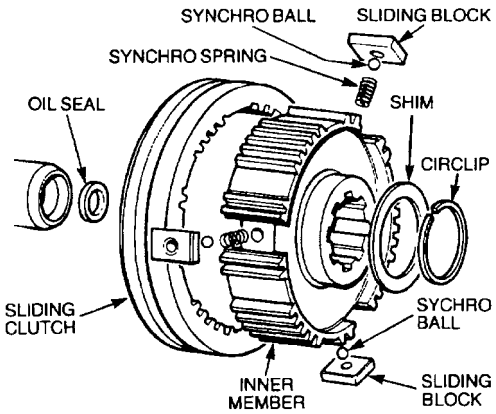


Figure 160 Third and Fourth Gear Synchromesh Exploded View

ee. Remove the third and second speed gears together with the thrust washers and needle roller bearings. Discard the bearings.

ff. Match mark the third and fourth gear synchromesh assembly, push down on the sliding blocks and remove the sliding clutch. Following the same procedure, dismantle the first and second gear synchromesh.

gg. Remove the oil seal fitted to the front end of the mainshaft and discard the oil seal.

hh. Remove the circlip retaining the input shaft to the bearing (Figure 161). Remove the shim and, using a suitable press, remove the input shaft. Discard the needle roller bearing.

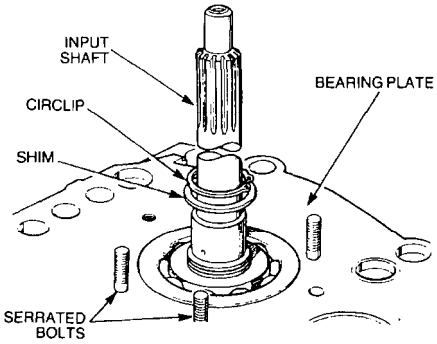


Figure 161 Removing the Input Shaft

ii. Using the extractor assembly (Table 3, Serial 42) and the removal adaptor (Table 3, Serial 68), remove the oil feed ring and oil seal from the input shaft. Discard the oil seal.

jj. Remove the two input shaft bearing retaining plates and serrated bolts. Using a suitable press, remove the bearing from the transmission bearing plate. Discard the bearing.

kk. Using a suitable press, remove the countershaft front bearing cup from the transmission bearing plate. Discard the bearing cup

ll. Using the extractor assembly (Table 3, Serial 42) and the extractor (Table 3, Serial 43) remove the countershaft rear bearing cup (Figure 162). Discard the bearing cup.

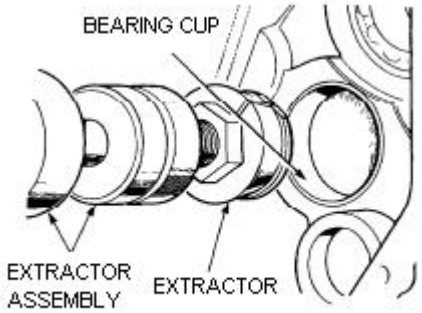


Figure 162 Removing the Countershaft Rear Bearing Cup

mm. Using a suitable press, remove the mainshaft rear bearing and oil seal. Discard the bearing and the oil seal.

61. Cleaning and Inspection. Clean and inspect the transmission as follows:

WARNING

DO NOT spin the bearings with compressed air as personal injury or damage to the bearings may result.

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

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 case, covers and all other parts of the transmission thoroughly with a suitable cleaning agent. Do not use compressed air to remove dust from the bell housing. If any doubt exists as to whether the dust inside the bell housing contains asbestos or not, the procedures described in EMEI Workshop E 410 shall be complied with. Ensure all traces of old gaskets and sealer are removed, then blow dry the components with compressed air.

b. Inspect the gear teeth for wear, damage, scoring, surface fatigue, ridging or cracking. The gears may also be checked by Magnaflux, or similar method of magnetic particle testing for cracks which would not otherwise be visible.

c. Replace the selector forks and/or sliding clutches if the side clearance in the groove is excessive.

d. Replace the selector shafts if they are cracked in either the detent or locating roll-pin holes.

NOTE

The front bearing plate and transmission case is supplied as a matched pair only.

e. Check the transmission case for cracks and damage and replace it if necessary. If the transmission case is to be replaced the front bearing plate must also be replaced as they are a matched pair.

f. Check the front bearing plate for cracks and damage and replace it if necessary. If the front bearing plate is to be replaced the transmission case must also be replaced as they are a matched pair.

g. Inspect the detent springs for damage or loss of tension and replace them as necessary.

h. Check all other parts for wear or damage. Replace all parts as required.

i. Clean up any damaged threads.

j. Inspect the oil pump drive gear teeth and shaft for damage or wear. Replace them as necessary.

62. Reassembly. Reassemble the transmission as follows:

NOTE

Do not degrease the new thrust washers and new roller bearings prior to assembly. Lubricate all items with clean engine oil and apply petroleum jelly on all bearing surfaces.

The countershaft bearing cones and cups are supplied as matched pairs only and should not be interchanged.

a. Using a suitable press, insert the new mainshaft rear bearing into the transmission case and secure it with the circlip. Using the seal inserter (Table 3, Serial 44), press in the oil seal with the lip towards the front of the case (Figure 163).

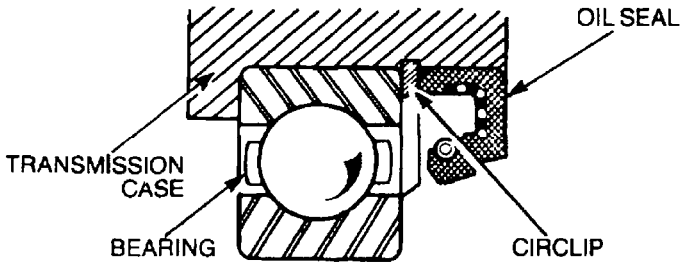


Figure 163 Installing the Main Shaft Rear Bearing and Oil Seal

b. Fit the oil seal to the front end of the mainshaft.

c. Install the third and fourth gear synchromesh inner member into the sliding clutch, ensuring that the match marks are aligned and the sliding clutch coned face is fitted towards the plain face of the inner member.

d. Install the sliding blocks with the radius face outwards. Insert the springs through the sliding blocks and into the locating bores in the inner member. Position the balls on the spring ends and push them fully into the inner member and then move the sliding clutch over until the balls are engaged in the annular groove in the sliding clutch.

e. Following the procedure described in sub-paras c and d, assemble the first and second gear synchromesh, ensuring that the sliding clutch coned face is installed towards the front end of the mainshaft.

f. Install a synchromesh cone along the mainshaft and engage the cone teeth in the first and second synchromesh sliding clutch (Figure 164).

g. Install a chamfered thrust washer, a thrust bearing and a scalloped thrust washer on the mainshaft. Fit a new needle roller bearing and the second gear (Figure 164).

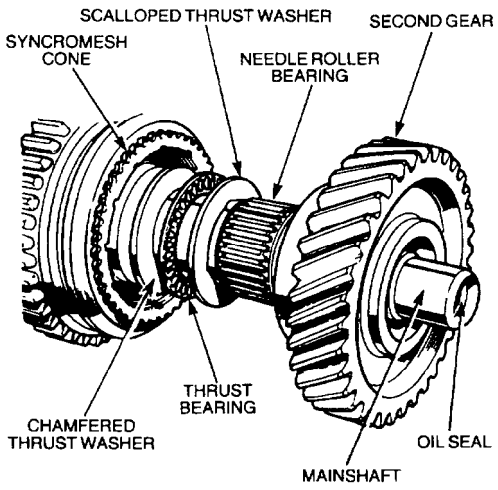


Figure 164 Installing the Second Gear

h. Install a scalloped thrust washer, a thrust bearing and another scalloped washer on the mainshaft. Fit a new needle roller bearing and the third gear (Figure 165).

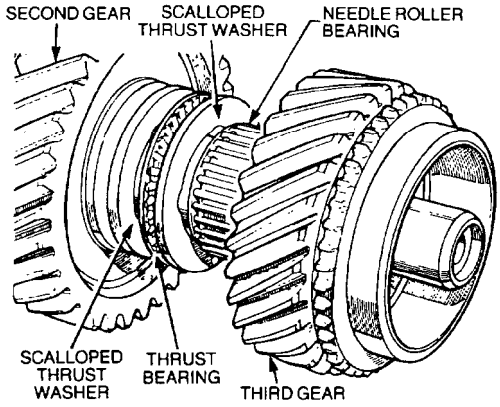


Figure 165 Installing the Third Gear

i. Install a scalloped thrust washer, a thrust bearing and another scalloped washer on the mainshaft. Position a synchromesh cone on the third gear and fit the third and fourth synchromesh assembly, ensuring that the coned face is towards the rear of the mainshaft (Figure 166).

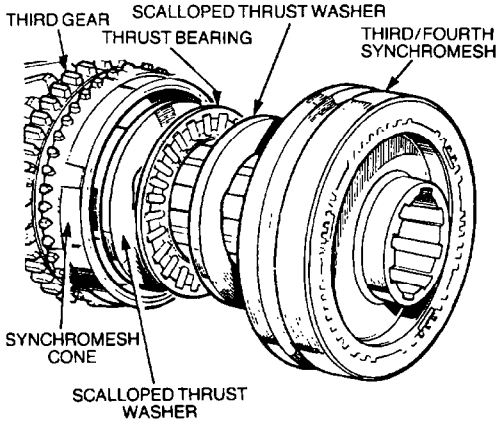


Figure 166 Installing the Third and Fourth Synchromesh

j. Position the mainshaft vertically with the front end uppermost and apply a light load on the gears to remove any end play. Insert a new circlip into the mainshaft groove and measure the distance between the circlip lower edge and the third and fourth synchromesh inner member (Figure 167). Install a suitable shim to obtain a clearance of between 0.025 to 0.150 mm (0.001 to 0.006 in) and install the circlip. The available shim range is from 1.85 mm (0.078 in) to 2.45 mm (0.096 in) in 0.15mm (0.006 in) increments.

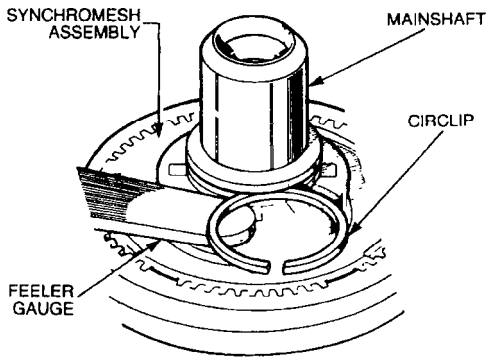


Figure 167 Main Shaft End-play Adjustment

k. Using a suitable press, install the countershaft bearing cones on the countershaft.

l. Using a suitable press, install the new countershaft rear bearing cup into the transmission case.

m. Using a suitable press, fit the new countershaft front bearing cup into the front bearing plate, but do not install it fully.

n. Position the countershaft into the transmission casing ensuring that the oil pump drive end is at the front of the transmission.

o. Install the front bearing plate and gasket on the transmission case and insert the retaining studs and locating dowels. Using suitable spacers, fit the bell housing retaining nuts, washers and bolts and tighten them securely (Figure 168).

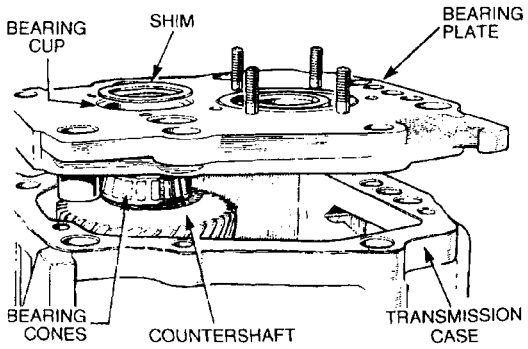


Figure 168 Countershaft Bearing Pre-load Adjustment

p. Press in the front bearing cup until all end-play is taken up and there is no load on the bearings and install a suitable shim (Figure 168) so that there is approximately 0.25 mm (0.010 in) standing proud of the bearing plate. The available shim range is from 1.575 mm (0.062 in) to 2.50 mm (0.098 in) in 0.025 mm (0.001 in) increments.

q. Install the oil pump cover and a new gasket, but do not include the pump drive gear. Ensuring the shim remains in position, secure the cover with the bolts and nuts and tighten them to 30 N.m (22 lbf.ft).

r. Determine if the front bearing pre-load is correct by using a spring balance and cord coiled around the larger diameter countershaft to measure the rolling resistance (Figure 169). With the bearings oiled, the rolling resistance must be 2.7 to 4.0 kg (6 to 8.5 lbs).

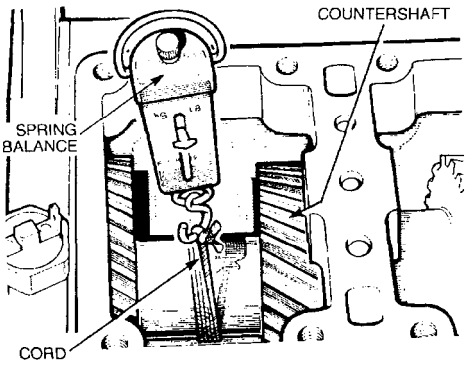


Figure 169 Countershaft Rolling Resistance

s. If the pre-load is not correct, remove the oil pump cover and gasket, remove the shim and replace it with a thicker one to increase the rolling resistance or a thinner one to reduce it. Refit the oil pump cover and gasket. Remeasure the rolling resistance as described in sub-paras q and r. Repeat this procedure until the pre-load is correct.

t. When the correct pre-load has been established remove the oil pump cover, front bearing plate, retaining studs and locating dowels.

u. Install a synchromesh cone along the rear end of the mainshaft and engage the cone teeth in the first and second synchromesh sliding clutch (Figure 170).

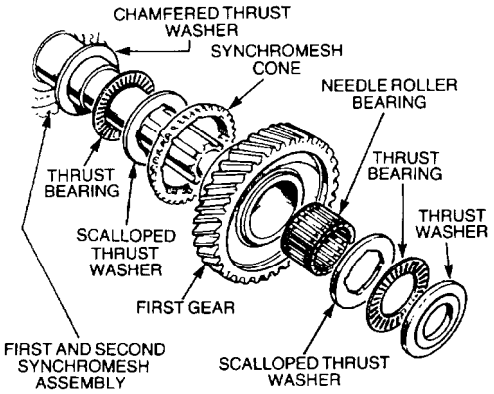


Figure 170 Installing the First Gear

v. Position a chamfered thrust washer, a thrust bearing and a scalloped thrust washer onto the mainshaft. Install the first gear and a new needle roller bearing ensuring that the gear synchromesh teeth are fitted towards the synchromesh assembly (Figure 170).

w. Install a scalloped thrust washer and a thrust bearing onto the mainshaft. Coat a stepped thrust washer with petroleum jelly to keep it in position during assembly and install it on the mainshaft with the stepped face outwards (Figure 170).

x. Slide the first gear complete with the thrust washers and bearing to the end of the mainshaft and install the mainshaft in the transmission and rear bearing.

CAUTION

To prevent damage to the mainshaft, smear a suitable petroleum jelly onto the stepped washer to retain the washer in position during assembly.

y. Push the mainshaft fully into the bearing, ensuring that the stepped washer, bearings and thrust washers are correctly located (Figure 171).

z. Install the mainshaft rear spacer on the shaft, ensuring it is positioned against the bearing and in the seal (Figure 171).

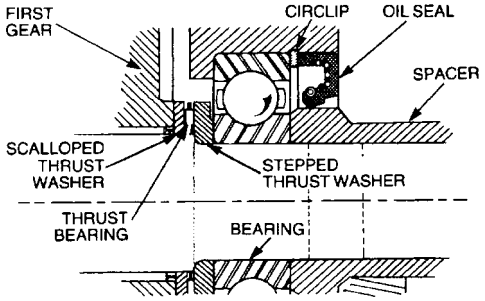


Figure 171 Installing the Main Shaft and Rear Spacer

aa. Fit the transfer gear to the mainshaft and temporally retain it with a new circlip (Figure 172).

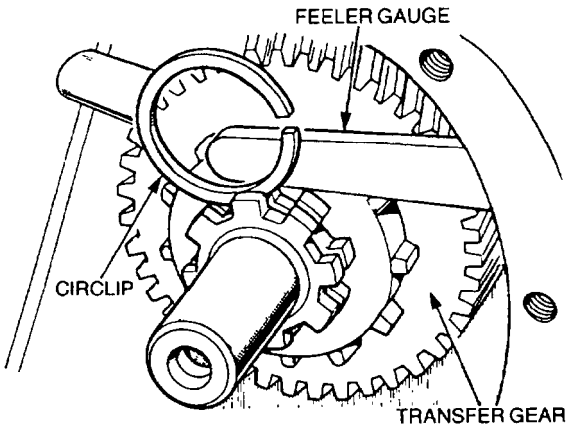


Figure 172 Main Shaft Pre-load Adjustment

bb. Push the mainshaft to the rear of the transmission and measure the clearance between the circlip and transfer gear (Figure 172). The maximum clearance between the circlip and transfer gear is 0.050 mm (0.002 in). To obtain the correct pre-load on the mainshaft, insert a shim of the appropriate thickness. The available shim range is 1.50 mm (0.060 in)and 1.70 to 2.00 mm (0.067 to 0.079 in) in increments of 0.05 mm (0.002 in).

cc. Remove the circlip, shim and the transfer gear and slide back the spacer as far as possible.

dd. Apply a thin coating of Loctite 275 to the exposed area of the shaft and push the spacer forward to contact the rear bearing.

ee. Apply Loctite 275 to the mainshaft rear splines, install the transfer gear and selected shim and secure them with the circlip.

ff. Install the mainshaft rear bearing cover complete with a new needle roller bearing and gasket. Fit the retaining bolts and new lock-washers and tighten them to 30 N.m (22 lbf.ft).

gg. Using a suitable press, install the new input shaft bearing in the front bearing plate until the bearing is flush with the plate (Figure 173).

hh. Press the input shaft fully into the input shaft bearing, install the shim and circlip and measure the clearance between the circlip and the shim (Figure 173). The maximum clearance is 0.05 mm (0.002 in).

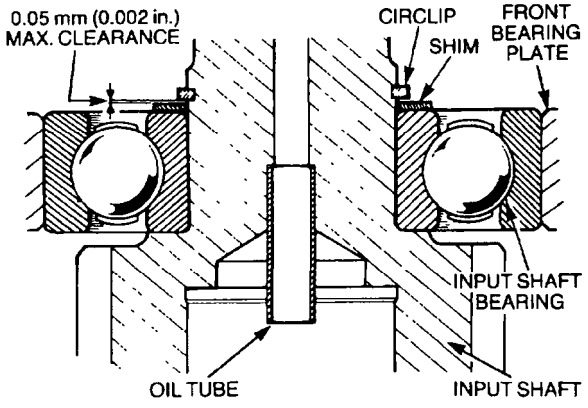


Figure 173 Installing the Input Shaft

ii. If the clearance is not correct, replace the shim with one of the correct thickness. The shim range is from 1.85 mm (0.072 in) to 2.15 mm (0.085 in) in 0.05 mm (0.002 in) increments.

jj. Install the input shaft bearing retaining plates into the front bearing plate and tap the plates lightly with a hammer to engage the stud serrations into the front bearing plate.

kk. Using the bearing replacer and adaptor ring (Table 3, Serial 45 and 46), press in the oil seal plain face first into the front cover (Figure 174).

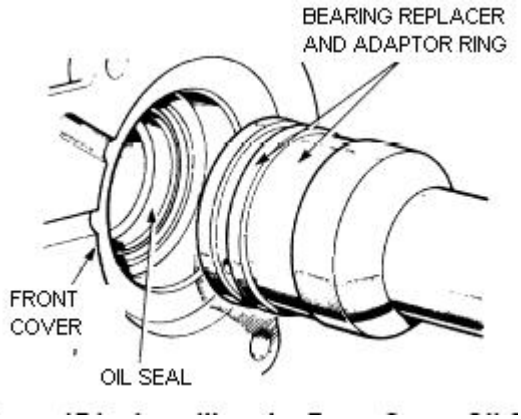


Figure 174 Installing the Front Cover Oil Seal

CAUTION

Aligning the oil feed ring and the oil delivery hole is critical. A restricted oil supply to the mainshaft will result if the holes are not aligned.

ll. Carefully align the centre oil hole on the oil feed ring with the oil delivery hole in the front cover and, using the bearing replacer and adaptor ring (Table 3, Serial 45 and 46), press the oil feed ring into the front cover (Figure 175).

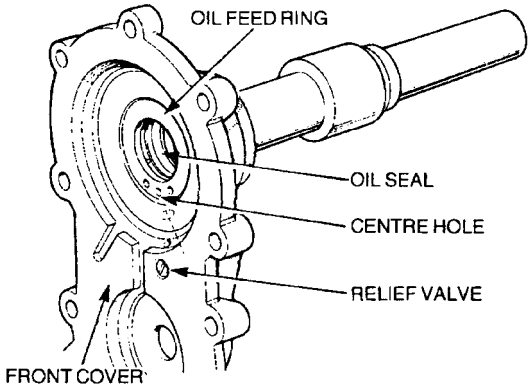


Figure 175 Installing the Oil Feed Ring and Relief Valve

mm. Ensure that the relief valve ball and spring are fully functional and check that the retaining plug is approximately one thread or 0.25 mm (0.010 in) below the front cover rear face.

nn. Install the countershaft in the front bearing plate and insert a synchromesh cone into the mainshaft first and second synchromesh sliding clutch.

CAUTION

A restricted oil supply will result if the input shaft oil tube and mainshaft oil seal are not seated correctly. Severe transmission damage can be caused by restricted oil flow.

oo. Rotate the input shaft and check that the oil feed tube is centrally located in the input shaft. The oil feed tube must be centrally located in the input shaft so that it correctly mates with the mainshaft during installation and maintains oil flow from the pump through the transmission. Relocate the tube if it is not located correctly.

pp. Smear the oil feed tube and the mainshaft oil seal with clean engine oil.

qq. Place a new gasket on the transmission case and carefully install the front bearing plate assembly ensuring that the oil feed tube does not damage the oil seal.

rr. Insert the dowel sleeves in the front bearing cover.

ss. Smear Loctite 242 on the threads of the upper studs. Install the remaining front bearing plate retaining studs and tighten them securely.

tt. Ensuring that the selected shim (sub-paras o to t) is installed on the countershaft front bearing, fit the oil pump front cover and a new gasket (Figure 176). Install the oil pump front cover new retaining lock-washers, nuts and bolts but do not tighten them at this stage.

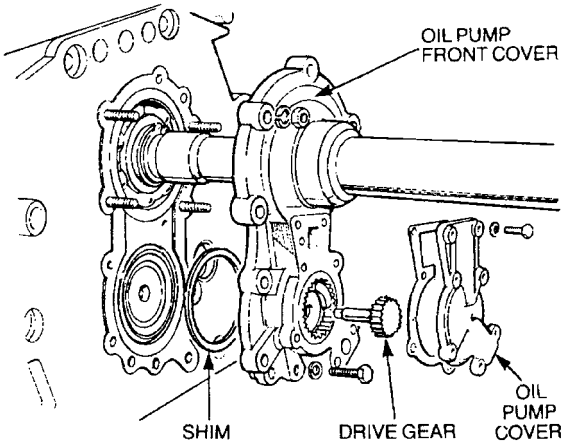


Figure 176 Installing the Oil Pump Front Cover

CAUTION

The oil pump drive gear is of fibre construction. Damage will result if the gear teeth and the square drive are not correctly engaged.

uu. Smear the oil pump drive gear with clean engine oil and carefully insert the drive gear into the oil pump and countershaft square drive, ensuring that the gear teeth and square drive are correctly engaged.

vv. Fit the oil pump cover and a new gasket. Install the retaining bolts and new lock-washers and tighten the bolts to 10 N.m (8 lbf.ft).

ww. Inspect the oil pump front cover to ensure it is evenly fitted around the input shaft. If so, tighten the bolts to 30 N.m (22 lbf.ft).

xx. Insert two new needle roller bearings in the reverse idler gear and fit the shim and two circlips.

yy. Check that the idler shaft support bush is fully functional. If not, replace the bush and secure it using Locquic primer grade T and Loctite 222.

zz. Install a new O ring onto the idler shaft and smear the O ring with clean engine oil. Insert the shaft into the transmission case ensuring that the bolt hole aligns.

aaa. Position the reverse idler in the transmission case and push the shaft in to support the idler, ensuring that the bolt hole remains aligned.

bbb. Prime the threads of the reverse idler retaining bolt with Locquic primer grade T and allow it to dry. Smear the threads with Loctite 222, install the bolt and tighten it securely.

ccc. Install the bottom cover with a new gasket, fit the retaining bolts and new lock-washers. Tighten the bolts to 30 N.m (22 lbf.ft).

ddd. Install the side cover with a new gasket. Fit the retaining bolts and new lock-washers. Tighten the bolts to 58 N.m (43 lbf.ft).

CAUTION

Loctite must not be allowed to enter the transmission or run on the exposed pivot bolt threads.

NOTE

Ensure that the reverse crossover lever pad is correctly engaged in the reverse idler groove prior to tightening the pivot bolt.

eee. Position the reverse crossover lever in the transmission case and locate the selector pad in the reverse idler groove. Ensure the crossover pad is correctly engaged in the reverse idler groove prior to tightening the pivot bolt. Apply Loctite 241 to the pivot bolt threads only and install the bolt and engage the crossover lever pivot hole. Tighten the pivot bolt securely (Figure 177).

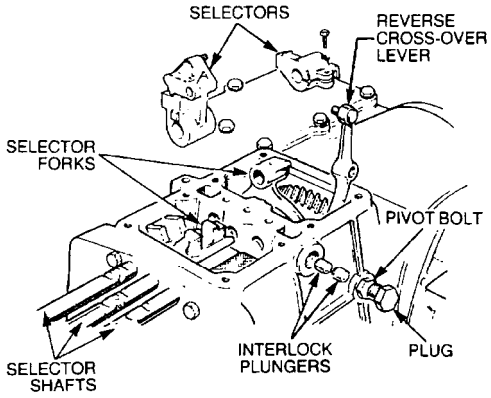


Figure 177 Installing the Selectors

fff. Smear the selector fork slippers with petroleum jelly and install them into the selector forks.

ggg. Locate the first and second gear selector fork in the sliding clutch groove with the boss on the fork facing towards the rear of the transmission (Figure 178). Position the boss on the right-hand side of the transmission.

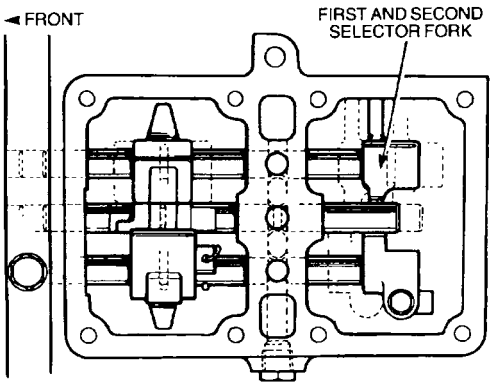


Figure 178 Installing the First and Second Gear Selector Fork

hhh. Locate the third and fourth gear selector fork in the outer member groove and position the fork with the roll-pin entry hole at the top right-hand side. Insert the third and fourth gear selector shaft and interlock pin assembly and secure the shaft to the selector fork with a new roll-pin (Figure 179).

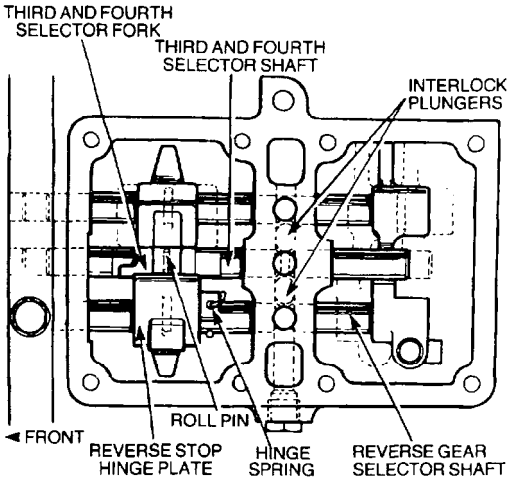


Figure 179 Installing the Third and Fourth Gear Selector Fork

iii. Insert an interlock plunger on either side of the third and fourth selector shaft and position the reverse stop hinge plate and selector in the transmission case adjacent to the third and fourth gear selector (Figure 179).

jjj. Install the reverse gear selector shaft and engage the selector and hinge spring (Figure 179). Push the shaft in fully and engage the reverse crossover lever intermediate selector. Do not tighten the pinch-bolt at this stage. Secure the reverse gear selector to the shaft with a new roll-pin.

kkk. Position the first and second gear selector in the transmission and install the first and second gear selector shaft, engaging the selector and selector fork as the shaft is pushed in fully (Figure 180). Secure the first and second gear selector fork with a new roll-pin. Secure the first and second gear selector with a new roll-pin (Figure 180).

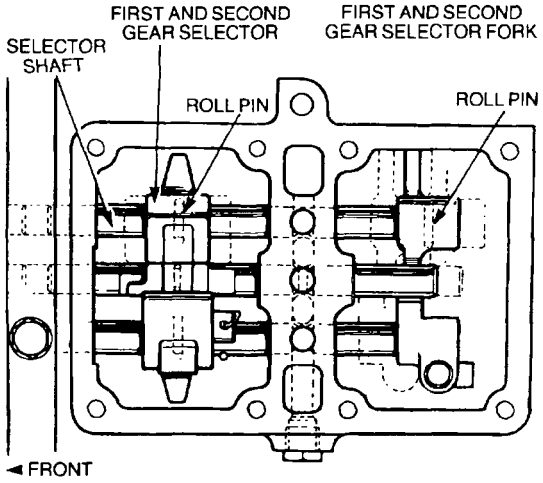


Figure 180 Installing the First and Second Gear Selector and Selector Fork

NOTE

Insert the feeler gauge in the specified position between selectors to obtain the correct setting.

lll. Move the reverse selector shaft forward until the reverse selector is against the transmission casing. Holding the reverse selector in position, move the intermediate selector forward on the shaft until it is against the casing, then move it to the rear so it just clears the casing. Insert a 0.25 mm (0.010 in) feeler gauge between the upper edges of the reverse and the third and fourth selector (Figure 181). Ensure that the feeler gauge is inserted at the upper edges of the selector jaws. The jaws taper slightly and the setting will not be correct if the feeler gauge is inserted lower down.

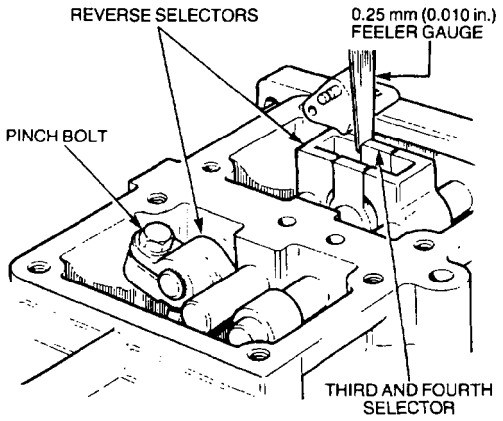


Figure 181 Reverse Selectors Adjustment

mmm. Hold the reverse, third and fourth selectors together to retain the feeler gauge. Rotate the reverse intermediate selector until it is against the third and fourth selector shaft and tighten the pinch-bolt (Figure 181).

nnn. Check the operation of the reverse gear selectors and check that there is sufficient clearance between the crossover lever and the intermediate selector during operation. If necessary, increase the clearance between the upper edges of the reverse and the third and fourth selector by 0.5 mm (0.020 in) to provide a smooth selection.

ooo. Ensure the crossover lever pivot bolt is secure then lock wire it to the side cover bolt. Connect the small hook to the reverse stop hinge pin (Figure 182).

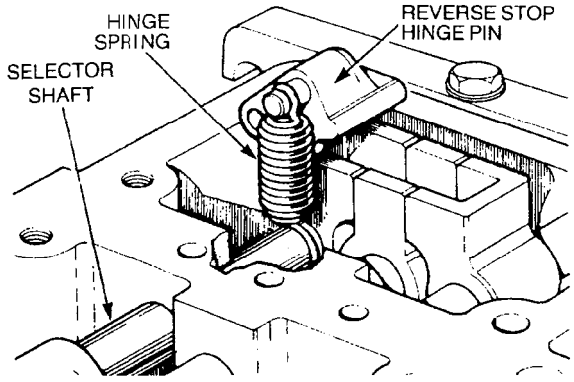


Figure 182 Installing the Reverse Hinge Spring

ppp. Insert the detent balls and springs ensuring that the spring painted yellow is installed on the reverse selector shaft.

qqq. Fit the top cover, new gasket and transfer lever cross-shaft to the transmission case.

rrr. Install the retaining bolts and new lock-washers. Tighten the bolts to 30 N.m (22 lbf.ft).

sss. Select neutral position on the transmission and install the reverse light switch in accordance with EMEI Vehicle G 103.

ttt. Apply a smear of suitable jointing compound around the three selector shaft holes in the bell housing rear face and install the bell housing, ensuring that the dowels are properly located.

uuu. Install the bell housing retaining nuts and bolts with new lock-washers. Tighten the larger bolts and nuts to 163 N.m (120 lbf.ft) and the smaller bolts to 95 N.m (70 lbf.ft).

vvv. Smear a thin film of molybdenum disulphide based grease on the front cover extension sleeve, install the release bearing and lever and secure the lever to the pivot with the clip and bolt.

www. Connect the transfer selector linkage at the lower ball joint and tighten the nut securely.

CAUTION

During installation of the engine or transmission, DO NOT use the bell housing bolts to pull the assemblies together if there is a gap evident. This will cause the input bearing retaining plates to bend, and allow excess end-float of the main shaft. If the plates are bent the transmission must be removed and returned for overhaul.

xxx. Install the clutch push rod and secure it with the clip.

yyy. Install the PTO (if fitted) and transmission assembly in accordance with EMEI Vehicle G 104-1.

zzz. Fit the transfer case caution decal in accordance with EMEI Vehicle G 197-4.

CAUTION

After installation, run the engine for ten minutes with the transmission in fourth gear and the transfer selector in neutral. This procedure will flush out any petroleum jelly used during reassembly and will ensure oil circulation to all bearings.

Transfer Case

63. Disassembly. Disassemble the transfer case 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 PTO (if fitted) and transmission assembly in accordance with EMEI Vehicle G 104-1.

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

c. Remove the transmission brake drum retaining screws and remove the brake drum.

d. Secure the rear output flange using the wrench (Table3, Serial 47) and remove and discard the locknut. Remove the flange, washer and felt seal.

e. Disconnect the park brake draw link clevis. Remove the four bolts securing the back plate to the speedometer housing and remove the back plate.

f. Remove the locknut retaining the speedometer spindle housing and remove the housing and the spindle from the transmission.

g. Remove the bolts and washers retaining the bottom cover (if fitted) and remove the cover.

h. Remove the lock-tab securing the intermediate gear retaining shaft and, while supporting the intermediate gear assembly, unscrew the shaft. Remove the intermediate gear assembly from the transmission as one unit.

i. Remove the shim installed on the end of the hollow sleeve and remove each gear complete with the bearing cups and cones (Figure 183).

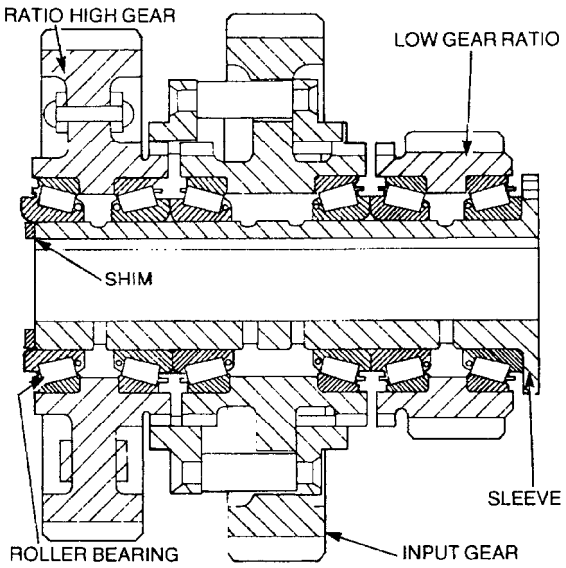


Figure 183 Intermediate Sectional View

j. Remove the intermediate gear shaft spacer from the rear of the transmission case and discard the two O rings.

k. Remove the pegged end cap from inside the transmission case.

l. Secure the front output flange using the wrench (Table 3, Serial 47). Remove and discard the locknut. Remove the flange.

m. Remove the bolts and lock-washers retaining the differential lock vacuum chamber assembly. Discard the lock-washers.

n. Remove the vacuum chamber assembly. Remove and discard the gasket (Figure 184). Take care not to lose the detent ball and spring during removal.

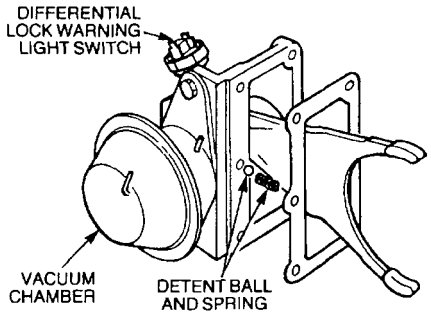


Figure 184 Removing the Differential Lock Vacuum Chamber Assembly

o. Remove the bolts and lock-washers securing the front output shaft housing to the transfer casing and withdraw the housing and output shaft (Figure 185). Discard the lock-washers.

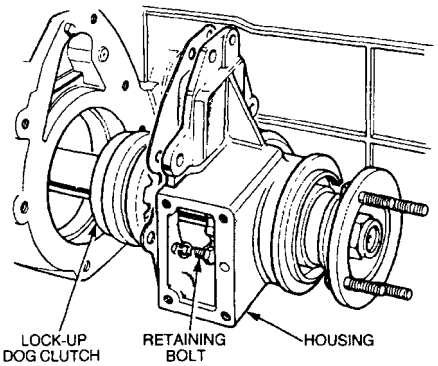


Figure 185 Removing the Front Output Shaft and Housing

p. Remove the lock-up dog-clutch, the output shaft and the oil seal.

q. Remove the bearing retaining circlip and, using a suitable press, remove the bearing.

r. Remove the bolts and lock-washers retaining the speedometer drive housing to the transfer case and remove the housing complete with the output shaft. Discard the lock-washers.

s. Remove the oil shield, oil seal and circlip (Figure 186) and, using a suitable press, remove the output shaft and bearing.

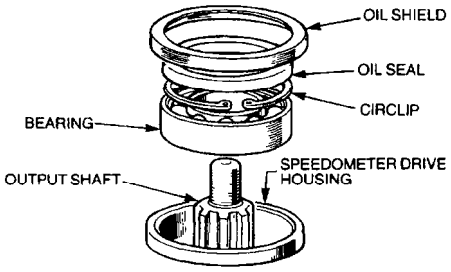


Figure 186 Removing the Output Shaft

t. Remove the differential assembly complete with the output (high) gear (Figure 187).

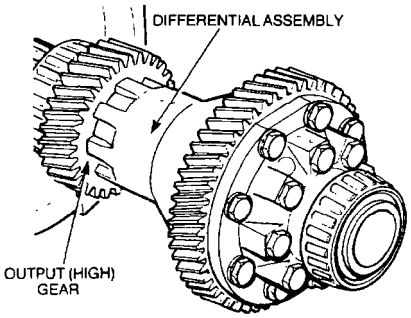


Figure 187 Removing the Differential Assembly

u. Remove the taper roller bearings using the extractor (Table 3, Serial 48) and a suitable press.

v. Remove the bearing cups from the transfer casing and the speedometer drive housing.

w. Match mark all differential components prior to removal. This will enable the components to be installed in their original positions during assembly and maintain their correct settings.

x. Using a suitable press, remove the output (high) gear from the differential assembly. The output (high) gear is secured to the differential assembly with Loctite 648 and considerable force may be required to free the gear from the differential shaft.

y. Remove the bolts and lock-washers retaining the output (low) gear to the differential and remove the gear (Figure 188). Discard the lock-washers.

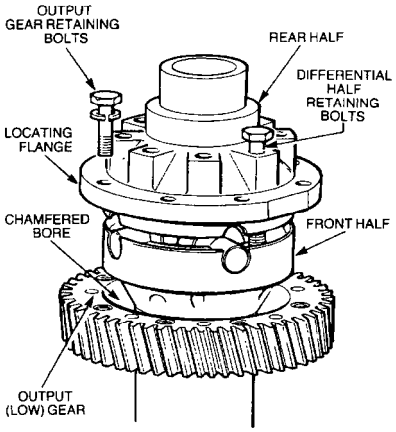


Figure 188 Removing the Output (Low) Gear

z. Support the differential assembly in the vertical position with the rear half uppermost. Remove the bolts and lock-washers retaining the two differential halves together. Lift off the rear half (Figure 188). Discard the lock-washers,

aa. Lift off the upper side gear, slide out the pinion shafts, remove the bevel gears, thrust washers and the lower side gear (Figure 189).

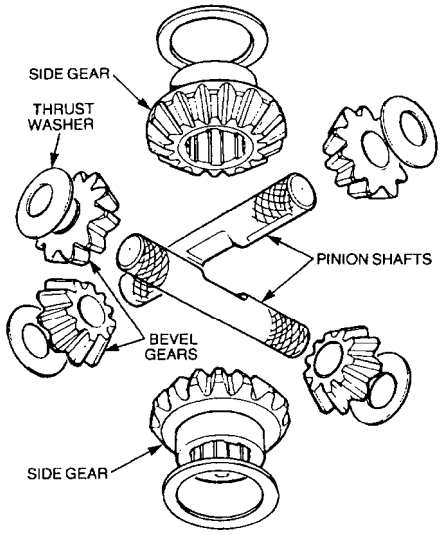


Figure 189 Removing the Differential Gears

bb. Remove the bolts and lock-washers retaining the transfer selector cover to the transfer casing and remove the cover. Discard the lock-washers.

cc. Remove the roll-pin securing the selector fork to the shaft and move the selector to the front of the casing (Figure 190).

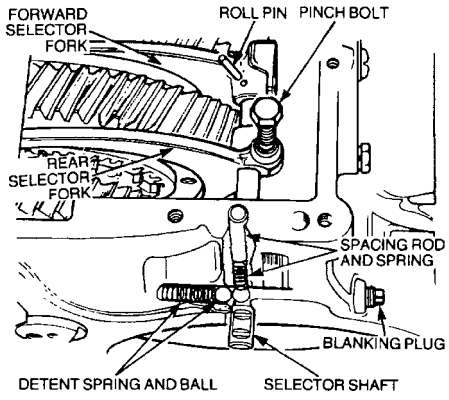


Figure 190 Removing the Transfer Selectors

dd. Pull the selector shaft to the rear to disengage the detent balls and remove the pinch-bolt on the rear selector fork.

ee. Partially withdraw the selector shaft to enable the selector forks to be removed and remove the selector forks.

ff. Carefully remove the selector shaft to allow the detent balls to be removed and remove the detent balls.

gg. Lift out the spacing rod and spring, remove the blanking plug and, using a piece of hooked wire, remove the detent spring from the drilling.

hh. Remove the roll-pin securing the transfer selector lever to the internal cross-shaft and remove the lever.

ii. Remove the two screws securing the retaining plates fitted to both ends of the cross-shaft and remove the two plates (Figure 191).

jj. Loosen the pinch bolt securing the selector to the cross-shaft, withdraw the shaft, selector and spacer. Remove and discard the two seals (Figure 191).

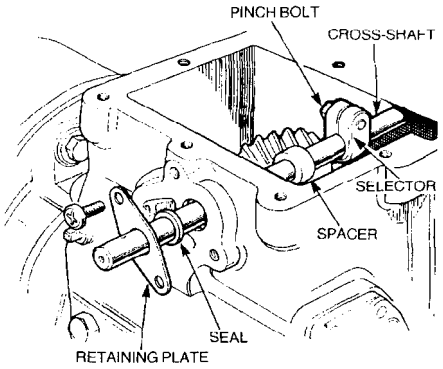


Figure 191 Removing the Transfer Selector Cross-shaft

64. Cleaning and Inspection. Clean and inspect the transfer case as follows:

WARNING

DO NOT spin the bearings with compressed air as personal injury or damage to the bearings may result.

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 bearings in a suitable cleaning agent and blow them dry with compressed air ensuring they are not allowed to spin while being dried.

b. Check the bearings for damage or wear (replace them as necessary).

c. Clean the case, covers and all other parts of the transfer case thoroughly with a suitable cleaning agent, ensuring that all traces of gasket material and sealer are removed and blow the parts dry with compressed air.

d. Inspect the gear teeth for wear, damage, scoring, surface fatigue, ridging or cracking. The gears may also be checked by Magnaflux, or similar magnetic particle crack detection method for cracks that would not otherwise be visible.

e. Replace the selector forks and/or sliding clutches if the side clearance in the groove is excessive.

f. Replace the selector shaft if there are cracks in either the detent or locating roll-pin holes.

g. Check the transfer case for cracks and replace it if necessary.

h. Inspect the detent springs for damage or loss of tension and replace them as necessary.

i. Check the security of the pegs in the pegged end cap and replace the cap if necessary.

j. Check all other parts for wear or damage. Replace all parts as required. Clean up any damaged threads.

CAUTION

The bevel pinions and side gears are supplied as a matched set of six and should not be interchanged. Replace as a set only.

k. Inspect the bevel pinions and side gears for wear, damage, scoring, surface fatigue, ridging or cracking. These components are supplied as a matched set and cannot be interchanged. If any need replacement, the whole set must be replaced.

l. Inspect the differential case halves for wear, distortion, damaged threads or any other damage. These components are supplied as a matched pair and cannot be interchanged. If one half needs replacement, both halves must be replaced.

m. Inspect the pinion shafts for wear, scoring, surface fatigue, ridging, cracking or any other damage. These components are supplied as a matched pair and cannot be interchanged. If one shaft needs replacement, both shafts must be replaced.

65. Reassembly. Reassemble the transfer case as follows:

a. General Instructions.

(1) It is important that the differential components are lubricated with clean oil during assembly All components must be lubricated with clean oil during assembly.

(2) Both the differential case halves and the pinion shafts are supplied as matched pairs only.

(3) The bevel pinions and side gears are supplied as a matched set of six and should not be interchanged. Replace them as a set only.

(4) The side gears must be adjusted to allow an end-float of 0.025 mm (0.010 in) and a pre-load of 0.025 mm (0.010 in).

(5) The range of shims available is from 1.05 to 1.45 mm (0.041 to 0.057 in) in 0.10 mm (0.004 in) increments.

b. Support the differential front half in the vertical position (Figure 192).

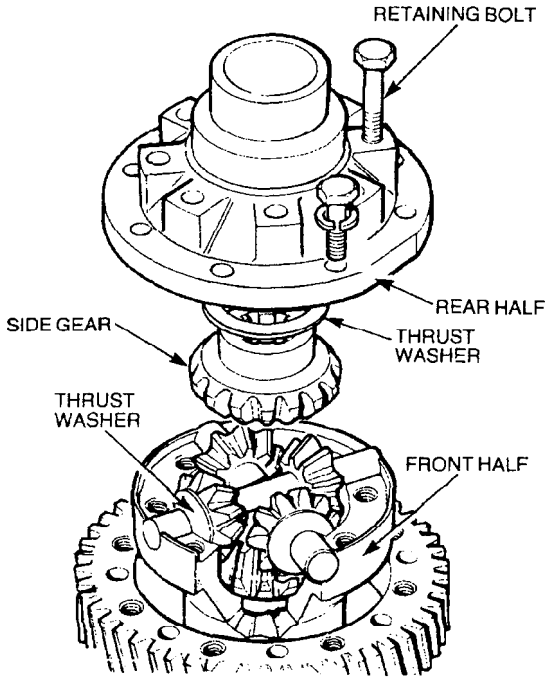


Figure 192 Differential Reassembly

c. Install a side gear and thrust washer into the front half of the differential. Fit the bevel pinions, thrust washers and pinion shafts on to the front half and side gear. Insert the remaining side gear and thrust washer into the rear half and fit the two halves together (Figure 192).

NOTE

If the differential assembly or bearings have been replaced, the differential bearing pre-load must be checked as described in Para 64 ff to ii.

d. Install the differential half retaining bolts and tighten them in sequence to 54 to 68 N.m (40 to 50 lbf.ft). Check that the adjustment of the side gears has provided an end float of 0.025 mm (0.001 in) and a pre-load of 0.025 mm (0.001 in).

e. If the adjustment is not correct remove the retaining bolts, lift off one differential half and remove the components. Replace the side gear thrust washers as required. Reassemble the differential, tighten the retaining bolts and re-check the side gear adjustment. Thrust washers are available in thickness of 1.05 to 1.45 mm (0.041 to 0.057 in) in 0.10 mm (0.004 in) increments. Continue the procedure until the correct adjustment is obtained.

f. Remove the differential half retaining bolts, apply Loctite 241 to the threads and install the bolts Partially tighten them in sequence, then fully tighten them in sequence to 54 to 68 N.m (40 to 50 lbf.ft).

NOTE

The bolt holes in the output (low) gear are not equally spaced to ensure the relationship between the differential housing and gear is maintained.

g. Install the output (low) gear over the front half of the differential ensuring that the chamfered bore and countersunk ends of the tapped hole are towards the locating flange (Figure 188) and align the bolt holes.

h. Apply Loctite 241 to the threads of the output gear retaining bolts and install them using new lock-washers. Partially tighten them in sequence, then fully tighten them in sequence to 60 to 64 N.m (44 to 47 lbf.ft).

NOTE

If the differential assembly or bearings have been replaced, the differential bearing pre-load must be checked as described in sub-paragraphs ff to jj.

i. Apply Loctite 648 to the splines of the output (high) gear, install the gear on the differential front half using a suitable press and insert the differential assembly in the transfer case.

j. Using a suitable press, install the new taper roller bearings on the differential front and rear halves.

k. Using a suitable press, install the bearing cup into the front of the transfer case.

l. Using a suitable press, install the bearing cups in the intermediate gears ensuring they are fully seated.

m. Thoroughly lubricate the gears and taper roller bearings with clean oil and install the gears and bearings on the sleeve. Do not fit the shim washer at this stage.

NOTE

The bearings must be fully seated prior to tightening the nut.

n. Using an 18 mm bolt, nut and large flat washers as a clamping mechanism (Figure 193), gradually tighten the nut to 130 N.m (96 lbf.ft) to pre-load the bearings while rotating and tapping the gears.

o. Position the assembly vertically with the nut uppermost, then remove the bolt, flat washers and nut, taking care not to disturb the gears and bearings.

p. Using a dial indicator, measure the gap between the shoulder of the sleeve and the face of the bearings (Figure 193) and select a shim washer to obtain a pre-load of 0.1 to 0.2 mm (0.004 to 0.008 in).

NOTE

Vehicles prior to ARN 49863 may be fitted with a grooved clamp bolt and a sleeve with two lubrication grooves. A new, different bolt and sleeve will be supplied when ordered.

q. Fit the pegged end cap to the inside of the casing and carefully position the intermediate gear assembly and the selected shim washer into the casing while ensuring that the groove in the sleeve is towards the top of the transmission and aligns with the oil hole.

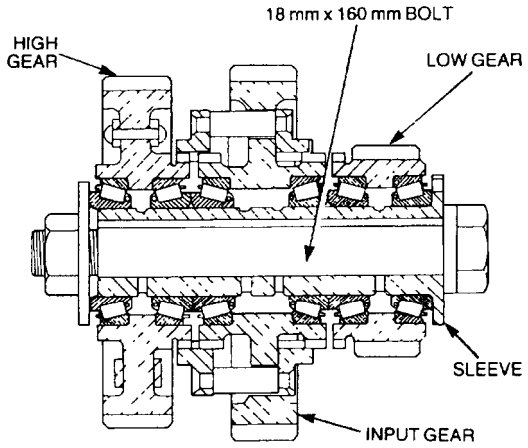


Figure 193 Intermediate Gear Assembly Pre-load Adjustment

r. Fit the new O rings to the end spacer and install the end spacer in the transmission case.

s. Insert the intermediate gear shaft with a new lock-tab, tighten the shaft to 170 to 190 N.m (125 to 140 lbf.ft) and check that the gears rotate freely. The maximum resistance to rotation should be 0.5 N.m (4.5 lbf.in). If the resistance is greater than specified, the pre-load will require resetting. When the pre-load is correct bend the lock-tab to secure the shaft.

t. Pour clean oil into both cast oil feed holes in the transfer case to ensure the intermediate shaft and bearings are adequately lubricated.

u. Position the cross-shaft selector in the transfer case and insert the cross-shaft and spacer engaging the selector (Figure 191).

v. Fit a new seal on both ends of the shaft, fit the retaining plates and tighten the retaining screw securely.

w. Align the hole in the transfer selector linkage lever with the hole in the cross-shaft and install a new roll-pin.

x. Insert the detent spring in the transfer case drilling, install the detent ball (Figure 190), push the ball against the spring and insert the selector shaft.

y. Position the rear selector, with the plain face to the rear, on the shaft, ensuring that the fork engages the rear side of the input gear.

z. Push the shaft further, then position the front selector on the cross-shaft selector with the extended boss to the rear and engaging the front side of the input gear.

aa. Insert the shaft fully, align the roll pin hole in the front selector with the hole in the shaft and secure it with a new roll pin.

bb. Install the detent ball, spring and spacing rod into the vertical drilling,. Smear a suitable sealing compound on the blanking plug threads and fit the plug in the casing (Figure 190).

cc. 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.

dd. Adjust the rear fork position on the selector shaft to allow a clearance of 0.12 to 0.25 mm (0.005 to 0.010 in) between the front face of the rear fork and the rear face of the input gear inner member (Figure 194) and tighten the pinch-bolt securely.

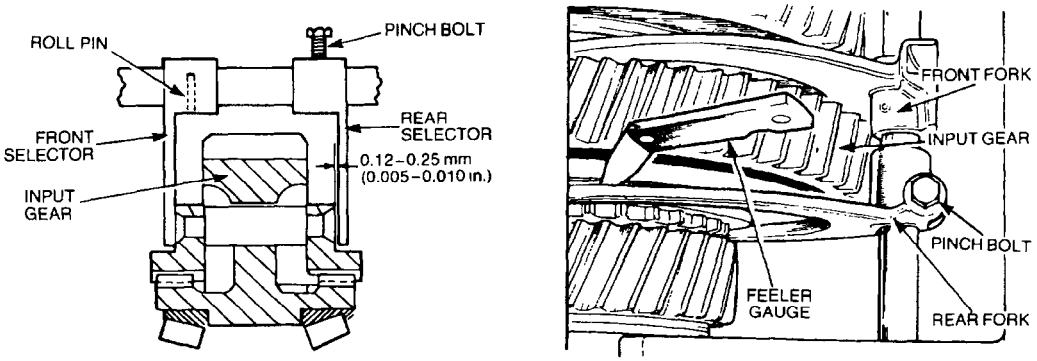


Figure 194 Transfer Selectors Adjustment

ee. Position a new gasket on the selector housing and install the cover. Fit the bolts and new lock-washers and tighten the bolts securely.

ff. Using a micrometer, measure the thickness of the new gasket to be installed between the speedometer drive housing and the transfer case and record the measurement.

gg. Install the shim that was previously fitted in the speedometer drive housing and, using a suitable press, fit the bearing cup.

hh. Position the speedometer drive housing without the gasket on the transfer case and measure the gap in at least four locations between the housing and transfer case joint faces. The measurement must be 0.1 mm (0.004 in) more than the thickness of the gasket measured in sub-para ff. The gap can be adjusted by replacing the shim installed behind the bearing cup (Figure 195). The range of shims available is from 1.65 to 2.80 mm (0.065 to 0.110 in) in 0.5 mm (0.002 in) increments.

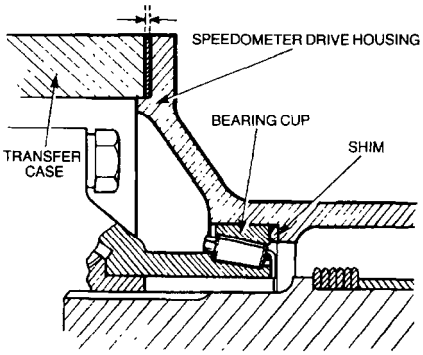


Figure 195 Differential Assembly Pre-load

ii. Remove the housing, install the selected gasket and refit the housing. Install the bolts and new lock-washers and tighten the bolts to 30 N.m (22 lbf.ft).

jj. Determine if the differential pre-load is correct by using a spring balance and cord coiled around the output shaft to measure the rolling resistance. With the bearings oiled, the differential lock disengaged and no oil seal fitted, the rolling resistance should be 6 to 7 kg (14 to 16 lbs). To obtain the correct rolling resistance, replace the shim with one of the correct thickness (Figure 195).

kk. Insert the rear output shaft, speedometer drive worm and spacer.

ll. Using a suitable press, install the output shaft bearing and secure it with the circlip.

mm. Press in the rear oil seal, open face first, until the seal plain face just clears the chamfer on the seal housing bore.

nn. Install the parking brake backing plate and secure it with the retaining bolts and new lock-washers.

oo. Using a suitable sealant, install and seal the oil catcher against the backing plate.

pp. Fit the coupling flange felt seal, plain washer and new locknut and tighten the locknut to 146 to 180 N.m (108 to 132 lbf.ft).

qq. Connect the park brake draw link and secure it with a new split pin.

rr. Install the brake drum and secure it with the retaining screws.

ss. Insert the speedometer drive spindle, new O ring and housing into the speedometer drive housing.

tt. Using a suitable press, install the bearing into the front output shaft housing and secure it with the circlip.

uu. Press in the front oil seal, open face first, until the seal plain face just clears the chamfer on the seal housing bore.

vv. Fit the lock-up dog clutch on the differential front half and insert the front output shaft.

ww. Locate a new gasket on the transfer case dowel and install the front output shaft housing. Install the retaining bolts and new lock-washers. Tighten the bolts to 30 N.m (22 lbf.ft) (Figure 196).

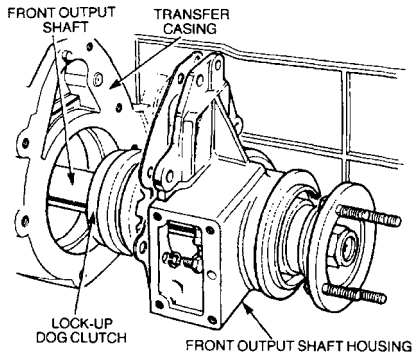


Figure 196 Installing the Front Output Shaft Housing

xx. Fit the mud shield on the front output shaft flange. Install the flange, plain washer and new locknut. Secure the flange using the wrench (Table 3, Serial 47) and tighten the locknut to 146 to 180 N.m (108 to 132 lbf.ft).

yy. Apply suitable sealing compound to the differential lock vacuum chamber housing gasket, install the housing, ensuring the selector fork is engaged in the lock-up dog clutch groove. Install the retaining bolts and new lock-washers and tighten them to 30 N.m (22 lbf.ft).

zz. Install the PTO (if fitted) and transmission assembly in accordance with EMEI Vehicle G 104-1.

Power Take-off (PTO) and Torque Limiter

66. Disassembly. Disassemble the PTO and torque limiter as follows:

a. Remove the PTO and torque limiter assembly in accordance with EMEI Vehicle G 104-1.

b. Remove and discard the two split pins securing the selection lever clevis pins and remove the clevis pins, flat washers and the selection lever.

c. Remove the two circlips, the flat washer and rubber boot from the selector shaft.

NOTE

The set-screw is secured to the selector fork by Loctite 245.

d. Remove the set-screw securing the selector fork to the shaft, partially remove the shaft to allow the selector fork to be disengaged. Disengage the selector fork and withdraw the shaft from the housing.

e. Remove the plug from the detent spring and ball drilling and remove the ball and spring.

f. Remove the selector shaft oil seal and discard it.

g. Remove the hexagonal cap from the torque limiter housing and discard the sealing washer.

h. With the housing appropriately supported and, using a suitable press and arbor, remove the torque limiter assembly from the housing (Figure 197).

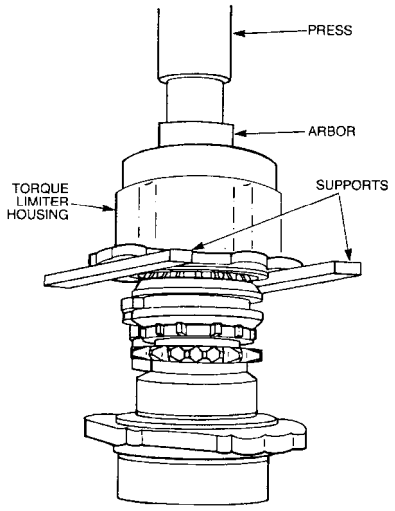


Figure 197 Removing the Shaft Assembly

i. Remove the external circlip retaining the ball bearing on the winch drive flange and, while supporting the end-plate, press the flange off the bearing (Figure 198).

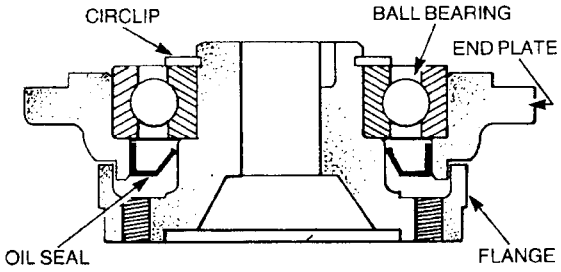


Figure 198 Removing the Winch Drive Flange, Bearing and Oil Seal

j. Support the end plate and press out the ball bearing and oil seal (Figure 198).

k. Remove the internal circlip retaining the ball bearing in the drive sprocket and, using a suitable arbor, press out the ball bearing and needle roller bearing (Figure 199).

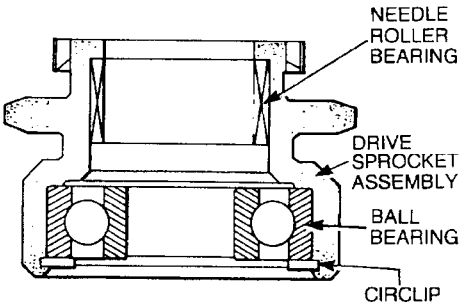


Figure 199 Removing the Drive Sprocket Bearings

l. Slide off the sliding clutch, clamp the shaft in the vice and remove the locknut and flat washer securing the torque limiter assembly to the shaft. Discard the locknut.

m. Support the torque limiter on the jaws of the vice and carefully tap the shaft through the drive flange (Figure 200).

n. Lift off the drive flange complete with the bearing, taking care not to lose the steel balls, and remove the spacer (Figure 200).

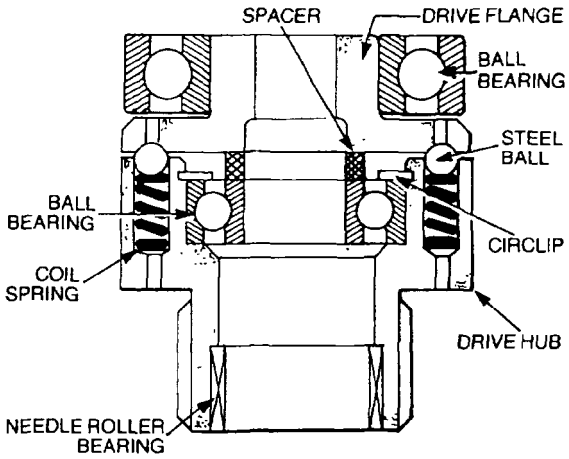


Figure 200 Removing the Torque Limiter

o. Support the large ball bearing assembly and carefully tap out the drive flange.

p. Remove the steel balls and coil springs and remove the internal circlip retaining the ball bearing in the drive hub.

q. Support the drive hub in the vice and carefully remove the needle roller bearing and ball bearing.

67. Cleaning and Inspection. Clean and inspect the PTO and torque limiter as follows:

WARNING

DO NOT spin the bearings with compressed air as personal injury or damage to the bearings may result.

a. Clean all components in a suitable cleaning agent and blow them dry with compressed air.

b. Inspect all components for excessive wear and replace parts as necessary.

c. Inspect the selector fork for excessive clearance in the sliding clutch groove and replace as required.

d. Inspect the springs for wear, damage or loss of tension and check that the spring heights are the same for all twelve springs (replace the springs as necessary).

68. Reassembly and Resetting. Reassemble the PTO and torque limiter and reset the torque limiter settings as follows:

a. Using a suitable press, install the ball bearing on the drive flange.

b. Support the drive hub, press in the ball bearing and needle roller bearing and secure the ball bearing with the internal circlip (Figure 201).

c. Clamp the output shaft in the vice, ensuring that the soft-jawed clamps are fitted, thoroughly lubricate the drive hub and bearings with clean oil and install the drive hub (Figure 201).

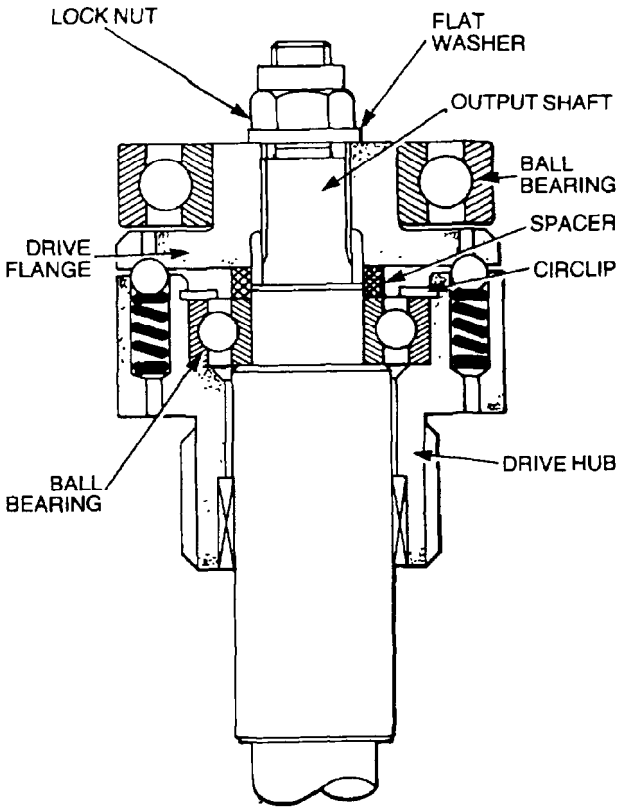


Figure 201 Installing the Torque Limiter on Output Shaft

d. Thoroughly lubricate the twelve steel balls and springs.

NOTE

The torque limiter drive hub has sixteen holes but only twelve balls and springs are fitted in this version. Accordingly, the balls and springs are to be installed in four groups of three.

e. Install the twelve springs and steel balls in four groups of three equally distributed around the drive hub.

f. Assemble the spacer, drive flange, flat washer and a new locknut to the output shaft (Figure 201) and tighten the locknut to 60 N.m (44 lbf.ft).

g. Clamp the drive hub in the vice ensuring the soft-jawed clamps are fitted. Ensure the torque limiter is adequately lubricated with clean oil and check that the breakaway torque is set at 110 N.m (82 lbf.ft). To increase the breakaway torque setting, decrease the spacer thickness and to decrease the break away torque setting, increase spacer thickness.

h. Press the needle roller and the ball bearing in the drive sprocket and secure the ball bearing with the internal circlip (Figure 202).

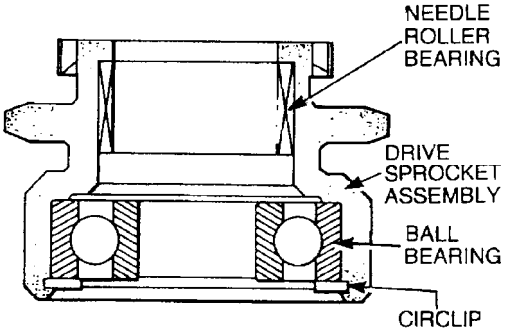


Figure 202 Installing Drive Sprocket Bearings

i. Press the ball bearing into the end plate.

j. Smear the oil seal with grease and fit the seal into the end-plate with the open face towards the bearing.

k. Support the torque limiter housing and carefully press the torque limiter and ball bearing assembly into the recess, ensuring that the output shaft is centred in the mounting face (Figure 203).

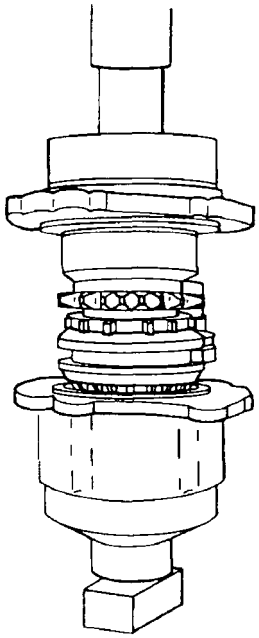


Figure 203 Installing the Torque Limiter into the Housing

l. Push a new selector shaft oil seal into the housing with the open face towards the selector fork.

m. Smear the shaft with petroleum jelly and push the shaft through the seal and housing.

n. Thoroughly lubricate the internal spline in the sliding clutch and install it on the output shaft.

o. Engage the selector fork in the sliding clutch groove and push the selector shaft into the fork.

p. Clean the fork set-screw and fork threads with Loctite T primer, apply Loctite 245 to the threads and tighten the screw securely, ensuring that the point seats in the shaft indent.

q. Insert the ball and detent spring in the drilling, install the plug and tighten it securely.

r. Install the hexagonal cap in the housing with a new sealing washer and tighten the cap securely.

s. Fit the rubber boot over the selector shaft and install the two circlips and flat washer on the shaft.

t. Position the selector lever to the selector shaft and housing, fit the two clevis pins and flat washers and secure the clevis pins with new split pins.

u. Check the operation of the selector and rectify any faults found.

v. Install the PTO and torque limiter assembly in accordance with EMEI Vehicle G 104-1.

Table 10 Transmission Group Specifications

Serial	Item	Specification
1	Mainshaft end-play on gears	0.025 to 0.150 mm (0.001 to 0.006 in)
2	Countershaft rolling resistance	2.7 to 4.0 kg (6 to 8.5 lb)
3	Transfer gear end-play	0.050 mm (0.002 in) max
4	Oil pump front cover	30 N.m (22 lbf.ft)
5	Rear bearing cover	30 N.m (22 lbf.ft)
6	Input shaft end-play	0.05 mm (0.002 in)
7	Oil pump cover	10 N.m (8 lbf.ft)
8	Bottom cover	30 N.m (22 lbf.ft)
9	Side cover	58 N.m (43 lbf.ft)
10	Top cover	30 N.m (22 lbf.ft)
11	Bell housing	
12	Large bolts	163 N.m (120 lbf.ft)
13	Small bolts	95 N.m (70 lbf.ft)
14	Differential casing bolts	54 to 68 N.m (40 to 50 lbf.ft)
15	Differential output (low) gear	60 to 64 N.m (44 to 47 lbf.ft)
16	Intermediate gears shaft	170 to 190 N.m (125 to 140 lbf.ft)
17	Intermediate gears rolling resistance	0.5 N.m (4.5 lbf.in)
18	Transfer selector fork clearance	0.12 to 0.25 mm (0.005 to 0.010 in)
19	Speedometer drive housing	30 N.m (22 lbf.ft)
20	Differential assembly rolling resistance	6 to 7 kg (14 to 16 lb.)
21	Propeller coupling flange (front and rear)	146 to 180 N.m (108 to 132 lbf.ft)
22	Front output shaft housing	30 N.m (22 lbf.ft)
23	Differential lock vacuum chamber housing	30 N.m (22 lbf.ft)
24	Torque limiter to shaft	60 N.m (44 lbf.ft)
25	Coupling flange to shaft	61 N.m (45 lbf.ft)
26	Torque limiter breakaway torque	110 N.m (82 lbf.ft)

REAR AXLE

Differential Carrier

69. Removal. Remove the differential carrier 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 rear axle in accordance with EMEI Vehicle G 104-1.

b. Remove the rear axle shafts from the axle in accordance with EMEI Vehicle G 103.

c. Drain the oil from the axle casing into a suitable container.

d. Remove the bolts, lock-washers and support strip retaining the differential cover. Remove the cover and the gasket (Figure 204). Discard the lock-washers and the gasket.

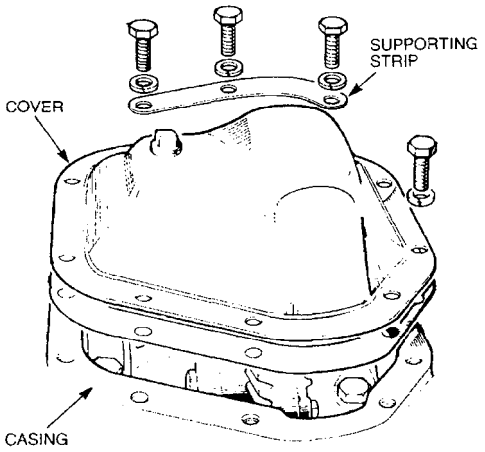


Figure 204 Removing the Differential Cover

e. Match mark the two bearing caps (Figure 205), remove the retaining bolts from the bearing caps and lift out the bearing caps.

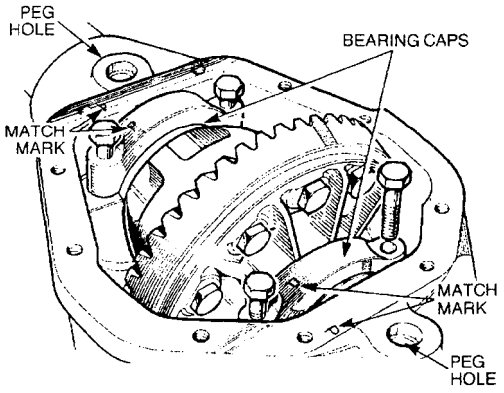


Figure 205 Match marking the Bearing Caps

f. Clean debris and excess paint from the two peg holes in the differential housing (Figure 205).

g. Install the axle spreader (Table 3, Serial 49) and adapter pegs (Table 3, Serial 50) onto the differential housing, ensuring that the adapter pegs are fully inserted into the peg holes (Figure 206).

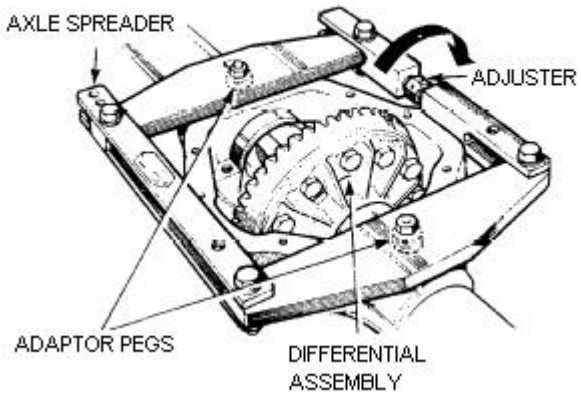


Figure 206 Removing the Differential Assembly

h. Turn the adjuster to take up the free play until the adjuster becomes stiff. The adjuster flats are numbered to enable a check to be made on the total amount turned during the spreading process.

CAUTION

Do not overstretch the differential casing when removing the differential. Overstretching can permanently damage the casing.

i. Ensure that the side members of the special tool are not in contact with the casing and rotate the adjuster one flat at a time to spread the casing until the differential assembly can be removed. Do not overstretch the casing. The maximum stretch permissible is 0.30 mm (0.012 in) which is the equivalent of three flats on the adjuster barrel.

j. Insert a suitable lever between the differential assembly and the axle casing and remove the differential, taking care not to damage the casing in the process.

k. Loosen the adjuster and remove the axle spreader.

l. Using the wrench (Table 3, Serial 47) to prevent the pinion flange from rotating, remove the locknut and flat washer (Figure 207). Discard the locknut.

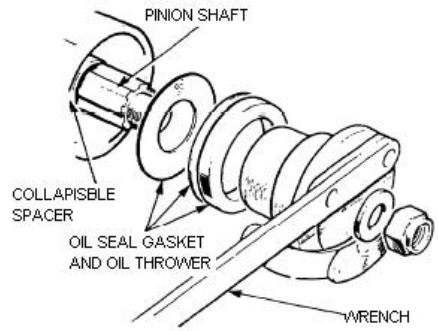


Figure 207 Removing the Pinion Flange and Shaft

m. Using a soft hammer, tap the pinion shaft through the pinion flange. Remove the flange and then the pinion shaft assembly.

n. Remove the oil seal, gasket, oil thrower, spacer and outer bearing cone.

o. Remove the collapsible spacer from the pinion shaft.

p. Using the extractor (Table 3, Serial 52) and bearing remover (Table 3, Serial 38), remove the inner bearing cone from the pinion shaft (Figure 208)

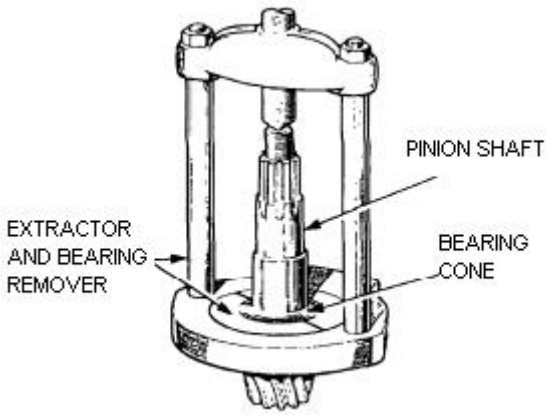


Figure 208 Removing The Pinion Bearing Cone

q. Using the extractor (Table 3, Serial 51), remove the inner and outer pinion shaft bearing cups from the casing. Remove the shims fitted behind the inner bearing cup (Figure 209) and record the shim thickness.

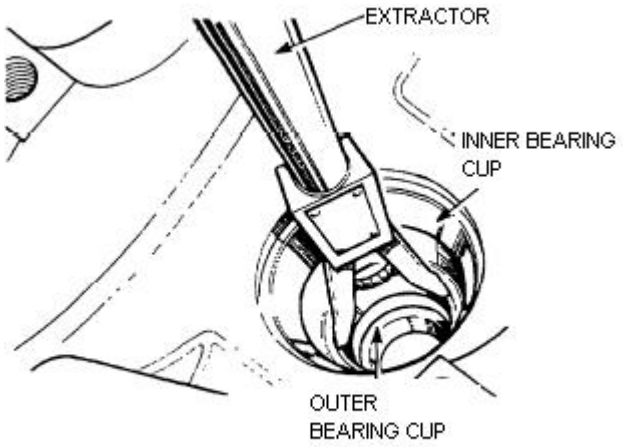


Figure 209 Removing the Pinion Bearing Cup

70. Disassembly. Disassemble the differential as follows:

a. Match mark the crown wheel and the differential to facilitate reassembly.

b. Remove the retaining bolts and separate the crown wheel from the differential (Figure 210).

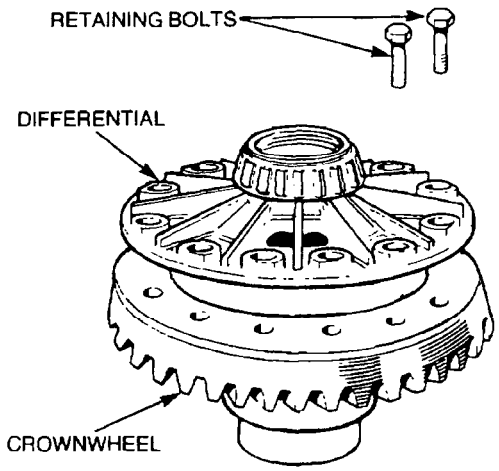


Figure 210 Removing the Crown wheel

c. Match mark the two differential halves.

d. Remove the bolts securing the two halves together (Figure 211) and remove the upper half.

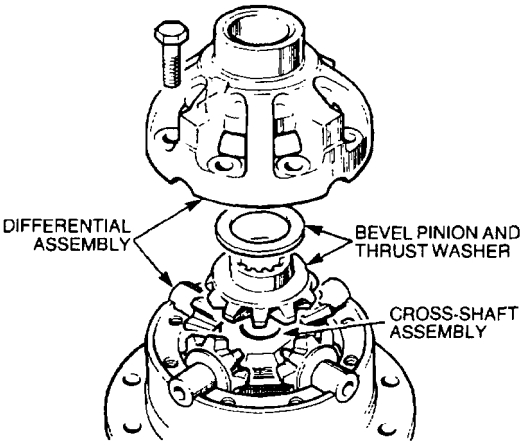


Figure 211 Differential Disassembly

e. Lift off the bevel pinion and thrust washer and discard the thrust washer (Figure 211).

f. Remove the cross-shaft assembly. Remove the dished thrust washers and pinions from the cross-shaft. Lift out the remaining bevel pinion and thrust washer and discard the thrust washers (Figure 212).

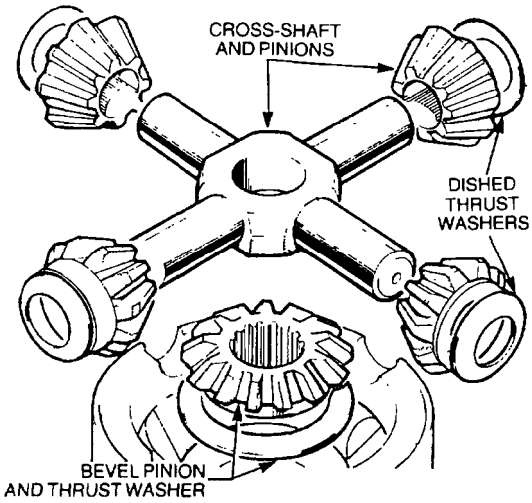


Figure 212 Cross-shaft Disassembly

g. Using the bearing replacer, extractor, bearing remover and adaptors (Table 3, Serial 45, 53, 38 and 48), remove the differential bearing cones and shims (Figure 213).

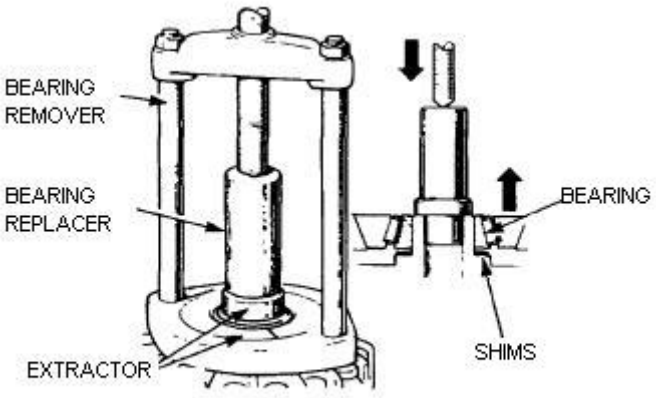


Figure 213 Removing the Differential Bearing

71. Cleaning and Inspection. Clean and inspect the differential as follows:

WARNING

DO NOT spin the bearings with compressed air as personal injury or damage to the bearings may result.

a. Thoroughly clean all components using a suitable cleaning agent and blow them dry with compressed air.

b. Inspect all gear teeth for signs of abrasive wear, scratching, ridging, scoring, surface fatigue, pitting, corrosive wear, digging in or cracking and replace parts as necessary.

c. If either the crown wheel or pinion is defective, both components must be replaced as a set as they are only available as a matched pair.

d. Inspect the crown wheel and pinion and check that that the serial number etched on the pinion end face matches the serial number etched on the crown wheel (Figure 220). If the numbers do not match replace the crown wheel and pinion set.

e. Ensure the pinion end-face is free of any raised burrs around the etched markings.

f. Inspect all bearings for flaking, cracks, fractures, fretting and corrosion and replace as necessary.

g. Inspect the crown wheel-to-differential joint faces for signs of damage and replace parts as necessary.

h. If either of the differential halves is defective, they must be replaced as a set as they are only available as a matched pair.

i. Ensure that all bearings, except the outer pinion bearing cone, are an interference fit when reassembling.

CAUTION

Ensure that the threads in the differential oil level plug hole are not stretched.

j. Inspect the differential oil level plug opening to ensure the threads in the cover plate are not stretched due to over tightening of the level plug during servicing. Stretched threads may allow the oil level plug to contact the crown wheel causing severe damage. If necessary rectify stretched threads in accordance with EMEI Vehicle G 203.

72. Reassembly. Reassemble the differential as follows:

a. Lubricate the bevel pinions, pinions and new thrust washers with clean OEP-220 oil.

b. Install a bevel pinion and thrust washer in the differential half.

c. Fit the four pinions and dished thrust washers on the cross-shaft, position the cross-shaft assembly in the differential half and install the remaining bevel pinion with a thrust washer (Figure 214).

d. Locate the remaining differential half on the differential assembly ensuring the match marks on the differential halves are aligned (Figure 214).

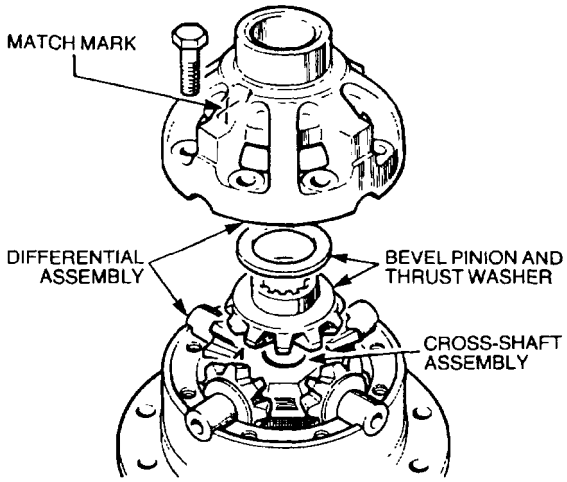


Figure 214 Differential Reassembly

e. Apply Loctite 271 to the retaining bolt threads, insert the bolts, partially tighten them evenly and finally tighten them to 89 to 102 N.m (66 to 75 lbf.ft).

f. Locate the crown wheel on the differential flange, ensuring that the match marks are aligned.

g. Apply Loctite 271 to the retaining bolt threads, insert the bolts, partially tighten them evenly and finally tighten them to 129 to 142 N.m (95 to 105 1bf.ft).

h. Using the bearing installation adaptor (Table 3, Serial 54) and a suitable press, install the bearing cones onto the differential assembly (Figure 215). Do not install the shims at this stage.

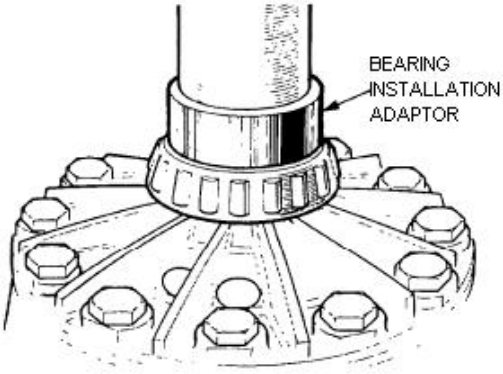


Figure 215 Installing the Differential Bearing Cones

i. Lubricate the bearing cones with clean oil OEP-220, fit the differential bearing cups onto the bearing cones, install the differential assembly in the axle casing and rotate the differential to centralize the bearings.

j. Position a dial indicator on the axle casing with the stylus in contact with the rear face of the crown wheel (Figure 216), rotate the differential and check the total run-out. This must not exceed 0.05 mm (0.002 in). If the run-out is excessive, check the crown wheel-to-differential cage mating faces for dirt or signs of damage and, if necessary, select a new position for the stylus to contact until the amount of run-out is below that specified.

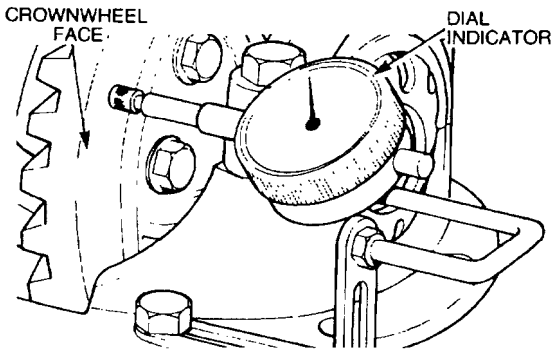


Figure 216 Measuring Differential Run-out

k. Using two levers inserted between the axle casing and the differential assembly, move the differential fully to one side, ensuring that the differential does not tilt. Rotate the differential to settle the bearings while continuing to apply pressure with the levers. Zero the dial indicator.

l. Lever the assembly fully to the opposite side while rotating the differential and note the reading on the indicator.

m. To obtain the required pre-load, add 0.005 in to the reading noted in sub-para l. The total is then equal to the nominal value of shims required for the differential bearings. The shim thicknesses are in thousandths of an inch and are supplied in thicknesses of 0.003 in, 0.005 in, 0.010 in and 0.030 in. The shims are not fitted until the differential backlash check has been carried out.

n. Remove the differential assembly from the axle casing.

73. Installation. Install the differential carrier as follows:

a. Select shims of the same thickness as those removed from the pinion inner bearing cup (Para 69.q).

b. Position the screw press and adaptor (Table 3, Serial 55 and 56) in the axle case pinion bearing nose (Figure 217).

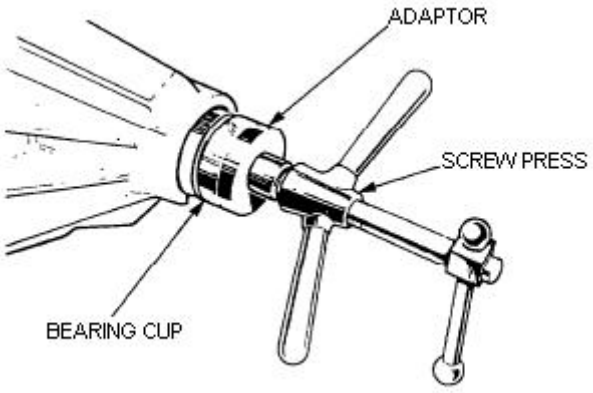


Figure 217 Installing the Pinion Bearing Cup Replacing Tool

c. Insert the selected shims in the inner bearing cup seat, position the inner bearing cup in the casing, fit the second adaptor (Table 3, Serial 56) onto the screw press and secure it with the nut (Figure 218).

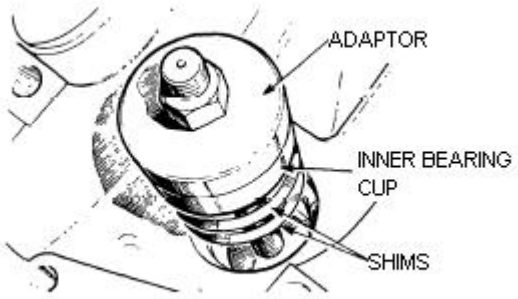


Figure 218 Installing the Inner Pinion Bearing Cup

d. Hold the centre bolt lever and turn the butterfly lever to press in both bearing cups. Remove the nut and remove the special tools.

e. Using the extractor and bearing remover (Table 3, Serial 52 and 38), press the inner bearing cone onto the pinion shaft (Figure 219).

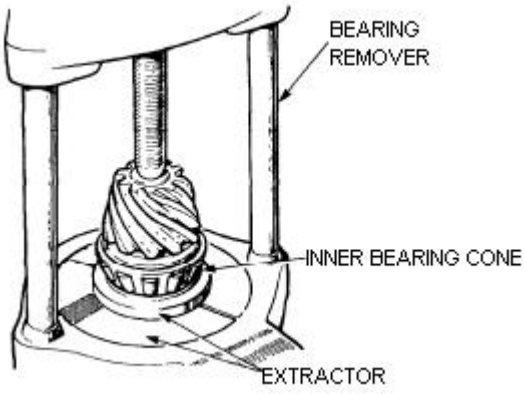


Figure 219 Installing the Pinion Inner Bearing Cone

f. Position the pinion shaft assembly in the case but do not install the collapsible spacer at this stage.

g. Fit the outer bearing cone on the pinion shaft, install the coupling flange, flat washer and nut and tighten the nut to remove all end-float.

h. Rotate the pinion to settle the bearings and tighten the nut further until a force of 1.0 to 1.35 N.m (8 to 12 lbf.in) is required to rotate the pinion.

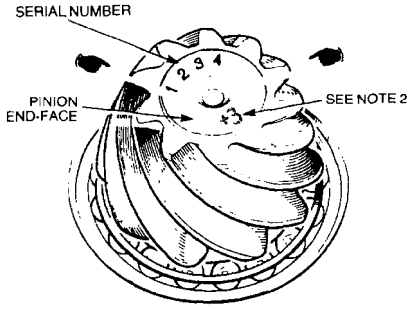


Figure 220 Pinion Shaft Markings

i. Remove the keep-disc from the magnetized base of the dial indicator (Table 3, Serial 57) and place the dial indicator and setting block (Table 3, Serial 63) on a flat surface. Zero the dial indicator stylus to the 30.93 mm setting on the setting block (Figure 221).

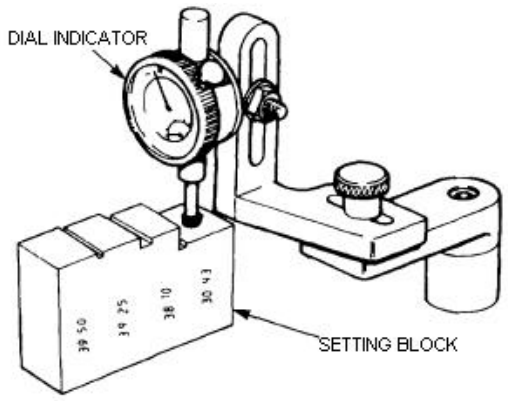


Figure 221 Zeroing the Dial Indicator

j. Position the magnetized base of the dial indicator on the pinion shaft end face and rest the stylus on the lowest point of one differential bearing cup bore (Figure 222). Note the dial indicator deviation from the zero setting.

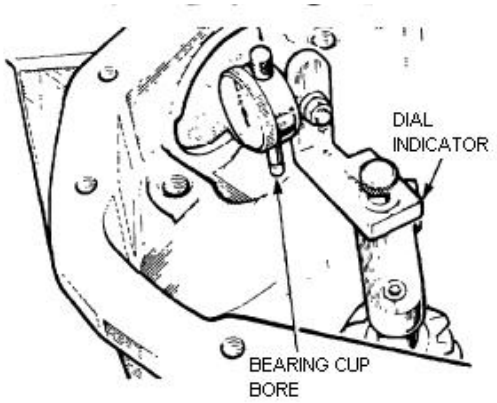


Figure 222 Measuring the Pinion Shaft Height

k. If the stylus has moved down, the amount is equivalent to the thickness of shims that must be removed from under the pinion inner bearing cup to bring the pinion down to the nominal position (Figure 224). If the stylus has moved up, the amount is equivalent to the additional thickness of shims required to bring the pinion up to the nominal position.

l. Repeat the procedure on the opposite bore and add together the two readings. Halve the total to obtain the mean reading and note whether the mean reading will cause the stylus to move up or down from the zero setting. If the stylus has moved down, the equivalent thickness of shims to the mean reading must be removed from under the pinion inner bearing cup. If the stylus has moved up, the equivalent thickness of shims to the mean reading must be added under the pinion inner cup bearing (ref Table 11 for examples).

Table 11 Pinion Height Setting Examples

Example 1		**Example 2**	
Left-hand side reading	+ 0.006 in	Left-hand side reading	+ 0.006 in
Right-hand side reading	– 0.003 in	Right-hand side reading	– 0.008 in
Add both readings	+ 0.006 in	Add both readings	+ 0.006 in
	– 0.003 in		– 0.008 in
Result of adding equals	+ 0.003 in	Result of adding equals	– 0.002 in
Dividing by 2 equals	+ 0.0015 in	Dividing by 2 equals	– 0.001 in
Therefore *subtract* 0.0015 in from the shim thickness behind the pinion inner bearing cup.		Therefore *add* 0.001 in to the shim thickness behind the pinion inner bearing cup.	

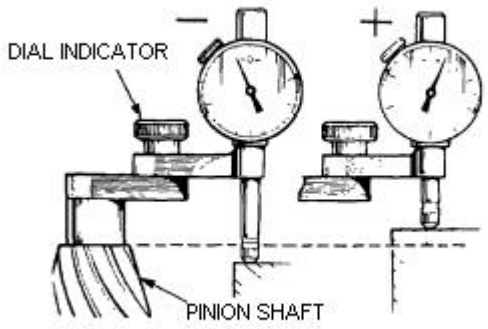


Figure 223 Measuring the Pinion Shaft Height Using the Zeroed Dial Indicator

m. Before adjusting the shim thickness, check the pinion end face marking opposite the serial number. If it has a plus (+) figure, subtract that amount, in thousandths of an inch, from the shim thickness obtained in sub-para k. Alternatively if the pinion has a minus (–) figure, add the amount to the shim thickness obtained in sub-para k.

n. Adjust the shim thickness behind the pinion inner bearing cup (Figure 224) by the amount determined in sub-paras l and m and recheck the pinion height settings as described in sub-paras j and l If the setting is correct, the mean reading on the dial indicator will agree with the figure marked on the pinion end-face. For example, with an end face marking of +4, the dial indicator reading should indicate that the pinion is 0.004 in below nominal. The shim thicknesses are in thousandths of an inch and are supplied in thicknesses of 0.003 in, 0.005 in, 0.010 in and 0.030 in.

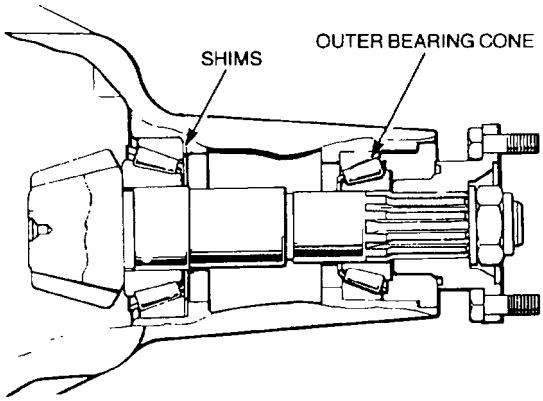


Figure 224 Installing the Pinion Shaft

o. When the pinion shaft setting is satisfactory, remove the nut, flat washer, coupling flange and outer bearing cone and install a new collapsible spacer with the flared end towards the flange end. Fit the bearing, oil slinger and oil seal gasket (Figure 225).

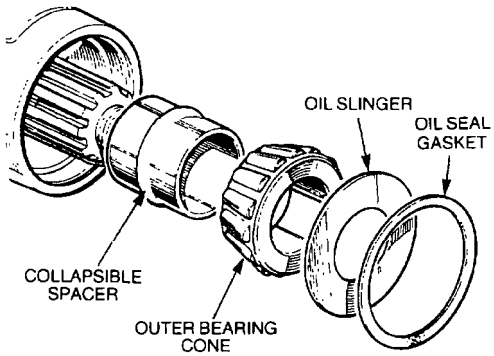


Figure 225 Installing the Collapsible Spacer and Outer Bearing

p. Smear grease on the seal lip. Using the pinion seal installer (Table 3, Serial 58), install the oil seal with the open face towards the bearing.

CAUTION

After the initial collapse, pinion shaft torque resistance build up is rapid. Frequent checks must be carried out, using a spring balance, to ensure the correct figures are not exceeded; otherwise a new collapsible bearing spacer will be required.

q. Fit the coupling flange and plain washer and loosely fit a new flange locknut. Using the wrench (Table 3, Serial 47) to prevent the flange from rotating, tighten the nut to obtain the correct resistance to rotation. A torque of approximately 339 N.m (250 lbf.ft) is required on the coupling flange nut to start collapsing the spacer. Torque resistance build up is rapid after the initial collapse of the spacer occurs and frequent checks are required to ensure the correct setting is not exceeded, otherwise a new collapsible spacer will be required. When using the original bearings, the resistance must be between 1.7 to 3.4 N.m (15 to 30 lbf.in). When using new bearings, the resistance must be between 3.4 to 4.5 N.m (30 to 40 lbf.in).

r. Install the differential in the axle casing and, using two levers, move the assembly away from the pinion gear until the opposite bearing cup is seated against the axle casing (Figure 226). Do not tilt the differential assembly.

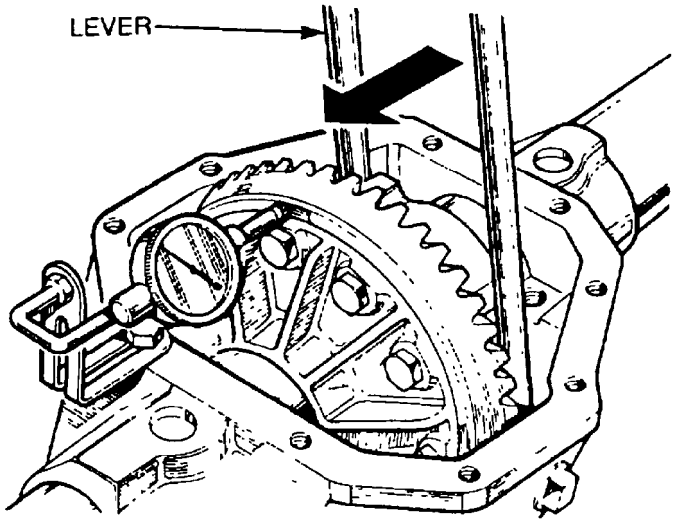


Figure 226 Setting Dial Indicator to Zero

s. Position the dial indicator on the axle casing with the stylus in contact with the back face of the crown wheel and zero the gauge (Figure 226).

NOTE

The shim dimensions are in thousandths of an inch, and the range is 0.003 in, 0.005 in, 0.010 in and 0.030 in.

t. Lever the differential assembly to engage the crown wheel teeth in full mesh with the pinion teeth, ensuring the differential assembly is not tilted. Note the total reading on the gauge.

u. Subtract 0.010 in from the reading obtained in sub-para t, to obtain the correct crown wheel backlash. This figure indicates the thickness of shims to be fitted between the axle case and the bearing cone on the crown wheel side of the differential. The shim thicknesses are in thousandths of an inch and are supplied in thicknesses of 0.003 in, 0.005 in, 0.010 in and 0.030 in.

v. Remove the differential assembly and, using the bearing replacer, extractor, bearing remover and adaptors (Table 3, Serial 45, 53, 38 and 48), remove the bearing cone on the crown wheel side.

w. From the total shim thickness determined in sub-para 72.m, subtract the shim value determined in sub-para u and fit to the crown wheel side bearing face. Using the bearing installation adaptor (Table 3, Serial 54) and a suitable press, install the bearing cone on the differential assembly.

x. Using the bearing replacer, extractor, bearing remover and adaptors (Table 3, Serial 45, 53, 38 and 48), remove the bearing cone from the opposite side of the differential assembly.

y. Install the remainder of the shims determined in sub-para 72.m and using the bearing installation adaptor (Table 3, Serial 54) and a suitable press, install the bearing cone.

z. Install the axle spreader (Table 3, Serial 49) and adapter pegs (Table 3, Serial 50) onto the differential housing (Figure 227) ensuring that the adapter pegs are fully inserted into the peg holes and the adjuster turns freely.

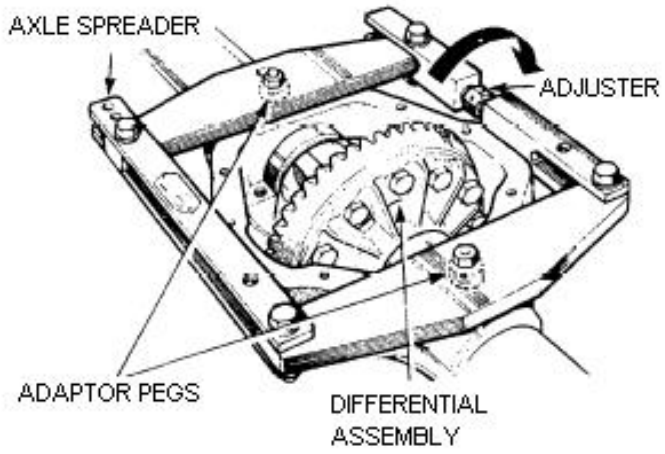


Figure 227 Installing the Differential Assembly

aa. Turn the adjuster to take up the free play and the adjuster becomes stiff. The adjuster flats are numbered to enable a check to be made on the total amount turned during the spreading process.

CAUTION

Do not overstretch the differential casing when installing the differential assembly. Overstretching can permanently damage the casing.

bb. Ensure that the side members of the special tool are not in contact with the casing, then rotate the adjuster one flat at a time to spread the casing until the differential assembly can be installed. Do not overstretch the casing. The maximum stretch permitted is 0.30 mm (0.012 in), the equivalent of three flats on the adjuster.

cc. Install the differential assembly.

dd. Loosen the adjuster and remove the special tool.

ee. Install the two bearing caps ensuring that the match marks align.

ff. Insert the retaining bolts and tighten them to 126 to 142 N.m (93 to 105 lbf.ft).

gg. Position the dial indicator (Table 3, Serial 57) on the axle casing and place the stylus on a crown wheel tooth (Figure 228). Hold the pinion shaft flange and measure the backlash between the crown wheel and pinion gear teeth. The backlash should be between 0.15 to 0.27 mm (0.006 to 0.011 in), if it is not within this range repeat the procedure described in sub-paras r to x.

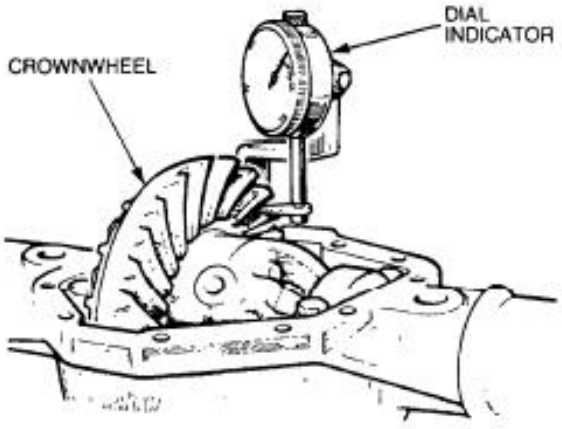


Figure 228 Differential Backlash Final Check

hh. Apply suitable sealing compound to both sides of the differential cover gasket, install the cover and supporting strip. Insert the retaining bolts and new lock-washers and tighten them to 27 to 34 N.m (20 to 25 1bf.ft). Ensure that the original differential cover is refitted. Covers must not be interchanged.

ii. Refill the axle casing with approximately 2.3 1itres of OEP-220 oil.

jj. Install the rear axle shafts in accordance with EMEI Vehicle G 103.

kk. Install the rear axle in accordance with EMEI Vehicle G 104-1.

Table 12 Rear Axle Specifications

Serial	Item	Specification
1	Crown wheel backlash	0.15 to 0.27 mm (0.006 to 0.11 in)
2	Differential bearings pre-load	0.127 mm (0.005 in)
3	Pinion height setting	30.93 mm (1.2177 in)
4	Pinion shaft and new bearings resistance	3.4 to 4.5 N.m (30 to 40 lbf.in)
5	Pinion shaft and original bearings resistance	1.7 to 3.4 N.m (15 to 30 lbf.in)
6	Crown wheel run-out	0.05 mm (0.002 in) Maximum
7	Differential casing bolts	89 to 102 N.m (66 to 75 lbf.ft)
8	Crown wheel bolts	129 to 142 N.m (95 to 105 lbf.ft)
9	Differential bearing caps	126 to 142 N.m (93 to 105 lbf.ft)
10	Differential cover	27 to 34 N.m (20 to 25 lbf.ft)

FRONT AXLE

Differential Carrier

74. Disassembly. Disassemble the differential carrier as follows:

a. Remove the front axle differential in accordance with EMEI Vehicle G 104-1.

b. Remove the roll pins securing the adjusting nut locking fingers to the side bearing caps (Figure 229). Remove the locking fingers and unscrew the adjusting nuts.

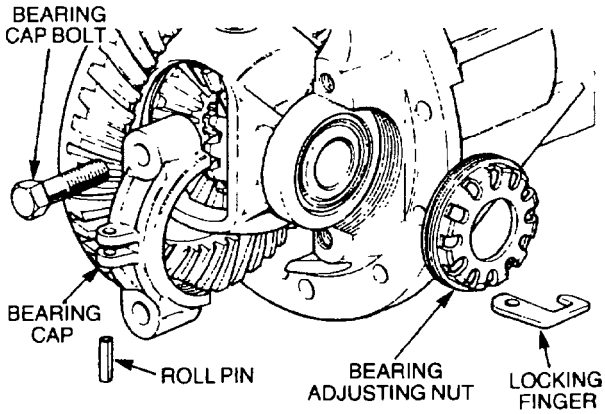


Figure 229 Locking Finger and Adjusting Nut Removal

c. Match mark the bearing caps to enable them to be returned to their original positions during reassembly, remove the retaining bolts, remove the caps and lift the differential assembly out of the carrier.

d. Removing the Pinion Shaft. In-service, there are currently two versions of the pinion shaft. The early version uses a slotted nut, flat washer and split pin to retain a square pinion flange and it also has a spacer under the pinion flange. The later version uses a washer headed bolt and flat washer to retain a round pinion flange and it does not have a spacer under the pinion flange. Instructions will be provided for both types.

(1) Early Version. Remove the early version pinion shaft as follows:

(a) Remove and discard the split pin securing the coupling flange nut. Using the wrench (Table 3, Serial 47) to prevent the pinion flange from rotating, remove the slotted nut and flat washer (Figure 230).

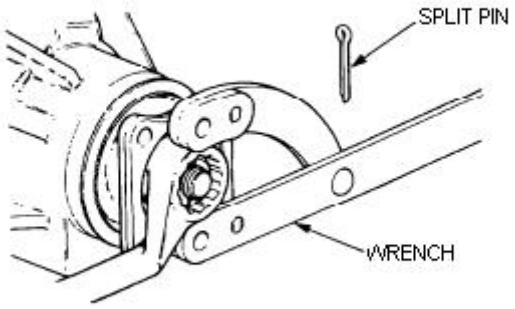


Figure 230 Removing The Coupling Flange Nut – Early Version

(b) Using a soft hammer, tap the pinion shaft through the pinion flange. Remove the flange and deflector assembly. Remove the pinion shaft complete with inner bearing cone and shims (Figure 231). Retain the shims for further use.

(c) Remove the oil seal, spacer and outer bearing cone (Figure 231).

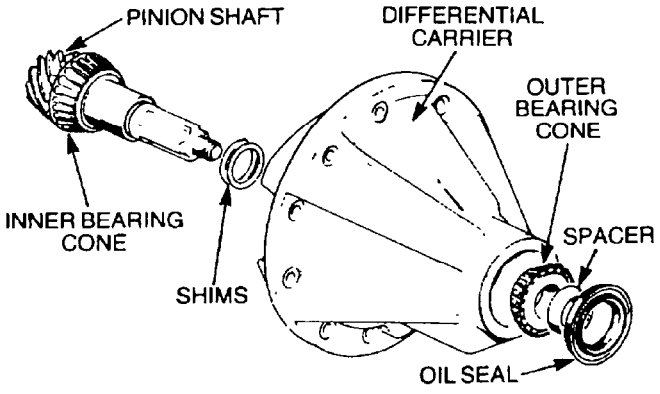


Figure 231 Removing The Pinion Shaft And Bearings – Early Version

(2) Later Version. Remove the later version pinion shaft as follows:

(a) Using the wrench (Table 3, Serial 47) to prevent the pinion flange from rotating, remove the bolt and flat washer (Figure 232).

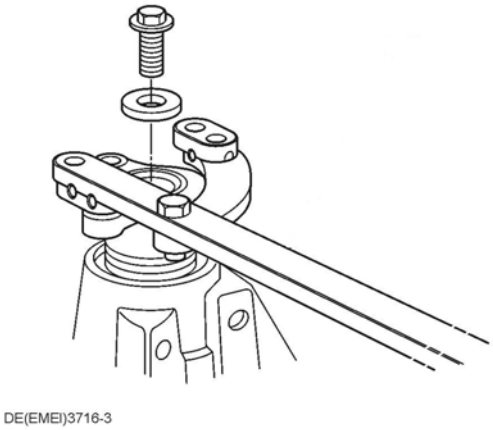


Figure 232 Removing Later Version Pinion Flange and Shaft

(b) Using a soft hammer, tap the pinion shaft through the pinion flange, remove the flange and deflector assembly and remove the pinion shaft complete with inner bearing cone and shims (Figure 233). Retain the shims for further use.

(c) Remove the oil seal and outer bearing cone (Figure 233).

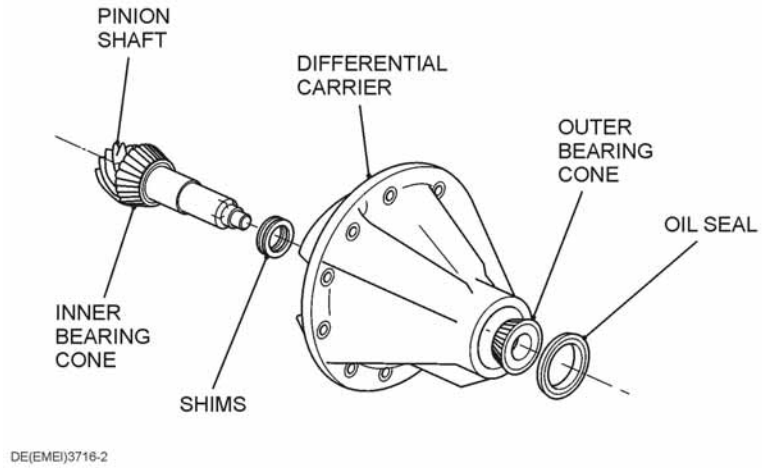


Figure 233 Removing Pinion Shaft – Later Version

e. Using the extractor (Table 3, Serial 59), remove the inner bearing cup from the differential carrier and retain the shims under the bearing cup for further use (Figure 234).

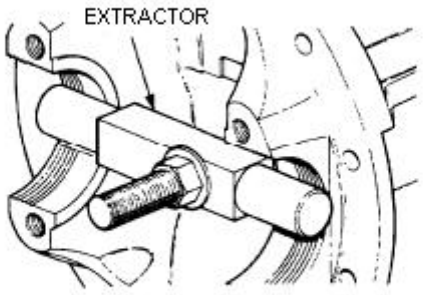


Figure 234 Removing the Pinion Shaft Inner Bearing Cup

f. Using a suitable drift, remove the outer bearing cup.

g. Using the bearing remover and the pinion head remover (Table 3, Serial 38 and 60), remove the pinion shaft inner bearing cone (Figure 235).

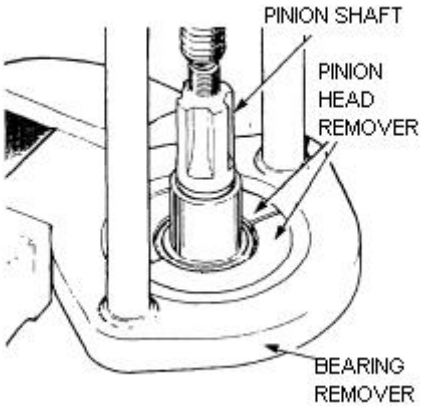


Figure 235 Pinion Shaft Inner Bearing Cone Removal

h. Using a suitable puller, remove the side bearings from the differential cage.

i. Remove the bolts and lock-washers securing the crown wheel to the differential flange and remove the crown wheel (Figure 236). Discard the lock-washers

j. Remove the two circlips retaining the differential cross-shaft, remove the shaft and remove the differential gears and pinions (Figure 236).

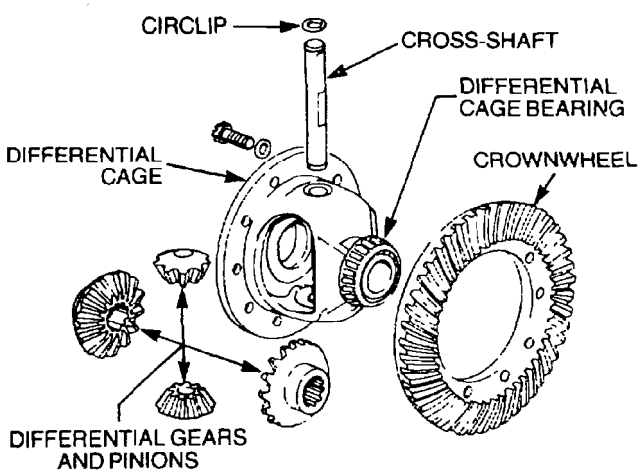


Figure 236 Differential Disassembly

75. Cleaning and Inspection. Clean and inspect the differential as follows:

WARNING

DO NOT spin the bearings with compressed air as personal injury or damage to the bearings may result.

a. Thoroughly clean all components using a suitable cleaning agent and blow them dry with compressed air.

b. Inspect all gear teeth for signs of abrasive wear, scratching, ridging, scoring, surface fatigue, pitting, corrosive wear, digging in or cracking and replace parts as necessary. If either the crown wheel or pinion is defective both components must be replaced as they are available only as a matched pair.

c. Check that the serial number etched on the pinion end face matches the serial number etched on the crown wheel (Figure 245). If the serial numbers do not match, discard the both the crown wheel and pinion and replace them with a new matched pair.

d. Ensure that the pinion end face is free of any raised burrs around the etched markings.

e. Inspect all bearings for flaking, cracks, fractures, fretting and corrosion and replace as necessary.

f. Inspect the crown wheel-to-differential joint faces for signs of damage and replace parts as necessary.

g. Ensure that the pinion shaft inner bearing cone is an interference fit on the shaft when reassembling.

h. If either the differential carrier or bearing caps are defective, both components must be replaced as a set as they are only available as a matched pair.

76. Reassembly. Reassemble the differential as follows:

a. Thoroughly lubricate the differential gears, pinions and the cross-shaft with clean OEP-220 oil.

b. Insert the differential gears and pinions in the differential cage. Fit the cross-shaft and secure it with the two circlips.

NOTE

The differential gears and pinions have no provision for backlash adjustment.

c. Check the gears for backlash. If excessive, replace the gears.

d. Ensure that the differential cage flange and crown wheel faces are thoroughly clean. Fit the crown wheel. Install the retaining bolts with new lock-washers and firmly tighten the bolts evenly. Do not fully tighten the bolts at this stage.

e. Using a suitable press, install the bearing cones on the differential cage.

f. Lubricate the bearing cones with clean OEP-220 oil and fit the bearing cups.

g. Insert the differential cage assembly in the carrier and install the bearing caps and retaining bolts (Figure 237). Do not tighten the bolts at this stage.

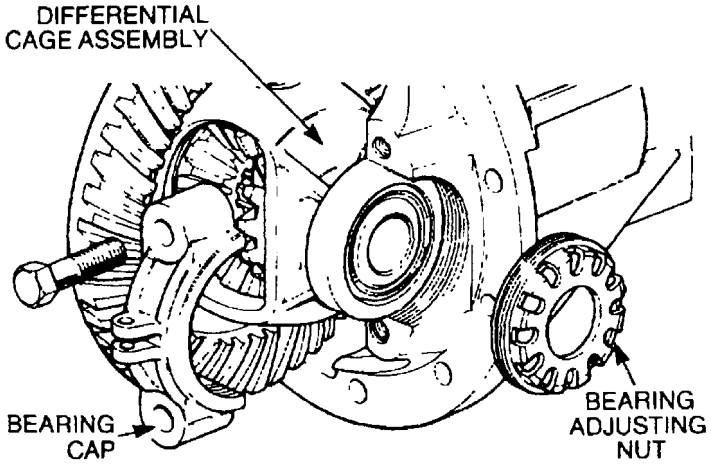


Figure 237 Installing the Differential Cage

h. Install the two bearing adjusting nuts and tighten them until all end float is taken up. Firmly tighten the bearing cap bolts. Do not fully tighten them at this stage.

i. Mount the dial indicator (Table 3, Serial 57) on the differential carrier flange. Rotate the differential and measure the crown wheel run-out (Figure 238), which should not exceed 0.10 mm (0.004 in).

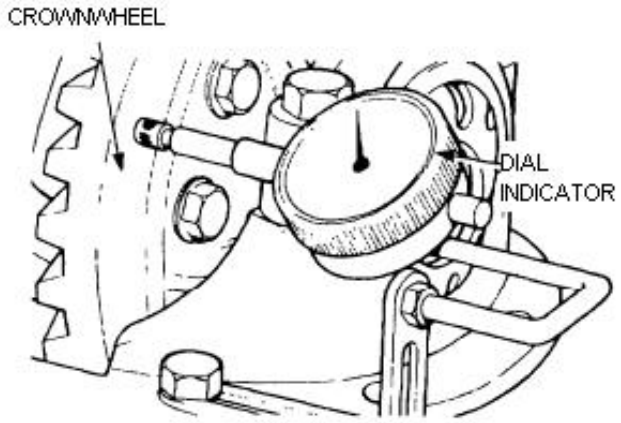


Figure 238 Checking the Crown Wheel Run-out

j. If the run-out is excessive, remove the crown wheel, inspect the mating faces for signs of dirt or burrs, re-install the crown wheel and check the run-out.

k. Excessive run-out may be caused by a damaged differential cage flange, in which case, the cage must be replaced.

l. If the run-out is within specification, remove the differential assembly. Remove the bolts and lock-washers from the crown wheel. Apply Loctite 275 to the threads of the bolts. Install the bolts and lock-washers and tighten them evenly to 61 to 75 N.m (45 to 55 lbf.ft).

m. Locate the shims removed in Para 74.e in the pinion shaft inner bearing cup recess (Figure 239). If the original shims have been damaged or lost, use a shim of approximately 0.050 in.

n. Using the extractor and adaptors (Table 3, Serial 59, 61 and 62), install the pinion shaft inner and outer bearing cups in the differential carrier (Figure 239).

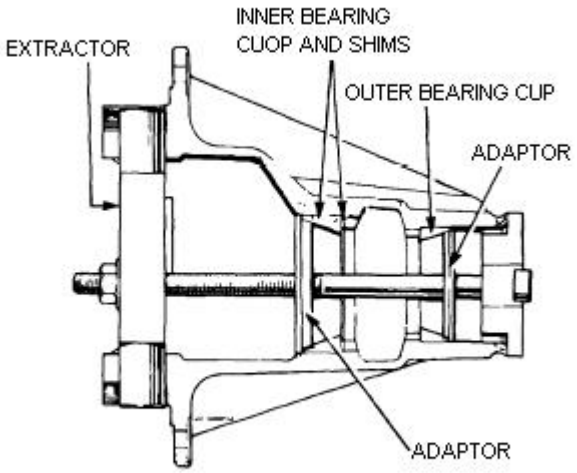


Figure 239 Installing the Pinion Bearing Cups

o. Using the bearing remover and the pinion head remover (Table 3, Serial 38 and 60), install the pinion shaft inner bearing cone on the pinion shaft (Figure 240).

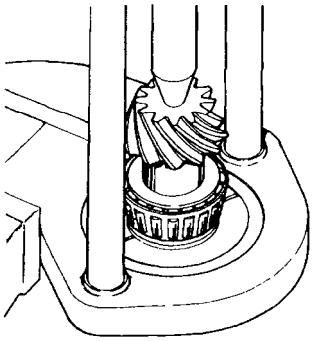
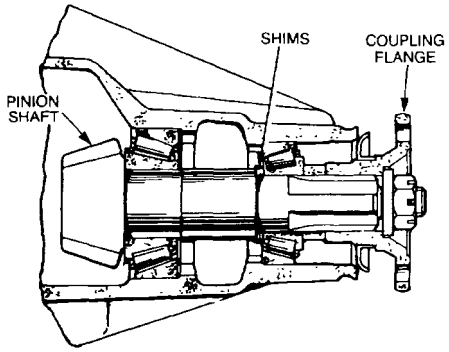


Figure 240 Installing the Pinion Shaft Inner Bearing Cone

p. Lubricate the inner bearing cone with clean OEP-220 oil, slide the shims removed in paragraph 74.d on the pinion shaft and insert the shaft in the differential carrier. If the original shims are damaged or lost, use a shim of approximately 0.160 in.

q. Lubricate the outer bearing cone with clean OEP-220 oil and install it onto the shaft and into the bearing cup (Figure 241).



Note. The early version of pinion shaft is shown here.

Figure 241 Pinion Shaft Pre-load Adjustment

r. On an early version pinion shaft, fit the spacer, the coupling flange, flat washer and nut (Figure 241). On a later version pinion shaft, fit the coupling flange, flat washer and bolt. Do not install the oil seal at this stage.

s. Using the wrench (Table 3, Serial 47) to prevent the coupling flange rotating, tighten the flange nut to 95 to 163 N.m (70 to 120 lbf.ft). Remove the wrench and check that the torque required to rotate the shaft with new bearings is between 2.6 to 3.95 N.m (20 to 35 lbf.in) and 1.3 to 1.6 N.m (10 to 15 lbf.in) with the original bearings after the shaft has started to rotate. The pre-load can be adjusted by changing the thickness of the shim installed between the shaft and outer bearing cone. A thicker shim will reduce pre-load and a thinner shim will increase pre-load. The shim thickness is in thousandths of an inch and are available in increments of 0.001 in from 0.060 to 0.070 in and in increments of 0.002 in from 0 072 to 0.078 in.

t. Remove the keep-disc from the magnetized base of the dial indicator (Table 3, Serial 57), place the dial indicator and the setting block (Table 3, Serial 63) on a flat surface and zero the dial indicator stylus on to the setting block marked 39.50 mm (Figure 242).

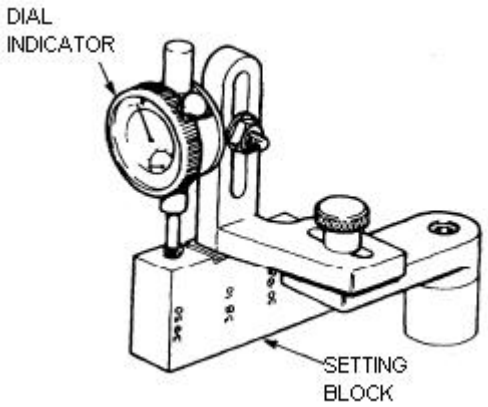


Figure 242 Zeroing the Dial Indicator

u. Position the magnetized base of the dial indicator on the pinion shaft end face and rest the stylus on the lowest point of one differential cup bore (Figure 243). Note the dial indicator deviation from the zero setting.

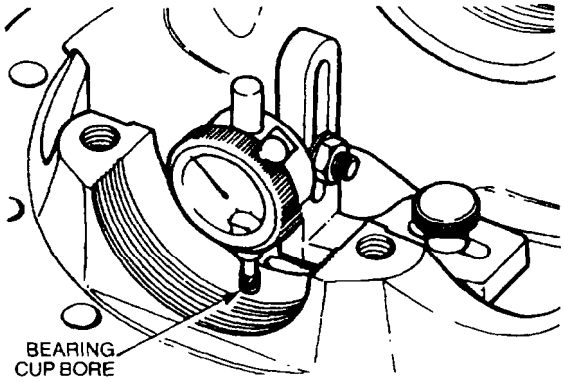


Figure 243 Measuring the Pinion Shaft Height

v. Repeat the procedure on the opposite bore and add together the two readings. Halve the total to obtain the mean reading and note whether the mean reading will cause the stylus to move up or down from the zero setting (Table 11).

w. If the stylus has moved down, the amount is equivalent to the thickness of shims that must be removed from under the pinion inner bearing cup to bring the pinion down to the nominal position (Figure 244).

x. If the stylus has moved up, the amount is equivalent to the additional thickness of shims required to bring the pinion up to the nominal position (Figure 244).

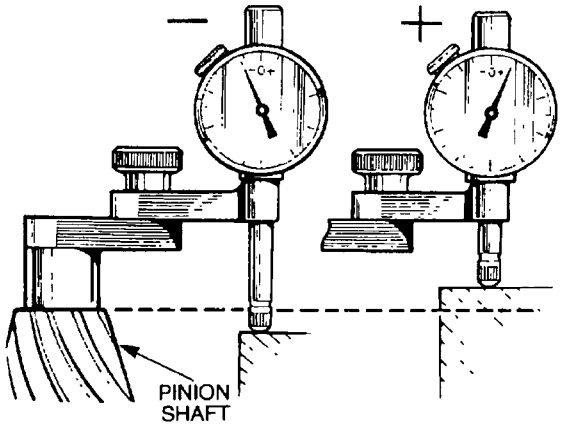


Figure 244 Examples of Pinion Shaft Height Using Dial Indicator

y. Before adjusting the shim thickness, examine the pinion shaft end-face and note the etched figure opposite the serial number (Figure 245). If it has a plus (+) figure, subtract that amount in thousandths of an inch from the shim thickness figure obtained in sub-paras t and v. If it has a minus (–) figure, add that amount to the shim thickness figure. If the figure is zero then no correction is required.

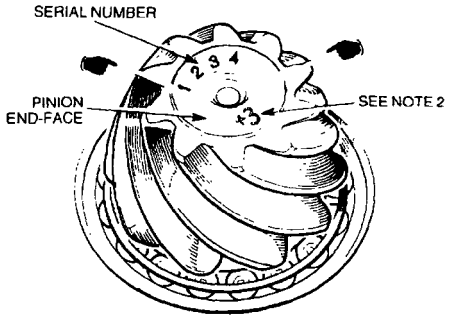


Figure 245 Pinion Shaft Markings

z. Adjust the shim thickness behind the pinion inner bearing cup, as required by the amount determined in sub-para y and recheck the pinion height setting as described in sub-paras t and v. If the setting is correct, the mean reading on the dial indicator will agree with the figure marked on the pinion end-face. For example, with an end-face marking of +4, the dial indicator reading should indicate that the pinion height is +0.004 in.

aa. Remove the coupling nut and flange, smear a suitable sealing compound on the outer periphery of the new pinion oil seal and using the seal inserter (Table 3, Serial 64), install the oil seal with the open face towards the bearing (Figure 246).

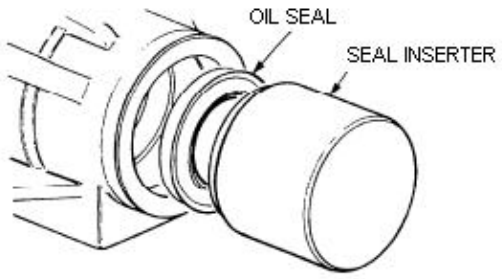


Figure 246 Installing the Pinion Oil Seal

bb. Apply grease to the seal lips and seal spring.

cc. Installing the Pinion Flange.

(1) Early Version. Install the early version pinion flange as follows:

(a) Install the spacer, coupling flange and deflector assembly, flat washer and slotted nut (Figure 247).

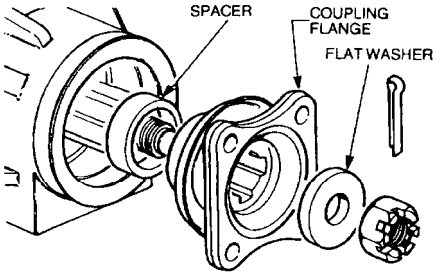


Figure 247 Installing the Coupling Flange – Early Version

(b) Using the wrench (Table 3, Serial 47) to prevent the pinion flange from rotating, tighten the nut to 95 to 163 N.m (70 to 120 lbf.ft) and install the split pin to secure the nut.

(2) Later Version. Install the later version pinion flange as follows:

(a) Install the coupling flange, flat washer and bolt (Figure 248).

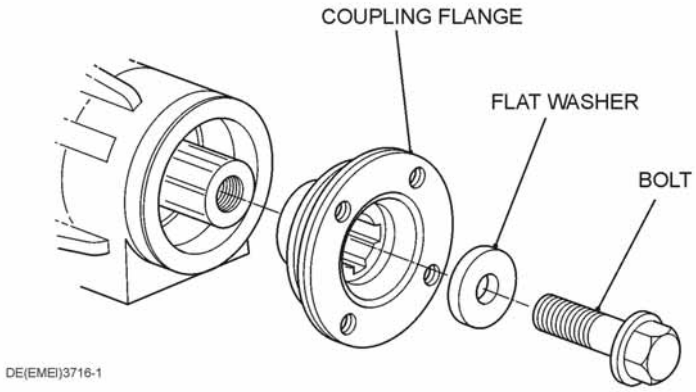


Figure 248 Installing The Coupling Flange – Later Version

(b) Using the wrench (Table 3, Serial 47) to prevent the pinion flange from rotating, tighten the bolt to 100 N.m (74 lbf.ft).

dd. Lubricate the bearing cones with clean OEP-220 oil and fit the bearing cups.

ee. Install the differential assembly in the differential carrier and fit the bearing caps and bolts ensuring that the caps are correctly installed to their relative match marks (Figure 237).

ff. Install the two bearing adjusting nuts and tighten them until all end float is taken up. Firmly tighten the bearing cap bolts. Do not fully tighten them at this stage (Figure 237).

gg. Set the crown wheel-to-pinion backlash to 0.20 to 0.25 mm (0.008 to 0.010 in) with zero end float. Turn the nuts in direction A to reduce backlash or in direction B to increase backlash (Figure 249). Turn both nuts equally during backlash setting to maintain zero end float. Finally, tighten the adjusting nuts one half of a serration and tighten the bearing cap bolts to 81 N.m (60 lbf.ft).

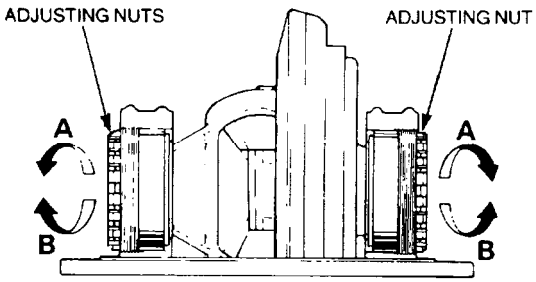


Figure 249 Crown Wheel Backlash Adjustment

hh. Position a dial indicator (Table 3, Serial 57) on the differential carrier flange (Figure 250) and place the stylus on a crown wheel tooth. Hold the pinion shaft flange and check the backlash between the crown wheel and pinion gear teeth. If the backlash is not between 0.20 to 0.25 mm (0.008 to 0.010 in), repeat the procedure described in sub-para gg.

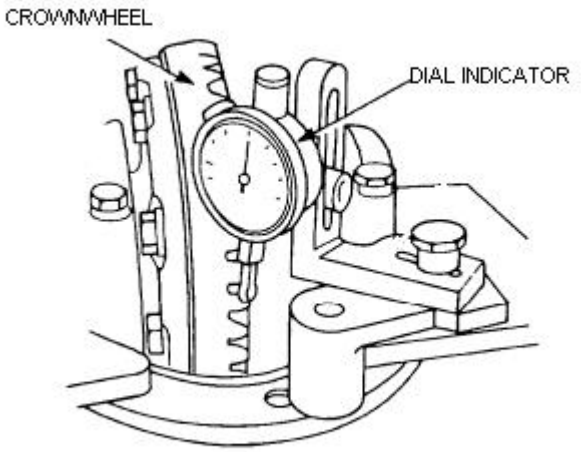


Figure 250 Differential Backlash Final Check

ii. Fit the adjusting nut locking fingers, bending the ends to engage the slots if necessary (Figure 251), then insert new roll pins. Do not alter the position of the adjusting nuts.

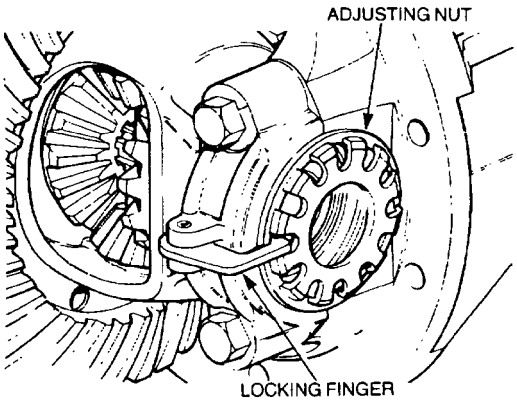


Figure 251 Installing the Locking Finger

jj. Thoroughly lubricate all components with clean OEP-220 oil and install the differential carrier assembly in the front axle in accordance with EMEI Vehicle G 104-1.

Front Axle Differential Cover Plate

77. Removal. Remove the front axle differential cover plate as follows:

a. Remove the front axle from the vehicle in accordance with EMEI Vehicle G 104-1.

b. Dismantle the axle assembly in accordance with EMEI Vehicle G 104-1.

c. Place the axle housing on a suitable bench and support it so that it will not move or become unstable during the repair.

d. Fit an unusable pinion housing to the axle housing and secure it using the 10 nuts.

WARNING

Take care when using grinding or Air Carbon Arc Gouging equipment, otherwise personal injury may occur.

e. Remove the existing differential cover plate from the axle housing using the Air Carbon Arc Gouging process or an angle grinder.

f. **Inspection.** After removing the cover plate, remove all weld metal residue and dross. Re-weld any indentations in the axle housing using the consumables listed in Para 78.d below and grind back the repaired area to the original profile.

78. **Installation.** Install the front axle differential cover plate as follows:

a. Position the cover plate on the axle housing, centrally located on the differential opening. The long centre line of the crown wheel clearance hump is to be at right angles to the transverse centre line of the axle housing and the filler plug opening is on the same side as the long axle tube (Figure 252).

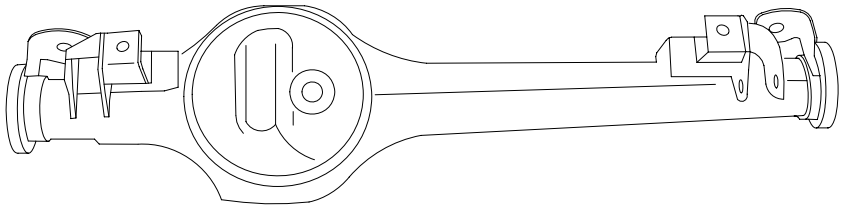


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Figure 252 Correct Location of Cover Plate to Axle Housing

b. Tack-weld the cover plate in position using the consumables listed in Para 78.d below.

c. Using a small hammer, tap the edge of the cover plate down onto the axle housing.

d. Weld the cover plate to the axle housing with a 2 mm continuous fillet weld, ensuring that the top edge of the weld joint is fully consumed, using the Gas Metal Arc Welding (GMAW) process, with consumables that conform to AS/NZS 2717.1:ES6-GC/M-W503AH and using shielding gas that conforms to AS 4822:SG – ACO – 16/2.75.

e. Clean off any weld splatter and remove any sharp edges and burrs.

f. Visually inspect the weld joint in accordance with AS/NZS 1554.1, Section 6, Table 6.2.2 (SP).

g. Check the welds for defects using the penetrant inspection method in accordance with EMEI Workshop D 180. Allow a penetrant dwell time of at least ten minutes. Repair any defects indicated using the consumables listed in paragraph 78.d and re-inspect.

h. Stamp the letters ‘RW’ with 6 mm letter stamps on the front face of the reinforcement bracket on the right-hand side of the axle housing adjacent to the radius arm bracket, (Figure 253).

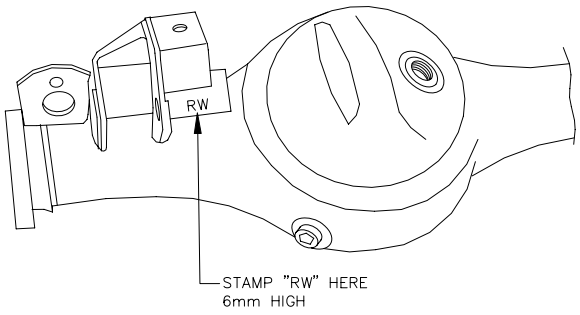

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Figure 253 Position to Stamp Indication of Rework

i. Remove the pinion housing from the axle housing and retain both the housing and nuts for future use.

j. Using a suitable cleaning process, thoroughly wash out the interior of the axle housing to remove all foreign matter.

k. The completed repair is to be painted with zinc phosphate primer and black paint.

l. Reassemble the axle assembly in accordance with EMEI Vehicle G 104-1.

m. Refit the front axle to the vehicle in accordance with EMEI Vehicle G 104-1.

Swivel Pin Housing and Bearing Housing

79. Removal. Remove the swivel pin housing and bearing housing as follows:

a. Remove the front hub assembly in accordance with EMEI Vehicle G 103.

b. Using the ball joint separator (Table 3, Serial 67), disconnect the tie rod and the left-hand drag link ball joints from the swivel housing steering arms.

c. Remove the bolts and locking plate retaining the hub stub axle to the swivel pin housing (Figure 254) and remove the stub axle.

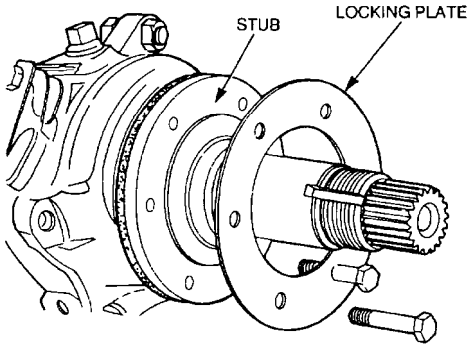


Figure 254 Removing the Stub Axle

d. Withdraw the drive shaft assembly from the axle.

e. Remove the bolts securing the seal retainer and seal to the swivel pin housing and move the seal away (Figure 255).

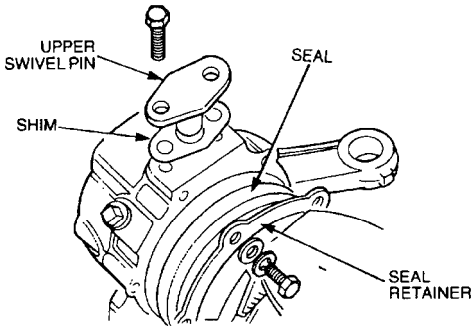


Figure 255 Removing the Swivel Housing Oil Seal

f. Remove the bolts and washers retaining the upper swivel pin, shims and hose retaining bracket (Figure 255) and remove the upper swivel pin and shim(s).

g. Remove the bolt securing the backing plate to the lower retaining bracket.

h. Remove the bolts and washers retaining the lower swivel pin and shims. Remove the lower swivel pin, shims and the swivel pin housing.

i. Remove the bolts retaining the bearing housing to the axle case and remove the bearing housing (Figure 256).

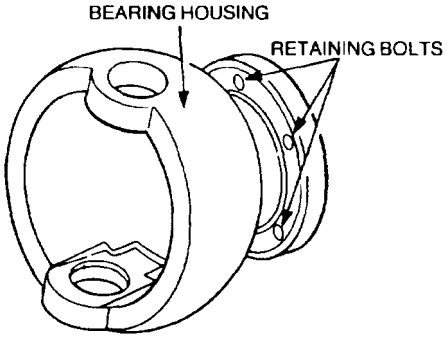


Figure 256 Removing the Bearing Housing

80. Disassembly. Disassemble the bearing housing and stub axle as follows:

a. Remove the oil seal from the bearing housing and using a suitable press, remove the lower bearing cup and upper bush housing (Figure 257).

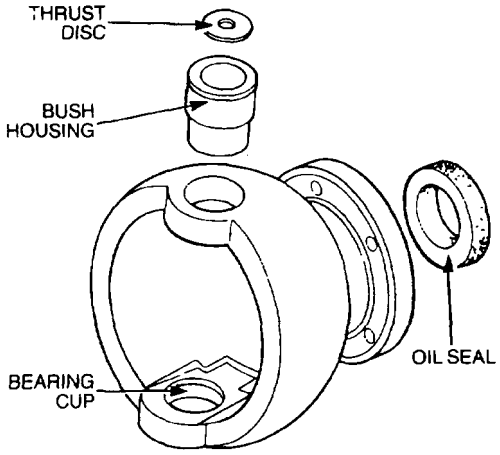


Figure 257 Bearing Housing Disassembly

b. Using the slide hammer and the adaptor (Table 3, Serial 42 and 68), remove the oil seal and bronze bush from the stub axle (Figure 258).

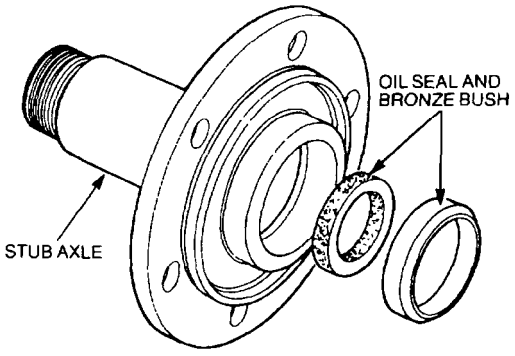


Figure 258 Removing the Stub Axle Oil Seal

81. Cleaning and Inspection. Clean and inspect the bearing housing and stub axle as follows:

WARNING

DO NOT spin the bearings with compressed air as personal injury or damage to the bearings may result.

CAUTION

Cleaning the upper swivel bush with a cleaning agent will destroy its lubrication characteristics and render it unusable for continued service.

a. Clean all components, except the upper swivel bush, in a suitable cleaning agent and blow them dry with compressed air.

b. If the upper swivel bush is to be re-used do not clean it using a cleaning agent but wipe it clean using a clean cloth.

c. Inspect the upper bush and housing and replace parts if they are excessively worn or pitted.

d. Ensure that the lower bearing is a push fit on the lower swivel pin and inspect the bearing for pitting, corrosion or excessive wear. Replace the bearing if necessary.

e. Clean all traces of gasket material from the stub axle and bearing housing mating flanges.

82. Reassembly. Reassemble the bearing housing and swivel pin housing as follows:

a. Press the lower bearing cup, wide face first, into the bearing housing.

b. Press in the upper swivel bush, with the machined flat towards the mounting flange, into the bearing housing and thoroughly lubricate the bush with clean oil.

c. Press the oil seal into the bearing housing, plain side first (Figure 257) and smear grease around the seal lip.

d. Press the oil seal, with the open face of the seal facing the mounting flange and the bronze bush in the stub axle.

83. Installation. Install the swivel pin housing as follows:

a. Fit the swivel housing oil seal and seal retainer over the bearing housing flange, ensuring that the open face of the seal is towards the spherical face of the housing.

b. Install the bearing housing and a new gasket onto the axle casing. Smear Loctite 275 on the retaining bolt threads, insert the bolts and tighten them to 65 to 80 N.m (48 to 59 1bf.ft).

c. Lubricate the upper thrust disc with clean oil and install it into the upper bush recess.

d. Lubricate the lower roller bearing cone with oil, locate it into the bearing housing cup and install the swivel pin housing onto the bearing housing.

e. Place a new gasket over the lower swivel pin, insert the swivel pin and gasket into the swivel housing and secure the swivel pin and the backing plate bracket with the retaining bolts and new lock-washers.

f. Place the original shims over the upper swivel pin and insert the swivel pin into the swivel housing and upper bush.

g. Install the brake hose bracket, new lock-washers and retaining bolts.

h. Tighten the upper pin bolts to 60 to 70 N.m (44 to 52 lbf.ft) and the lower pin bolts to 22 to 28 N.m (16 to 21 lbf.ft).

i. Connect a spring balance to the steering arm ball joint eye and measure the resistance to rotation after the initial movement (Figure 259). The resistance must be 4.5 to 9 kg (10 to 20 lbs). Adjustment can be made by adding or subtracting shims installed under the upper swivel pin. Shims are available in thicknesses of 0.076, 0.127, 0.254and 0.762 mm (0.003, 0.005, 0.010and 0.030 in).

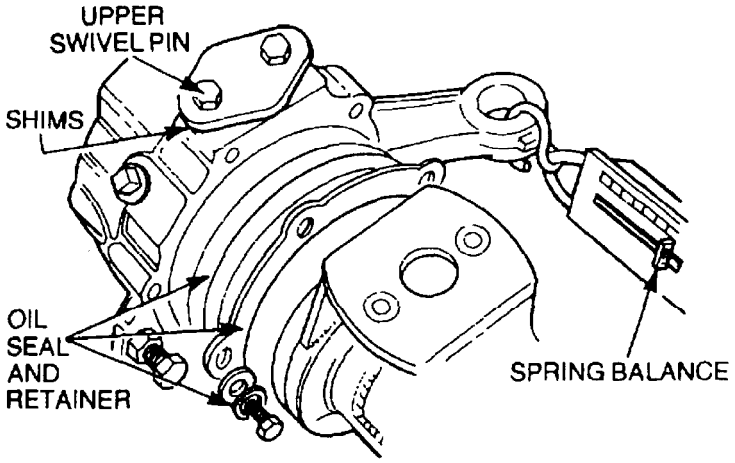


Figure 259 Measuring the Rotating Resistance

j. When the resistance is within specification, remove the upper and lower swivel pin retaining bolts, apply Loctite 275 to the threads and reinstall the bolts. Tighten the upper bolts to 60 to 70 N.m (44 to 52 lbf.ft) and the lower bolts to 22 to 28 N.m (16 to 20 lbf.ft).

k. Repeat the rotating resistance check and re-adjust the shims if required.

l. Smear the swivel housing oil seal with grease and install the seal and seal retaining plate.

m. Install the retaining bolts with new lock-washers (Figure 259). Tighten the bolts to 7 to 10 N.m (5 to 7 lbf.ft) and check that the seal wipes the entire spherical surface of the bearing housing.

n. Insert the drive shaft assembly into the axle.

o. Lubricate the oil seal and bush running surfaces on the drive shaft with clean oil.

p. Install a new gasket and the stub axle onto the swivel pin housing ensuring that the stub axle is correctly located onto the drive shaft.

q. Apply Loctite 275 to the threads of the stub axle retaining bolts. Install the locking plate, bolts and new lock-washers. Tighten the bolts to 60 to 70 N.m (44 to 52 lbf.ft).

r. Connect the tie-rod to the steering arm (and the drag link on the left side) and, while applying pressure on the ball joint, tighten the nut securely and lock the nut in position with a new split pin.

s. Install the hub assembly in accordance with EMEI Vehicle G 103.

t. Install the lower plug into the swivel pin housing and tighten it securely.

CAUTION

Inserting excessive quantities of grease into the swivel pin housing can cause damage to seals, resulting in loss of grease and subsequent component damage.

u. Insert the entire contents of one Molytex grease EP00 sachet into the swivel pin housing, install the filler plug and tighten it securely. Do not insert more than one sachet of grease into the swivel pin housing.

Drive Shaft

84. Removal. Remove the drive shaft as follows:

a. Drain the oil from the axle case into a suitable container.

b. Remove the front hub assembly in accordance with EMEI Vehicle G 103.

c. Remove the bolts and locking plate retaining the hub stub axle to the swivel housing (Figure 260) and remove the stub axle.

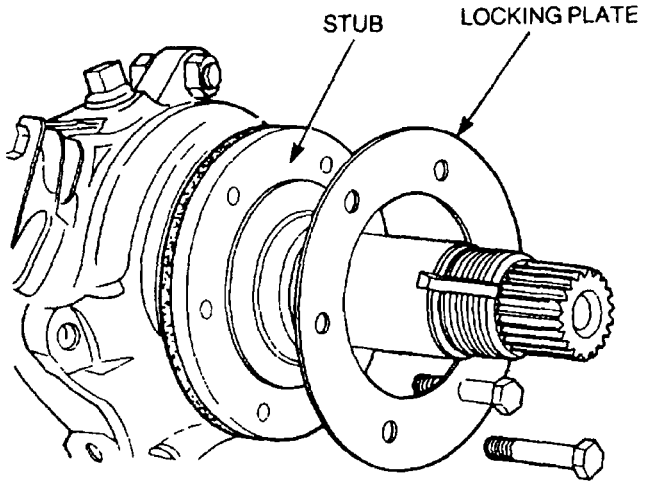


Figure 260 Removing the Stub Axle

d. Withdraw the drive shaft from the axle housing.

85. Disassembly. Disassemble the drive shaft as follows:

a. Clamp the axle end of the shaft firmly in a vice fitted with soft-jawed protectors and using a soft-faced hammer, remove the constant velocity joint from the shaft.

b. Remove the circlip and collar from the shaft and match mark the constant velocity joint inner and outer race to the cage.

c. To remove the balls, tilt and swivel the cage and the inner race (Figure 261).

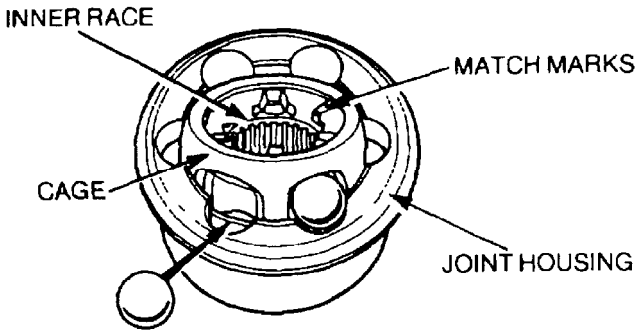


Figure 261 Constant Velocity Joint Steel Ball Removal

d. Swivel the cage to line up with the axis of the constant velocity joint (Figure 262), turn the cage until two opposite windows line up with two lands of the joint housing and remove the cage.

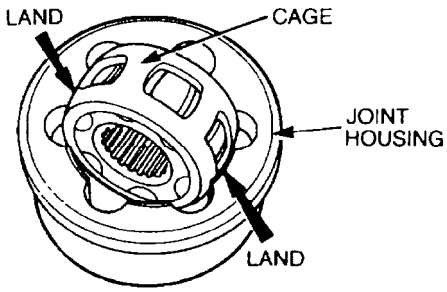


Figure 262 Removing the Constant Velocity Joint Cage

e. Turn the inner race at right angles to the cage with two of the lands opposite the cage windows and remove the race (Figure 263).

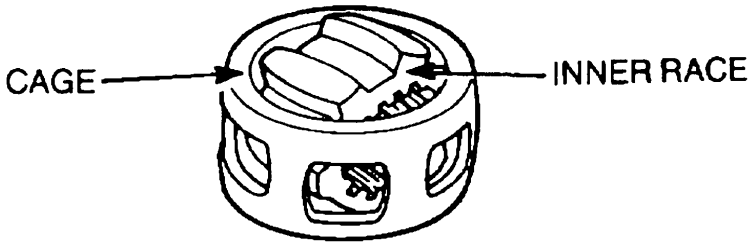


Figure 263 Removing the Inner Race

86. Cleaning and Inspection. Clean and inspect the drive shaft as follows:

a. Thoroughly clean all components in a suitable cleaning agent and blow them dry with compressed air.

b. Inspect all components for wear, chips, pitting and cracks.

c. Replace components as necessary complete assembly if any part is excessively worn.

87. Reassembly. Reassemble the drive shaft as follows:

a. Thoroughly lubricate all components with OEP-220 oil.

b. Turn the inner race at right angles to the cage with two of the lands opposite the cage windows and insert the race (Figure 263).

c. Position the cage on the constant velocity joint (Figure 262) and line up two opposite windows with two opposite lands, then fit the cage.

d. Align the match marks made on the joint inner and outer race and the cage and tilt and swivel the cage to allow the steel balls to be inserted (Figure 261).

e. Fit the collar and circlip on the shaft and, using a soft-faced hammer, install the constant velocity joint onto the shaft.

f. Measure the end float between the inner race and the joint housing. The maximum permissible end-float on the assembled constant velocity joint is 0.64 mm (0.025 in).

88. Installation. Install the drive shaft as follows:

a. Clean all traces of the old gasket from the mating surfaces of the bearing housing and stub axle.

b. Insert the drive shaft assembly into the axle housing.

c. Lubricate the oil seal and bush running surfaces on the drive shaft with clean oil.

d. Using a new gasket, install the stub axle and locking plate, apply Loctite 275 to the bolt threads, install the bolts and tighten them to 60 to 70 N.m (44 to 52 lbf.ft).

e. Install the hub assembly in accordance with EMEI Vehicle G 103.

f. Fill the axle housing with OEP-220 oil to the correct level.

Swivel Pin-to-bush Clearance

89. Inspection and Adjustment. Inspect and adjust the swivel pin-to-bush clearance in accordance with EMEI Vehicle G 188-1.

Table 13 Front Axle Specifications

Serial	Item	Specification
1	Crown wheel backlash	0.20 to 0.25 mm (0.008 to 0.010 in)
2	Differential bearings pre-load	0.79 to 1.35 N.m (7 to 12 lbf.in)
3	Pinion height setting	39.50 mm (1.55 in)
4	Pinion shaft torque resistance	0.60 to 2.80 N.m (6-25 lbf.in)
5	Crown wheel run-out	0.10 mm (0.004in)
6	Crown wheel bolts	61 to 75 N.m (45 to 55 lbf.ft)
7	Differential bearing caps	81 N.m (60 lbf.ft)
8	Coupling flange	100 N.m (74 lbf.ft)
9	Swivel bearing housing	65 to 80 N.m (48 to 59 lbf.ft)
10	Swivel pin (upper)	60 to 70 N.m (44 to 52 lbf.ft)
11	Swivel pin (lower)	22 to 28 N.m (16 to 21 lbf.ft)
12	Swivel pin housing rotation resistance	4.5 to 9 kg (10 to 20 lb)
13	Swivel pin housing seal retainer	7 to 10 N.m (5 to 7 lbf.ft)
14	Constant velocity joint maximum end-play	0.64 mm (0.025 in)

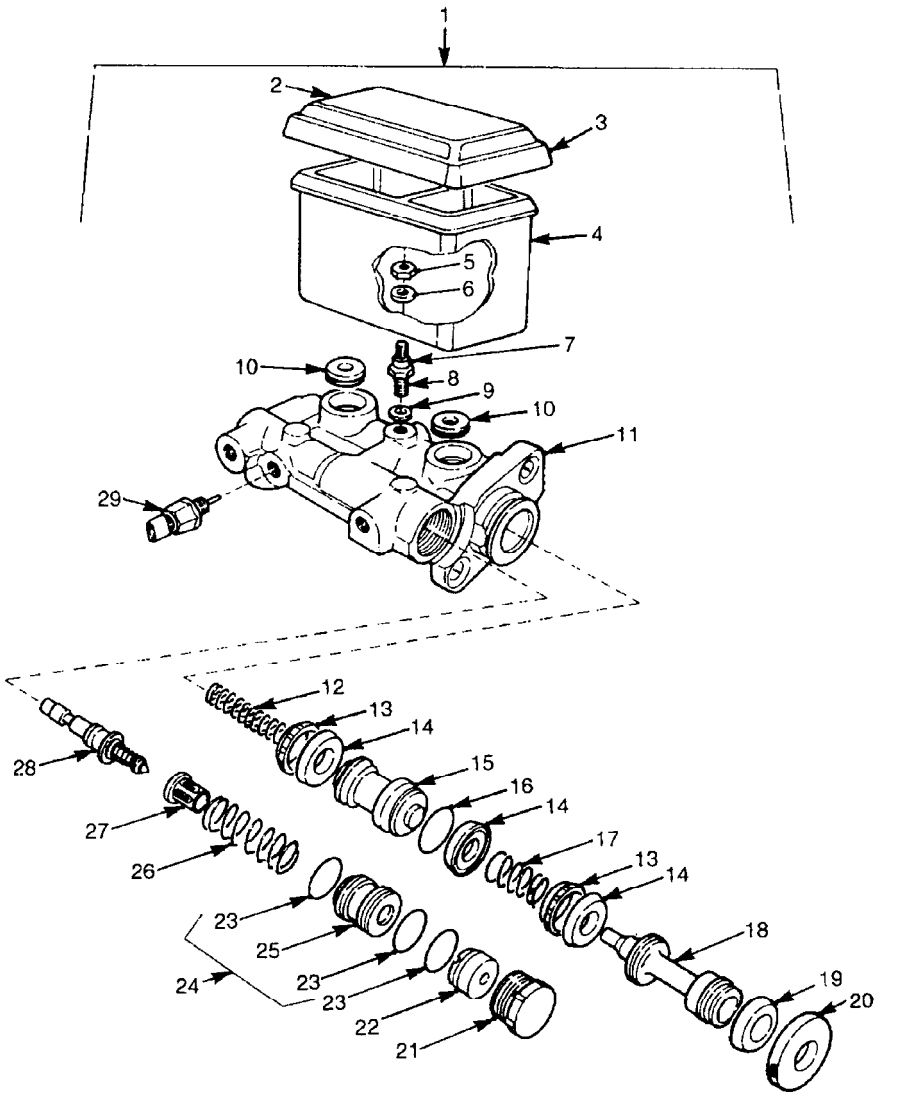
BRAKE SYSTEM

WARNING

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

Master Cylinder

90. Disassembly. Disassemble the brake master cylinder as follows (Figure 264):



1. Master cylinder
2. Reservoir cap
3. Seal
4. Reservoir
5. Nut
6. Washer
7. O-ring
8. Bolt
9. Gasket
10. Seal
11. Body
12. Spring
13. Cup retainer
14. Cup seal
15. Secondary piston
16. O-ring
17. Spring
18. Primary piston
19. Cup seal
20. Retainer plate
21. Screw cap
22. Plug
23. O-ring
24. Proportioning valve
25. Valve
26. Spring
27. Poppet retainer
28. Piston and poppet
29. Pressure differential switch

Figure 264 Brake Master Cylinder – Exploded View

a. Remove the brake master cylinder in accordance with EMEI Vehicle G 103.

b. Remove the reservoir cap (Item 2). Remove and discard the seal (Item 3).

c. Remove the nut (Item 5) and washer (Item 6) located inside the reservoir (Item 4) and remove the reservoir from the body (Item 11).

d. Remove and discard the two seals (Item 10).

WARNING

Ensure that the retainer plate (Item 20) is restrained during removal to prevent the primary piston being forced out by spring pressure and causing personal injury.

e. Hold the steel retainer plate (Item 20) firmly, prise up the two locating lugs to release it and carefully remove the retainer plate, ensuring it is restrained to prevent the primary piston (Item 18) being forced out by spring pressure.

f. Remove the primary piston (Item 18) and the spring (Item 17).

g. Depress the secondary piston (Item 15) into the bore, remove the bolt (Item 8) and remove the secondary piston and spring (Item 12) from the cylinder.

h. Remove and discard both the O ring (Item 7) and gasket (Item 9) from the bolt (Item 8).

i. Carefully remove the cup seals (Items 19 and 14) and the cup retainer (Item 13) from the primary piston. Discard the seals.

NOTE

Some primary and/or secondary pistons are not fitted with a cup retainer.

j. Carefully remove the two primary cup seals (Item 14), the cup retainer (Item 13) and the O ring (Item 16) from the secondary piston. Discard the seals and the O ring.

k. Unscrew the pressure differential switch (Item 29) from the side of the cylinder body.

CAUTION

Ensure that the screw cap is held firmly during removal to prevent the proportioning valve being forced out under spring pressure and causing personal injury.

l. Carefully remove the screw cap (Item 21) ensuring it is restrained to prevent the proportioning valve being forced out by spring pressure, remove the plug (Item 22) and the proportioning valve (Item 24).

NOTE

If these components are stuck in the bore, tap the cylinder body lightly to assist their removal.

m. Remove the spring (Item 26), the poppet retainer (Item 27) and the piston and poppet (Item 28).

n. Remove the O ring (Item 23) from the plug (Item 22). Discard the O ring.

o. Remove and discard the two O rings (Item 23) from the valve (Item 25).

91. Cleaning and Inspection. Clean and inspect the brake master cylinder as follows:

a. Clean all components with a recommended cleaning agent and blow them dry with compressed air, paying particular attention to the recesses, openings and internal passages of the cylinder body. Ensure that all traces of seal and gasket residue are removed.

NOTE

The brake master cylinder cannot be reconditioned by honing.

b. Inspect the master cylinder for scoring, excessive wear or other damage and if its condition renders it unserviceable it must be replaced.

c. Inspect all other components for nicks, burrs, corrosion, excessive wear or damage. Replace as necessary.

d. Ensure that the plunger in the pressure differential switch moves freely and using suitable test equipment, check that the switch operates correctly (replace if required).

92. Reassembly. Reassemble the brake master cylinder as follows (Figure 266):

a. Lubricate all internal components with clean brake fluid, including the cylinder bore.

NOTE

There are two types of seals fitted to the pistons. These are the primary cup seal and the secondary cup seal. The primary seal is distinguished from the secondary seal by the six recuperating grooves around the circumference (Figure 265).

b. Install a new O ring (Item 16) into the smaller of the two grooves at the end of the secondary piston (Item15) and install a new primary cup seal (Item 14) into the second groove, ensuring that the seal lip faces away from the O ring (Figure 265).

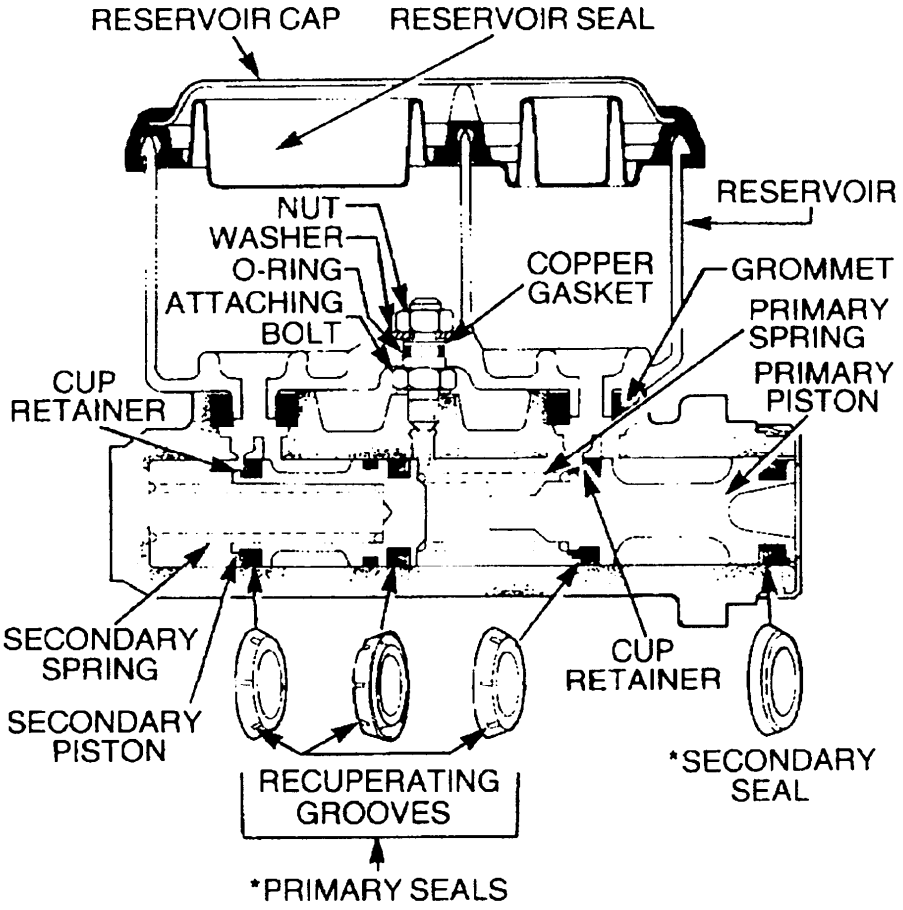


Figure 265 Brake Master Cylinder Pistons – Sectional View

c. Install a new primary cup seal (Item 14) into the shallow groove at the spring end of the secondary piston (Item15) ensuring that the seal lip faces towards the spring end (Figure 265).

NOTE

Some secondary pistons do not have the cup seal retainer groove.

d. If the secondary piston has cup retainer groove at the spring end, locate part of the cup seal retainer (Item 13) in the groove on the piston, hold the retainer in position (Figure 266) and using a small screwdriver, clip the retainer into the groove, ensuring that the cup seal is not damaged. If the piston does not have a groove for the retainer, discard the retainer.

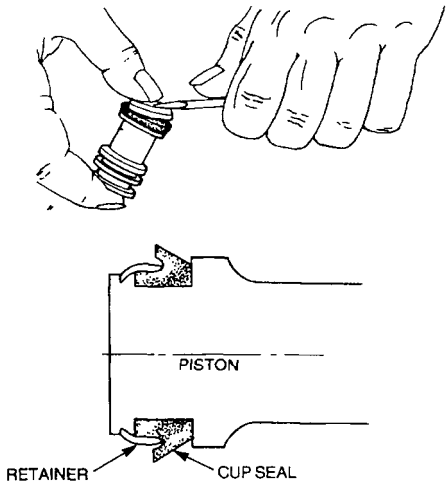


Figure 266 Installing the Seal Retainer

e. Install a new primary cup seal (Item 14) into the shallow groove at the spring end of the primary piston (Item 18) ensuring that the seal lip faces toward the spring end (Figure 265). Locate part of the cup seal retainer (Item 13) in position (Figure 266) and using a small screwdriver, clip the retainer into the groove ensuring that the cup seal is not damaged.

f. Install a new secondary cup seal (Item 19) into the groove at the push-rod hole end of the primary piston (Item 18) ensuring that the seal lip faces away from the push-rod hole end of the piston (Figure 265).

g. Insert the secondary return spring (Item 12) into the secondary piston (Item 15) and insert the assembly, spring end first into the main bore.

h. Fit a new copper gasket (Item 9) to the reservoir attaching bolt (Item 8).

i. Fully depress the secondary piston and, while holding the piston in position, screw the bolt in the full thread length by hand. Tighten the bolt to 6.2 to 6.8 N.m (4.5 to 5 lbf.ft) and release the secondary piston.

j. Fit the primary return spring (Item 17) to the primary piston (Item 18) and insert the assembly spring end first into the main bore.

k. Depress the primary piston until the end of the piston is flush with the end of the main bore. Hold the piston in position, install the retainer plate (Item 20) over the end of the main bore and secure it with two locating lugs.

l. Position the proportioning valve bore vertically and carefully insert the piston and poppet assembly (Item 28) orientated as shown in Figure 264.

m. Insert the poppet retainer (Item27) large end first into the bore and over the poppet.

n. Push the poppet retainer with a finger to ensure that the assembly is correctly located in the bore and verify that the assembly is correctly located by checking the dimension from the top of the bore to the small end of the poppet retainer with a depth gauge. The correct reading is 44.5 mm (1.7519 in).

o. Insert the large spring (Item 26) into the bore and over the poppet retainer.

p. Install two new O rings (Item 23) on the proportioning valve (Item 25) and insert the valve washer end first into the bore and onto the large spring.

q. Install a new O ring (Item 23) on the plug (Item 22) and install the plug into the bore.

r. Install the screw cap (Item 21) and tighten it to 34 to 40 N.m (25 to 29 lbf.ft).

s. Lubricate two new reservoir joining seals (Item 10) with clean brake fluid and install them into the cylinder body.

t. Lubricate a new reservoir attaching bolt O ring (Item 7) with clean brake fluid and fit it over the reservoir attaching bolt.

u. Fit the reservoir over the attaching bolt and into the joining seals, install the retaining nut and washer (Items 5 and 6) and tighten the nut to 5 to 5.6 N.m (3.7 to 4.1 lbf.ft).

v. Install the pressure differential switch (Item 29) and tighten it securely.

w. Prime the master cylinder with clean brake fluid. Operate the cylinder by pushing on the end of the primary piston with a screwdriver. Check that the cylinder operates smoothly and also check for a spurt of fluid in the front secondary side reservoir as the pistons are slightly depressed.

x. After bleeding, block the master cylinder outlet ports with suitable plastic plugs to prevent fluid escaping.

y. Fit a new reservoir cap seal (Item 3) to the reservoir cap (Item 2) and fit the cap to the reservoir.

z. Install the master cylinder and bleed the brake system in accordance with EMEI Vehicle G 103.

Servo Vacuum Chamber

93. Disassembly. Disassemble the servo vacuum chamber as follows (Figure 267):

WARNING

The servo vacuum chamber contains springs under high tension; take care when disassembling as personal injury may occur.

a. Remove the servo vacuum chamber in accordance with EMEI Vehicle G 103.

b. Match mark the front and rear covers (Items 8 and 25) to ensure correct orientation on reassembly.

c. Remove and discard the vacuum check-valve (Item 5) and grommet (Item 7) from the front cover. Remove the front seal (Item 2) and the support plate (Item 3). Remove the front push rod (Item 6) with the retainer (Item 4). Discard the seal and the retainer.

d. Remove the nut (Item 23) and clevis (Item 22) from the input rod and plunger (Item 24). Discard the nut.

e. Remove the dust cover (Item 18) and the felt air filter (Item 19) from the input rod. Remove the protector (Item 20) and the foam air filter (Item 21). Discard all components.

f. Place the vacuum chamber in a screw press, or equivalent, with the rear cover studs in the holes in the base of the tool. Place the bar wrench and adapter over the studs in the front cover (Figure 268).

g. Align the tool clamp with the base and attach the hook bolts to the base.

h. Tighten the centre bolt sufficiently to free the lock at the rim of the front cover.

i. Turn the bar wrench anticlockwise until the cut-outs in the front cover align with the indentations of the rear cover and loosen the centre bolt.

j. The covers should begin to separate as the centre bolt is loosened. If not, check the alignment of the cut-outs and indentations. Tapping the front cover lightly with a soft-faced hammer will assist to break the seal.

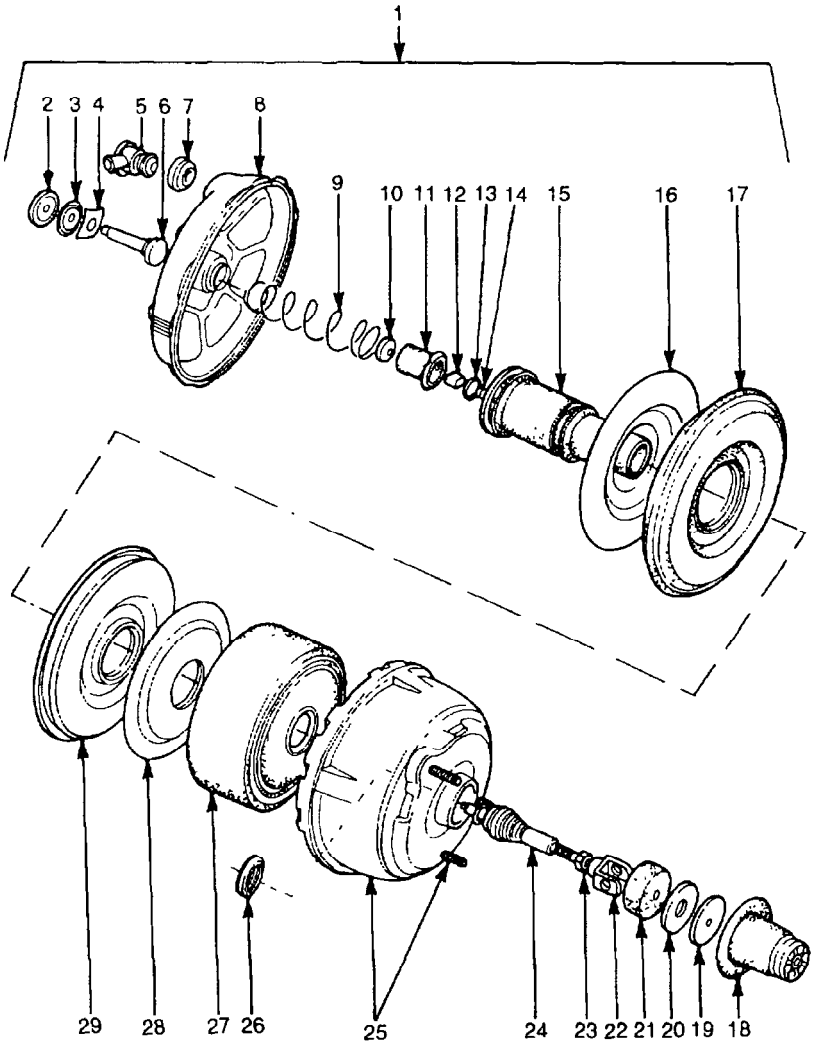
k. Unscrew the centre bolt sufficiently to release pressure on the return spring.

l. Remove the front cover (Item 8) and the return spring (Item 9). Remove the vacuum chamber from the press.

m. Remove the reaction disc (Item 10), the reaction hub (Item 11) and the reaction plunger and seal (Items 12 and 13) from inside the valve body (Item 15). Discard the reaction hub and the seal.

n. Push on the input rod and plunger (Item 24) to remove the valve body (Item 15) and diaphragm assemblies (Items 16, 17, 27, 28 and 29) from the rear cover (Item 25).

o. Remove the circlip (Item 14) from the plunger and withdraw the input rod and plunger assembly from the valve body. Discard both components.



1. Brake servo assembly
2. Seal
3. Support plate
4. Retainer
5. Check valve
6. Front push rod
7. Grommet
8. Front cover
9. Return spring
10. Reaction disc
11. Reaction hub
12. Reaction plunger
13. Seal
14. Circlip
15. Valve body
16. Front pressure plate
17. Front diaphragm
18. Dust cover
19. Felt air filter
20. Protector
21. Foam air filter
22. Clevis
23. Nut
24. Rod and plunger
25. Rear cover
26. Seal
27. Rear diaphragm
28. Rear pressure plate
29. Centre plate and seal

Figure 267 Servo Vacuum Chamber – Exploded View

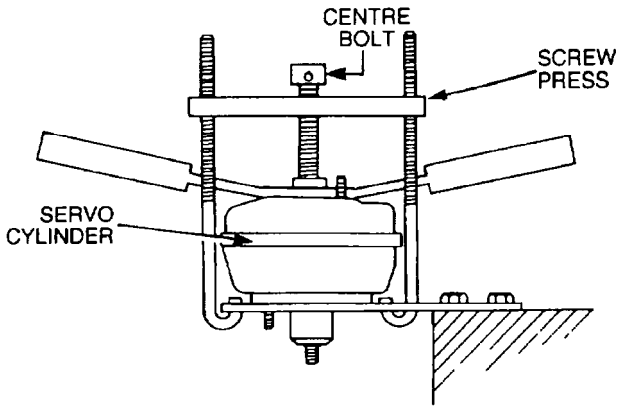


Figure 268 Servo Vacuum Chamber Disassembly

p. Hold the valve body assembly firmly on a bench, with the front pressure plate (Item 16) facing downward. Pull the rear diaphragm (Item 27) upward to remove it from the valve body (Figure 269).

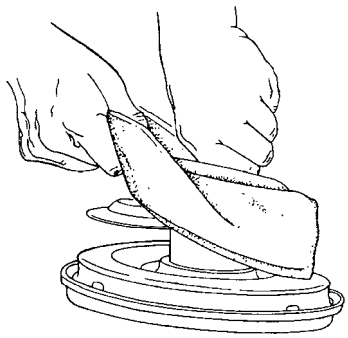


Figure 269 Removing the Rear Diaphragm

q. Remove the rear pressure plate (Item 28) and the centre plate (Item 29) from the valve body.

r. Pull the front diaphragm (Item 17) upward to remove it from the valve body then remove the front pressure plate (Item 16).

s. Pry the seals from the centre plate (Item 29) and the rear cover (Item 25). Discard the seals.

t. Remove the seal (Item 26) from inside the rear cover.

94. Cleaning and Inspection. Clean and inspect the servo vacuum chamber as follows:

a. Clean all components with a recommended cleaning agent and blow them dry with compressed air, paying particular attention to recesses, openings and valve holes.

b. Inspect all components for nicks, burrs, corrosion, excessive wear or damage. Replace as necessary. Minor rust may be removed with fine emery cloth and if appropriate, touch up the affected area with paint.

c. Inspect the front and rear covers for loose or damaged studs. Replace the covers as necessary.

CAUTION

Do not reclaim the covers by welding.

d. Do not attempt to reclaim front and rear covers by welding as the heat will distort them and render them unusable.

95. Reassembly. Reassemble the servo vacuum chamber as follows (Figure 267):

a. Lightly smear a new seal (Item 26) with rubber grease, support the rear cover (Item 25) on a wooden block and carefully install the seal (plastic bearing ring side first), using a suitable arbor.

b. Lightly smear a new centre plate seal with rubber grease, support the centre plate (Item 29) on a wooden block with the seal lead-in edge of the hole facing upwards and carefully install the seal rubber side first using a suitable arbor.

c. Position the valve body (Item 15) on the bench with the wider end facing down and install the front pressure plate (Item 16) on the valve body.

d. Lightly smear the inner bead of the front diaphragm (Item 17) and the diaphragm locating groove in the valve body (Item 15) with rubber grease.

e. Install the front diaphragm (Item 17) on the valve body (Item 15) ensuring that the inner bead seats correctly in the locating groove between the pressure plate and the valve body (Figure 270).

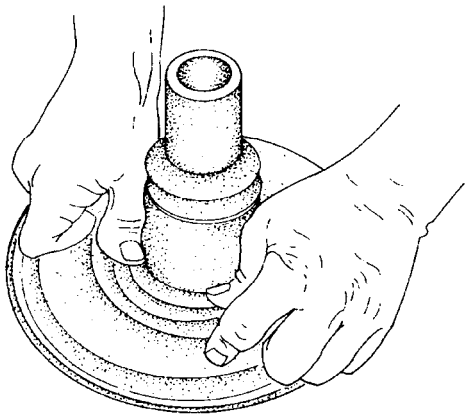


Figure 270 Installing the Front Diaphragm

CAUTION

Ensure that the rubber sealing lip of the large seal is not damaged or turned over when passing over the air holes in the valve body.

f. Lightly smear the larger bearing surface of the valve body (Item 15) with rubber grease and install the centre plate and seal assembly (Item 29).

g. Install the rear pressure plate (Item 28) and then install the rear diaphragm (Item 27), ensuring that the outer bead of the rear diaphragm seats correctly over the outer edge of the centre plate and seal assembly (Item 29).

CAUTION

Ensure that the circlip seats correctly in the groove on the rod and plunger assembly.

h. Lightly smear a new rod and plunger assembly (Item 24) with rubber grease, insert the assembly into the bore of the valve body and secure the rod and plunger with a new circlip (Item 14) from the other end of the valve body, ensuring that the circlip is seated correctly.

i. Lightly smear the smaller bearing surface of the valve body and the outside beads of the front and rear diaphragms with rubber grease.

j. Carefully insert the valve body assembly into the rear cover (Item 25) and through the rear seal ensuring that the rear diaphragm outer bead remains correctly located over the outer edge of the centre plate.

k. Position the rear cover in the screw press.

l. Lightly smear a new small square sectioned seal (Item 13) and the reaction plunger (Item 12) with rubber grease, insert the seal into the bore at the hexagon end of the reaction hub (Item 11) and insert the reaction plunger into the centre bore of the reaction hub.

m. Carefully insert the reaction hub assembly, large end first, into the centre of the valve body (Item 15), ensuring that the reaction plunger does not fall out.

n. Lightly smear the reaction disc (Item 10) with rubber grease and insert the disc into the reaction hub, ensuring that the small rubber protrusion of the disc faces the reaction plunger.

o. Position the return spring (Item 9) over the reaction hub and against the hub shoulder.

p. Position the front cover (Item 8) over the return spring onto the rear cover, ensuring that the match marks are adjacent to each other.

q. Place the bar wrench over the studs in the front cover and make the screw press ready for operation.

r. Screw the centre bolt to compress the return spring and bring the covers together while aligning the cut-outs in the front cover with the indentations in the rear cover. Continue to operate the press until the covers can be locked together and then turn the bar wrench clockwise to lock the two covers.

NOTE

Do not tip the servo vacuum chamber upside down at this stage.

s. Loosen the centre bolt and remove the servo chamber from the screw press, ensuring that it is not turned upside down. If the chamber is turned upside down the reaction plunger and disc will fall out and the assembly will have to be dismantled and the components re-fitted.

t. Lightly smear the front push-rod (Item 6) with rubber grease. Carefully lower the push-rod through the front cover aperture and into the reaction hub against the reaction disc and slide a new push-rod retainer (Item 4) over the push-rod pushing it firmly into position with a screwdriver.

u. Install the support plate (Item 3) and a new seal (Item 2) over the push-rod and into the front cover recess.

v. Invert the vacuum chamber and install a new foam air filter (Item 21) over the rod and plunger and into the valve body.

w. Fit a new protector (Item 20), felt air filter (Item 19) and dust cover (Item 18) over the rod and plunger.

NOTE

Ensure that the clevis adjustment is correct for the type of pedal box fitted to the vehicle.

x. Install a new nut and the clevis on the rod and plunger and adjust the nut and clevis to obtain the required distance from the centre of the clevis pin hole to the vacuum chamber rear cover (Figure 271), depending on the configuration. The correct setting for the early pedal box is 110 mm and for the later pedal box it is 120 mm.

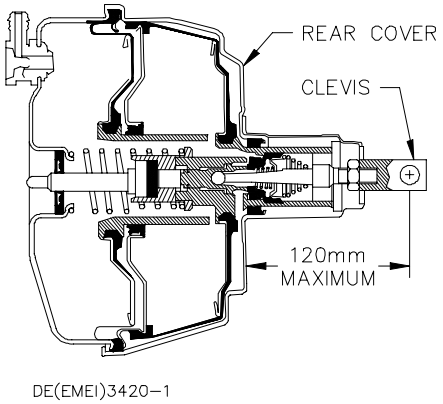


Figure 271 Clevis Adjustment

y. Install a new grommet (Item 7) into the aperture in the front cover and then insert a new check valve (Item 5) into the grommet.

Table 14 Brake Specifications

Serial	Item	Specification
1	Reservoir attaching bolt	6.2 to 6.8 N.m (54 to 50 lbf.in)
2	Reservoir retaining nut	5 to 5.6 N.m (45 to 49 lbf.in)
3	Poppet retainer alignment depth in bore	44.5 mm (1.75 in)
4	Proportioning valve screw cap	34 to 40 N.m (25 to 29 lbf.ft)
5	Vacuum chamber clevis adjustment clevis to rear cover	Early pedal box 110 mm (4.33 in) Late pedal box 120 mm (4.72 in)

STEERING

Steering Box

96. Disassembly. Disassemble the steering box as follows:

a. Remove the steering box in accordance with EMEI Vehicle G 103.

b. Using the drop arm remover (Table 3, Serial 69), remove the drop arm from the steering box.

c. Using the ball joint separator (Table 3, Serial 67) disconnect the drop-arm ball joint from the drop-arm.

d. Remove the filler plug and fibre washer. Discard the fibre washer.

e. Remove the adjuster locknut, the bolts and washers securing the top cover to the steering box housing (Figure 272).

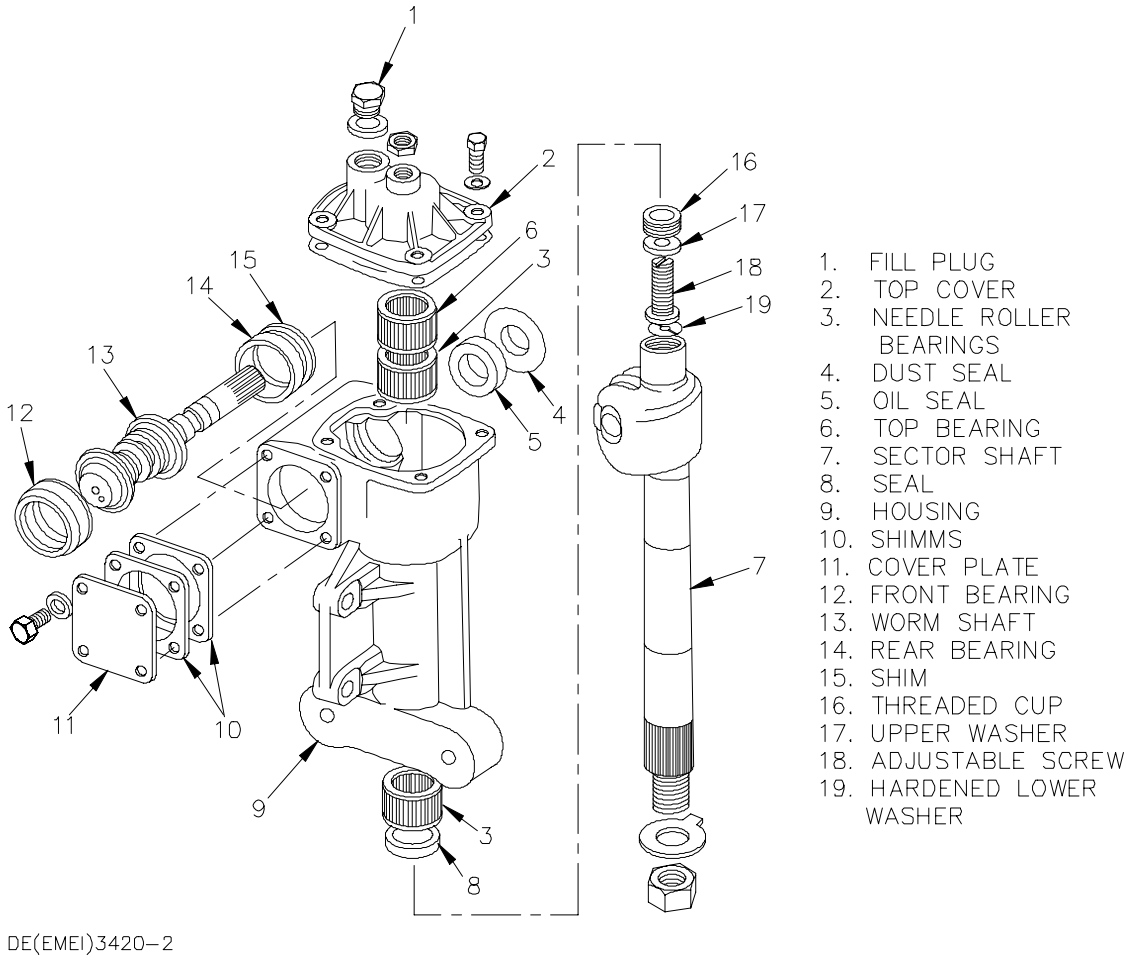


Figure 272 Steering Box – Exploded View

NOTE

The adjuster is threaded into the top cover.

f. Turn the adjuster screw in a clockwise direction to lift the top cover from the adjuster. Remove the top cover and bearing assembly and the gasket. Discard the gasket.

g. Empty the oil into a suitable container and lift out the sector shaft.

h. Remove the dust seal from the splined end of the worm shaft.

i. Remove the bolts securing the worm shaft cover plate and remove the cover plate, gasket and shims. Discard the gasket.

j. Remove the taper bearing cup and worm shaft with bearing cones from the steering box.

k. Using a suitable arbor, tap out the worm shaft oil seal and bearing cup and remove the shim from behind the bearing cup.

l. Using a suitable puller, remove the bearing cones from the worm shaft.

m. Using a micrometer, measure and record the thickness of the worm shaft shims, as these shims, or ones of the same thicknesses, are to be used in the reassembly.

n. Remove the sector shaft oil seal and then using a suitable arbor, press out the sector shaft needle roller bearings from the housing.

97. Cleaning and Inspection. Clean and inspect the steering box as follows:

a. Thoroughly clean all components in a suitable cleaning agent and blow them dry with compressed air.

b. Check whether the steering box is embossed with the letter 'W' on the circular casting protrusion on the rear of the sector shaft shoulder boss (opposite side of the worm wheel). If the letter 'W' is not present, the sector shaft and top cover must be modified in accordance with EMEI Vehicle G 197-14 before proceeding further.

NOTE

The top cover and upper sector shaft bearing must be replaced as an assembly.

c. Inspect the bearings for excessive wear or damage and replace them if necessary.

d. Clean all trace of gasket material from the housing, top cover and worm shaft retaining plate.

e. Inspect the worm shaft for excessive wear or damage and replace it if necessary.

f. Inspect the sector shaft for excessive wear or damage, ensure that there is no discernable end play in the adjuster screw. Replace it if necessary.

98. Reassembly. Reassemble the steering box as follows:

a. Using a suitable arbor, press the bearing cup and the original shims into the worm shaft bearing recess, ensuring the cup is pressed in fully and is correctly seated.

b. Using a suitable press and arbor, install the bearing cones onto the worm shaft.

c. Lubricate the worm shaft bearing cones with clean oil and insert the shaft into the housing.

d. Install the bearing cup into the steering box housing. Assemble the worm shaft retaining plate, new gasket and original shims onto the housing, Install the bolts with new lock-washers and tighten the bolts to 25 to 30 N.m (18 to 22 lbf.ft).

e. Install the torque set tool (Table 3, Serial 70) onto the worm shaft splines (Figure 273), coil string around the tool and attach a spring balance to the free end of the string.

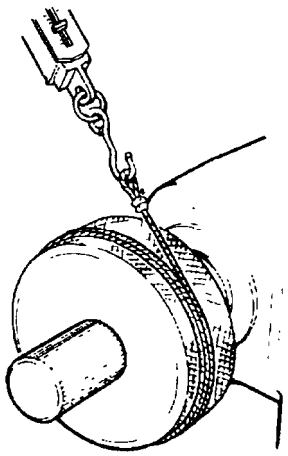


Figure 273 Measuring the Worm Shaft Pre-load

f. Pull on the spring balance and check that the rolling resistance is between 2.26 to 2.72 kg (5 to 6 lbs). If necessary, adjust the rolling resistance by changing the thickness of the shims installed behind the worm shaft retaining plate until the correct resistance is obtained.

g. When the correct resistance has been obtained, remove the bolts, apply a suitable sealing compound to the threads, reinstall and tighten the bolts to 25 to 30 N.m (18 to 22 lbf.ft).

h. Lubricate the sealing lip of a new oil seal with clean oil and install it into the steering box, ensuring that the sealing lip is facing the worm shaft bearing.

CAUTION

Take care not to damage the sector shaft needle roller bearings when pressing them into the steering box housing.

i. Using a suitable arbor, press the sector shaft upper bearing in to a depth of 83 mm (3.15 in) from the top machined face of the steering box housing. Ensure that force is applied only to the hardened square end of the bearing when pressing it in.

j. Using a suitable arbor, press the lower bearing in until it is 1.00 mm (0.040 in) below the chamfer. Ensure that force is applied only to the hardened square end of the bearing when pressing it in.

k. Lubricate the bearing surfaces of the sector shaft with clean oil and install it into the steering box with the roller positioned in the centre of the worm.

l. Position a new gasket on the housing top face, locate the top cover on the adjuster screw and then rotate the adjuster in an anticlockwise direction to draw the top cover onto the adjuster screw until the top cover is correctly positioned.

m. Install the retaining bolts and new lock-washers and finger tighten the bolts.

n. Use the adjuster screw to provide adequate back lash to prevent the sector shaft roller being unduly forced into the worm shaft when the top cover retaining bolts are fully tightened.

o. Tighten the top cover retaining bolt to 25 to 30 N.m (18 to 22 lbf.ft).

p. Install the adjuster locknut, but do not tighten it.

q. Lubricate the sealing lip of a new oil seal and press it over the sector shaft and into the housing, ensuring that the sealing lip is facing into the housing.

r. With the sector shaft in the straight ahead position, fit the drop arm aligning the master drive spline and check the position of the arm to the housing (Figure 274). Fit a new lock-washer. Install and tighten the nut to 169 N.m (125 lbf.ft).

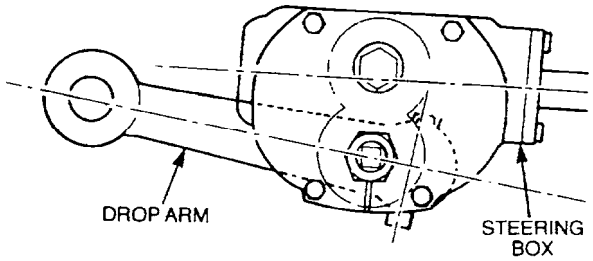


Figure 274 Drop-arm Alignment

s. Turn the adjuster clockwise until a pre-load is applied to the sector shaft, back it off to allow a slight backlash when the worm shaft is turned half a turn in either direction, tighten the locknut and finally check the backlash.

t. Install a new dust seal over the worm shaft splines.

u. Fill the steering box with approximately 0.43 litres (0.75 pint) of clean oil OEP 220 to 25 mm (1.0 in) below the top of the fill hole, install the filler plug and a new fibre washer and tighten the plug to 20 N.m (15 lbf.ft).

v. Install the steering box in accordance with EMEI Vehicle G 103.

w. Carry out the wheel alignment procedure in accordance with EMEI Vehicle G 103.

Table 15 Steering Specifications

Serial	Item	Specification
1	Worm shaft retaining plate	25 to 30 N.m (18 to 22 lbf.ft)
2	Worm shaft pre-load	2.26 to 2.72 kg (5 to 6 lb)
3	Top cover	25 to 30 N m (18 to 22 lbf.ft)
4	Drop-arm	169 N.m (125 lbf.ft)
5	Filler plug	20 N.m (15 lbf.ft)

ELECTRICAL

99. General Precautions. General precautions for working on the wiring harness are as follows:

CAUTION

Prior to commencing work on electrical systems, ensure all precautions are adhered to in order to avoid damage to equipment.

a. Use suitable testing meters or circuit testers to trace or locate faults or check circuits. The practice of arcing wires to earth to determine if the wire is live will destroy solid state components and must not be used.

b. After tracing electrical faults and before carrying out any electrical repairs, disconnect the battery, negative terminal first and then disconnect the positive terminal.

c. Before carrying out any electrical arc welding on the vehicle, disconnect the battery and the alternator. Failure to disconnect the alternator will cause the transistors and diodes to fail as a result of current flow throughout the chassis when arc welding.

d. When installing the battery, ensure that the terminals are connected to the correct posts. Reversing battery polarity will cause serious damage.

Starter Motor

100. Disassembly. Disassemble the starter motor as follows:

a. Remove the starter motor in accordance with EMEI Vehicle G 103.

b. Remove the nuts securing the two wires to the solenoid switch terminals and remove the two wires.

c. Remove the screws and washers securing the switch to the housing and remove the switch (Figure 275).

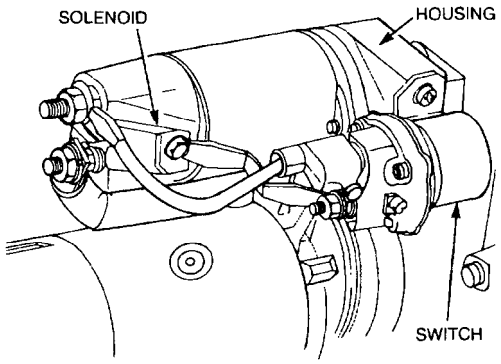


Figure 275 Removing the Solenoid Switch

d. Remove the small hexagonal-headed screw securing the field wire to the solenoid.

e. Match mark the solenoid to the starter motor housing.

f. Remove the screws securing the solenoid to the starter motor housing, remove the solenoid by disengaging the plunger from the clutch lever (Figure 276) and remove the shim.

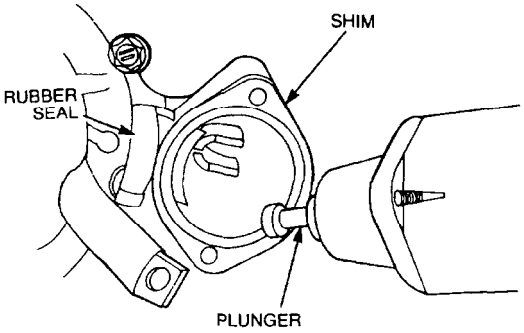


Figure 276 Removing the Solenoid

g. Match mark the brush cover and field housing in relation to the starter motor housing.

h. Remove the screws securing the brush cover and the long screws securing the field housing to the starter motor housing.

i. Disengage the brushes from the brush holder, remove the field housing and brush assembly from the starter motor housing (Figure 277).

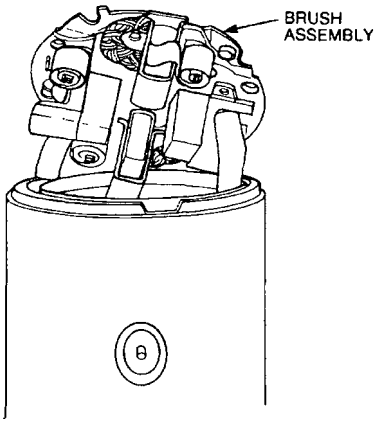


Figure 277 Field Housing and Brush Assembly Removal

j. Remove the armature and bearings from the housing.

k. Remove the single bolt securing the bearing plate to the housing and remove the screws securing the cover to the plate (Figure 278).

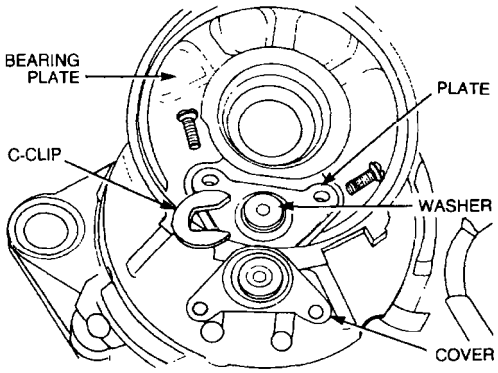


Figure 278 Removing the Bearing Plate

l. Remove the cover and C-clip from the end of the clutch, remove the washer and plate, withdraw the bearing plate from the housing and remove the washers from the shaft (Figure 278).

m. Note the position of the pinion drive gear in relation to the clutch shaft.

n. Apply pressure on the pinion retaining collar. Remove the circlip and remove the collar, pinion and spring (Figure 279).

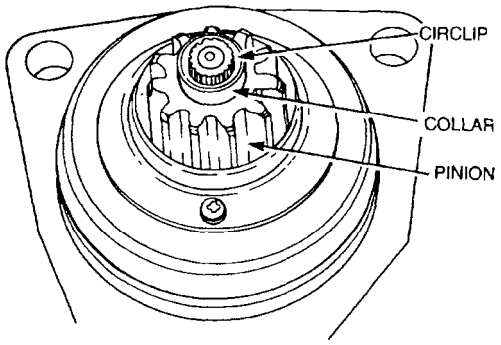


Figure 279 Removing the Pinion Gear

o. Remove the two screws securing the pinion cover and plate to the housing and remove the cover and plate (Figure 280).

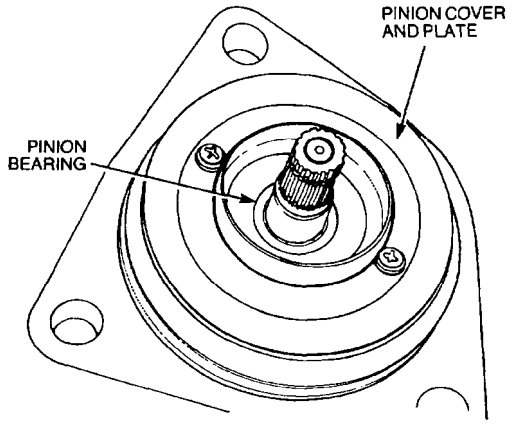


Figure 280 Removing the Pinion Cover and Plate

p. Remove the rubber seal from the clutch pivot bore. Remove the shims and plastic spacer. Remove the clutch assembly, lever and pivot bush (Figure 281).

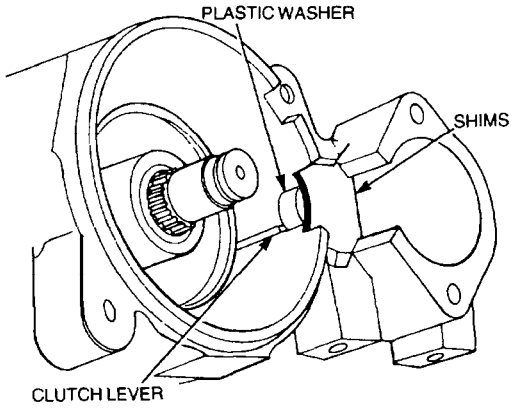


Figure 281 Removing the Clutch Lever and Pivot Bush

q. Remove the clutch lever pivot pin and pivot bush halves, taking note of the position of the bush halves (Figure 282).

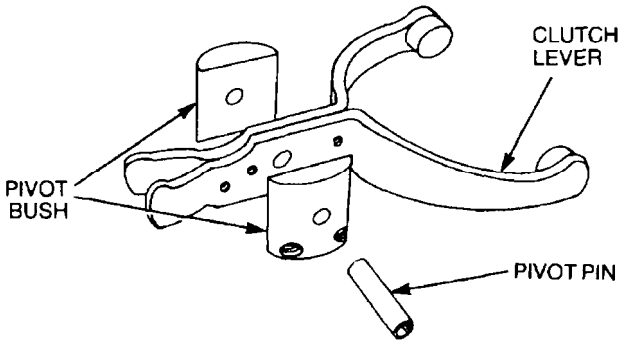


Figure 282 Removing the Pivot Bush and Pin

r. Remove the bearing from the pinion housing and remove the oil seal (Figure 283).

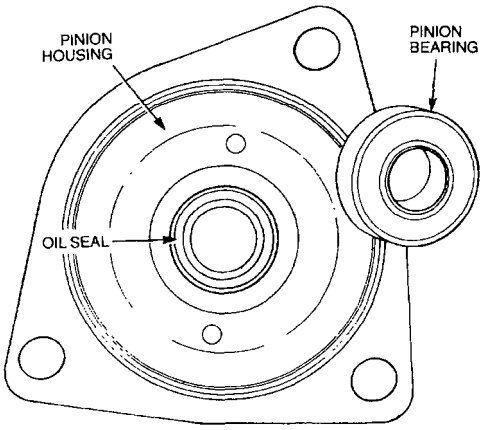


Figure 283 Removing the Pinion Bearing and Seal

101. Cleaning and Inspection. Clean and inspect the starter motor as follows:

a. Clean all components in a suitable cleaning agent and blow them dry with compressed air.

b. Check that the bearings rotate smoothly without any noise and replace them if necessary.

c. Measure the brushes and discard them if they are less than or approaching 9 mm (0.35 in) long.

d. Replace the brush springs if they appear weak.

e. Inspect the commutator for excessive wear or scoring and replace it if it is worn more than 1.0 mm (0.039 in).

f. Inspect the commutator for excessive undercut and replace it if it exceeds 0.2 mm (0.007 in).

g. Discard all seals, gaskets and O rings.

102. Reassembly. Reassemble the starter motor as follows:

NOTE

The pinion oil seal must be installed in the correct direction.

The starter motor is a waterproof component, use only new seals, gaskets and O rings during reassembly.

a. Install a new oil seal into the pinion housing with the seal lip facing the pinion bearing recess. Using a suitable press, install the pinion bearing.

b. Install the pinion bearing retaining plate and cover and secure it in place with two screws and washers.

c. Smear grease in and around the pivot pin hole in the clutch lever and on the flat faces of the pivot bush halves.

d. Position the clutch lever bush halves on the clutch lever and insert the pivot pin (Figure 284).

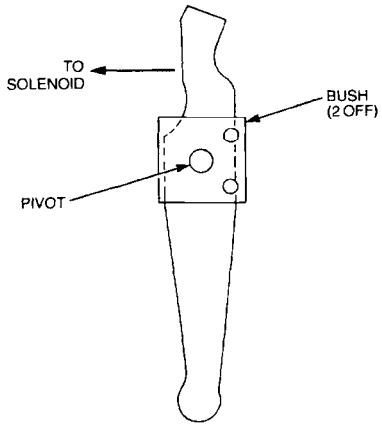


Figure 284 Installing the Pivot Bush

e. Locate the clutch lever and bush assembly in the pivot bore of the pinion housing.

f. Smear grease on the clutch shaft and clutch groove and install the clutch assembly in the housing, ensuring that the fork engages with the clutch groove.

g. Install the plastic bush, the shims and the rubber seal into the housing, ensuring that the locating tab on the seal is positioned on the screw hole.

NOTE

Ensure the pinion is re-assembled correctly.

h. Install the pinion spring, the pinion and retaining collar onto the clutch shaft ensuring that the pinion gear is fitted in the correct position as noted in the disassembly procedure in Para 100.l.

i. Support the clutch shaft and apply pressure on the collar and install the circlip.

j. Lubricate the clutch gear and install it on the clutch shaft and fit the shim washers on the clutch shaft.

k. Lubricate the clutch shaft bearing in the bearing plate. Locate the bearing plate on the pinion housing, fit the single retaining bolt and tighten it securely.

l. Fit the plate and washer on the bearing plate (Figure 278). Install the C clip to secure them. Install the cover and secure it with the two cover screws.

m. If the original armature bearings were discarded, install new bearings on the armature shaft using a suitable press and arbor.

n. Apply grease to the armature shaft teeth. Install the armature and bearings in the bearing plate, ensuring the shaft teeth engage with the clutch gear teeth and the bearings enter fully into the bearing plate.

o. Fit the O ring into the bearing plate. Locate the field housing over the armature onto the bearing plate, ensuring the match marks align and fit the O ring onto the field housing engaging the two tabs in the slots provided.

p. Install the wave washer onto the armature shaft.

q. Position the brush holder on the field housing and install the two field brushes into their holders.

r. Push back the four brushes into their holders and place the brush holder over the commutator. Fit the brush cover on the brush holder and secure it with the two screws.

s. Align the match marks on the brush holder and field housing. Locate the brush holder and brush cover assembly onto the field housing and armature bearing and secure it with the two long screws.

t. Locate the solenoid and shim on the housing, ensuring the plunger engages the clutch fork and the match marks align. Fit the two retaining screws and tighten them securely.

u. Connect the field wire to the solenoid lower terminal and tighten the nut securely.

v. Fit the solenoid switch to the housing and secure it with the screws and washers.

w. Connect the wire from the switch lower terminal to the solenoid side terminal and tighten the small hexagonal headed screw securely (Figure 275).

x. Connect the wire from the switch upper terminal (with the protective boot) to the solenoid upper terminal and tighten the nut securely.

y. Install the starter motor in accordance with EMEI Vehicle G 103.

Alternator and Vacuum Pump

103. Disassembly. Disassemble the alternator and vacuum pump as follows:

a. Remove the alternator and vacuum pump assembly in accordance with EMEI Vehicle G 103.

b. Vacuum Pump. Disassemble the vacuum pump as follows:

(1) Remove the bolts securing the vacuum pump to the alternator, secure the centre plate and remove the vacuum pump from the alternator rotor shaft (Figure 285).

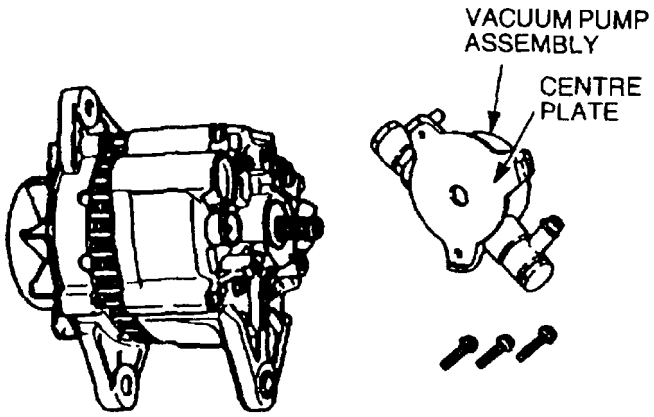


Figure 285 Removing the Vacuum Pump

(2) Hold the pump housing and turn the vacuum pump centre plate to release it from the three lugs and remove the plate, rotor and vanes (Figure 286).

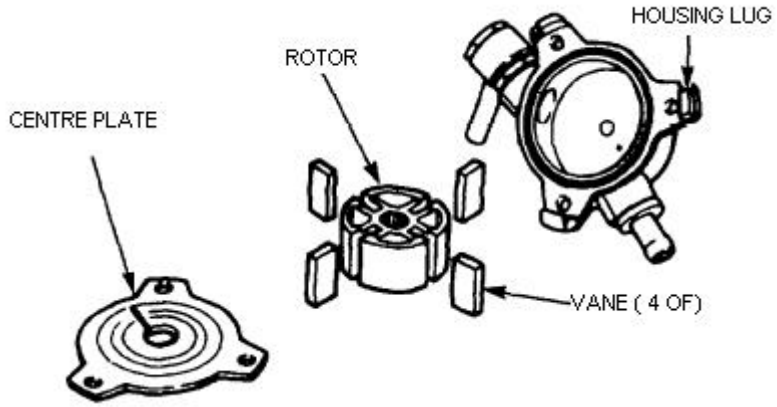


Figure 286 Vacuum Pump Disassembly

c. Alternator. Disassemble the alternator as follows:

(1) Match mark the stator and rear cover to enable them to be reassembled in their correct positions.

(2) Apply suitable protective tape to the rotor shaft splines, remove the through-bolts that secure the rear cover to the front cover and carefully remove the rear cover assembly from the front cover assembly (Figure 287), taking care not to dislodge the stator coils and damage the rear seal.

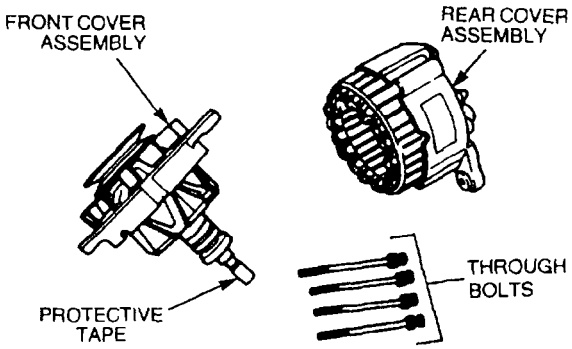


Figure 287 Removing the Alternator Rear Cover

(3) Carefully clamp the rotor in a vice fitted with soft jaw protectors, remove the nut retaining the pulley (Figure 288) and remove the washer, pulley, fan, spacer collar and front cover from the rotor.

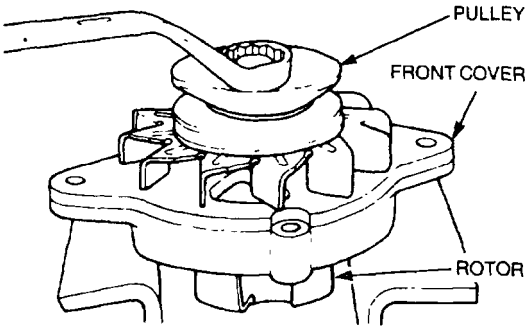


Figure 288 Removing the Front Pulley and Cover

(4) Remove the screws and washers securing the bearing retaining plate to the front cover (Figure 289), remove the plate and using a suitable press and arbor, remove the bearing.

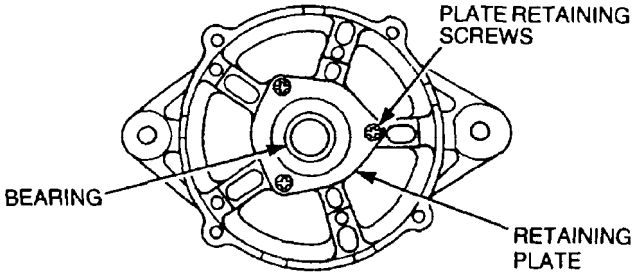


Figure 289 Removing the Front Cover Bearing

(5) Remove the nut retaining the B-terminal to the rear cover (Figure 290). Remove the nuts retaining the diode holder, taking note of the insulating washer positions and remove the stator and diode assembly from the housing.

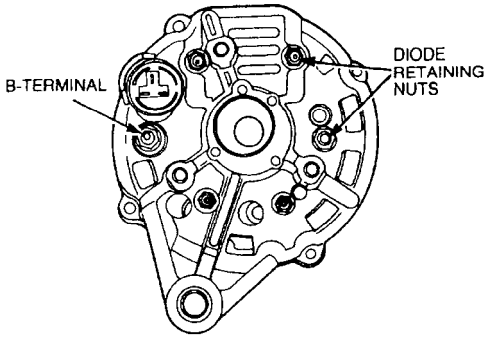


Figure 290 Removing the Diode Assembly

CAUTION

Do not allow diodes to overheat and cause them to malfunction.

(6) Hold the lead wire connecting the stator coil to the diode with long nose pliers and melt the solder connection with a soldering iron (Figure 291). When using a soldering iron to separate the diodes from the stator coil always hold the lead wire with long nose pliers to act as a heat sink and prevent the diodes from overheating and malfunctioning.

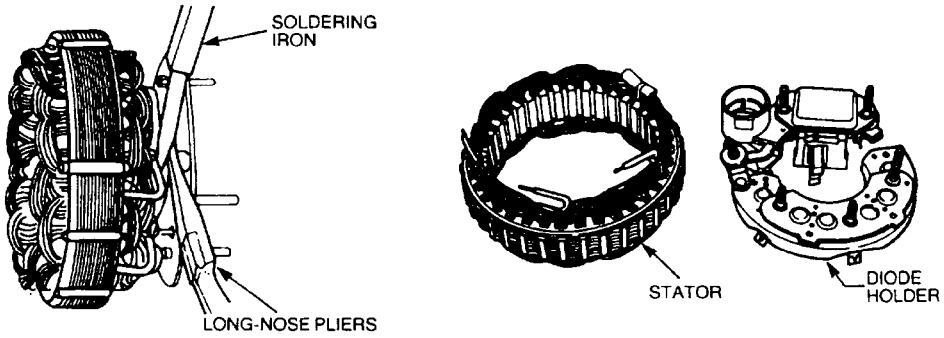


Figure 291 Removing the Diode Holder

(7) Repeat the procedure for the remaining connections and then separate the coil from the diode holder.

104. Cleaning and Inspection. Clean and inspect the alternator and vacuum pump as follows:

a. Alternator. Clean and inspect the alternator as follows:

(1) Clean all components in a suitable cleaning agent and blow them dry with compressed air.

(2) Check the bearings and seals for damage or excessive wear and replace parts if necessary.

(3) Using a vernier caliper, measure the outside diameter of the slip rings (Figure 292). The measurement must be between 33.6 to 34.6 mm (1.31 to 1.36 in). If the slip rings are outside the specification, replace the rotor assembly.

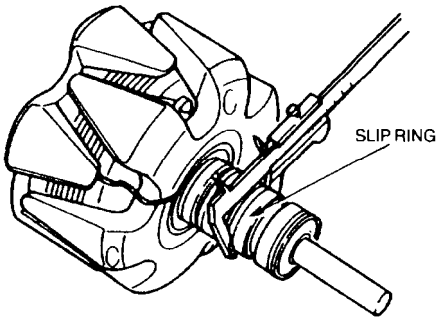


Figure 292 Measuring the Slip Rings

(4) Using an ohmmeter, check the resistance across the slip rings. If continuity does not exist, replace the rotor assembly (Figure 293).

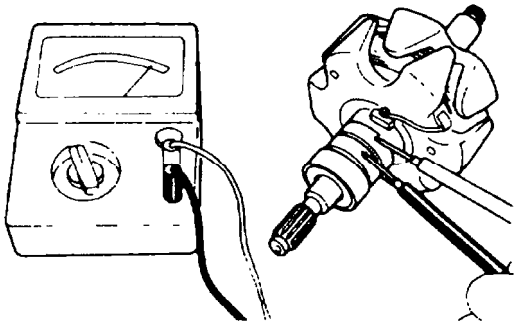


Figure 293 Rotor and Slip Ring Continuity Test

(5) Check for continuity between the slip ring and rotor core (or shaft). If continuity exists, replace the rotor assembly (Figure 294).

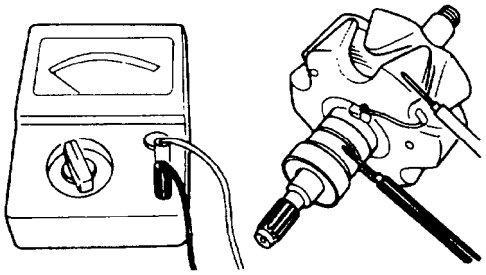


Figure 294 Rotor and Slip Ring Earth Test

(6) Check for continuity across the stator coils (Figure 295). If continuity does not exist, replace the coil assembly.

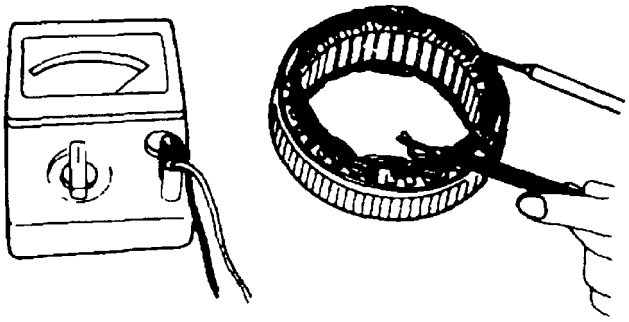


Figure 295 Stator Coil Continuity Test

(7) Check for continuity across one of the stator coils and stator core (Figure 296). If continuity exists, replace the coil assembly.

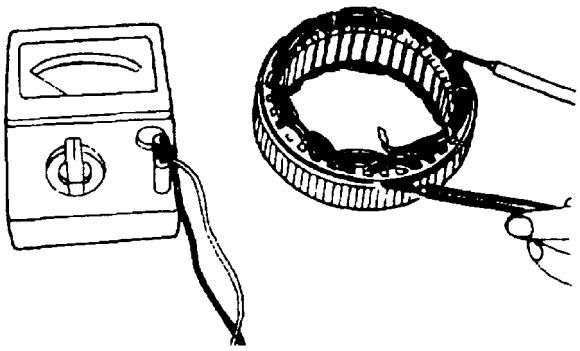


Figure 296 Stator Coil Earth Test

(8) Measure the length of the brushes and check that the length is between 5.5 to 12.5 mm (0.22 to 0.49 in). Replace the brushes if they are less than the specified length or worn to the line scribed on the brush (Figure 297).

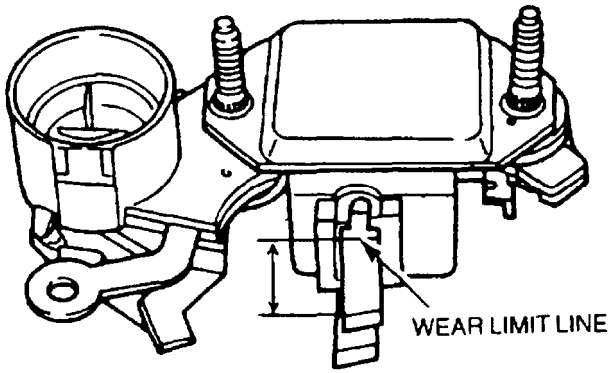


Figure 297 Brush Length Inspection

(9) Check each diode for continuity across the diode terminals and ensure that continuity exists in one direction and does not exist in the opposite direction. Replace the diode assembly if any diode is suspected of being faulty.

(10) Replace the regulator if it is suspected of being faulty.

(11) Figure 298 is included as an aid to circuit tracing.

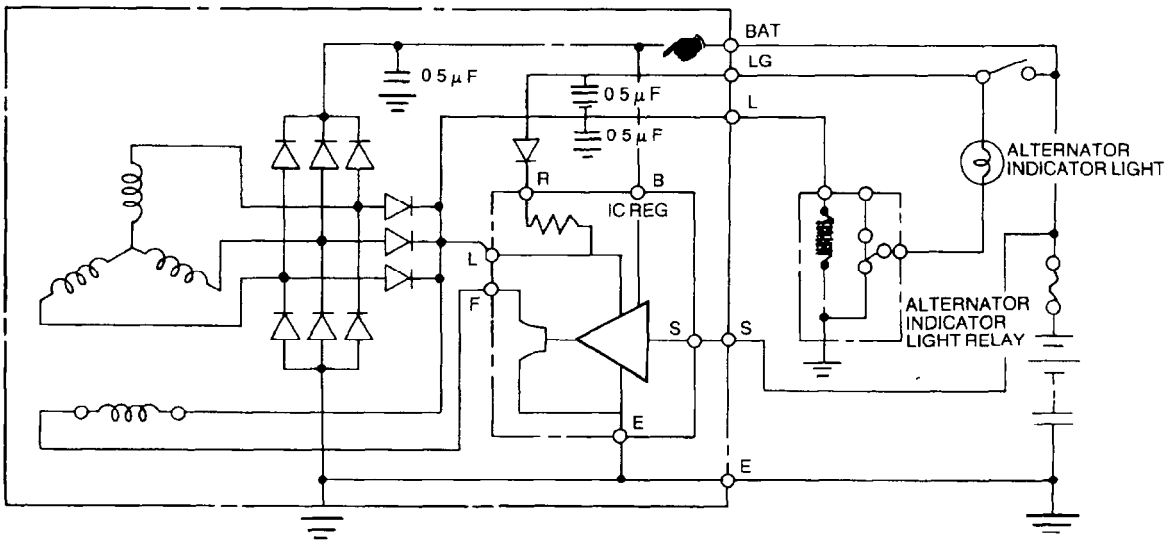


Figure 298 Alternator Circuit Diagram

b. Vacuum Pump. Clean and inspect the vacuum pump as follows:

(1) Clean all components in a suitable cleaning agent and blow them dry with compressed air.

(2) Inspect the vacuum pump for damage or excessive wear and replace the vanes if the overall length of the vane is not between 12.5 to 13.5 mm (0.492 to 0.531 in) (Figure 299).

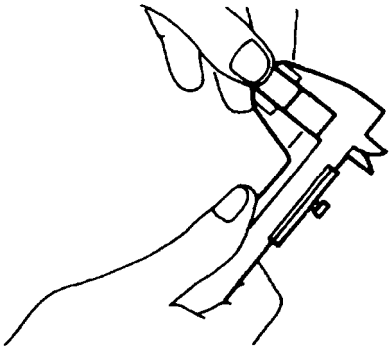


Figure 299 Measuring the Vacuum Pump Vanes

(3) Measure the inside diameter of the vacuum pump housing and check that the dimension is between 57.0 to 57.1 mm (2.244 to 2.248 in). Replace the vacuum pump assembly if it is not within specification (Figure 300).

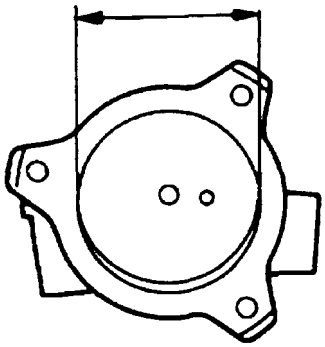


Figure 300 Measuring the Vacuum Pump Housing

(4) Check the vacuum pump oil seal for signs of damage or excessive wear and if necessary, replace it.

(5) Ensure that the pump check valve operates smoothly.

105. Reassembly. Reassemble the alternator and vacuum pump as follows:

a. Alternator. Reassemble the alternator as follows:

CAUTION

Do not allow the diodes to overheat as this may cause them to malfunction.

(1) Position the diode holder on the stator coil assembly and solder each connection, ensuring the lead wires are held by long nose pliers to prevent the heat damaging the diodes (Figure 301). When using a soldering iron to connect the diodes to the stator coil always hold the lead wire with long nose pliers to act as a heat sink and prevent the diodes from overheating and malfunctioning.

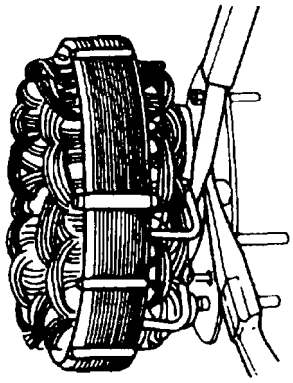


Figure 301 Reconnecting the Stator to Diode Holder

(2) Press the new bearing into the front cover, install the retaining plate and secure it with the screws and lock-washers.

(3) Clamp the rotor in a vice fitted with soft jaw protectors and install the front cover over the rotor shaft. Fit the spacer collar, fan, pulley, a new lock-washer and nut. Tighten the nut to 45 to 58 N.m (33 to 43 lbf.ft).

(4) Insert the diode holder and stator into the rear cover, aligning the match marks and ensuring that the insulating washers are in the correct locations. Install the new lock-washers and nuts and tighten them securely.

(5) Push the brushes into their holders and insert a piece of wire through the rear cover to hold the brushes back in the holder (Figure 302).

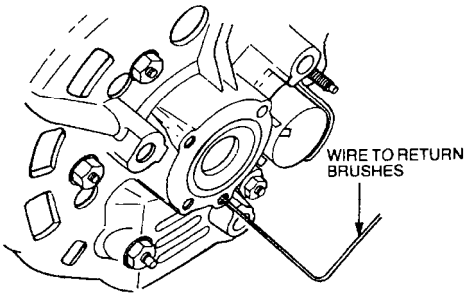


Figure 302 Holding Brushes In The Brush Holders

(6) Install the rotor into the stator and rear cover assembly, ensuring that is correctly located. Remove the wire when the rotor is fully installed and check that the rear bearing and locking ring engage fully.

(7) Insert a suitable bar or rod through the front and rear pivot holes to correctly align the front and rear covers, install the through-bolts and tighten them securely (Figure 303).

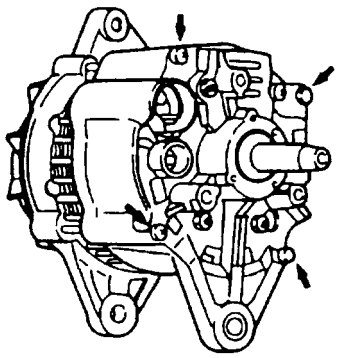


Figure 303 Installing the Rear Cover Through-bolts

(8) Remove the protective tape from the rotor shaft splines.

(9) Spin the pulley and ensure that the rotor turns freely and without noise or roughness.

b. Vacuum Pump. Reassemble the vacuum pump as follows:

(1) Using a suitable arbor, press in the new seal (Figure 304).

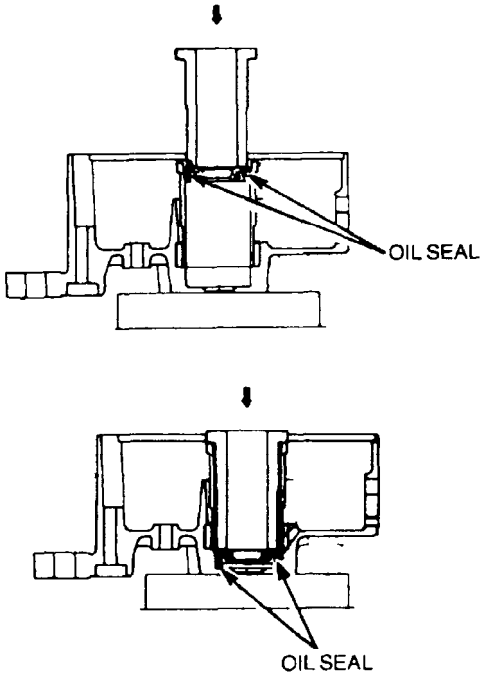


Figure 304 Installing The Vacuum Pump Oil Seal

(2) Insert the vacuum pump rotor in the housing with the serrated boss uppermost. Fit the vanes in the rotor with the round end towards the housing (Figure 305).

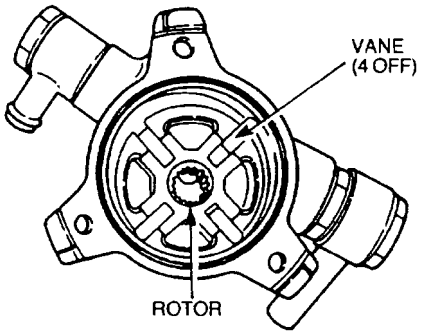


Figure 305 Installing the Vacuum Pump Rotor and Vanes

(3) Fit a new O ring on the pump housing, install the centre plate and turn the plate to engage the three lugs provided in the housing (Figure 306).

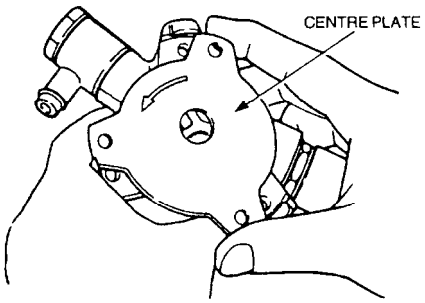


Figure 306 Installing the Centre Plate

(4) Position a new O ring on the alternator pump mounting face.

(5) Align the rotor bore and the centre plate hole and install the pump on the alternator. If necessary turn the housing to align with the holes in the alternator rear cover (Figure 307), insert the retaining bolts and tighten them securely.

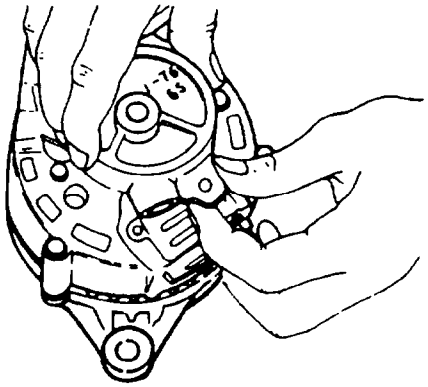


Figure 307 Installing the Vacuum Pump

(6) Apply a few drops of clean engine oil through the filler port and rotate the alternator pulley to ensure that the pump is adequately lubricated on initial start-up.

(7) Spin the pulley and check that the vacuum pump rotates smoothly.

c. Install the alternator and vacuum pump assembly in accordance with EMEI Vehicle G 103.

Wiring Harness

NOTE

Ensure the link cable to the headlamp electrical circuit has been fitted in accordance with EMEI Vehicle G 187-1.

Ensure the instrument light and inspection light socket circuits are fused in accordance with EMEI Vehicle G 197-7.

106. Replacement. Replace a wiring harness as follows:

a. Use standard workshop fault finding procedures to determine which wiring harness requires replacement (Figures 308, 309 and 310)

b. Disconnect the battery, negative terminal first and then the positive terminal.

NOTE

All electrical wiring in the vehicle is colour coded for identification and reference. If necessary, refer to the wiring diagram (Ref EMEI Vehicle G 103), in conjunction with the relevant illustration, when replacing a wiring harness.

c. Disconnect the harness from the relevant electrical equipment. As an added precaution and to assist in the installation of the replacement harness, tag each wire and terminal in turn as the wire is disconnected.

d. Remove the cable ties and clamps used to restrain and support the harness, and remove the harness from the vehicle.

e. Before installing the replacement harness, verify that it incorporates the modifications specified in EMEI Vehicle G 187-1 and EMEI Vehicle G 197-7 as appropriate.

f. Install the replacement harness and route it correctly in the vehicle. Loosely install cable ties and clamps to support the harness while connecting it.

g. Using the old harness and tags as a guide, connect the wires to the appropriate terminals. All electrical wiring in the vehicle is colour coded for identification and reference. If necessary, refer to the wiring diagram in EMEI Vehicle G 103, in conjunction with the relevant illustration, when replacing a wiring harness.

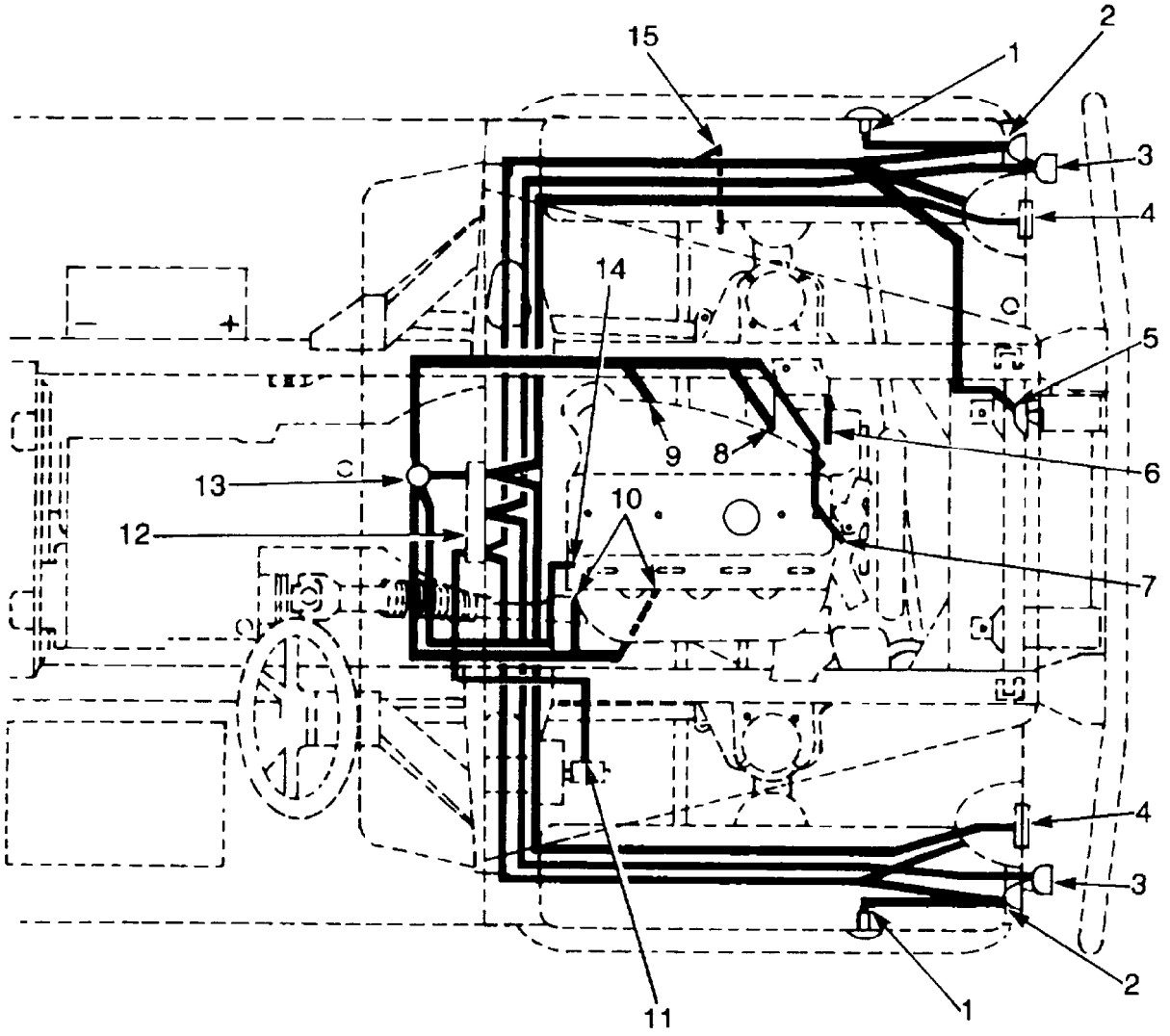
h. Fully secure all the cable ties and clamps.

i. Check whether the vehicle has been modified in accordance with EMEI Vehicle G 197-7 and if not, carry out the modification.

j. Verify that the numeral 20 on the vehicle modification plate has been defaced in accordance with EMEI Vehicle G 187-1.

k. Connect the battery, positive terminal first and then the negative terminal.

l. Test the function of the components associated with the wiring harness that has been replaced to ensure correct function.



1. Repeater light.
2. Indicator/park light.
3. Reduced head lights.
4. Blackout lights
5. Horn.
6. Earth strap.
7. Water temperature sender unit.
8. Alternator.
9. Starter motor.
10. Oil pressure switches.
11. Brake master cylinder.
12. Fuse and relay panel.
13. Multi-pin connector.
14. Glow plugs.
15. Pad wear indicator

Figure 308 Front Wiring Harness

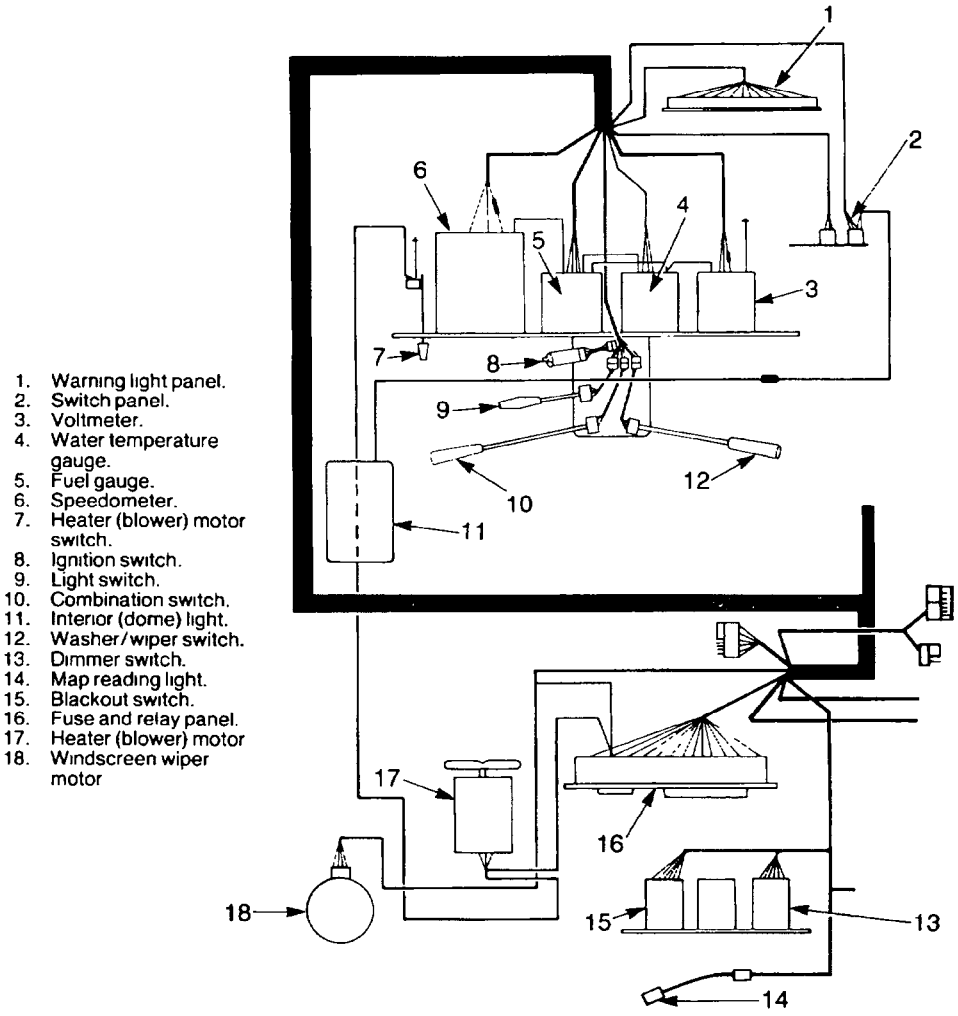
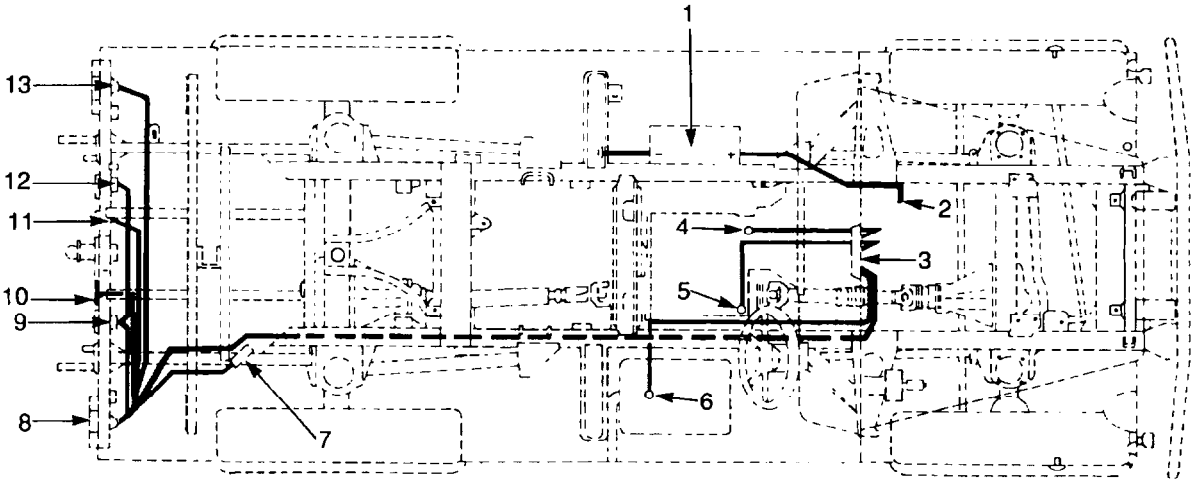


Figure 309 Cab Wiring



1. Battery.
2. Starter motor.
3. Fuse and relay panel.
4. Reverse light switch.
5. Diff. lock warning light switch.
6. Fuel tank.
7. Convoy light.
8. Tail light assembly right hand side.
9. Blackout light right hand side
10. Number plate light.
11. NATO socket.
12. Blackout light left hand side
13. Tail light assembly left hand side

Figure 310 Rear Wiring Harnesses

Table 16 Electrical Specifications

Serial	Item	Specification
1	Starter motor brush length	9 mm (0.35 in)
2	Commutator maximum wear	1.0 mm (0.039 in)
3	Commutator maximum undercut	0.2 mm (0.007 in)
4	Alternator slipring outer diameter	33.4 to 34.6 mm (1.31 to 1.36 in)
5	Alternator brush length (minimum)	To the scribed line on the brush
6	Vacuum pump vane length	12.50 to 13.50 mm (0.492 to 0.531 in)
7	Vacuum pump housing inner diameter	57.0 to 57.10 mm (2.244 to 2.248 in)
8	Fanbelt pulley	45 to 58 N.m (33 to 43 lbf.ft)

FRAME

107. Inspection. Inspect the frame assembly for cracks and corrosion and replace the frame if the repairs are beyond standard workshop procedures.

108. If the chassis exhibits any of the following damage it can be repaired in accordance with EMEI Vehicle G 189-15:

a. chassis cracks, either full or partial;

b. elongated chassis holes that are used to mount components; or

c. crushed chassis member where components have been secured to the chassis by through-bolts without supporting bushes being fitted inside the chassis member.

109. Alignment. Check the frame alignment as follows:

a. Place the assembled vehicle on a level floor and hold a plumb line against one of the points shown in Figure 311. Mark the point with chalk directly below the plumb-bob. Repeat the procedure for the remaining points to determine the frame squareness.

NOTE

When measuring the diagonals, ensure that the exact opposite plumbline positions are used on both frame side rails.

b. Move the vehicle forward away from the chalk marks, then take the dimension between the related diagonal. Each dimension must be within 9.5 mm (0.375 in).

c. Using a suitable measuring device, measure the distance between each axle centre line on both sides (dimension S) and the distance from the front face of the side rail extensions to each axle centre line (X and S).

NOTE

When checking the frame for misalignment using the datum line, not all dimensions can be determined with the body and engine in position.

d. Side rail checks can be made while referring to Figure 311.

e. If the frame dimensions are not within the specification listed in Table 17 and cannot be aligned using standard workshop procedures, the frame assembly must be replaced.

Table 17 Frame Dimensions

Check Point and Dimension	Check Point and Dimension
A — 200.5 mm	R — 2 808.5 mm
B — 531-534 mm	S — 2 794 mm (wheelbase)
C — 634-636 mm	T — 136.5 mm
D — 122 mm	U — 54 mm
E — 1 008 mm	V — 15.9 mm
F — 401.5 to 402.5 mm	W — 245 mm
G — 484.5 to 485.5 mm	X — 701.4 mm
H — 1 443.6 to 1 445.6 mm	Y — 123.4 mm
I — 2 054.6 to 2 056.6 mm	Z — 108.5 mm
J — 2 124.1 to 2 127.1 mm	AA — 68.5 to 69.5 mm
K — 3 108.9 to 3 109.9 mm	AB — 98.2 mm
L — 3 962.6 ± 2.0 mm	AC — 6.9 mm
M — 4 229.6 to 4 234.6 mm	AD — 317 to 318 mm
N — 44.4 mm	AE — 590 to 592 mm
O — 7.8 mm	AF — 466 mm
P — 147.2 mm	AG — 22 mm
Q — 12.0 to 13.5 mm	

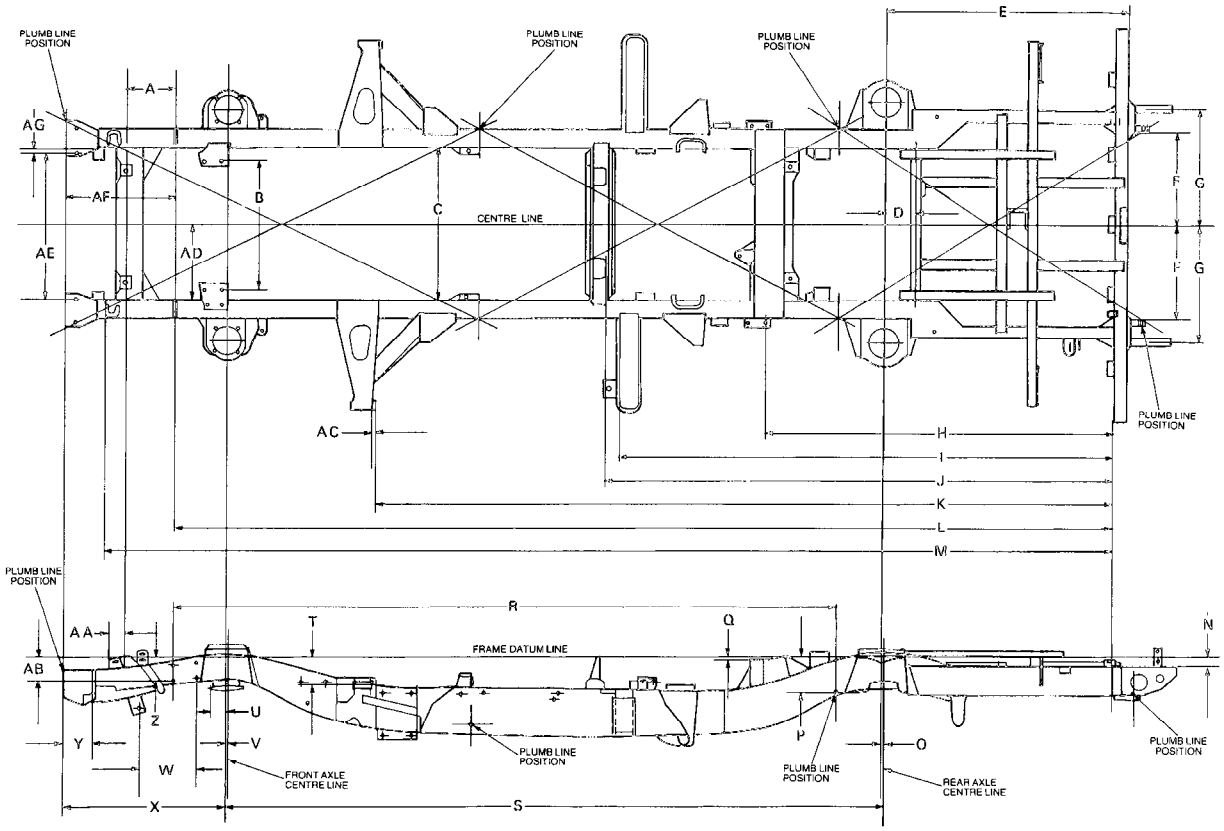


Figure 311 Frame Alignment

BODY

Rollover Protection

110. The vehicle is fitted with a rollover protection system. Refer to EMEI Vehicle G 107-2 for fitting instructions.

111. Repair and Replacement. The following repair and replacement provisions are applicable to the rollover protection system:

WARNING

The structural integrity of the rollover protection structure must not be compromised under any circumstances. Modifications and unauthorised repairs are strictly prohibited. The repair and replacement provisions of this instruction must be strictly adhered to. Failure to comply with the provisions may result in the injury or death of personnel.

a. The rollover protection system is to replaced in the following circumstances:

(1) The vehicle has been involved in a rollover accident.

(2) The rollover protection system or the capping rails have become distorted.

(3) Any welds forming part of the rollover protection system have failed or are cracked.

(4) Rollover protection system components have areas of serious corrosion.

b. The rollover protection system is not to be repaired by drilling, grinding or welding any of the components.

c. Except in the cases of repairing paint work and areas of minor surface corrosion and damaged rivnuts (sub-para d) the rollover protection system is to be repaired by replacement.

d. Loose/damaged rivnuts used for mounting the camouflage net carrier are authorised to be repaired in accordance with the procedure detailed in EMEI Vehicle G 104-1.

Dashboard

112. Removal. Remove the dashboard as follows:

a. Disconnect the battery, negative terminal first and then the positive terminal.

b. Remove the steering wheel in accordance with EMEI Vehicle G 103.

c. Remove the instrument panel in accordance with EMEI Vehicle G 103.

d. Tag and disconnect all wiring harnesses and connections.

e. Disconnect the speedometer cable.

f. Remove the central switch panel in accordance with EMEI Vehicle G 103.

g. Remove the screws securing the driver's side end panel and heater control to the fascia and then move the panel away from the fascia.

h. Remove the screws securing the upper crash pad to the firewall and the fascia support panel (Figure 312). Remove the support panel.

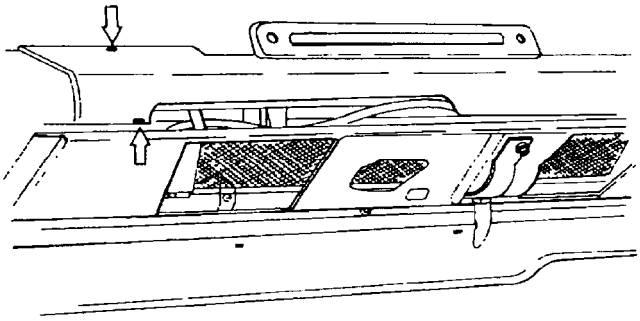


Figure 312 Removing the Upper Crash Pad

i. Remove the two demister duct inserts secured to the top of the upper crash pad at the heater ducting outlet. Slightly lift the crash pad adjacent to the windscreen and move the crash pad to the rear and out of the vehicle.

j. Remove the parcel tray and heater duct in accordance with EMEI Vehicle G 103.

113. Installation. Install the dashboard as follows:

a. Install the fascia support panel and secure it to the firewall.

b. Install the upper crash pad, ensuring that the support panel engages in the crash pad channel and secure the pad with the screws.

c. Fit the parcel tray and heater duct in accordance with EMEI Vehicle G 103.

d. Install the heater control panel and secure it to the fascia.

e. Install the central switch panel in accordance with EMEI Vehicle G 103, ensuring that all connections are secure.

f. Install the instrument panel in accordance with EMEI Vehicle G 103, ensuring that all connections are secure.

g. Install the steering wheel in accordance with EMEI Vehicle G 103.

h. Connect the battery, positive terminal first and then the negative terminal.

Body

114. Removal. Remove the body as follows:

a. Remove the canopy, fold it and remove it to a storage area.

b. Remove the doors in accordance with EMEI Vehicle G 104-1.

c. Remove the tailgate in accordance with EMEI Vehicle G 103.

d. Remove the bonnet in accordance with EMEI Vehicle G 104-1.

e. Remove the stretcher retaining clamps if fitted (Ref EMEI Vehicle G 107-3).

f. Remove the rollover protection structure if fitted (Ref EMEI Vehicle G 107-2).

g. Remove the windscreen in accordance with EMEI Vehicle G 103.

h. Remove the brush guard in accordance with EMEI Vehicle G 103.

i. Remove the winch and fairlead in accordance with EMEI Vehicle G 104-1.

j. Remove the grille in accordance with EMEI Vehicle G 103.

k. Remove the mudguards in accordance with EMEI Vehicle G 104-1.

l. Remove the steering column in accordance with EMEI Vehicle G 104-1.

m. Remove the exhaust system in accordance with EMEI Vehicle G 103.

n. Remove the axle breather hoses in accordance with EMEI Vehicle G 103.

o. Remove the parking brake cable in accordance with EMEI Vehicle G 103.

p. Remove the speedometer cable in accordance with EMEI Vehicle G 103.

q. Remove the battery and cables in accordance with EMEI Vehicle G 103.

r. Remove the floor panels in accordance with EMEI Vehicle G 103.

s. Remove the heater assembly in accordance with EMEI Vehicle G 103.

t. Remove the clutch master cylinder in accordance with EMEI Vehicle G 103.

u. Remove the brake servo cylinder and pedal bracket in accordance with EMEI Vehicle G 103.

v. Remove the radiator in accordance with EMEI Vehicle G 103.

w. Remove the dashboard in accordance with EMEI Vehicle G 103.

x. Remove the engine in accordance with EMEI Vehicle G 104-1.

y. Remove the transmission in accordance with EMEI Vehicle G 104-1.

z. Remove the wiring harnesses (Para 106).

aa. Remove the bolts securing the firewall toe-box brackets to the chassis (Figure 313) and using suitable overhead lifting equipment with a minimum safe working load of 500 kg, attach two slings to the windscreen mounting holes.

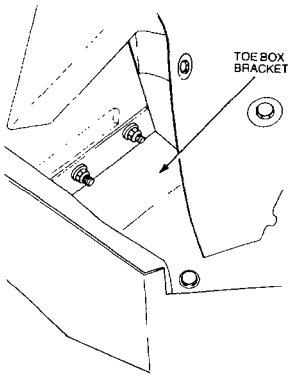


Figure 313 Removing the Toe-box Bracket

bb. Remove the bolts securing the firewall to the outriggers and raise the firewall off the chassis frame.

cc. Remove the bolts, nuts and washers securing the body mounting brackets to the chassis frame outrigger (Figure 314), then repeat the procedure for the opposite side. Remove the battery earth cable from the left side outrigger.

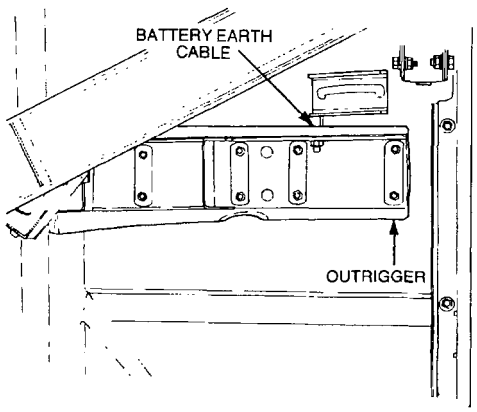


Figure 314 Removing the Body Mounting Bracket

dd. Remove the bolts, nuts and washers securing both sill panels to the body and stay (Figure 315); remove the plastic clips securing the wheel arch extensions to the sills and remove the sills.

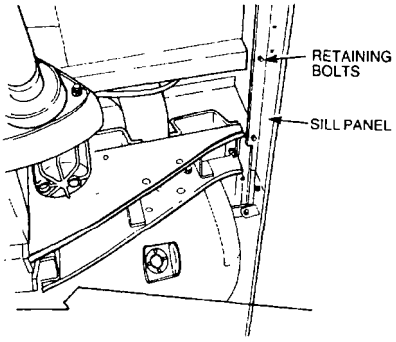


Figure 315 Removing the Sill

ee. Drain the fuel from the fuel tank into a suitable clean receptacle and store it in a safe area.

ff. Loosen the hose clamps securing the fuel tank breather hose and filler hose (Figure 316) and remove the hoses from the fuel tank.

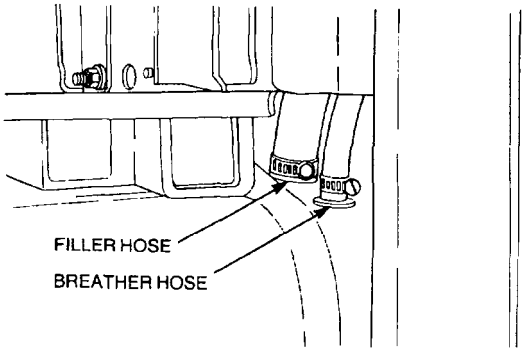


Figure 316 Removing the Fuel Tank Filler and Breather Hose

gg. Remove the bolts securing the rear body restraining stays (Figure 317) to the chassis.

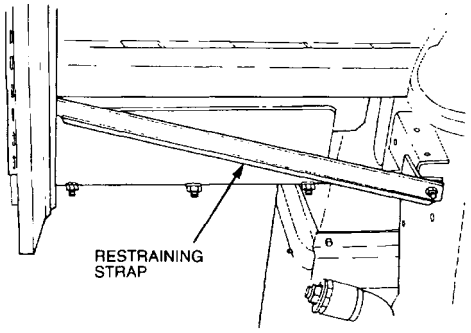


Figure 317 Removing the Body Restraining Strap

hh. Remove the bolts securing the front body mountings to the chassis brackets (Figure 318).

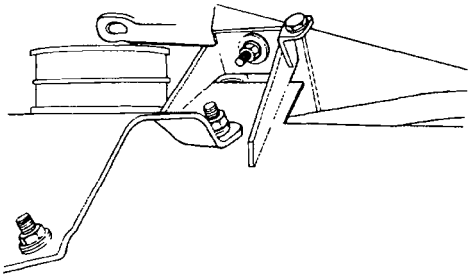


Figure 318 Removing the Front Body Mountings

ii. Remove the bolts, nuts and washers securing the front body support brace to the chassis frame (Figure 319).

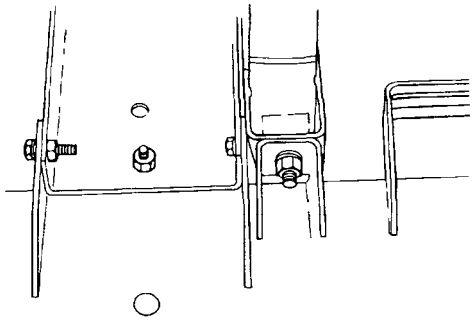


Figure 319 Removing the Body Support Brace

jj. Remove the bolts, nuts and washers securing the rear body support brace to the chassis frame (Figure 320).

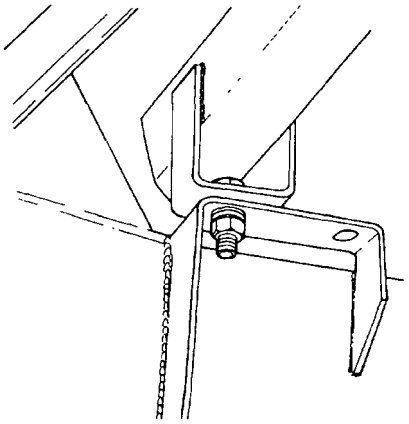


Figure 320 Removing the Body Crossmember

kk. Remove the bolts securing the front seat runners to the seat base (Figure 321)and remove the seats.

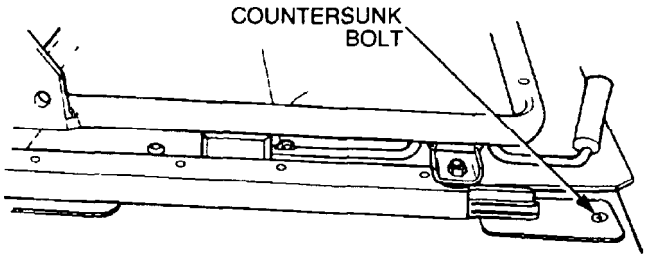


Figure 321 Removing the Front Seats

ll. Remove the bolts securing the jerrican holders to the chassis and body and remove the bolts securing the body to the rear crossmember (Figure 322).

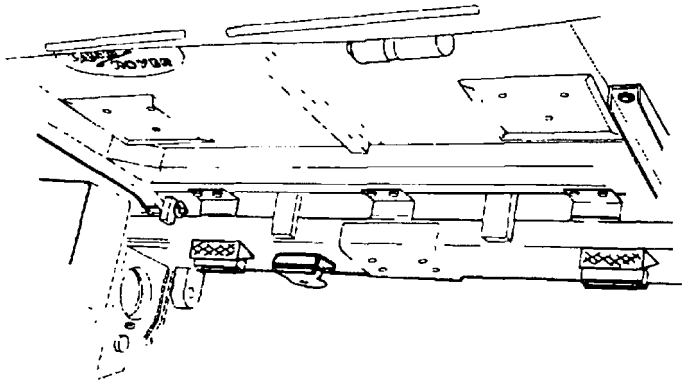


Figure 322 Rear Body Mountings

CAUTION

Ensure that the roll bars are secure and all loose items have been removed prior to raising the body.

mm. Check that all the mounting bolts and cables have been removed or disconnected. Position suitable lifting slings at the points shown in Figure 323 and carefully raise the body using suitable overhead lifting equipment with a minimum safe working load of 500 kg. Lower the body onto suitable axle stands.

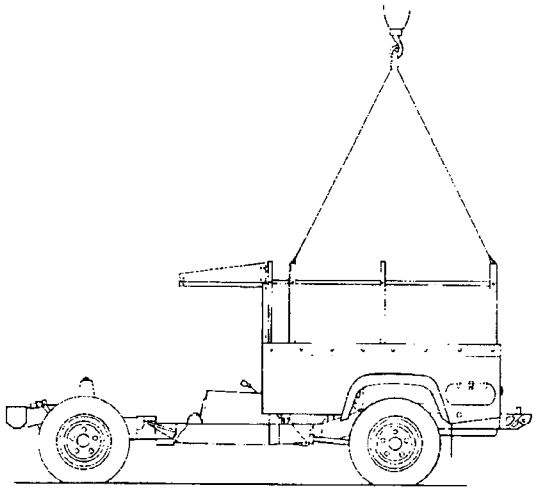


Figure 323 Removing the Body Assembly

115. Inspection. Inspect the body for corrosion, dents, cracks and loose rivets and repair or replace panels as necessary, using standard workshop procedures. Also inspect the body to check that:

a. lashing rings have been fitted in accordance with EMEI Vehicle G 197-12; and

b. stowage bin drain holes have been drilled in accordance with EMEI Vehicle G 197-1.

NOTE

If these modifications are not present on the vehicle then they must be incorporated into the vehicle before the body is installed.

116. Installation. Install the body as follows:

a. Using suitable overhead lifting equipment with a minimum safe working load of 500 kg, attach the slings to the roll bars (Figure 323), raise the body assembly and then lower it on to the chassis frame and with the weight of the body still supported by the lifting equipment, ensure that all mounting brackets are positioned correctly. Fit the bolts, washers and nuts that secure the brackets to the chassis frame, but do not tighten them at this stage. Remove the slings and lifting equipment.

b. Insert the retaining bolts through the rear body mountings (Figure 322), ensure that the body is correctly aligned and securely tighten all of the body mounting bolts.

c. Install the jerrican holders on the chassis, fit the retaining bolts, washers and nuts and tighten them securely.

d. Install the nuts, washers and bolts retaining the rear body support brace (Figure 320) and tighten them securely.

e. Install the nuts, washers and bolts retaining the front body support brace (Figure 319) and tighten them securely.

f. Install the nuts, washers and bolts retaining the front body mountings (Figure 318) and tighten them securely.

g. Install the rear body retaining stays (Figure 317) and tighten the nuts, washers and bolts securely.

h. Fit the fuel tank breather and filler hoses and tighten the hose clamps securely.

i. Install the sill panels and tighten the nuts, washers and bolts securely.

j. Secure the wheel arch extensions to the sills with new plastic clips.

k. Install the nuts, washers and bolts retaining the body mounting brackets to the chassis frame outrigger (Figure 314) and tighten them securely. Repeat the procedure for the opposite side.

l. Install the battery earth cable on the left side outrigger and tighten the retaining bolt, washer and nut securely.

m. Install the front seats and runners and tighten the retaining bolts securely.

n. Attach the lifting sling to the firewall windscreen mounting holes and, using the lifting equipment, position the firewall on the chassis frame. Install the bolts, washers and nuts that retain the firewall to the outriggers and tighten them securely. Remove the sling and lifting equipment.

o. Install the windscreen and frame in accordance with EMEI Vehicle G 103. Insert the bolts retaining the door upper frame to the windscreen, but do not tighten them at this stage.

p. Install the front doors in accordance with EMEI Vehicle G 104-1and check that the doors fit squarely in the door frame. If necessary, loosen the lower mounting bolts and move the firewall as required. Tighten the mounting bolts and the windscreen-to-door frame bolts securely.

q. Install the two toe-box brackets and the packing pieces if necessary (Figure 313) and tighten the bolts, washers and nuts securely.

r. Install the wiring harnesses (Para 106).

s. Install the transmission in accordance with EMEI Vehicle G 104-1.

t. Install the engine in accordance with EMEI Vehicle G 104-1.

u. Install the dashboard in accordance with EMEI Vehicle G 103.

v. Install the radiator in accordance with EMEI Vehicle G 103.

w. Install the brake pedal bracket and servo cylinder in accordance with EMEI Vehicle G 103.

x. Install the clutch master cylinder in accordance with EMEI Vehicle G 103.

y. Install the heater assembly in accordance with EMEI Vehicle G 103.

z. Install the floor panels in accordance with EMEI Vehicle G 103.

aa. Install the battery and cables in accordance with EMEI Vehicle G 103.

bb. Install the speedometer cable in accordance with EMEI VEH Vehicle G 103.

cc. Install the parking brake cable in accordance with EMEI Vehicle G 103.

dd. Install the axle breather hoses in accordance with EMEI Vehicle G 103.

ee. Install the exhaust system in accordance with EMEI Vehicle G 103.

ff. Install the steering column in accordance with EMEI Vehicle G 104-1.

gg. Install the mudguards in accordance with EMEI Vehicle G 104-1.

hh. Install the grille in accordance with EMEI Vehicle G 103.

ii. Install the winch and fairlead in accordance with EMEI Vehicle G 104-1.

jj. Install the brushguard in accordance with EMEI Vehicle G 103.

kk. Install the bonnet in accordance with EMEI Vehicle G 104-1.

ll. Install the tailgate in accordance with EMEI Vehicle G 103.

mm. Install the stretcher retaining clamps if originally fitted (Ref EMEI Vehicle G 107-3).

nn. Install the rollover protection structure if originally fitted (Ref EMEI Vehicle G 107-2).

oo. Install the canopy, ensuring that all straps and ropes are secure and that the front is adequately sealed on the windscreen.

WINCH

117. Disassembly. Disassemble the winch as follows:

a. Remove the winch assembly in accordance with EMEI Vehicle G 104-1.

b. Remove the winch rope in accordance with EMEI Vehicle G 103.

c. Remove the breather banjo bolt, filler and drain plugs from the winch gear housing and drain the oil into a suitable receptacle.

d. Remove the bolts and washers securing the fairlead frame to the winch housing.

e. Remove the bolts and washers securing the winch rear mounting bracket to the winch housing.

f. Withdraw the dog clutch housing and lever (Figure 324).

g. Remove the grub screw from the clutch and remove the detent spring.

h. Remove the dog clutch and detent.

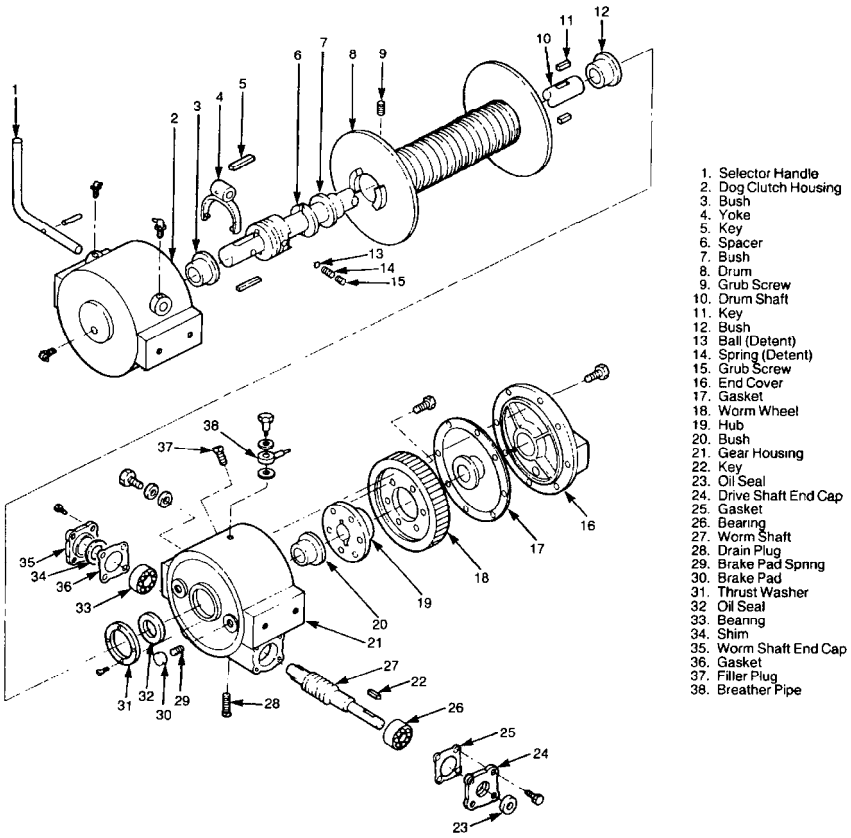


Figure 324 Winch Assembly – Exploded View

i. Remove the two drive keys from the shaft and slide the collar off the shaft (Figure 325).

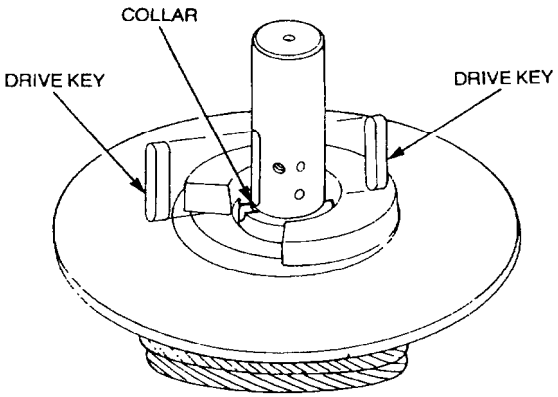


Figure 325 Removing the Winch Drum

j. Withdraw the drum from the shaft taking care not to lose the brake pads and springs.

k. Remove the two brake pads and springs (Figure 326).

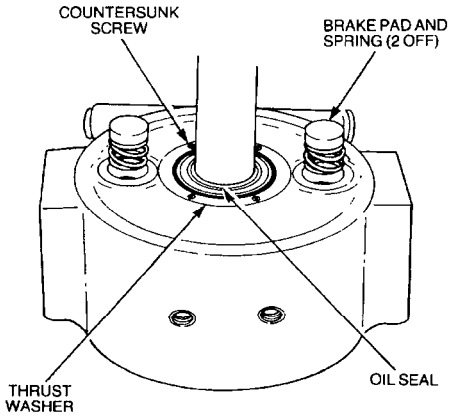


Figure 326 Removing the Brake Pad

l. Remove the bolts that secure the end cover and gasket.

m. Remove the cover and discard the gasket (Figure 327).

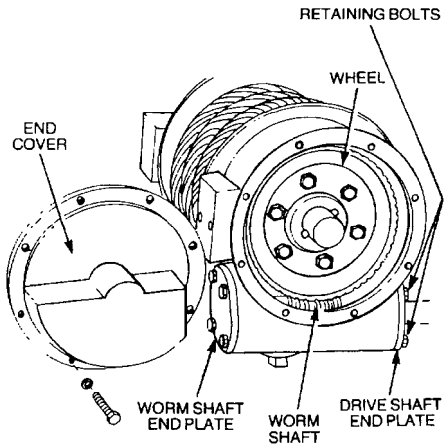


Figure 327 Removing the End Cover

n. Remove the bolts securing the worm shaft end plate to the gear housing.

o. Remove the worm shaft end plate and discard the gasket.

p. Remove the worm shaft drive key and remove the bolts securing the drive shaft end plate to the housing.

q. Remove the end plate and discard the gasket.

r. Remove the oil seal from the end plate and discard the oil seal.

s. Remove the plastic thrust washer from the worm shaft bearing and using a suitable press, remove the worm shaft through the bearing and remove the worm shaft from the housing.

t. Using a suitable puller, remove the remaining bearing from the worm shaft.

u. Remove the wheel and shaft assembly from the housing and remove the bolts securing the wheel to the hub.

v. Carefully press the wheel from the hub. Using a suitable press, separate the shaft from the hub and retain the two keys.

w. Remove the countersunk screws securing the nylon thrust washer to the winch gear housing (Figure 326).

x. Carefully prise the thrust washer from the winch gear housing and discard the thrust washer.

y. Using a suitable tool, carefully remove the oil seal from the winch gear housing, ensuring that the main shaft bronze bush is not damaged. Discard the oil seal.

118. Cleaning and Inspection. Clean and inspect the winch as follows:

a. Clean all components in a suitable cleaning agent and blow them dry with compressed air.

b. Measure the thrust washers for wear. If they are less than 5.50 mm (0.216 in), replace them.

c. Measure the internal diameter of the gear housing and clutch housing bushes. If the dimension exceeds 32.13 mm (1.265 in), use a suitable press to replace the bush as necessary.

d. Check the drum shaft for run-out and discard it if the run-out is more than 0.250 mm (0.010 in).

e. Check the overall condition of the shaft and keyways and replace them as necessary.

f. Measure the diameter of the winch drum in at least three places to check for distortion and discard the drum if the measurements differ in excess of 0.50 mm (0.020 in) from each other.

g. Ensure the winch drum has been modified in accordance with EMEI Vehicle G 187-8 prior to reassembling the winch.

h. Visually inspect the drive wheel and worm for any signs of abnormal wear and replace them as necessary.

i. Replace the brake pads if their overall length is 6 mm or less.

119. Reassembly. Reassemble the winch as follows:

a. Press the worm wheel onto the worm wheel hub ensuring that the bolt holes are aligned.

b. Apply oil to the threads of the worm wheel retaining bolts, install the bolts into the hub and tighten them to 13 to 16 N.m (10 to 12 lbf.ft).

c. Fit the two drive keys to the winch drum drive shaft and, using a suitable press, install the shaft into the hub.

d. Using a suitable tool, install the new oil seal into the winch gear housing.

e. Install the nylon thrust washer and align the four mounting holes. Apply Loctite 262 to the threads of the countersunk thrust washer retaining screws, install the screws and tighten them to 3.95 N.m (35 lbf.in).

NOTE

Lubricate the oil seal lip to prevent it being damaged during installation of the drum shaft.

f. Apply a smear of grease onto the oil seal lip, lubricate the gear drive housing bush with clean oil and fit the winch drum shaft and worm wheel assembly into the gear drive housing.

g. Using a suitable press, install a bearing to the keyed end of the worm shaft ensuring the thrust side of the bearing, when fitted, is towards the keyed end of the shaft.

NOTE

Ensure the worm shaft keyed end is installed in the correct position on reassembly.

h. Fit the worm shaft and bearing into the drive housing so that the keyed end is in the same position as shown in Figure 324.

i. Using a suitable press and supports, press the remaining bearing on to the worm shaft, ensuring the thrust side on the bearing is facing towards the outside of the housing.

j. Lubricate the worm shaft bearings with clean oil.

k. Place a new gasket and the end plate on the housing, apply a suitable sealing compound to the threads of the plate retaining bolts, install the bolts and tighten them securely.

l. Press a new oil seal into the drive shaft end plate, ensuring the sealing lip faces the winch drive housing.

m. Using plastic thrust washers between the worm shaft bearing and drive shaft end plate, adjust the worm shaft end float until a end float of below 0.05 mm (0.002 in) is achieved.

n. Apply Loctite 261 to the threads of the drive shaft end-plate retaining bolts, install the bolts and tighten them securely.

o. Lubricate the drum shaft and drum bushes with clean oil, install the drum on the shaft ensuring that the two brake pads and springs are located in the winch gear housing and push the drum towards the housing.

NOTE

The collar must be fitted correctly.

p. Fit the collar to the drum shaft with the machined end towards the keys and aligned with the machined grooves on the shaft.

q. Fit the two keys on the shaft, lubricate the shaft and keys with clean oil, install the dog-clutch and check that the keys do not restrict the sliding action of the clutch.

r. Remove the clutch, insert the detent ball and spring in the drilling and install the clutch on the shaft.

s. Apply Loctite 262 to the threads of the grub screw and the threads in the clutch drilling and install and tighten the grub screw until the head is flush with the outer face of the clutch.

t. Check that the clutch slides freely over the keys and, if necessary, change the keys until the movement is satisfactory.

u. Smear grease on the bearing surface of the drum shaft bush and the selector lever pivot holes in the dog clutch housing.

v. Position the dog clutch yoke inside the dog clutch housing, install the selector lever into the housing and through the yoke, align the retaining pin holes and insert a new retaining pin.

w. Lubricate the dog clutch groove. Install the dog-clutch housing and lever, ensuring that the selection fork engages the clutch groove.

x. Position the rear mounting bracket on the winch gear housing and dog clutch housing. Apply suitable sealing compound to the threads of the retaining bolts. Install the bolts and new washers and tighten the bolts to 77 N.m (57 lbf.ft).

y. Position the fairlead frame on the winch gear housing and dog clutch housing. Apply suitable sealing compound to the threads of the retaining bolts, install the bolts and new washers and tighten the bolts to 77 N.m (57 lbf.ft)..

z. Using a dial indicator on the periphery of the worm wheel, check that the worm-to-worm wheel clearance does not exceed 1.02 mm (0.040 in). Replace the worm and worm wheel if the specified clearance is exceeded.

aa. Install the gear wheel housing end plate and gasket. Apply suitable sealing compound to the threads of the retaining bolts, install the bolts and tighten them securely.

NOTE

Ensure the winch guard has been modified in accordance with EMEI Vehicle G 197-3.

bb. Install the winch assembly in accordance with EMEI Vehicle G 104-1, ensuring that the winch guard is fitted with countersunk screws as detailed in EMEI Vehicle G 197-3.

cc. Remove the filler plug from the winch gear housing and fill it with approximately 1.3 1itres of clean OEP-220 oil. Fit the plug and tighten it securely.

dd. Lubricate the dog-clutch operating linkage (3 points) with grease.

ee. Install the winch rope in accordance with EMEI Vehicle G 103.

Table 18 Winch Specifications

Serial	Item	Specification
1	Oil capacity	1.3 Litres
2	Drum shaft bush wear limit (maximum diameter)	32.13 mm (1.265 in)
3	Brake pad minimum thickness	6 mm
4	Drum shaft run-out (maximum)	0.25 mm (0.010 in)
5	Winch drum distortion (maximum)	0.50 mm (0.020 in)
6	Thrust washer wear limit (minimum thickness)	5.50 mm (0.216 in)
7	Wheel-to-shaft (oiled)	13-16 N.m (10-12 lbf.ft)
8	Thrust bearing screws	3.95 N.m (35 lbf.in)
9	Winch mountings tightening torque	77 N.m (57 lbf.ft)
10	Worm wheel to worm gear clearance (maximum)	1.02 mm (0.040 in)
11	Standard	0.12 to 0.17 mm (0.005 to 0.007in)

END

Distribution List: **VEH G 16.0 – Code 2** (Maint Level)
(Sponsor: CGSVSPO, Light B Vehicles)
(Authority: EC-006634)