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**TRUCK UTILITY MEDIUM
(HEAVY DUTY),
6X6 PPV VECTOR
REPAIR INSTRUCTIONS**

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AMENDMENT RECORD

Amdt No.	Incorporated By (Signature)	Date
1	BAE Systems Land Systems Pinzgauer Limited	Apr 07
2	BAE Systems Land Systems Pinzgauer Limited	Aug 07
3	BAE Systems Land Systems Pinzgauer Limited	Nov 07
4	BAE Systems Land Systems Pinzgauer Limited	Dec 07
5	BAE Systems Land Systems Pinzgauer Limited	Dec 07
6	BAE Systems Land Systems Pinzgauer Limited	Sep 08
7	Incorporated	Sep 11
8	Incorporated	Mar-12
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PREFACE**Sponsor : DEC CSS****Publications Authority: DLO Andover****INTRODUCTION**

1 Service users should forward any comments on this publication through the channels prescribed in AESP 0100-P-011-013. An AESP Form 10 is provided after the preliminary pages of this publication; it should be photocopied and used for forwarding comments on this AESP.

2 AESPs are issued under Defence Council authority and where AESPs specify action to be taken, the AESP will of itself be sufficient authority for such action and also for the demanding of the necessary stores, subject to the provisions of Para 3 below.

3 The subject matter of this publication may be affected by Defence Council Instructions (DCIs), by Standing Operating Procedures (SOPs) or by local regulations. When any such Instruction, Order or regulation contradicts any portion of this publication it is to be taken as the overriding authority.

4 The subject matter of this publication details information specific to Truck Utility Medium (Heavy Duty) 6x6 PPV VECTOR Pinzgauer variant.

5 For periods of servicing and lubricants to be used reference must be made to the Maintenance Schedule.

EQUIPMENT IDENTITY

6 The details are listed in Table 1

TABLE 1 EQUIPMENT IDENTITY

Serial (1)	Asset Code (2)	Designation (3)	UCE/ UCA
1	1774 3100	Truck Utility Medium (Heavy Duty) 6X6 PPV VECTOR	A
2		Truck Utility Medium (Heavy Duty) 6X6 PPV VECTOR 2	B
3	1045 3100	Ambulance Protected TUM (HD) 1 Stretcher 6x6 2.5 LTR DSL VECTOR	C
4	1045 3101	Ambulance Protected TUM (HD) 1 Stretcher 6x6 2.5 LTR DSL VECTOR 2	D

6.1 The Original Equipment Manufacturer (OEM) is as follows:

BAE Systems Land Systems
PO Box 106
Hadley Castle Works
Telford
Shropshire
TF1 6QW
England

www.baesystems.com

6.2 Contract Nos:

SUVC1/0077

RELATED AND ASSOCIATED PUBLICATIONS

Related publications

7 The Octad for the subject equipment consists of the publications shown opposite. All are prefixed with the first eight digits of this publication. The availability of the publications can be checked by reference to the relevant Group Index (see AESP 0100-A-001-013).

Category/Sub-category			Information Level			
			1 User/ Operator	2 Unit Maintenance	3 Field Maintenance	4 Base Maintenance
1	0	Purpose and Planning	101	101	101	101
	1	Equipment Support Policy Directives	111	111	111	111
2	0	Operating Information	201	201	201	201
	1	Aide Memoire	*	*	*	*
	2	Training Aids	*	*	*	*
3		Technical Description	*	302	302	302
4	1	Installation Instructions	411	411	411	411
	2	Preparation for Special Environments	*	*	*	*
5	1	Failure Diagnosis	*	512	512	512
	2	Maintenance Instructions	201	522	522	522
	3	Inspection Standards	*	532	532	532
	4	Calibration Procedures	*	*	*	*
6		Maintenance Schedules	601	601	601	601
7	1	Illustrated Parts Catalogue	711	711	711	711
	2	Commercial Parts List	*	*	*	*
	3	Complete Equipment Schedule, Production	*	*	*	*
	4	Complete Equipment Schedule, Service Edition (Simple Equipment)	741	741	741	741
	5	Complete Equipment Schedule, Service Edition (Complex Equipment)	*	*	*	*
8	1	Modification Instructions	811	811	811	811
	2	General Instructions, Special Technical Instructions and Servicing Instructions	821	821	821	821
	3	Service Engineered Modification Instructions (RAF only)	*	*	*	*

* Category/Sub-category not published

NOTES

- (1) Reference to AESP 0100-A-001-013 must be made to ensure the availability of the listed publications.
- (2) Category 8 preliminary pages to be issued with the first Modification or General Instruction.

Associated publications

8	<u>Reference</u>	<u>Title</u>
JSP 800	JSP 341	JSP 800 (E) Volume 7 Joint Services Movement Data & Equipment Index Regulations
JSP 800		Joint Service Road Transport Regulations
		Defence Movements and Transportation Regulations Volume 5 Road Transport

COMMENT(S) ON AESP*

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CHAPTER 1

ENGINE REPAIR INSTRUCTIONS

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INTRODUCTION

1 This Chapter details the procedures for all work carried out on the engine. Some minor maintenance tasks (e.g. refilling oil levels) are covered in AESP 2320-D-503-201 Chapter 4 and are therefore not repeated.

WARNINGS

- (1) **LETHAL VOLTAGE. TO AVOID ELECTRIC SHOCK, ALWAYS ISOLATE VEHICLE ELECTRICS PRIOR TO MAINTENANCE. BEFORE ATTEMPTING ANY WORK ON THE ENGINE, THE MASTER SWITCH MUST BE TURNED "OFF" AND THE IGNITION KEY REMOVED.**
- (2) **DANGER TO LIFE AND LIMB. ALL PERSONNEL MUST STAND CLEAR WHEN VEHICLE IS BEING RAISED OR LOWERED.**
- (3) **DANGER TO LIFE AND LIMB. NEVER WORK UNDER A PARTIALLY RAISED VEHICLE. THE VEHICLE MUST BE RAISED OR LOWERED TO FULL EXTENT OF TRAVEL.**
- (4) **TOXIC FUME HAZARD. DO NOT RUN ENGINE IN CLOSED OR POORLY VENTILATED BUILDING.**
- (5) **HEAVY WEIGHT. WHEN LIFTING THE ENGINE AND GEARBOX, ALL LIFTING EQUIPMENT IS TO BE VERIFIED AS BEING IN DATE AND OF THE CORRECT CAPACITY FOR THE TASK IN HAND.**
- (6) **BURN HAZARD. CONTACT WITH HOT ENGINE OIL WILL CAUSE PERSONAL INJURY.**
- (7) **BURN HAZARD. CONTACT WITH HOT COOLANT WILL CAUSE PERSONAL INJURY. REMOVING THE FILLER CAP WHILE THE ENGINE IS HOT CAN BE DANGEROUS. REMOVE THE FILLER CAP WITH CARE, ALLOWING THE EXCESS PRESSURE TO ESCAPE.**
- (8) **HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.**
- (9) **PERSONAL INJURY. DO NOT ALLOW ANY LOOSE ITEMS OF CLOTHING TO BECOME CAUGHT IN THE FAN BLADES OR ANY OTHER MOVING ENGINE PARTS. REMAIN ALERT AS TO THE LOCATION OF THE ROTATING FAN, PULLEYS, BELTS ETC, WHEN WORKING ON A RUNNING ENGINE. FIT MAINTENANCE FAN GUARD (800.1.56.028.1) AS NECESSARY.**

CAUTIONS

- (1) **EQUIPMENT DAMAGE. Never run engine with batteries disconnected (or damage to electrical charging system may result).**
- (2) **LUBRICANT CHECK. Before operating vehicle, ensure oils and lubricants are filled to the correct level.**
- (3) **WASTE PRODUCTS. Personnel responsible for the disposal of waste products must comply with local regulations and procedures.**
- (4) **FLUID SPILLS. Spilt oils, lubricants, fluids etc. should be contained immediately with spill absorbent materials.**

NOTE

When disconnecting pipes or hoses, suitable blanks are to be fitted to all open ends. All disconnected electrical cable/harnesses are to be tagged for identification and tied clear of working or lifting area.

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools and test equipment are shown in Table 1.

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Item (1)	NSN (2)	Part No. (3)	Designation (4)
1	5120-99-922-4448	800.1.56.001.1	Oil seal puller
2	5120-99-724-2800	800.1.56.002.1	Flexible-head spanner
3	5120-99-422-8582	800.1.56.003.1	Dial gauge adapter
4	5210-99-131-8919	800.1.56.004.1	Ring spanner
5	5120-99-854-9415	800.1.56.005.1	Brace (modified)
6	NTU	NTU	NTU
7	4030-99-488-7255	800.1.56.007.1	Additional hook (pair)
8	4910-99-273-7917	800.1.56.008.1	Lifting tackle
9	5210-99-930-6995	N/A	Dial gauge (range 0 - 3 mm)
10	TBA	N/A	Adapter (compression tester)
11	6625-99-601-8637	800.1.56.015.1	Diagnostic CD-ROM complete with cable
12	4910-99-190-7143	800.1.56.016.1	Test box.
13	TBA	N/A	Compression pressure tester kit
14	5120-99-272-2809	800.1.56.018.1	Oil filter wrench
15	2815-99-503-3511	800.1.56.028.1	Maintenance fan guard
16	5120-99-608-9365	800.1.56.030.1	Universal dial gauge holder
17	5210-12-194-8607	905.3.12.102.1	Setting bar
18	5210-12-196-8982	905.3.12.104.0	Adjustment device for TDC point
19	5120-99-983-1011	905.3.14.102.0	Mounting sleeve for oil seal
20	5120-12-176-1105	905.3.15.101.0	Guide pin set
21	5120-12-194-8771	905.3.15.101.1	Ring spanner
22	5120-12-194-0691	905.3.15.104.1	Socket – cylinder head bolt
23	5120-99-833-8581	905.3.16.103.2	Locking device for flywheel
24	5120-99-301-1615	905.3.36.103.2	Counter hold tool
25	4910-99-269-2501	800.1.56.037.1	Eye bolt (used with brace 800.1.56.005.1)

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings in this Chapter are shown in Table 2. The exploded views throughout this Chapter also give torque figures where appropriate.

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Oil drain plug	50	64.6 191.3
2	Mounting bolts for seats	26	4.2 5.5 13.16
3	Engine mountings	75	17 125
4	Right mounting brackets		
	Engine support	25	17
	Cylinder block	45	17
	Bracket - axle tube	75	17
5	Left mounting brackets		
	Bracket - cross member	25	17
	Engine support	75	17
6.	Camshaft belt tensioner retainer bolt	20	118 124 178
7.	Camshaft belt vibration damper / crankshaft gear	160	123
8.	V-belt tensioner	20/40	77
9.	Camshaft pulley bolt	85/100	120
10.	Oil pressure relief valve	40	61
11.	Cylinder head bolts	40/60	38
12.	Flywheel anti-fatigue retaining bolts	60	19.2
13.	Camshaft bearing cap nuts	20	57.2 57.3
14.	Injection pump blocking bolt	30	171
15.	Sump bolts	10	64.5
16.	Mounting bolt for engine mount (M12)	75	17
17.	Mounting bolt for inlet manifold	35	12.3 130
18.	Mounting nuts for exhaust manifold heat shield	25	12.5
19.	Steering wheel nut	40	13.1
20.	Cylinder head cover bolts	10	129
21.	Engine cover bolts	66	5.3
22.	Oil filter	25	

ENGINE COVER

WARNINGS

- (1) **INJURY TO PERSONNEL.** INSTALLATION/REMOVAL OF THE SEATS IS ONLY TO BE CARRIED OUT BY A QUALIFIED VEHICLE MECHANIC AND THE GENERAL CONDITION OF THE SEAT FIXINGS AND MOUNTINGS SHOULD BE INSPECTED PRIOR TO INSTALLATION/REMOVAL.
- (2) **PERSONAL INJURY.** TO MAINTAIN THREAT INTEGRITY ENSURE THAT THE ENGINE COVER IS ALWAYS RE-FITTED IN ACCORDANCE WITH THE STATED PROCEDURE, USING ALL BOLTS.
- (3) **IMPACT HAZARD.** HANDLE ENGINE COVER WITH CARE WHEN PERFORMING ROUTINE MAINTENANCE TASKS (TOP PLATE 16 KG, LEFT HAND SIDE 34 KG, RIGHT HAND SIDE 32 KG).

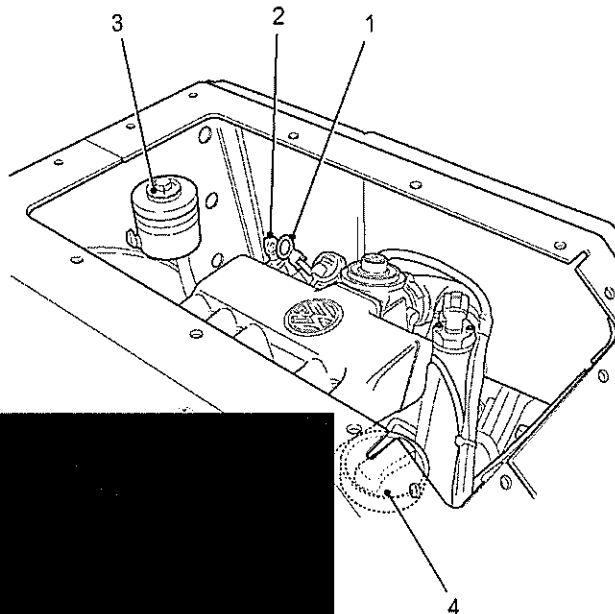
CAUTION

DAMAGE TO ENGINE COVER BLANKET. Do not place sharp objects on the blanket.

Removal

4

The majority of maintenance tasks covered in Chapter 1 require removal of the top and left and right sides of the engine maintenance cover or at the very minimum the engine cover top plate (to access the: engine oil dip stick (see Fig1 (1)); automatic gearbox fluid dip stick (2); power steering fluid reservoir (3); engine oil fill point (4), for routine maintenance tasks). To remove the engine cover proceed as follows:-



- 4.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.
- 4.2 Remove the driver and passenger seats in the vehicle cab. Each seat is held in place with four M8 fixings (torque to 26 Nm).
- 4.3 [REDACTED]
- 4.4 Using the 17mm socket and ratchet provided in the vehicle CES remove and retain the 14 off bolts securing the top plate of the engine cover and carefully remove top plate from the vehicle.
- 4.5 Disconnect the profile hose from the air filter. The hose passes through a circular cut-out in the right hand side of the engine cover. Slacken the jubilee clip and slide the hose through the engine cover.
- 4.6 Remove the box-cover over the air filter, with a fire extinguisher and jack attachment.
- 4.7 Remove the retaining bolts securing the left and right hand sides of the engine cover and carefully remove from the vehicle commencing with the right hand side.

Refitting

5 Upon completion of maintenance task refitting of the engine cover is the reverse of the removal procedure, noting the following:

- 5.1 Check serviceability of securing bolts and threads in engine cover. **Do not return the vehicle to service without the engine cover in place or with missing or damaged bolts.**
- 5.2 Re-fit the engine cover and re-fit all securing bolts using the 17mm socket and ratchet provided in the vehicle CES.
- 5.3 Using the 17mm socket and pre-set 66 Nm torque wrench provided in the vehicle CES, tighten all bolts. The bolts are tight when the torque wrench clicks.

5.4 [REDACTED]

NOTE

- [REDACTED]
- 5.5 Re-fit the driver and passenger seats in the vehicle cab. Each seat is held in place with four M8 fixings (torque to 26 Nm).
- 5.6 Stow tools back onboard vehicle.

ENGINE

Removal (general)

NOTES

- (1) The engine removal and replacement procedure is a two person task.

- (2) Prior to removing the engine, the automatic gearbox must be removed. Removal instructions are given in Chapter 3 of this publication. Removal of the gearbox is ideally undertaken with the vehicle on a ramp. With the gearbox removed, the engine must be supported using a suitable brace and/or workshop supporting device.
- (3) All cable ties released or cut open when removing the engine must be remounted in the same locations when installing engine.
- (4) Pull off hoses after slackening hose (jubilee) clips. Retain all hoses and clips for re-fitting.
- (5) In order to remove the engine from a Pinzgauer fitted with a hard top body, it is necessary to first remove the inlet manifold, and the filler / breather assembly from the cylinder head cover to enable the engine to be raised to sufficient height at the removal stage.

6 To remove the engine proceed as follows:

- 6.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.
- 6.2 Locate the vehicles automotive batteries. The battery box is located at the forward end of the rear compartment. Two pairs of 12V 85Ah Absorbed Glass Mat (AGM) maintenance free sealed for life lead acid batteries supply the 12/24V dc automotive electrical system and 24V dc FFR circuit. Automotive batteries are located on the right hand side of the battery box. FFR batteries are located on the left hand side.
- 6.3 Disconnect the yellow 12V ECU feed wire, from the automotive batteries then the vehicles negative (-ve) battery terminals and ensure that it is safely stowed, i.e. so that it cannot unintentionally reconnect with the terminal.
- 6.4 Open vehicle doors.
- 6.5 Remove automatic gearbox, see Chapter 3.

NOTE

This procedure facilitates the removal of the main inlet pipe from the top of the engine.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN ENGINE IS HOT.

- 6.6 Undo and remove the coolant drain plug located in the bottom pipe and drain coolant into a suitable fluid container for disposal in accordance with local health and safety procedures, see Chapter 12.

NOTE

It is advisable to use a large tray that covers the area beneath the whole engine bay for collecting all fluids for disposal, particularly the coolant, which escapes from several points during engine removal.

- 6.7 Remove engine sump plug using a 19 mm spanner and drain engine oil from sump into a suitable fluid container for disposal in accordance with local health and safety procedures.
- 6.8 Remove the electro magnetic fan clutch blade assembly and shroud from the front of the engine, see Chapter 12.
- 6.9 Remove the fan shroud mounting ring, see Chapter 12.

Removal (LH side of engine)

7 Working from the LH side of the engine proceed as follows:

CAUTION

DAMAGE TO HOSES/WIRING. Ensure that all hoses, wires and connectors are clear of the engine so they do not get trapped during the engine removal procedure.

7.1 Disconnect and remove hose from EGR actuator.

7.2 Disconnect and remove smaller vacuum hose from non-return valve.

7.3 Loosen hose (jubilee) clip and disconnect vacuum pipe from vacuum pump and stow securely.

CAUTION

DAMAGE TO WIRING. Use release catches on wiring connections. Do not pull wires.

7.4 After first noting position, cut all cable ties securing the wiring loom to the cable tray located on the top of the engine.

NOTE

Take note of the current location of all wiring and sensor connections, paying particular attention to routing around the engine. This will aid the refit process.

7.5 Remove wiring and unplug the connections to the engine sensors:

- (1) Coolant temperature sender (G62)
- (2) Intake manifold temperature sensor (G71/G72)
- (3) Temperature sensor for dash display
- (4) Alternator signal
- (5) Oil pressure sensor
- (6) Needle lift sender (G80)
- (7) Injection pump (G81)
- (8) Engine speed sender (G28)

7.6 Remove ribbed V-belt (FEAD). Refer to procedure detailing replacement of ribbed V-belt (FEAD) and tensioning element in Para 66.

7.7 Undo and remove mounting bolts securing the hydraulic pump and remove the pump (see Chapter 17).

NOTE

There should be no need to disconnect the hoses from the hydraulic pump. When the pump has been unbolted from the engine, lay back away from the working area ready to reassembly. Temporarily secure the pump/hose assembly away from the engine to prevent damage/movement.

7.8 Fold back the engine wiring loom away from the working area. Temporarily secure the loom away from the engine to prevent damage/movement.

7.9 Disconnect the glow plug loom by removing the glow plug lead caps from the tops of the glow plugs. Route the wiring away from the engine bay and secure.

7.10 Undo and remove the two M8 bolts securing engine oil dipstick carrier tube and bracket.

- 7.11 Undo and remove the two M5 bolts securing the cable tray to the EGR manifold and remove the tray.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN ENGINE IS HOT.

- 7.12 Undo and remove the coolant hose that connects to the engine cylinder head and the two coolant hoses to the thermostat housing. Drain coolant into a suitable fluid container for disposal in accordance with local health and safety procedures. Route coolant hoses away from engine bay and secure.

- 7.13 With a 22 mm spanner, disconnect the power steering high pressure hose from the power steering pump. Loosen the jubilee clip holding the low pressure feed hose to the power steering pump. Drain fluid from system into a suitable fluid container for disposal in accordance with local health and safety procedures. Route PAS hoses away from engine bay and secure.

- 7.14 Undo and disconnect the hoses for the fuel supply line and return line from the fuel filter to the tank. The pipe located at the rear of the fuel filter is the feed line. The return pipe to the tank is identified with a grey in-line one-way valve. Route fuel hoses away from the engine bay and secure.

- 7.15 Remove the power steering reservoir from its holder.

- 7.16 Remove M8 bolt and release clip holding gearbox dipstick tube to rear belt cover.

Removal (RH side of engine)

- 8 Working from the RH side of the engine proceed as follows:

CAUTION

DAMAGE TO HOSES/WIRING. Ensure that all hoses, wires and connectors are clear of the engine so they do not get trapped during the engine removal procedure.

- 8.1 After first noting position, cut non-releasable cable ties and undo re-useable cable ties on right-hand side of engine bay so that wiring on this side can be moved freely. Unplug wiring loom from air-mass flow meter (G70).
- 8.2 Disconnect the two vacuum hoses at joints adjacent to the right-hand seat mounting bracket.
- 8.3 Disconnect and remove turbocharger to intercooler hose pipe.
- 8.4 Unclip and remove air cleaner canister.
- 8.5 Disconnect and remove engine breather hose and 'P' clip, which is joined to the main air-mass flow meter (G70) to turbocharger hose.
- 8.6 Remove jubilee clips from air-mass flow meter (G70) to turbocharger hose.
- 8.7 Unplug the electro magnetic fan clutch fly lead from the main loom that is cabled tied to the intercooler pipe. After first noting positions, cut all cable ties that secure the main electro magnetic fan clutch loom to the engine cable tray, and secure the main loom to bulkhead during the engine removal process to prevent damage.
- 8.8 Disconnect and remove the hose between the intercooler and the main air intake pipe, and disconnect and remove the rear coolant hose from the rear of the cylinder block.
- 8.9 Working beneath the vehicle - between the inboard side of the fuel tank and outside of the engine bay bulkhead - undo and remove the M6 fixings securing the air-mass flow meter (G70)

bracket. Remove the air-mass flow meter (G70) including its bracket and pipes as one complete section.

- 8.10 Undo the two retaining nuts and remove the exhaust manifold heat shield.
- 8.11 Disconnect the clamp holding the EGR pipe to the exhaust manifold.
- 8.12 Undo the eight M8 bolts and remove the inlet manifold complete with EGR pipe, remove and discard inlet manifold gasket.
- 8.13 Remove the filler / breather assembly from the cylinder head cover.
- 8.14 Disconnect and remove the vacuum hose from the turbocharger waste gate actuator.
- 8.15 Undo the hose clip and detach the coolant bleed hose from the cylinder head.
- 8.16 Undo steering wheel nut and using a suitable pulling device remove steering wheel.
- 8.17 Provide suitable protective covering for the following areas: top and bottom of door aperture, steering column, dashboard area adjacent to door opening and floor area on top of wheel arch inside cab.

Removal (of engine)

- 9 Working from both sides and beneath the vehicle proceed as follows:

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN ENGINE IS HOT.

9.1 After first noting positions, cut the cable ties; undo and remove the coolant hose to the engine oil cooler and the coolant hose from the top of the cylinder head. Drain coolant into a suitable fluid container for disposal in accordance with local health and safety procedures. Route coolant hoses away from engine bay and secure.

CAUTION

DAMAGE TO ENGINE. The engine may tilt rearwards when the down pipe from the turbo is removed. A suitable brace or a second person may be required to prevent this.

- 9.2 Disconnect the down pipe from the turbocharger. Undo and remove the three M8 nuts securing the pipe and slide the down pipe rearwards off the studs. Dispose of the nuts and the down pipe gasket in accordance with local health and safety procedures.
- 9.3 After first noting positions, cut cable ties securing gear selector cable and pull cable towards front of vehicle to release it from the oil sump area.
- 9.4 Before proceeding with the engine removal, jack the vehicle and remove both front wheels, this allows access for the workshop engine lifting crane where necessary.
- 9.5 Support the vehicle on suitable axle stands.

NOTE

Keeping the axle hubs low to the ground will ease engine removal.

9.6 Fit the lifting tackle 800.1.56.008.1 (see Fig 2) to the two lifting eyes provided on the top of the engine.

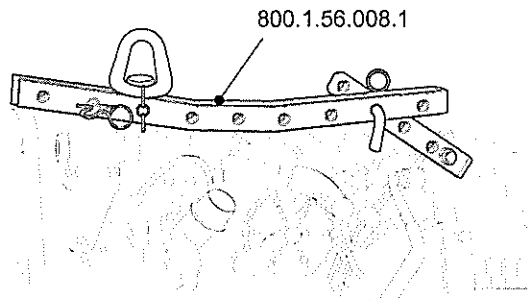


Fig 2 Typical engine lifting tackle installation

9.7 Using a suitable workshop engine lifting crane, take the full weight of the engine and remove any brace and/or workshop device supporting the engine.

9.8 Working from beneath the vehicle, undo and remove the vertical bolts (M12) which secure the left and right engine mounts to the chassis.

CAUTIONS

- (1) **DAMAGE TO HOSES/WIRING.** Ensure that all hoses, wires and connectors are clear of the engine so they do not get trapped during the engine removal procedure.
- (2) **DAMAGE TO ENGINE/VEHICLE.** Engine removal is a two person operation.

9.9 Using the workshop engine lifting crane, carefully raise the engine and swivel the front end towards the driver's door, lower the engine onto the drivers side wheel arch ensuring the protective covering remains in place. With the second operative within the cab, manoeuvre the engine towards the door aperture until the engine lifting crane clears the top of the door frame. Steady the rear of the engine and extract carefully from the vehicle ensuring clearance is maintained around the engine at all times.

9.10 If necessary, place engine on a suitable engine support – workplace engine mounting - to enable easy access of the components.

Refitting (general)

CAUTION

DAMAGE TO HOSES/WIRING. Ensure that all hoses, wires and connectors are clear of the engine so they do not get trapped during the engine installation procedure.

NOTES

- (1) A dressed spare engine is fitted with a cable tray so that the engine oil dipstick is supported during transit. A dressed engine is also fitted with a glow plug wiring harness, inlet manifold, filler / breather assembly etc, all items that need to be removed before engine fitment commences.
- (2) Route all types of lines (e.g. fuel, hydraulic, coolant, vacuum) and electrical wiring so the original line routing is restored. Use cable ties as required.
- (3) Ensure sufficient clearance to all moving or hot components.
- (4) Use new gasket and three new M8 nuts to secure turbocharger down pipe.

- (5) Use new gasket for inlet manifold.
- 10 To refit the engine, take the following steps:

10.1 If the engine is a dressed spare engine:

10.1.1 Undo and remove the two M8 bolts securing the oil dipstick tube to the retainer bracket. Retain complete for refitting at a later stage.

10.1.2 Undo and remove the two M5 bolts securing the cable tray on the top of the engine to the EGR housing. Retain complete for refitting at a later stage.

10.1.3 Remove ribbed V-belt (FEAD). Refer to procedure detailing replacement of ribbed V-belt (FEAD) and tensioning element in Para 66.

10.1.4 Undo and remove the glow plug wiring harness. Retain for spares.

10.1.5 Undo the two retaining nuts and remove the exhaust manifold heat shield.

10.1.6 Disconnect the clamp holding the EGR pipe to the exhaust manifold.

10.1.7 Undo the eight M8 bolts and remove the inlet manifold complete with EGR pipe, remove and discard inlet manifold gasket

10.1.8 Remove filler / breather assembly from cylinder head cover.

CAUTIONS

(1) **DAMAGE TO HOSES/WIRING.** Ensure that all hoses, wires and connectors are clear of the engine so they do not get trapped during the engine installation procedure.

(2) **DAMAGE TO ENGINE/VEHICLE.** Installation is a two person operation.

10.2 Fit the lifting tackle 800.1.56.008.1 (see Fig 2) to the two lifting eyes provided on the top of the engine.

10.3 Using the workshop engine lifting crane, carefully manoeuvre the engine, convertor plate first, in through the driver's door aperture. Steady the rear of the engine and pay particular attention to the oil sump, when this has cleared the doorway lower the engine enough to allow the lifting device to clear the upper edge of the door opening. Manoeuvre the engine into the vehicle and lower into position in the engine bay.

10.4 Working from beneath the vehicle, with a second person above the engine, locate the left and right engine mounts and refit their centre bolts (M12), tighten up, but do not torque at this stage.

10.5 Using a second person to steady the engine, support the engine using a suitable brace and/or workshop supporting device.

CAUTION

DAMAGE TO ENGINE. The engine may tilt rearwards until the down pipe from the turbo is reconnected. A suitable brace or a second person will be required to prevent this.

10.6 Once satisfied that the engine is held in place safely using a suitable brace and/or workshop supporting device, the lifting device (crane) may be removed. If the engine is not secured at this stage it is possible that the brake pipes may be damaged.

NOTE

When the engine is secured on its mounts the transmission can be refitted (refer to Chapter 3 for refitting).

10.7 Working from beneath the vehicle, ensure all bolts for engine mounts are tightened to the correct torque values, see Table 2.

10.8 Refit the coolant hose to the engine oil cooler and the coolant hose from the top of the cylinder head. Re-route the hoses and secure with cable ties.

Refitting (left-hand side of engine)

11 Working from the left-hand side of the engine proceed as follows:

11.1 Re-route and refit coolant pipes to thermostat housing using cable ties as required and tighten up all hose (jubilee) clips.

11.2 Re-route and reconnect all fuel hoses to the fuel filter using cable ties as required.

11.3 Re-route and reconnect vacuum hose pipe to the vacuum pump and tighten up hose (jubilee) clip.

11.4 Re-route and reconnect glow plug harness to glow plugs using cable ties as required.

11.5 Refit hydraulic pump (see Chapter 17) and replace V belt (FEAD). Refer to procedure for installing ribbed V-belt Para 69.

11.6 Refit PAS reservoir to mounting bracket on bulkhead.

11.7 Reconnect the high-pressure hose to the power steering pump using a 22 mm spanner. Re-connect the low pressure hose to the power steering pump. Tighten hose (jubilee) clips and re-route hoses and secure with cable ties as required.

11.8 Refit M8 bolt and clip holding gearbox dipstick tube to rear belt cover.

11.9 Refit cable tray to the top of the engine:

11.9.1 Refit the two M8 bolts securing the engine oil dipstick tube to the retainer bracket.

11.9.2 Refit the two M5 bolts securing the cable tray on the top of the engine to the EGR housing.

11.10 Reconnect all sensors to the main wiring loom; the cables should have yellow ID tags to aid this process. Re-route the wiring loom and secure to the cable tray using cable ties.

11.11 Refit switchover valve for engine shut off valve (N239) but **do not** connect to wiring loom.

11.12 **Do not** connect the vacuum hose from the engine shut off valve to the switchover valve for EGR solenoid flap (N239).

11.13 Refit and reconnect hoses for EGR actuator.

11.14 Refit and reconnect smaller vacuum hose for non-return valve.

Refitting (right-hand side of engine)

- 12 Working from the right-hand side of the engine proceed as follows:
- 12.1 Refit and reconnect the hose between the intercooler and the main air intake pipe. Tighten hose (jubilee) clips.
 - 12.2 Refit filler / breather assembly to cylinder head cover.
 - 12.3 Refit inlet manifold using new gasket. Torque fixings to 25 Nm.
 - 12.4 Refit the clamp holding the EGR pipe to the exhaust manifold.
 - 12.5 Refit the exhaust manifold heat shield. Torque fixings to 25 Nm.
 - 12.6 Working from beneath the vehicle, reconnect the exhaust down pipe to the turbocharger. Slide the pipe onto the studs. Fit three new M8 nuts securing the pipe and a new gasket.
 - 12.7 Working beneath the vehicle - between the inboard side of the fuel tank and outside of the engine bay bulkhead - refit the M6 fixings securing the air-mass flow meter (G70) bracket. Refit the air-mass flow meter (G70) including its bracket and pipes as one complete section.
 - 12.8 Refit hose from air-mass flow meter (G70) to turbocharger and tighten hose (jubilee) clips.
 - 12.9 Refit and reconnect engine breather hose and 'P' clip, which joins to the main air-mass flow meter (G70) to turbocharger hose.
 - 12.10 Refit and reconnect the vacuum hose from the turbocharger waste gate actuator. Tighten hose (jubilee) clips.
 - 12.11 Refit coolant bleed hose to cylinder head. Tighten hose (jubilee) clip.
 - 12.12 Refit and reconnect the hose between the intercooler and the main air intake pipe. Tighten hose (jubilee) clips.
 - 12.13 Secure the electro magnetic fan clutch main loom to the cable tray and plug into the fan clutch fly lead. Secure loom to the intercooler pipe.
 - 12.14 Feed the gear selector cable back through past the oil sump and cable tie it in the original position.
 - 12.15 Re-route the vacuum hoses and wiring for the air-mass flow meter (G70) using cable ties to secure to the eyelets provided on the main intake pipe on top of the engine.
 - 12.16 Reconnect the two vacuum supply pipes adjacent to the right-hand seat mounting bracket and reconnect the wiring loom to the air-mass flow meter (G70).
 - 12.17 Fasten re-useable cable ties and use additional cable ties as required on right-hand side of engine bay so that wiring on this side is routed correctly.

Refitting (ancillary items and testing)

- 13 Proceed as follows:
- 13.1 Refit the steering wheel. Torque nut to 40 Nm.
 - 13.2 Refill PAS reservoir with ATF (approx. one litre required for system).
 - 13.3 Refill the engine oil via the filler cap (approx. seven litres).

- 13.4 Open bonnet hatch and refill coolant in expansion tank. Connect a suitable workshop pressure tester tool to check system integrity and pressure and top up as required. Close and secure bonnet hatch.
- 13.5 Check hydraulic system oil level (see Chapter 17).
- 13.6 Prime the fuel system (see Chapter 11).
- 13.7 Jack up the front axle and refit both front wheels. Tighten nuts to specified torque.
- 13.8 Ensuring both front wheels are clear of the ground, from the driver's position turn the steering wheel side-to-side several times to charge the PAS system and expel any air present. Observe the fluid level in the PAS reservoir and top up with ATF as required.
- 13.9 Lower the vehicle back to the ground.
- 13.10 Refit the fan shroud mounting ring, see Chapter 12.
- 13.11 Refit fan assembly to electro magnetic fan clutch. Refit fan shroud. See Chapter 12.
- 13.12 Refit the automatic gearbox (see Chapter 3).
- 13.13 Refit the engine cover (see Para 5).
- 13.14 Refit air cleaner canister and reconnect the hose. The profile hose passes through a circular cut-out in the right-hand side of the engine cover. Remove the rear inspection hatch in the engine cover, slide the hose through the hole and tighten hose (jubilee) clip.
- 13.15 Re-check the fluid level of the engine, gearbox and PAS oil and top up as required. Re-fit the rear maintenance hatch of the engine cover.

WARNING

INJURY TO PERSONNEL. INSTALLATION/REMOVAL OF THE SEATS IS ONLY TO BE CARRIED OUT BY A QUALIFIED VEHICLE MECHANIC AND THE GENERAL CONDITION OF THE SEAT FIXINGS AND MOUNTINGS SHOULD BE INSPECTED PRIOR TO INSTALLATION/REMOVAL.

- 13.16 Refit driver and passenger seats in the vehicle cab. Each seat is held in place with four M8 fixings (torque to 26 Nm).
- 13.17 Ensure the battery isolation switch in the vehicle cab, located behind the passenger's seat is in the OFF position and the vehicle ignition is switched OFF. Reconnect the vehicle's negative (-ve) battery terminals and tighten up. Switch vehicle isolation switch to the ON position.
- 13.18 Connect the diagnostic software tool (see AESP 2320-D-503-512 Chapter 1) and perform the following tests:
 - (1) Check fault codes
 - (2) Check throttle potentiometer calibration.
- 13.19 If diagnostic tests are OK, start the engine and allow it to run at idle speed.

NOTE

By starting the engine, fuel system is vented automatically. Starter should be operated for a maximum of 10 seconds. Pause between each starting attempt.

CAUTION

OIL PRESSURE. Engine oil pressure warning lamp must go out after a few seconds.

13.20 Carry out road test on vehicle.

13.21 Once road test complete, check for any fluid loss (e.g. coolant leaks) and re-check all vehicle fluid levels: engine and gearbox oil; power steering fluid; coolant and top up as required, see AESP 2320-D-503-201 Chapter 4 for location of all dipsticks and fillers.

ENGINE MOUNTINGS**Removal (general)**

14 The engine mountings are removed as follows:

14.1 Remove both front seats and engine cover, see Para 4.

14.2 Disconnect the main intake pipe located over top/front of the engine that connects to the EGR plenum chamber of the inlet manifold. After first noting position, cut all cable ties securing the wiring loom to the pipe and unplug the connector for the intake manifold pressure / temperature sender (G71 / G72) located on the top of the pipe. The pipe is held in clamped place with hose (jubilee) clips at each end and is fixed to the cylinder head on the right-hand side with a bracket and M6 bolt and an M8 bolt that passes through the engine lifting eye on the top.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN DRAINING HOT FLUIDS.

14.3 Carefully undo the hose (jubilee) clip on the coolant pipe/engine breather hose, feed disconnected hose through the eyelet on the main intake pipe and re-connect as quickly as possible, re-tighten hose (jubilee) clip. Coolant fluid will escape and should be collected in a suitable container for correct disposal in accordance with local procedures.

14.4 Remove the main intake pipe complete.

14.5 Support the engine using the lifting eye provided on the top and a suitable workshop lifting device.

Removal (RH mounting)

15 The RH engine mounting is removed as follows:

15.1 Working from below the vehicle, remove the M12 vertical securing bolt from the right-hand engine mount.

15.2 Use the lifting device, to raise the right hand side of engine, check that there is a gap between the right hand engine mount and its mounting bracket.

15.3 Using a 6 mm Allen key, remove M8 fastening bolts securing the rubber mounting to the engine support bracket.

15.4 Slide out rubber mounting.

Removal (LH mounting)

16 The LH engine mounting is removed as follows:

16.1 Working from below the vehicle, remove the M12 vertical securing bolt from the left-hand engine mount.

16.2 Use the lifting device, to raise the left-hand side of engine, check that there is a gap between the left-hand engine mount and its mounting bracket.

16.3 Using a 6 mm Allen key, remove M8 fastening bolts securing the rubber mounting to the engine support bracket.

16.4 Slide out rubber mounting.

Refitting

17 The engine mountings are refitted in the reverse sequence to the procedures above. Observe tightening torque, see Table 2.

CRANKSHAFT OIL SEAL – FLYWHEEL END

Removal

18 The crankshaft oil seal – flywheel end is removed as follows:

18.1 Remove both front seats and engine cover, see Para 4.

18.2 Remove automatic gearbox, see Chapter 3.

18.3 Remove flywheel using locking brace 905.16.103.2, retain shims.

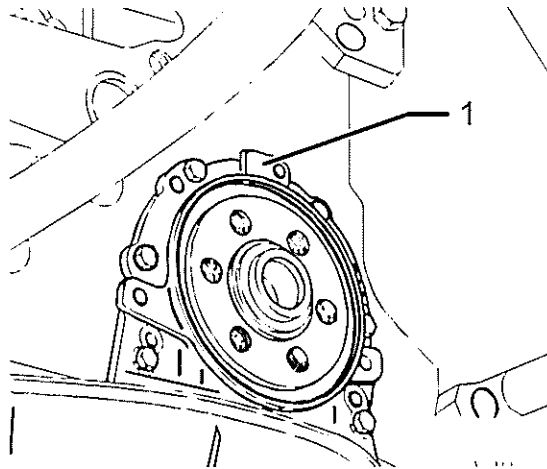


Fig 3 Crankshaft oil seal – flywheel end

18.4 Remove sealing flange (see Fig 3 (1)).

NOTES

(1) Do not dismantle sealing flange further.

(2) Only renew complete unit.

Refitting

NOTE

The oil seal of the sealing flange is provided with a mounting aid.

19 The crankshaft oil seal – flywheel end is installed as follows:

- 19.1 Push sealing flange evenly onto crankshaft flange by hand and carefully remove mounting aid.
- 19.2 Install flywheel using locking brace 905.16.103.2 and tighten new M10 mounting bolts with 60 Nm torque and turn another 90° (1/4 turn).
- 19.3 Install automatic gearbox, see Chapter 2.

CRANKSHAFT OIL SEAL – BELT PULLEY END

Removal

- 20 The crankshaft oil seal – belt pulley end is removed as follows:
 - 20.1 Remove both front seats and engine cover, see Para 4.
 - 20.2 Remove camshaft belt see Para 78.

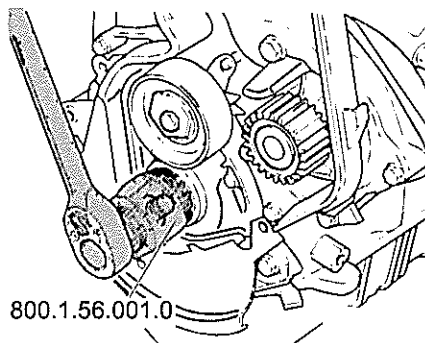


Fig 4 Crankshaft oil seal – belt pulley end (removal)

- 20.3 Screw inner section of oil seal puller 800.1.56.001.1 two turns (approx 3 mm) from outer section and lock in place with knurled screw (see Fig 4).
- 20.4 Oil threaded head of oil seal puller 800.1.56.001.1, position and screw into oil seal as far as possible using high pressure.
- 20.5 Unscrew knurled screw and turn inner section against crankshaft until oil seal is pulled out.

Refitting

- 21 The crankshaft oil seal – belt pulley end is installed as follows:
 - 21.1 Lightly oil sealing lips of oil seal.
 - 21.2 Push oil seal over guide sleeve using 905.3.14.102.0.

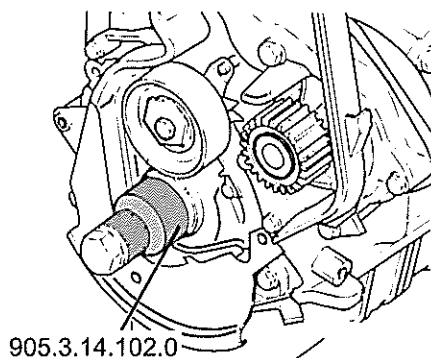


Fig 5 Crankshaft oil seal – belt pulley end (refitting)

21.3 Press in oil seal as far as possible with pressure sleeve from tool 905.3.14.102.0 and central bolt of vibration damper (see Fig 5).

21.4 Install/replace camshaft belt see Para 78.

CHECKING COMPRESSION PRESSURE

NOTE

Engine oil temperature should be at least 30 °C.

Test procedure

22 The test procedure is as follows:

22.1 Remove both front seats and engine cover, see Para 4.

22.2 Fit maintenance fan guard 800.156.028.1 to cover the fan at the front of the engine.

22.3 Pull plug for fuel cut-off valve/commencement of injection valve (N108) off injection pump.

22.4 Separate connector to quantity adjuster of injection pump.

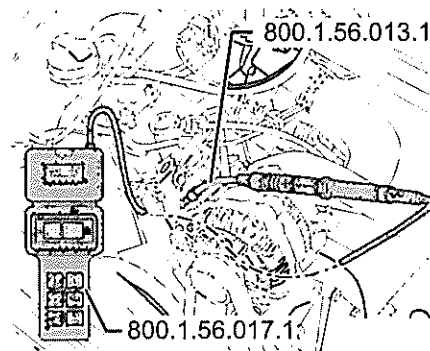
22.5 Disconnect 2-pin connector plug from thermostat for coolant circulation run-on (F95).

WARNING

BURN HAZARD. THE GLOW PLUGS MAY BE VERY HOT PLEASE HANDLE WITH EXTREME CARE.

22.6 Disconnect plugs from all glow plugs.

22.7 Remove all glow plugs with a flexible-head spanner 800.1.56.002.1.



NOTE:

Hydraulic pump fitted in place of alternator on Vector PPV Pinzgauer variant.

Fig 6 Testing compression pressure

22.8 Screw in adaptor 800.1.56.013.1 in place of glow plugs.

22.9 Check compression pressure with compression pressure tester 800.1.56.017.1.

22.10 Actuate starter until no further pressure increase is indicated by tester.

Compression pressure values

23 Compression pressure values are:

23.1 New: 25 -31 bar gauge pressure.

- 23.2 Wear limit: 24 bar gauge pressure.
- 23.3 Permissible difference between all cylinders: 5 bar.

Post-test action

- 24 Continue the procedure as follows:
 - 24.1 Install glow plugs with flexible-head spanner 800.1.56.002.1. Tightening torque is 15 Nm.
 - 24.2 Interrogate fault memory.

NOTE

Faults are saved when the connectors to the injection pump are separated. Therefore, interrogate the fault memory and clear it if necessary.

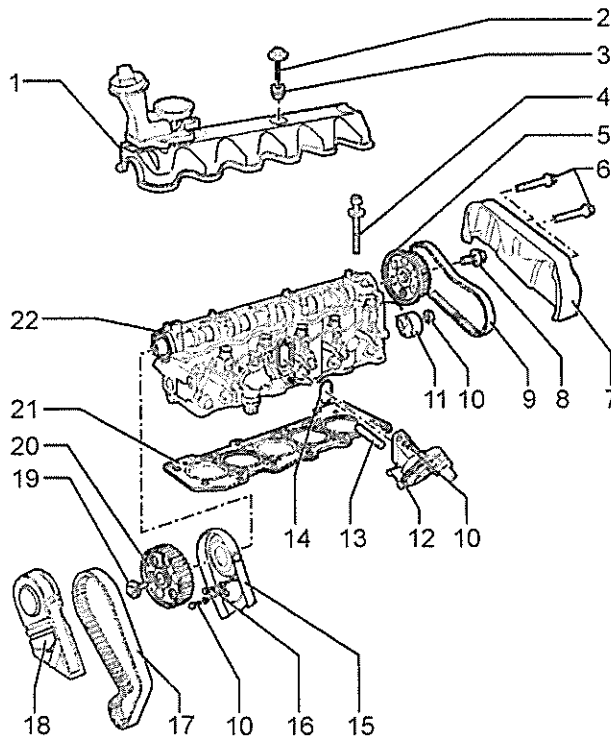
- 24.3 Remove maintenance fan guard 800.156.028.1.
- 24.4 Refit engine cover and both front crew seats (see Para 5).

CYLINDER HEAD

25 Check the compression pressure, see Para 22.

NOTES

- (1) When installing a replacement cylinder heads with a mounted camshaft, the contact surfaces between the bucket tappets and the cam surface must be oiled after the head is installed
- (2) The plastic washers provided to protect the open valves must not be removed until directly prior to fitting the cylinder head.
- (3) When renewing the cylinder head, the entire coolant must be renewed.



- | | | | |
|----|--|----|---|
| 1 | Cylinder head cover | 11 | Idler pulley |
| 2 | Bolt for cylinder head cover (item 1) – 10 Nm torque | 12 | Vacuum pump |
| 3 | Seal (for items 1 and 2) | 13 | Tappet |
| 4 | Cylinder head screw | 14 | O-ring |
| 5 | Drive sprocket for injection pump | 15 | Rear camshaft belt guard |
| 6 | Mounting bolt for FIP belt guard (item 7) – 20 Nm torque | 16 | Screw for rear FIP belt guard (item 15) – 10 Nm torque |
| 7 | FIP belt guard | 17 | Camshaft belt |
| 8 | Belt for fuel injection pump (FIP) | 18 | Upper section of camshaft belt guard |
| 9 | Belt for fuel injection pump (FIP) | 19 | Mounting bolt for camshaft sprocket (item 20) – 85 or 100 Nm torque |
| 10 | Nut for idler pulley (item 11) – 20 Nm torque | 20 | Camshaft sprocket |
| | | 21 | Cylinder head gasket |
| | | 22 | Cylinder head |

Fig 7 Cylinder head – exploded view

Removal

26 To remove the cylinder head:

26.1 Remove both front seats and engine cover, see Para 4.

26.2 Drain coolant, see Chapter 12.

26.3 Disconnect the induction feed pipe to the inlet manifold.

26.4 Disconnect engine 'degas' hose.

26.5 Disconnect the main intake pipe located over top/front of the engine that connects to the EGR plenum chamber of the inlet manifold. After first noting position, cut all cable ties securing the wiring loom to the pipe and unplug the connector for the intake manifold pressure / temperature sender (G71 / G72) located on the top of the pipe. The pipe is held in clamped place with hose (jubilee) clips at each end and is fixed to the cylinder head on the right-hand side with a bracket and M6 bolt and an M8 bolt that passes through the engine lifting eye on the top.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN DRAINING HOT FLUIDS.

26.6 Carefully undo the hose (jubilee) clip on the coolant pipe/engine breather hose, feed disconnected hose through the eyelet on the main intake pipe. Coolant fluid will escape and should be collected in a suitable container for correct disposal in accordance with local procedures.

26.7 Remove the main intake pipe complete.

CAUTION

DAMAGE TO HOSES/WIRING. Ensure that all hoses, wires and connectors are clear of the engine so they do not get trapped during the cylinder head removal procedure.

26.8 Disconnect and remove hose from EGR actuator.

26.9 Disconnect the vacuum hose from the EGR actuator to the switchover valve for EGR solenoid flap (N239).

26.10 Remove switchover valve for EGR solenoid flap (N239) and stow safely for re-use.

26.11 Disconnect and remove smaller hose from non-return valve.

26.12 Loosen hose (jubilee) clip and disconnect pipe from vacuum pump and stow securely.

NOTE

Disconnect all associated wiring, hoses and conduit etc. to allow free removal.

CAUTION

DAMAGE TO WIRING. Use release catches on wiring connections. Do not pull wires.

26.13 After first noting position, cut all cable ties securing the wiring loom to the cable tray located on the top of the engine.

NOTE

Take note of the current location of all wiring and sensor connections, paying particular attention to routing around the engine. This will aid the refit process.

26.14 Remove wiring and unplug the connections to the engine sensors:

- (1) Coolant temperature sender (G62)
- (2) Intake manifold temperature sensor (G71/G72)
- (3) Temperature sensor for dash display
- (4) Alternator signal
- (5) Oil pressure sensor
- (6) Needle lift sender (G80)
- (7) Injection pump (G81)
- (8) Engine speed sender (G28)

26.15 Undo and remove mounting bolts securing the hydraulic pump and remove the pump (see Chapter 17).

NOTE

There should be no need to disconnect the hoses from the hydraulic pump. When the pump has been unbolted from the engine, lay back away from the working area ready for reassembly. Temporarily secure the pump/hose assembly away from the engine to prevent damage/movement.

26.16 Fold back the engine wiring loom away from the working area. Temporarily secure the loom away from the engine to prevent damage/movement.

26.17 Disconnect the glow plug loom by prising the glow plug lead caps from the tops of the glow plugs. Route the wiring away from the engine bay and secure.

26.18 Undo and remove the two M8 bolts securing engine oil dipstick carrier tube and bracket.

26.19 Undo and remove the two M5 bolts securing the cable tray to the EGR manifold and remove the tray.

26.20 Remove inlet manifold and EGR assembly, see Chapter 11.

26.21 Remove exhaust manifold, see Chapter 11.

26.22 Remove the electro magnetic fan clutch blade assembly, shroud and shroud ring from the front of the engine, see Chapter 12.

26.23 Remove ribbed V (FEAD) belt, see Para 68.

26.24 Remove camshaft belt, see Para 78.

26.25 Remove FIP belt, see Para 145.

26.26 Undo and remove 12 bolts, in reverse of tightening order shown in Fig 11, retaining cylinder head.

26.27 Remove complete cylinder head and gasket.

Check cylinder head for warping

27 To check the cylinder head for warping use a straight edge and feeler gauge as shown in Fig 8. The maximum permissible warping (detected by the feeler gauge) is 0.2 mm.

NOTE

It is not permissible to re-machine diesel engine cylinder heads.

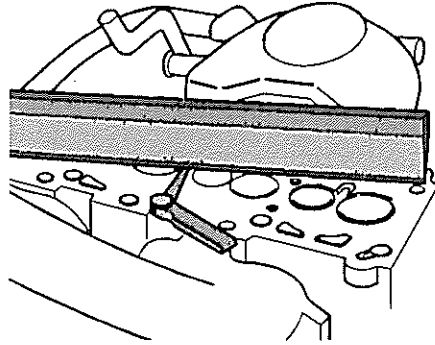


Fig 8 Check cylinder head for warping

Cylinder head markings

28 The part number is marked on the head gasket (see Fig 9 (A)). Notches/holes in the gasket are shown in Fig 9 (B).

NOTE

Depending on the piston overhang, cylinder head gaskets of various thicknesses are installed. When renewing the gasket, install a new gasket with the same marking.

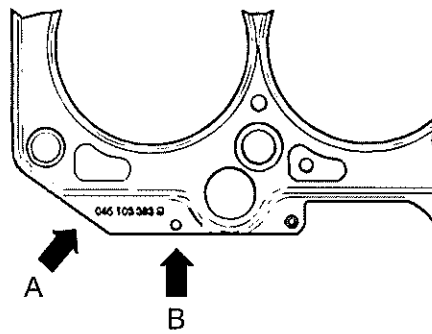


Fig 9 Cylinder head gasket markings

Installing cylinder head

CAUTIONS

- (1) **DAMAGE TO CYLINDER HEAD.** Do not use abrasive paper below 100 grit for cleaning cylinder head or cylinder block.
- (2) **DAMAGE TO CYLINDER HEAD GASKET.** Handle gasket with extreme care. Damage to the silicone layer and in the bead area results in leaks.

NOTES

- (1) Route all types of lines (e.g. fuel, hydraulic, coolant and refrigerant, brake fluid, vacuum) and electric cables so that the original line routing is restored.
 - (2) Ensure sufficient clearance to all moving or hot components.
 - (3) Always renew cylinder head bolts.
 - (4) Remove gasket residues from the cylinder head and cylinder block when making repairs. Make sure that long grooves or scratches do not result when cleaning off residue.
 - (5) Carefully remove all sanding and grinding residue.
 - (6) Do not remove the new cylinder head gasket from the package until directly prior to installation.
- 29 Set crankshaft to the TDC marking before fitting cylinder head.
- 30 Turn the crankshaft in direction opposite engine rotating direction (turn anti-clockwise) until no piston is at TDC.
- 31 Fit cylinder head gasket.

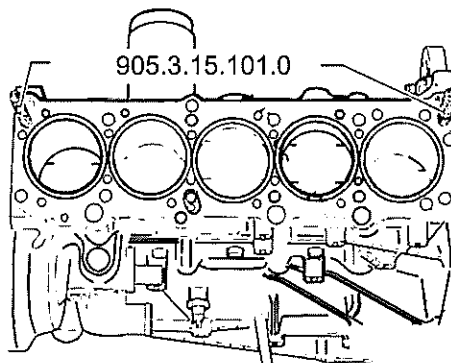


Fig 10 Fitting cylinder head

- 32 Screw guide pin from 905.3.15.101.0 into outer holes on intake side to centre
- 33 Fit cylinder head gasket.
- 34 Screw guide pin from 905.3.15.101.0 into outer holes on intake side to centre.
- 35 Fit cylinder head, inserting remaining 10 new cylinder head bolts and tighten hand-tight.

36 Unscrew, guide pins through bolt holes with pin turner from 905.3.15.101.0 and mount new cylinder head screws.

37 Tighten cylinder head in four steps in tightening order shown in Fig 11.

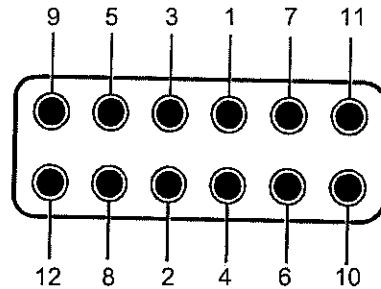


Fig 11 Cylinder head bolt tightening order

38 Pre tighten with torque spanner:

38.1 Step 1 = 40 Nm

38.2 Step 2 = 60 Nm

39 Tighten further with rigid spanner:

39.1 Step 3 = ¼ turn (90°)

39.2 Step 4 = ¼ turn (90°)

NOTES

(1) Loosen cylinder head in reverse order.

(2) It is not necessary to retighten the cylinder head bolts following repairs.

40 After mounting cylinder head, turn crankshaft so that cams for cylinder 1 point upward evenly. Set crankshaft to TDC in engine rotating direction (clockwise) before fitting belt.

41 Replace FIP belt, see Para 145.

42 Replace camshaft belt, see Para 78.

43 Refit exhaust manifold.

44 Refit inlet manifold and EGR assembly and induction feed pipe.

NOTE

Reconnect all associated wiring, hoses and conduit etc.

45 Replace (see Chapter 17) pump and ribbed V (FEAD) belt, see Para 68.

46 Refit the fan shroud mounting ring and fan assembly to electro magnetic fan clutch. Refit fan shroud. See Chapter 12.

47 Refill coolant system, see Chapter 12.

48 Fit maintenance fan guard 800.156.028.1 to cover the fan at the front of the engine.

49 Run the engine and interrogate the fault memory using the diagnostic reader.

50 Once complete, remove the maintenance fan guard 800.156.028.1, refit engine cover and front seats, see Para 5.

CHECKING HYDRAULIC BUCKET TAPPETS

NOTES

- (1) Only renew bucket tappets in complete sets they cannot be adjusted or serviced
- (2) Irregular valve noises are normal during starting.

Test procedure

51 The test procedure is as follows:

- 51.1 Remove both front seats and engine cover, see Para 4.
- 51.2 Fit maintenance fan guard 800.156.028.1 to cover the fan at the front of the engine.
- 51.3 Start engine and allow it to warm up.
- 51.4 Increase engine speed to approx. 2500 rpm for 2 minutes.

52 If the hydraulic bucket tappets are still loud, determine the defective tappet(s) as follows:

- 52.1 Remove cylinder head cover, see Para 26.
- 52.2 Turn crankshaft in engine rotating direction (clockwise) until cams of bucket tappets to be checked are facing upward.
- 52.3 Determine clearance between cam and bucket tappet using feeler gauges.
- 52.4 If clearance is greater than 0.1 mm renew bucket tappet. If clearance is less than 0.1 mm or no clearance is determined continue check.

53 Press down bucket tappet with wood or plastic wedge. If a play of more than 0.1 mm until the valve opens can be felt replace the tappet.

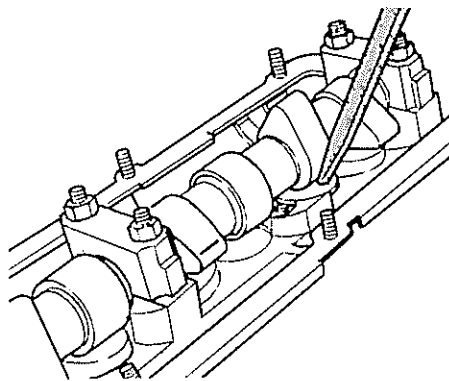
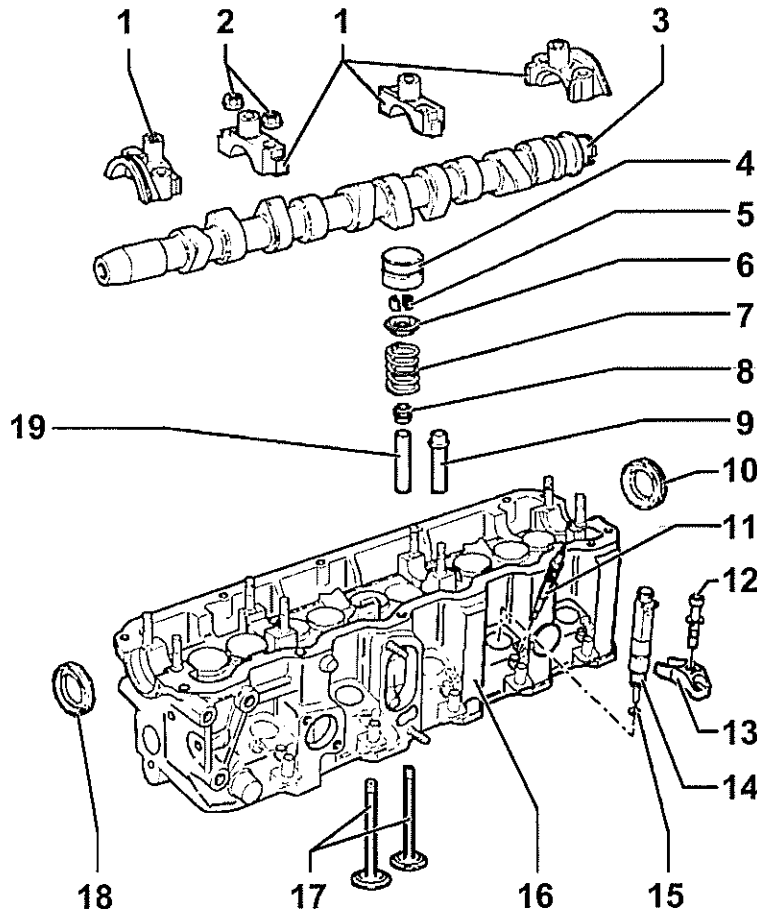


Fig 12 Checking tappets

CAUTION

ENGINE DAMAGE. After installing new bucket tappets, the engine must not be started for approx 30 minutes. Hydraulic compensation elements must settle, otherwise the valves set down on the pistons.



- 1 Bearing cap
- 2 Nut for bearing cap (item 1) – 20 Nm torque
- 3 Camshaft
- 4 Bucket tappet
- 5 Valve cotters
- 6 Valve spring pocket
- 7 Valve spring
- 8 Valve stem seal
- 9 Repair valve guide
- 10 Sealing ring
- 11 Glow plug
- 12 Bolt for injector clamp (item 13) – 30 Nm torque
- 13 Clamp
- 14 Injector
- 15 Heat shield
- 16 Cylinder head
- 17 Valves
- 18 Sealing ring
- 19 Valve guide

Fig 13 Camshaft – exploded view

Remove and install bucket tappets

54 To renew the bucket tappets proceed as follows.

Removing camshaft

55 To remove the camshaft proceed as follows:

NOTE

The camshaft is only removed to service the tappets.

55.1 Remove vacuum pump and plunger (see Fig 7 (12 and 13)).

55.2 Remove bearing cap 1 and 3 first. Unscrew bearing cap 2 and 4 alternately and diagonally.

55.3 Remove camshaft and sealing rings.

Renewing bucket tappets

56 To renew the tappets proceed as follows:

56.1 Remove defective bucket tappets (do not interchange) and lay down with running surface facing downward

56.2 Using universal dial gauge holder 800.1.56.030.1 and dial gauge 5210-99-930-6995, check axial clearance of camshaft before re-installing. Carry out measurement with bucket tappets removed and first and last bearing cap mounted. The wear limit indicated on the gauge is 0.15 mm.

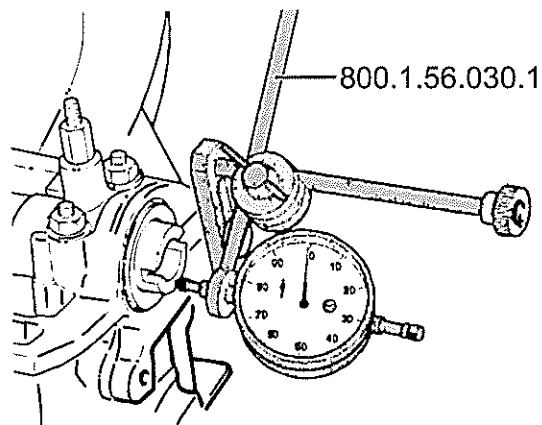


Fig 14 Checking camshaft axial clearance.

56.3 Replace the defective bucket tappets.

56.4 Oil running surface.

Installing camshaft

NOTES

- (1) When installing the camshaft, the cams for cylinder 1 must face upward
- (2) When installing the bearing caps, watch centre offset of hole by fitting bearing cap and determining installation position prior to installation.

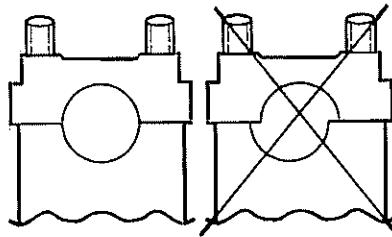


Fig 15 Camshaft centre offset

- 57 To install the camshaft proceed as follows:
 - 57.1 Oil camshaft running surfaces.
 - 57.2 Tighten bearing caps 2 and 4 alternately and diagonally to 20 Nm torque.
 - 57.3 Install bearing caps 1 and 3 and also tighten to 20 Nm torque.
 - 57.4 Install and tension camshaft belt according to procedure in Para 109.
 - 57.5 Install the FIP belt according to procedure in Para 161.

CAUTION

ENGINE DAMAGE. After installing new bucket tappets, the engine must not be started for approx 30 minutes. Hydraulic compensation elements must settle, otherwise the valves set down on the pistons.

- 57.6 Refit exhaust manifold.
- 57.7 Refit inlet manifold and EGR assembly and main air intake pipe.

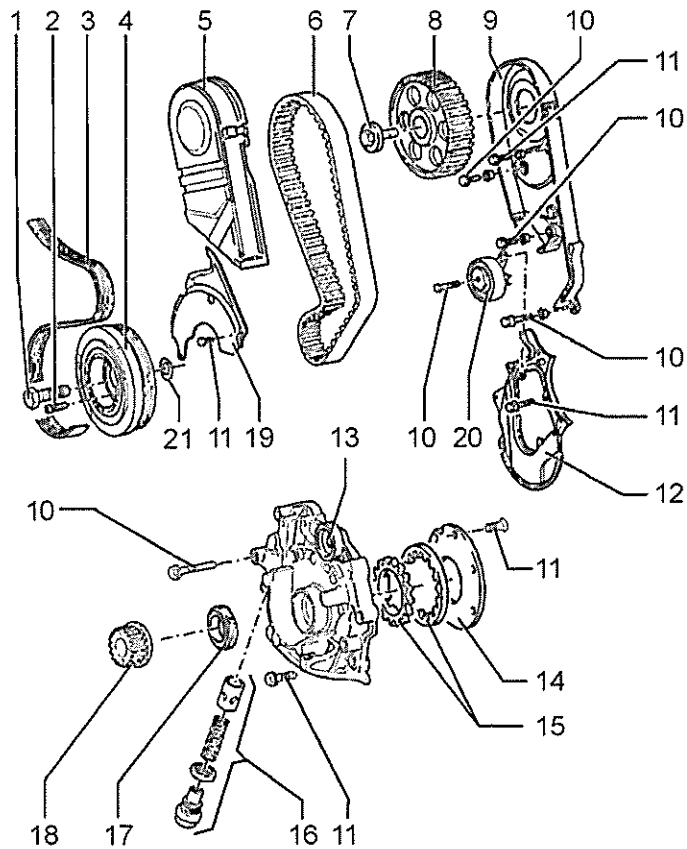
NOTE

Reconnect all associated wiring, hoses and conduit etc.

- 57.8 Refit engine cover and front seats, see Para 5.

- 58 Re-perform test procedure, see Para 51.
- 59 Remove maintenance fan guard 800.156.028.1 and refit engine cover and front seats.

OIL PRESSURE RELIEF VALVE



Key

- 1 Central screw for vibration damper (item 4) – 160 Nm torque + ½ (180 °) additional turn
- 2 Screw for vibration damper (item 4) – 20 Nm torque
- 3 Ribbed V-belt (FEAD)
- 4 Vibration damper with ribbed V-belt pulley
- 5 Upper section of camshaft belt guard
- 6 Camshaft belt
- 7 Mounting bolt for camshaft sprocket (item 8) – 85 or 100 Nm torque
- 8 Camshaft sprocket
- 9 Rear camshaft belt guard
- 10 Screw for camshaft belt guard (item 9) – 20 Nm torque
- 11 Bolt for camshaft belt guard (item 9) – 10 Nm torque
- 12 Lower section of camshaft belt guard
- 13 Oil pump
- 14 Closing cover
- 15 Oil pump gears
- 16 Oil pressure relief valve – 40 Nm torque
- 17 Sealing ring
- 18 Camshaft belt sprocket for crankshaft
- 19 Camshaft belt guard
- 20 Tensioner
- 21 Washer (diamond coated)

Fig 16 Oil pump – exploded view

Removal

60 To gain access for removal of the oil pressure relief valve the oil pump must first be accessed, (see Fig 16):

60.1 Working from beneath the vehicle, undo and remove the nut securing the valve in bottom / side of the oil pump.

60.2 Remove oil pressure relief valve located on the bottom / side of the oil pump, (see Fig 16/16).

Installation

61 Installation is the reverse of the above. The oil pressure relief valve must be tightened to 40 Nm torque. Check oil pressure.

REPLACE OIL PUMP

62 To replace the oil pump

62.1 Remove both front seats and engine cover, see Para 4.

62.2 Remove the electro magnetic fan clutch blade assembly, shroud and shroud ring from the front of the engine, see Chapter 12.

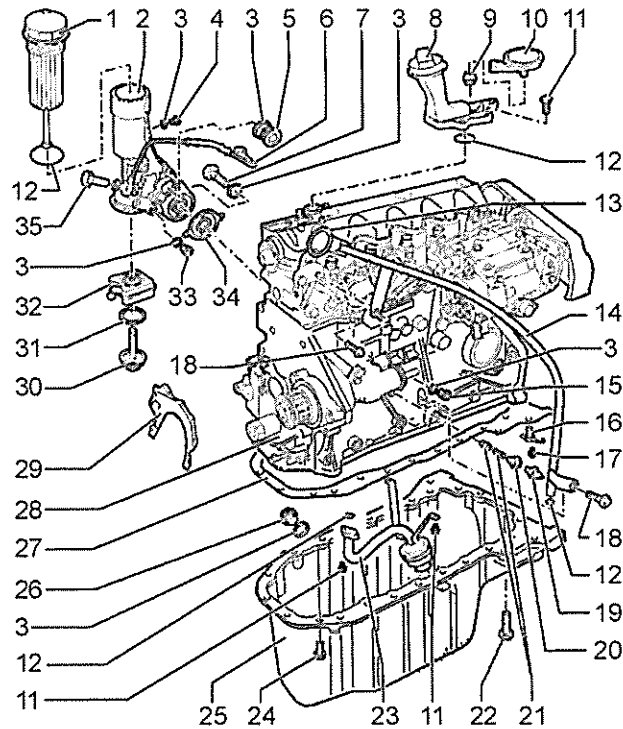
62.3 Remove ribbed V-belt (FEAD), see Para 66.

62.4 Remove camshaft belt and belt guards, see Para 78.

62.5 Remove oil pump.

62.6 Refit in reverse order.

OIL PRESSURE SWITCH AND OIL PRESSURE HOLDING VALVE



- | | | | |
|----|--|----|--|
| 1 | Oil filter | 20 | Adapter for oil pressure switch (item 19) – 50 Nm torque |
| 2 | Oil filter holder | 21 | Oil pressure holding valve |
| 3 | Sealing ring | 22 | M8 hexagon head bolt for oil sump (item 25) mount on gearbox side – 20 Nm torque |
| 4 | Sealing plug – 20 Nm torque | 23 | Vacuum line |
| 5 | Sealing plug | 24 | Bolt for oil sump (item 25) – 10 Nm torque |
| 6 | Oil supply line | 25 | Oil sump (see note) |
| 7 | Banjo bolt for oil filter holder (item 2) – 100 Nm torque | 26 | Oil drain plug – 50 Nm torque |
| 8 | Oil filler pipe | 27 | Oil sump gasket |
| 9 | Seal | 28 | Driver for oil pump |
| 10 | Pressure control valve | 29 | Seal |
| 11 | Bolt for oil filler pipe (item 8) and vacuum line (item 23) – 10 Nm torque | 30 | Oil cooler cover |
| 12 | O-ring | 31 | Sealing ring for oil cooler (item 32) |
| 13 | Oil dip stick | 32 | Oil cooler |
| 14 | Guide tube for oil dip stick (item 13) | 33 | Sealing plug for oil filter holder (item 2) – 40 Nm torque |
| 15 | Sealing plug | 34 | Seal for oil filter holder (item 2) |
| 16 | Oil spray nozzle | 35 | Banjo bolt for oil filter holder (item 2) – 30 Nm torque |
| 17 | Fitting for oil spray nozzle (item 16) – 10 Nm torque | | |
| 18 | Bolt for guide tube (item 14) – 20 Nm torque | | |
| 19 | 0.3 bar oil pressure switch (F22) – 25 Nm torque | | |

NOTE

Sump fitted will differ in shape from item 25.

Fig 17 Oil system – exploded view

Removal and replacement

63 Both the oil pressure holding valve and oil pressure switch are located on the near-side of the engine block:

- 63.1 Remove both front seats and engine cover, see Para 4.
- 63.2 Remove cable for oil warning lamp sender covering the switch.
- 63.3 Remove the blue 0.3 bar oil pressure switch (F22, blue insulation), adapter and oil pressure holding valve.
- 63.4 Pinch off and renew the sealing rings of the 0.3 bar oil pressure switch and adapter to help avoid leaks.
- 63.5 Renew and install the oil pressure holding valve.
- 63.6 Renew and install the adaptor tightened to 50 Nm torque.
- 63.7 Renew and install the 0.3 bar oil pressure switch (F22) and tighten to 25 Nm.

OIL SUMP**NOTE**

It is advisable to replace the engine oil filter at the same time as replacing the oil and sump. See Para 191.

Remove and replace

64 To remove the oil sump proceed as follows:

- 64.1 Remove the engine (and gearbox), see Para 6.
- 64.2 Remove oil drain plug located in rear of sump and drain engine oil into a suitable container for correct disposal.
- 64.3 Remove the 23 M6 retaining bolts and remove the oil sump and gasket.
- 64.4 Clean the mating surfaces of the cylinder block and sump pan.
- 64.5 Align new gasket, assemble to engine with the 23 retaining bolts, tightened to 10 Nm torque.

NOTE

Silicone RTV may be required to seal the gasket.

- 64.6 Install sump plug and washer and tighten to 50 Nm torque.
- 64.7 Re-fill the engine with new oil. (7.8 litres).
- 64.8 Re-install engine and gearbox.

OIL COOLER

NOTES

- (1) If large quantities of metal chips and abrasion caused by seizing, such as crankshaft and conrod bearing damage, is found in the engine oil. The oil cooler must be renewed and the oil channels thoroughly cleaned to prevent subsequent damage.
- (2) This operation may be easier if performed from beneath the vehicle.

Remove and replace

65 To remove the oil cooler proceed as follows:

- 65.1 Remove hose-ends connected to oil cooler.
- 65.2 Undo and remove oil cooler cover. Retain for re-use if serviceable otherwise discard.
- 65.3 Remove the sealing ring and oil cooler.
- 65.4 Coat contact surfaces to oil filter holder outside of sealing ring with AMV 188 100 02.
- 65.5 Ensure clearance from surrounding components; install a new sealing ring and oil cooler.
- 65.6 Refit oil cooler cover.

REPLACE RIBBED V (FEAD) BELT AND TENSIONING ELEMENT

Removal of ribbed V-belt

NOTE

If the ribbed V-belt is not being replaced mark the running direction before removing the ribbed V-belt. Ensure proper seating in the belt pulley when installing.

- 66 Remove both front seats and engine cover, see Para 4.
- 67 Lift tensioner and remove ribbed V-belt from hydraulic pump belt pulley
- 68 Remove ribbed V-belt.

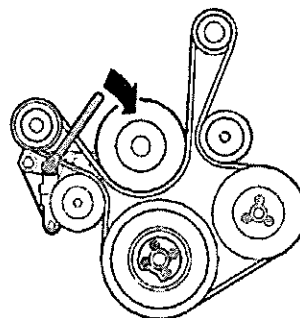


Fig 18 Ribbed V-belt (FEAD) - removing

Installing ribbed V-belt

- 69 Install ribbed V-belt (FEAD):

NOTE

Before installing the ribbed V-belt, make sure that all units (hydraulic pump, steering pump, etc.) are securely mounted.

69.1 Lay ribbed V-belt on vibration damper with ribbed V-belt pulley.

69.2 Lift tensioner, lay on ribbed V-belt and tension.

70 Refit engine cover and both front crew , see Para 5.

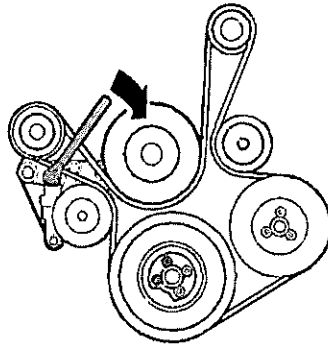


Fig 19 Ribbed V-belt (FEAD) – installing

Removing tensioning device and servicing vibration damper for ribbed V-belt

71 Remove ribbed V-belt as above, see Para 66.

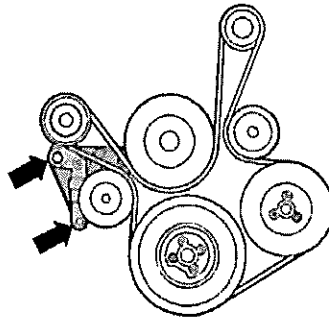


Fig 20 Ribbed V-belt (FEAD) - removing tensioning element

72 Unscrew mounting bolts (see Fig 20).

73 Dismantle tensioning device as required (see Fig 21).

74 Renew the diamond coated washer (see Fig 21 (3)) for the vibration damper (4).

75 Using brace / counter-hold tool 800.1.56.005.1 to loosen and tighten (to 160 Nm + ½ (180°) additional turn), renew the central screw (see Fig 21 (6)) for the vibration damper (see Fig 20 (4)).

NOTE

Thread and collar of central screw (see Fig 21 (6)) must be oil and grease free.

76 Replace the vibration damper (4) care must be taken when re-mounting.

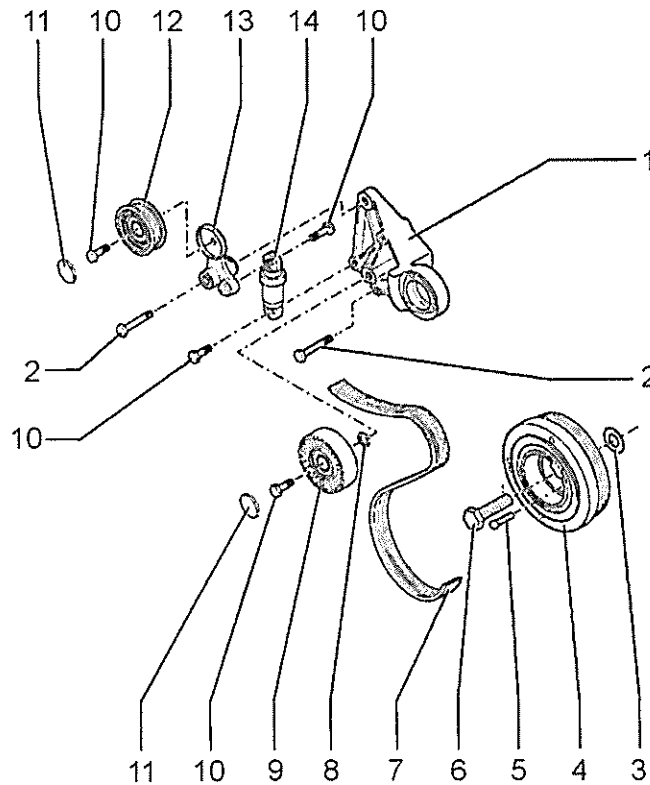
Installing tensioning device for ribbed V-belt

77 The tensioning device for the ribbed V-belt is installed in the reverse order. The mounting bolts are re tightened to the following torque settings:

- 77.1 M8 bolt – 20 Nm.
- 77.2 M10 bolt – 40 Nm.

NOTE

Ensure proper installation position of tensioning element marking "TOP" "OBEN".

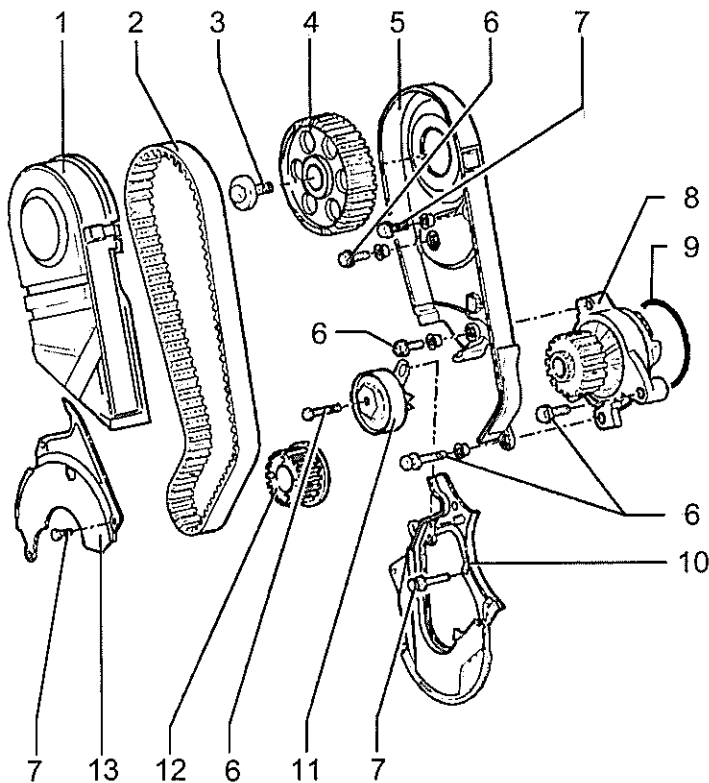


- 1 Bracket
- 2 M10 bolt for bracket (item 1) – 40 Nm torque
- 3 Washer
- 4 Vibration damper with ribbed v-belt pulley
- 5 M8 Captive screw (hexagon head) for vibration damper (item 4) – 20 Nm torque
- 6 Central bolt for vibration damper (item 4) – 160 Nm torque
- 7 Ribbed V-belt
- 8 Spacer washer for idler pulley (item 9)
- 9 Idler pulley
- 10 M8 bolt for tensioning element (item 14) – 20 Nm torque
- 11 Dust cap for idler pulley (item 12)
- 12 Idler pulley
- 13 Bracket
- 14 Tensioning element for tensioner

Fig 21 Tensioning element for ribbed V-belt (FEAD) –exploded view

REPLACE CAMSHAFT BELT AND TENSIONING ELEMENT**Removal of camshaft belt**Initial removal

78 Turn the battery isolation switch, located in the vehicle cab behind the passenger's seat, to the OFF position. Open the rearmost battery box, located on the left-hand side of the vehicle, this contains the vehicles automotive batteries, disconnect the yellow 12V feed wire then the vehicle's negative (-ve) battery terminals and ensure that this is safely stowed, ie so that it cannot reconnect with the terminal unintentionally.



- 1 Upper section of camshaft belt guard
- 2 Camshaft belt
- 3 Mounting bolt for camshaft sprocket (item 4) – 85 Nm (grade 8.8) or 100 Nm (grade 10.9) torque
- 4 Camshaft sprocket
- 5 Rear camshaft belt guard
- 6 Bolt for coolant pump (item 8) – 20 Nm torque
- 7 Bolt for belt guards (items 5, 10 and 13) – 10 Nm torque
- 8 Coolant pump
- 9 O-ring for coolant pump (item 8)
- 10 Lower section of camshaft belt guard
- 11 Tensioner
- 12 Camshaft belt sprocket for crankshaft
- 13 Camshaft belt guard

Fig 22 Camshaft belt – exploded view

- 79 Remove both front seats and engine cover, see Para 4.
- 80 Disconnect air intake hose and remove air cleaner canister.
- 81 Remove the electro magnetic fan clutch assembly, see Chapter 12.

NOTE

If camshaft belt is being retained for re-fitting, mark the running direction before removing the belt. Check for wear. Do not kink.

- 82 Remove Ribbed V-belt (FEAD). Refer to procedure detailing removal of ribbed V-belt (FEAD) and tensioning element in Para 66.
- 83 Remove electromagnetic fan clutch assembly, see Chapter 12.

NOTE

Electro magnet and spindle does not need removing from engine.

- 84 Remove upper section of camshaft belt guard (see Fig 22 (1))
- 85 Remove tensioner assembly (See Para 71).
- 86 Remove belt guards for both front camshaft and rear FIP belts.
- 87 Disconnect the main intake pipe located over the top/front of the engine that connects to the intake manifold. After first noting position, cut all cable ties securing the wiring loom to the pipe and unplug the connector for the intake manifold pressure / temperature sender (G71 / G72) located on the top of the pipe. The pipe is held in place clamped with hose (jubilee) clips at each end and is fixed to the cylinder head on the right-hand side with a bracket and M6 bolt and an M8 bolt that passes through the engine lifting eye on the top.
- 88 Carefully undo the hose (jubilee) clip on the coolant pipe / engine breather hose, feed disconnected hose through the eyelet on the main intake pipe and re-connect as quickly as possible, re-tighten hose (jubilee) clip. Coolant fluid will escape and should be collected in a suitable container for correct disposal in accordance with local procedures.
- 89 Disconnect crankcase breather hose from cylinder head cover.
- 90 Remove the four M6 bolts from the filler / breather assembly and remove it from the cylinder head cover.
- 91 Remove the cylinder head cover securing bolts.
- 92 If no Vehicle Installation Kit (VIK) is fitted, and the vehicle is provided with an access cover in the rear bulkhead, remove the access cover and remove the cylinder head cover through the aperture.
- 93 If a VIK is fitted or the vehicle is not provided with an access cover in the rear bulkhead, proceed as follows:
- 94 Disconnect and remove the hose from the EGR actuator.
- 95 Undo the two retaining nuts and remove the exhaust manifold heat shield.
- 96 Disconnect the clamp holding the EGR pipe to the exhaust manifold.
- 97 Undo the eight M8 bolts and remove the inlet manifold complete with EGR pipe, remove and dispose of inlet manifold gasket.

- 98 Remove cap from gearbox TDC inspection hole.
- 99 Turn crankshaft in engine rotating / running direction (clockwise) to TDC position of #1 cylinder.
- 100 Markings on the injection pump and drive pulley must be aligned (see Fig 23).

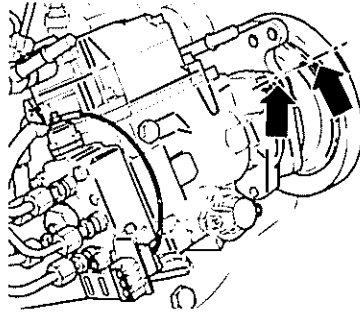


Fig 23 Injection pump - alignment markings

- 101 Markings on the converter plate and gearbox casing must be aligned (see Fig 24).

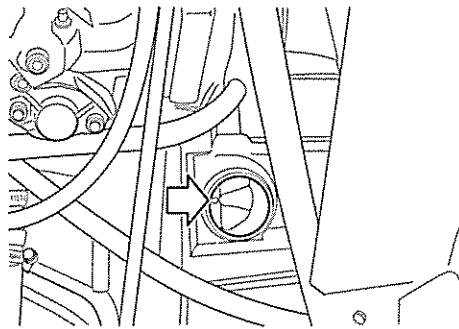


Fig 24 Gearbox - alignment markings

NOTE

This alignment state is only achieved in every second TDC position.

With engine removed

NOTE

Follow this procedure if the engine is removed from the vehicle.

- 102 Set TDC setting tool 905.3.12.104.0 to 125.5 mm; left notch of Vernier gauge is reference point.
- 103 Screw in TDC setting tool to correct location on flywheel housing (see Fig 25).

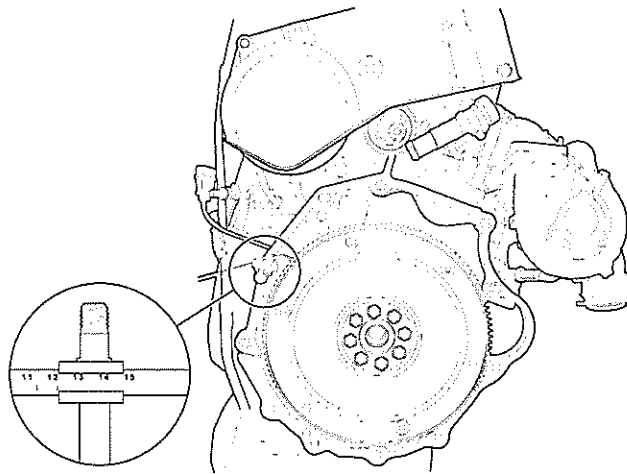


Fig 25 Location of TDC setting tool

104 Turn crankshaft until TDC marking on drive plate aligns with edge of setting tool (see Fig 26) and markings on injection pump pulley and bracket are in alignment.

NOTE

This alignment of the injection pump mark is only achieved every second TDC position.

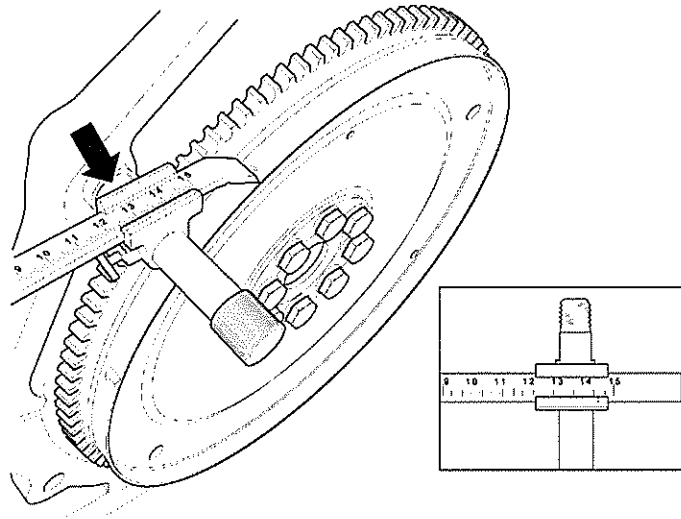


Fig 26 TDC flywheel marking

105 Fit brace tool (800.1.56.005.1). The brace tool is secured to the engine block in two different ways dependant on vehicle. Inspect the engine block prior to fitting the brace tool to ensure the correct securing bolt is used. The brace tool is secured using either an M10 bolt into engine block side tapping (See Fig 27 (1)) or using a vertical eye bolt and nut (2).

106 If the brace tool must be secured with the vertical eye bolt and nut, proceed as follows:

- 106.1 Using a suitable workshop engine lifting crane, take the full weight of the engine via the front engine lifting eye.
- 106.2 Once the engine is supported undo the M12 bolt securing the off side engine mount.
- 106.3 Carefully lift the engine just enough to allow the brace tool to be fitted and secured with eye bolt and nut.

CAUTION

DAMAGE TO TOOL. It is essential to screw the brace tool modified 800.1.56.005.1 onto the cylinder block as shown (Fig 27) otherwise the tool will be damaged.

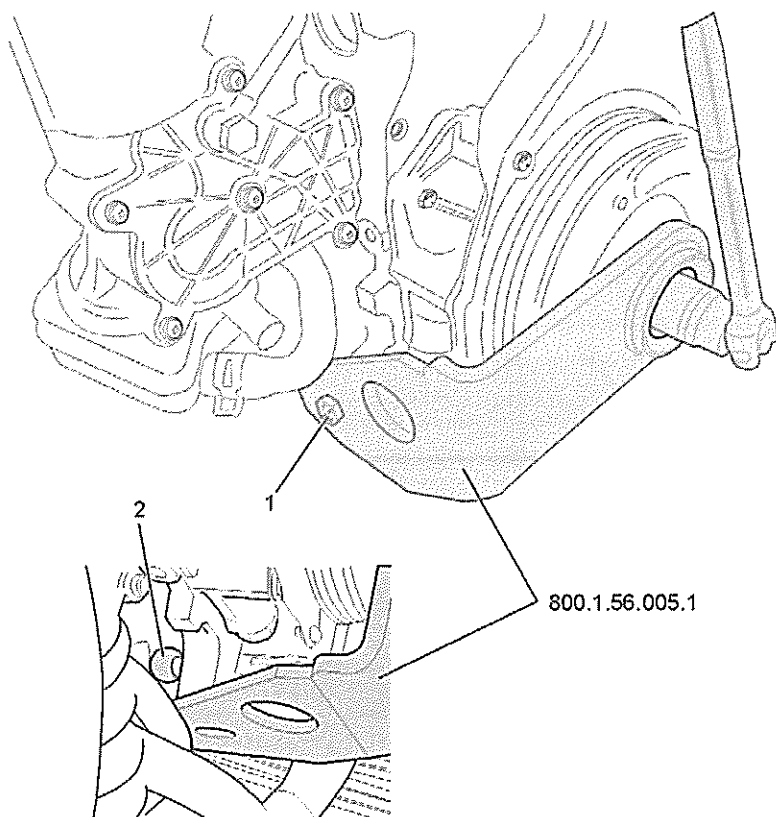


Fig 27 Vibration damper – loosening/tightening

107 Remove fuel injection pump (FIP) belt. Refer to Para 145 for removing and fitting procedure.

108 Remove the camshaft belt. To remove the belt:

- 108.1 Unscrew the four M8 mounting bolts of the vibration damper / crankshaft camshaft belt pulley.
- 108.2 Unscrew and remove the central bolt for vibration damper / camshaft belt sprocket on crankshaft.

108.3 Once the vibration damper bolt has been removed the brace tool should also be removed. If the offside engine mounting bolt has been removed, lower the engine and secure the engine mount using the M12 bolt. There is no need to re-torque the bolt at this stage.

108.4 Remove vibration damper.

NOTE

When removing the vibration damper care should be taken not to lose the shim located between the damper and the crankshaft.

108.5 Remove belt guard.

108.6 Mark running direction / rotation of camshaft belt.

108.7 Relax camshaft belt tensioner with ring spanner 800.1.56.004.1.

108.8 Remove belt.

Installation of camshaft belt and tensioner

109 Remove drive pulley for injection pump.

110 Check if TDC marking on flywheel and reference mark are aligned.

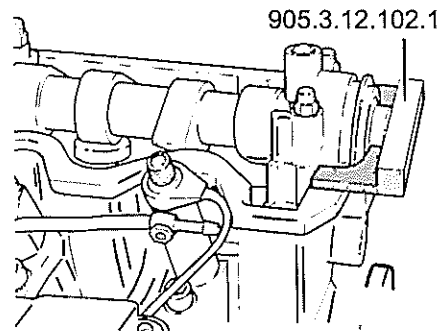


Fig 28 Locking camshaft in place

111 Lock camshaft in place with adjustment ruler 905.3.12.102.1 (see Fig 28)

112 Centralise the adjustment ruler as follows:

112.1 Turn the locked camshaft until one end of the adjustment ruler strikes the cylinder head.

112.2 Measure the resulting clearance at the other end of the adjustment ruler with a feeler gauge.

112.3 Push a feeler gauge with half the clearance dimension between the adjustment ruler and the cylinder head.

112.4 Turn the camshaft until the adjustment ruler contacts the feeler gauge.

112.5 Insert a second feeler gauge with the same dimension between the adjustment ruler and the cylinder head at the other end.

113 Loosen mounting bolt of camshaft sprocket $\frac{1}{2}$ turn. Separate camshaft sprocket from taper of camshaft (see Fig 29) by striking with a hammer blow (using a drift through the hole in the rear camshaft belt guard).

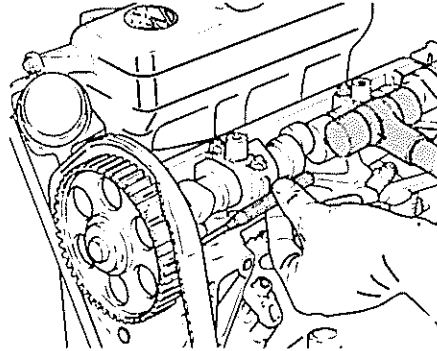


Fig 29 Separating camshaft sprocket using drift

114 Install tensioner (see Fig 30 (1)) so that tab (see Fig 30/2) of tensioner is seated in anti-twist pin of lower section of camshaft belt guard (see Fig 22 (10)).

115 Fit camshaft belt. With a used belt running direction must be observed.

116 Tighten mounting bolt of tensioner hand-tight.

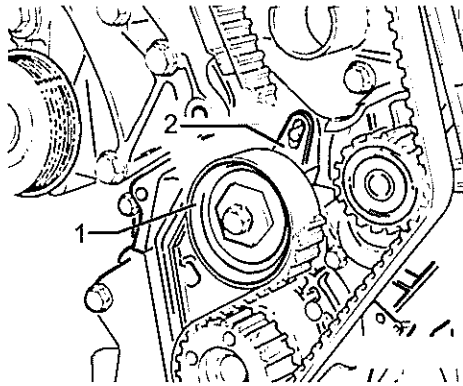


Fig 30 Install tensioner

CAUTION

DAMAGE TO TENSIONER. The right edge of pointer (A) must not be turned past the right edge of pointer (B) because there is danger of pre-damage to the tensioner. If it is accidentally turned too far once, the tensioner must be completely relaxed and re-tensioned. The eccentric should not be turned back only by the amount it was turned too far.

117 To tension camshaft belt, turn tensioner clockwise with ring spanner 800.1.56.004.1 until right edge of pointer (see Fig 31 (A)) is aligned with right edge of pointer (see Fig 31 (B)).

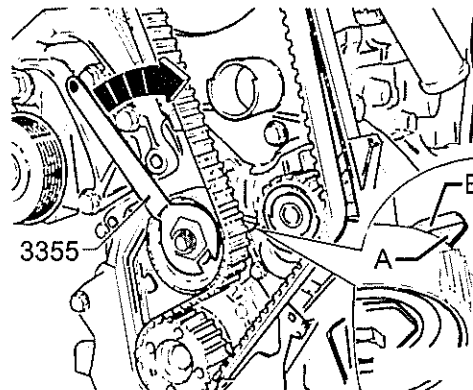


Fig 31 Tensioning camshaft belt

- 118 Tighten mounting bolt of tensioner to 20 Nm torque.
- 119 Check whether crankshaft is still at TDC of cylinder 1 and correct if necessary.
- 120 Tighten mounting bolt for camshaft sprocket with brace 905.3.36.103.2 using the following torque figures. Note tensile steel identification on bolt head:
 - 120.1 Grade 8.8 = 85 Nm.
 - 120.2 Grade 10.9 = 100 Nm.
- 121 Remove adjustment ruler 905.3.12.102.1 from camshaft (see Fig 25). Install bottom camshaft belt guard.
- 122 Insert the four M8 securing bolts of the vibration damper finger tight.
- 123 Fit vibration damper with new central bolt. Insert brace tool (800.1.56.005.1) – see Para 105, 106 and Fig 27 – and tighten central bolt on vibration damper / camshaft belt gear to 160 Nm plus ½ turn (180°) (turning further may be carried out in several steps).
- 124 Tighten the four M8 securing bolts of the vibration damper / camshaft belt pulley-crankshaft to 20 Nm torque.
- 125 Remove the brace tool. If the offside engine mounting bolt has been removed, lower the engine and secure the engine mount using the M12 bolt. Tighten to 75 Nm.
- 126 Turn the engine two revolutions in rotating direction (clockwise) until crankshaft is at TDC for #1 cylinder again.
- 127 Check pointer position of tensioner again (see Fig 31). If right edges of pointers (A) and (B) do not align, tensioning must be repeated.
- 128 Refit FIP belt. Refer to Para 145 for removing and fitting procedure.
- 129 Install belt guards for both camshaft and FIP belts and re-fit cylinder head cover (torque to 10 Nm).
- 130 Re-fit inlet manifold with new gasket. Torque fixings to 25 Nm.
- 131 Re-fit clamp securing EGR pipe to exhaust manifold.
- 132 Re-fit exhaust manifold heat shield.
- 133 **Do not** connect the plug for shut off valve N239.
- 134 Replace and secure hose to EGR actuator.

- 135 If the inlet manifold was not removed, replace and secure fuel pump access cover.
- 136 Replace cylinder head cover and refit filler / breather assembly.
- 137 Re-connect crankcase breather hose to cylinder head cover.
- 138 Re-route and reconnect the main intake pipe located over the top / front of the engine that connects to the inlet manifold. The pipe is held in place with hose (jubilee) clips at each end and is fixed to the cylinder head on the right-hand side with a bracket and M6 bolt and an M8 bolt that passes through the engine lifting eye on the top.
- 139 Carefully undo the hose (jubilee) clip on the coolant pipe/engine breather hose, feed disconnected hose through the eyelet on the main intake pipe and re-connect as quickly as possible, re-tighten hose (jubilee) clip. Coolant may escape and should be collected in a suitable container for correct disposal in accordance with local procedures. Use cable ties as necessary, paying particular attention to retaining the anti-chafing sleeve in place, where the hose passes through the eyelet provided on the main intake pipe.
- 140 Re-fit front and rear belt guards.
- 141 Re-fit tensioner assembly (see Para 77).
- 142 Re-fit upper section of camshaft belt guard (see Fig 22 (1)).
- 143 Refit electro magnetic fan clutch assembly, see Chapter 12.
- 144 Install ribbed V-belt (FEAD):

NOTE

Before installing the ribbed V-belt, make sure that all units (hydraulic pump, steering pump, etc) are securely mounted.

144.1 Lay ribbed V-belt on vibration damper with ribbed V-belt pulley.

144.2 Lift tensioner, lay on ribbed V-belt and tension.

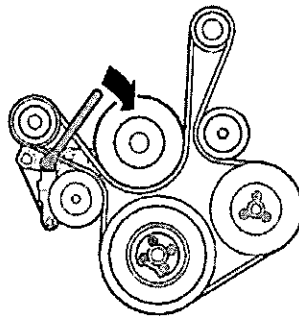


Fig 32 Ribbed V-belt (FEAD) - installing

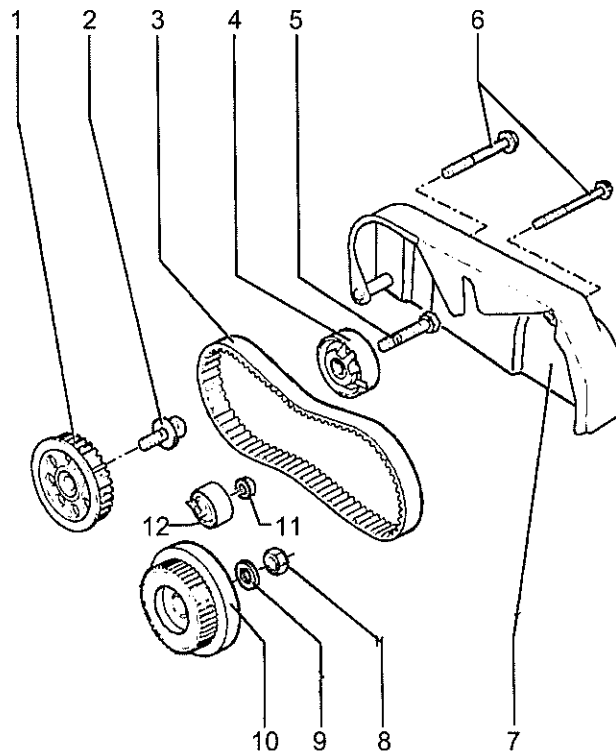
REPLACE BELT AND TENSIONING ELEMENT FOR INJECTION PUMP

Removal of fuel injection pump (FIP) belt and tensioner

NOTE

If re-using existing belt, mark the running direction before removing the ribbed V-belt.

145 Check the belt for wear and do not kink when handling.



- 1 Drive gear for injection pump
- 2 Mounting bolt for injection pump drive gear (item 1) – 160 Nm torque
- 3 Belt for injection pump
- 4 Tensioning roller
- 5 Central bolt for tensioning roller (item 4) – 15 Nm torque
- 6 Bolt (M8) for belt guard (item 7) – 20 Nm torque
- 7 Belt guard
- 8 Nut for injection pump sprocket (item 10) – 90 Nm torque
- 9 Washer for injection pump sprocket (item 10)
- 10 Injection pump sprocket
- 11 Nut for idler pulley (item 12) – 20 Nm torque
- 12 Idler pulley

Fig 33 Belt for injection pump and tensioner – exploded view

- 146 Remove both front seats and engine cover, see Para 4.
- 147 Lift PAS reservoir from its holder and move away from the working area.
- 148 Undo and remove the LH (nearside) M8 bolt (see Fig 33 (6)) securing the belt guard. The bolt passes through the 'P' clip retaining the gearbox oil dipstick. Move dipstick tube away from the working area.
- 149 Undo and remove the right-hand M8 bolt (see Fig 33 (6)) securing the belt guard.
- 150 After first noting position, cut cable ties on the cables secured to the cable tray on the top of the engine so that the cables can be moved freely away from the working area.
- 151 Remove belt guard (7) for the injection pump drive.
- 152 Remove the electro magnetic fan clutch blade assembly, fan shroud, and mounting ring from the front of the engine, see Chapter 12.

With engine fitted

NOTE

Follow this procedure if the engine is fitted to the vehicle.

- 153 Remove inspection cap from gearbox hole so that the edge of the flywheel can be viewed through the aperture. The TDC marking '0' is located on the edge of the flywheel

NOTE

A second person is required for this operation.

- 154 Rotate engine using the crankshaft securing bolt in engine running direction (clockwise) until the TDC markings are aligned on the flywheel and gearbox.

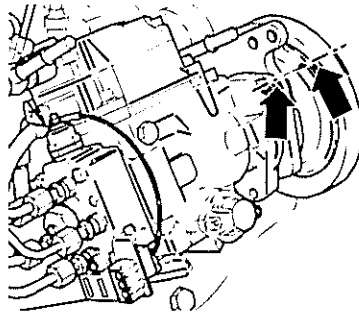


Fig 34 Injection pump - alignment markings

- 155 Once the engine has been set to TDC using the markings in the flywheel / gearbox aperture, observe the markings on the fuel injection pump drive pulley and mounting flange, these must also be aligned. This alignment state is only achieved at every second TDC position, so another rotation of the engine may be required before this is attained.

NOTE

If the pump timing is incorrectly set the marks on the fuel injection pump will not align.

With engine removed

NOTE

Follow this procedure if the engine is removed from the vehicle.

156 Set TDC setting tool 905.3.12.104.0 to 125.5 mm, left notch of Vernier gauge is reference point.

157 Screw in TDC setting tool to correct location on flywheel housing (see Fig 35).

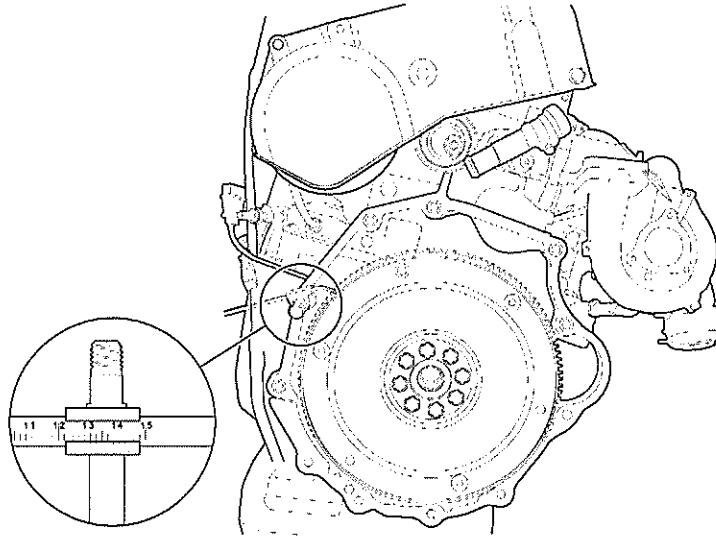


Fig 35 Location of TDC setting tool

158 Turn crankshaft until TDC marking on drive plate aligns with edge of setting tool (see Fig 36) and markings on injection pump pulley and bracket are in alignment.

NOTE

This alignment state is only achieved in every second TDC position.

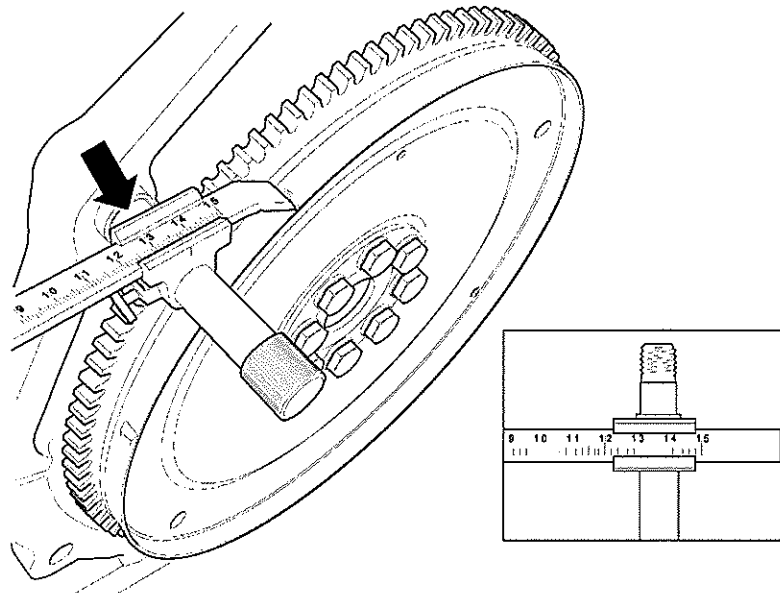


Fig 36 TDC flywheel marking

Removal

159 To remove the FIP belt and tensioner:

159.1 Mark running direction / rotation of FIP belt.

159.2 Hold the drive gear for the injection pump (see Fig 33 (1)) in place using Brace tool, 5120-99-301-1615.

159.3 Unscrew the mounting bolt (anti-clockwise turn) using a 21 mm ratchet / spanner and remove the drive gear.

159.4 Undo the M8 bolt on the tensioner pulley.

159.5 Loosen the FIP belt tensioner using an Allen key.

159.6 Remove the belt.

Installation

160 Prior to refitting the belt and tensioner, block the injection pump from delivery commencement as follows:

Blocking injection pump from delivery commencement

NOTE

The injection timing must be reset.

161 Remove the securing bolt from the front of the injection pump.

162 To block the injection pump from delivery commencement, in place of the securing bolt, screw in dial gauge adapter 800.1.56.003.1 (see Fig 37).

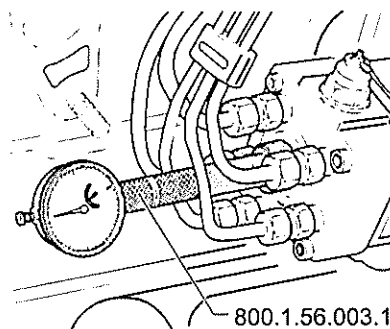


Fig 37 Blocking injection pump

163 Insert the dial gauge 5210-99-930-6995 (measurement range 0 to 3.0 mm) with approximately 2.0 mm initial tension (preload) in the adapter.

164 Check whether the markings on the injection pump pulley and injection pump match up. (see Fig 38). If not the engine must be brought back to TDC.

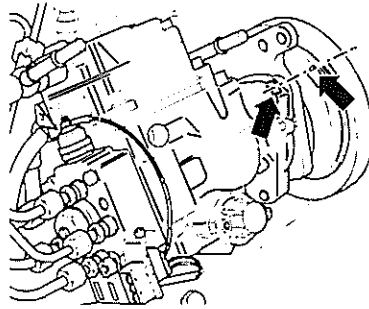


Fig 38 Alignment marks – injection pump and pulley

165 After first noting position, cut off cable ties so the wiring loom connections for the 10-pin injection pump socket and engine speed sender (G28) can be freely moved away from the area of work. Slacken the blocking screw (see Fig 39 (2)) on the injection pump.

166 Remove the underlying intermediate plate (1) and stow in a safe location for re-use.

NOTE

It is important that the intermediate plate is not misplaced as this acts as a 4mm spacer for the blocking screw.

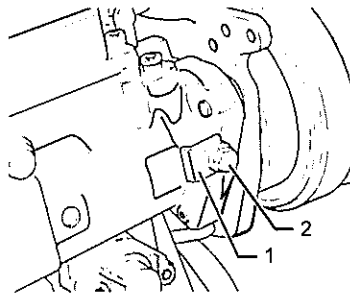


Fig 39 Injection pump – blocking screw

167 Set the dial gauge meter 5210-99-930-6995 to zero.

168 To ensure that the high pressure piston in the injection pump is at BDC, slowly turn the retainer tool 905.3.36.103.2 to turn the injection pump sprocket against the direction of engine rotation (anti-clockwise). The dial gauge needle must remain at zero; if necessary reset the dial gauge on the meter to zero after reaching the BDC position.

169 Using retainer tool 905.3.36.103.2, slowly turn the injection pump in the direction of engine rotation (clockwise) until the dial gauge needle shows 0.55 mm stroke / lift.

170 Check that the injection pump is still at TDC position, with the sprocket TDC mark aligned with the TDC mark on the injection pump bracket.

171 Tighten injection pump blocking bolt to a torque tightness of 30 Nm.

172 Remove the dial gauge adapter 800.1.56.003.1 and replace sealing bolt in injection pump.

Re-fitting belt and tensioner

173 Check whether the TDC marking on the flywheel matches the reference point.

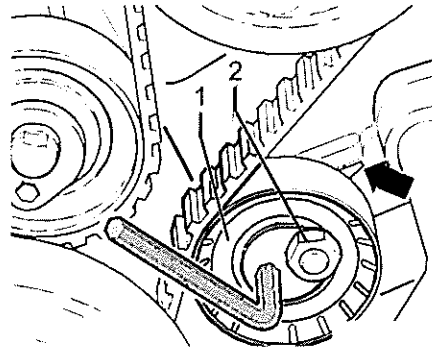


Fig 40 Idler pulley

NOTE

If re-fitting a used belt, note the running direction.

174 Refit the drive sprocket for the injection pump (see Fig 40 (1)).

175 Place the FIP belt on the injection pump sprocket. Insert the drive sprocket for the injection pump into the belt and secure the sprocket on the camshaft so that it can still be turned by hand.

176 Refit the idler pulley (1).

177 Check the installation position of the idler pulley:

177.1 If required, turn the idler pulley (1) until the pointer (arrow) is flush with the flange contour of the cylinder head. If necessary loosen the securing nut (2) and adjust the idler pulley.

177.2 Tighten the securing nut (2) to 20 Nm torque.

178 Fit the tensioning roller (see Fig 41 (1)) so that the tab of the tensioning roller is seated in the recess in the console (see Fig 41 (B)).

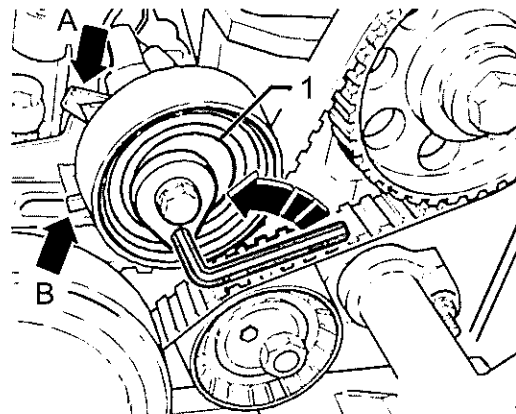


Fig 41 Tensioning roller

179 Tighten the securing screw by hand.

180 To tension the FIP belt, turn the tensioning roller anti-clockwise until the two pointers are aligned (see Fig 41 (A)).

NOTE

This is usually achieved by turning until the tensioning roller internal stop is reached, then backing off the tensioning roller until the pointers are aligned.

181 Tighten the securing bolt to 15 Nm torque.

182 Using retainer tool 905.3.36.103.2, tighten the securing bolt for the injection pump drive sprocket to 160 Nm.

NOTE

When tightening the securing bolt, make sure that none of the torque is transferred to the injection pump shaft which is blocked for delivery commencement.

183 Slacken the blocking screw on the injection pump (see Fig 39 (2)).

184 Insert the intermediate plate (1) and tighten the blocking screw to 12 Nm.

185 Re-route and cable tie the wiring loom that was moved away for access.

186 Turn crankshaft two rotations in engine rotating direction (clockwise) until crankshaft is positioned at TDC for cylinder 1 again.

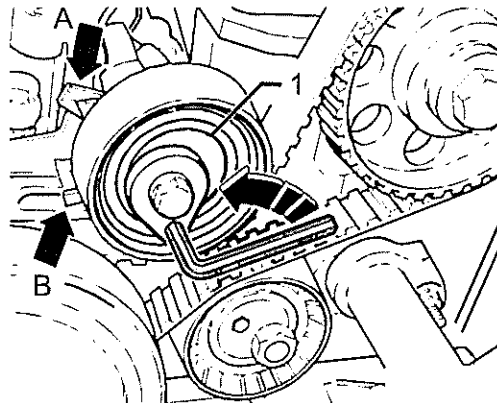


Fig 42 Tensioning roller - pointers

187 Check the position of the pointers (see Fig 42 (A)). The pointers should be opposite each other. If pointers are not opposite each other, however the front pointer is located within the metal contour located behind it, then this is permissible.

NOTE

If the front pointer is outside the metal contour located behind it then the tensioning procedure must be repeated.

188 Re-fit the FIP belt guard. Refit the gearbox dipstick retaining tube which is secured with the left-hand M8 bolt. Tighten the M8 securing bolts to 20 Nm. Re-route all wiring and secure using cable tie to the cable tray. Refit PAS reservoir in its holder.

189 Refit the fan shroud mounting ring and fan assembly to electro magnetic fan clutch. Refit fan shroud. See Chapter 12.

190 Test the commencement of injection dynamically and adjust if necessary using the procedure in Chapter 11.

REPLACE OIL/FILTER

WARNING

BURN HAZARD. CONTACT WITH HOT ENGINE OIL WILL CAUSE PERSONAL INJURY.

CAUTIONS

(1) **WASTE PRODUCTS.** Personnel responsible for the disposal of waste products must comply with local regulations and procedures.

(2) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc. should be contained immediately with spill absorbent materials.

NOTE

Drain oil when the engine is warm and the vehicle is level.

191 To replace the oil/filter, proceed as follows

191.1 Remove both front seats and engine cover, see Para 4.

191.2 Place a suitable container under the vehicle to catch oil draining out. Unscrew the oil drain plug located in the engine sump and oil filler cap located on the top of the engine (see Fig 1/4) clean drain plug and renew the sealing ring.

191.3 Drain the engine oil completely into a suitable container for proper disposal before refitting the sump plug, tightened to correct torque – see Table 2, Ser 1.

191.4 The oil filter is located on the offside / right of the cylinder block. Unscrew the cap of the oil filter, using the oil filter wrench (5120-99-272-2809) and remove the engine oil filter allowing oil to flow out of the filter housing into a suitable container for proper disposal.

CAUTION

INGRESS OF FOREIGN BODIES. It is to be ensured that no foreign bodies enter the oil filter housing. Do not attempt to clean out the filter housing under any circumstances.

191.5 Lubricate the replacement sealing ring on the new oil filter with fresh engine oil.

191.6 Insert the new oil filter element in place in the filter housing and screw on and tighten the screw cap to the correct torque (see Table 2, Ser 22) using oil filter wrench (5120-99-272-2809).

191.7 Re-fill the engine with the required amount of new oil into the oil filler hole. Replace the oil filler cap and tighten securely by hand.

191.8 Run the engine until the oil pressure warning lamp extinguishes.

191.9 Stop the engine and check the tightness of the sump plug (tightened to correct torque – see Table 2, Ser 1 as required).

191.10 Check the oil level using the dipstick, the correct level being just below the maximum mark (see Fig 2).

191.11 Refit engine cover and seats (see Para 5).

RESTRICTED

RESTRICTED

CHAPTER 3

GEARBOX REPAIR INSTRUCTIONS

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Para

- 1 Introduction
- 2 Special tools and test equipment
- 3 Torque wrench settings
- Automatic gearbox (WARNINGS) (CAUTIONS)
- 4 Removal (WARNINGS) (CAUTION)
- 5 Refitting (gearbox) (WARNINGS) (CAUTION)
- 6 Refitting (ancillary items and testing) (WARNING)
- Selector cable
- 7 Removal
- 8 Refitting
- Selector lever
- 9 Removal
- 10 Refitting
- Throttle potentiometer kickdown cable
- 11 Removal
- 12 Refitting
- Starter cut-off switch
- 13 Removal
- 14 Refitting
- Hoses and connections
- 15 Removal
- 16 Refitting
- Gearbox connectors
- 17 Removal
- 18 Refitting
- Oil cooler hoses
- 19 Removal
- 20 Refitting
- Rotary shaft seal ring to oil pump
- 21 Removal
- 22 Refitting
- Rotary shaft seal ring on driven side
- 23 Removal
- 24 Refitting
- Converter
- 25 Removal
- 26 Refitting

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INTRODUCTION

1 This chapter details the removal and refitting of the automatic transmission.

2

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools and test equipment are shown in Table 1.

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Item (1)	NSN (2)	Manfr No. (3)	Designation (4)
1	5120-99-663-6809	905.336.205.1	Torque converter retainer
2	5120-99-442-6184	905.336.203.1	Puller hooks
3	5120-99-573-2037	905.015.006.2	Torx TX 27
4	5120-99-663-8042	905.332.201.2	Control unit gauge
5	5120-99-052-1676	905.336.203.0	Converter extractors
6	5120-99-535-7813	905.334.204.1	Mounting sleeve
7	5120-12-194-1225	001.589.66.21.00	Torque spanner
8	5120-12-329-2483	000.589.10.99.16	Spanner socket
9	5120-99-413-8212	001.589.89.33.00	Puller

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings in this chapter are shown in Table 2.

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	M10 Bolts for R/H engine mount	44	4.18 5.19
2	M12 Bolts for securing gearbox bell housing to engine	75	5.3
3	M8 Bolts for securing gearbox bell housing to engine	25	5.5
4	M8 Bolts for gearbox support bracket	18	5.4
5	M12 Bolts for securing starter motor to gearbox bell housing	50	5.18
6	M8 Bolts for seats	26	4.5 6.10
7	Cardan shaft nuts	35	23.5
8	Control unit screws	8	12.9
9	Oil screen	8	12.10
10	Oil sump screws	8	12.11
11	Collar nut	100	23.3
12	Engine cover bolts	66	5.3

AUTOMATIC GEARBOX

WARNINGS

- (1) **TWO PERSON LIFT. TWO PERSONS ARE REQUIRED TO LIFT THE AUTOMATIC GEARBOX.**
- (2) **LIFTING EQUIPMENT. WHEN LIFTING THE ENGINE AND GEARBOX, ALL LIFTING EQUIPMENT IS TO BE VERIFIED AS BEING IN DATE AND OF THE CORRECT CAPACITY FOR THE TASK IN HAND.**
- (3) **LETHAL VOLTAGE. BEFORE ATTEMPTING ANY WORK ON THE ENGINE, THE MASTER SWITCH MUST BE TURNED "OFF" AND THE IGNITION KEY REMOVED.**
- (4) **DANGER TO LIFE AND LIMB. ALL PERSONNEL MUST STAND CLEAR WHEN VEHICLE IS BEING RAISED OR LOWERED.**
- (5) **DANGER TO LIFE AND LIMB. NEVER WORK UNDER A PARTIALLY RAISED VEHICLE. THE VEHICLE MUST BE RAISED OR LOWERED TO FULL EXTENT OF TRAVEL.**
- (6) **TOXIC FUME HAZARD. DO NOT RUN ENGINE IN CLOSED OR POORLY VENTILATED BUILDING.**
- (7) **SCALDING/BURNS HAZARD. DANGER OF SCALDING AND/OR BURNS WHEN DRAINING HOT FLUIDS AND/OR VEHICLE IS HOT.**

CAUTIONS

- (1) **EQUIPMENT DAMAGE. Never run engine with batteries disconnected (or damage to electrical charging system may result).**

- (2) **EQUIPMENT DAMAGE.** The gearbox contains close tolerance components, all work should be carried out with absolute cleanliness and in a clean environment.
- (3) **REFILLING OIL.** Oil level is dependant on gearbox temperature. The dipstick indicates two temperature zones, Hot +80 deg C and Cold +20 deg C. Ensure that oil level is in correct zone when checking level.
- (4) **LUBRICANT CHECK.** Before operating vehicle, ensure oils and lubricants are filled to the correct level.

NOTE

When disconnecting pipes or hoses, suitable blanks are to be fitted to all open ends. All disconnected electrical cable/harnesses are to be tagged for identification and tied clear of working or lifting area.

Removal

- 4 Removal of the automatic gearbox is as follows:

- 4.1 Position the vehicle on level ground or a maintenance ramp, ensuring that the maximum Safe Working Load (SWL) of the ramp is not exceeded. Apply the vehicle handbrake and chock the wheels.

WARNINGS

- (1) **INJURY TO PERSONNEL. INSTALLATION/REMOVAL OF THE SEATS IS ONLY TO BE CARRIED OUT BY A QUALIFIED VEHICLE MECHANIC AND THE GENERAL CONDITION OF THE SEAT FIXINGS AND MOUNTINGS SHOULD BE INSPECTED PRIOR TO INSTALLATION/REMOVAL.**
- (2) **PERSONAL INJURY. TO MAINTAIN THREAT INTEGRITY ENSURE THAT THE ENGINE COVER IS ALWAYS RE-FITTED IN ACCORDANCE WITH THE STATED PROCEDURE, USING ALL BOLTS.**
- (3) **IMPACT HAZARD. HANDLE ENGINE COVER WITH CARE WHEN PERFORMING ROUTINE MAINTENANCE TASKS (TOP PLATE 16 KG. LEFT HAND SIDE 34 KG. RIGHT HAND SIDE 32 KG).**

- 4.2 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

- 4.3 Locate the vehicles automotive batteries. The battery box is located at the forward end of the rear compartment. Two pairs of 12V 85Ah Absorbed Glass Mat (AGM) maintenance free sealed for life lead acid batteries supply the 12/24V dc automotive electrical system and 24V dc FFR circuit. Automotive batteries are located on the RH side of the battery box. FFR batteries are located on the LH side.

- 4.4 Disconnect the yellow 12V ECU feed wire, from the automotive batteries then the vehicles negative (-ve) battery terminals and ensure that it is safely stowed, ie so that it cannot unintentionally reconnect with the terminal.

- 4.5 Remove the driver and passenger seats in the vehicle cab. Each seat is held in place with four M8 fixings (torque to 26 Nm).

- 4.6 

- 4.7 Using the 17mm socket and ratchet provided in the vehicle CES remove and retain the 14 off bolts securing the top plate of the engine cover and carefully remove top plate from the vehicle.
- 4.8 Disconnect the profile hose from the air filter. The hose passes through a circular cut-out in the right hand side of the engine cover. Slacken the jubilee clip and slide the hose through the engine cover.
- 4.9 Remove the box-cover over the air filter, with a fire extinguisher and jack attachment.
- 4.10 Remove the retaining bolts securing the left and right hand sides of the engine cover and carefully remove from the vehicle commencing with the right hand side.
- 4.11 Disconnect the remaining hoses and remove the air filter.
- 4.12 Disconnect the kick down cable from the throttle potentiometer pulley by undoing the M8 securing nut and pass back through the grommet that is located on the rear bulkhead of the cab.
- 4.13 Remove cable tie on gearbox breather hose located rear of the bell housing on the gearbox casing and disconnect the tube from the canister located on the rear bulkhead of the cab.
- 4.14 Disconnect the main intake pipe located over top/front of the engine that connects to the EGR plenum chamber of the inlet manifold. Cut all cable ties securing the wiring loom to the pipe and unplug the connector for the intake manifold pressure / temperature sender (G71 / G72) located on the top of the pipe. The pipe is held in clamped place with hose (jubilee) clips at each end and is fixed to the cylinder head on the right-hand side with a bracket and M6 bolt and an M8 bolt that passes through the engine lifting eye on the top.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN DRAINING HOT FLUIDS.

- 4.15 Carefully undo the hose (jubilee) clip on the coolant pipe/engine breather hose, feed disconnected hose through the eyelet on the main intake pipe and re-connect as quickly as possible, re-tighten hose (jubilee) clip. Coolant fluid will escape and should be collected in a suitable container for correct disposal in accordance with local procedures.
- 4.16 Remove the main intake pipe complete.
- 4.17 Support the engine using the lifting eye provided on the top and a suitable workshop lifting device.
- 4.18 Working from below the vehicle, remove the vertical securing bolt from the right-hand engine mount.
- 4.19 Using the lifting device, to raise the right hand side of engine, check that there is a gap between the right hand engine mount and its mounting bracket.
- 4.20 Working from below the vehicle, undo the M8 securing nut on the front of the starter motor and disconnect the fly lead (spade connector) of the starter motor solenoid, cut off the cable tie and route the wiring loom away from the engine and gearbox.
- 4.21 Working from below the vehicle, undo the two M12 securing bolts that pass through the gearbox bell housing to secure the starter motor to the engine block.
- 4.22 Working from below the vehicle, undo the three M10 bolts of the right-hand engine mount bracket. Remove the right-hand engine mount bracket. Slide out the starter motor and remove.

4.23 Working from below the vehicle, re-fit the right hand engine mount, use Loctite 242 on the threads of the M10 bolts. Lower the engine back into position; refit the vertical securing bolt for the right-hand engine mount to chassis. Torque to 44 Nm.

4.24 Remove the electro magnetic fan clutch blade assembly and shroud from the front of the engine, see Chap 12.

4.25 Working from below the vehicle, rotate engine by turning the crankshaft clockwise (with 27 mm socket) until the torque converter securing bolts can be seen through the starter motor aperture, remove the three M8 securing screws. This operation must be repeated three times with the engine turned by 1/3 each time to provide access for each bolt.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN DRAINING HOT FLUIDS.

4.26 Working from below the vehicle, drain the gearbox Automatic Transmission Fluid (ATF) from the gearbox sump, into a suitable container, by removing nut using a 5 mm allen key. This ATF should be inspected for particles and indications of any internal gearbox damage or wear and then disposed of in accordance with local health and safety procedures.

4.27 Working from below the vehicle, replace gearbox sump plug, and remove the dipstick-securing bolt from the sump pan (with 27 mm spanner). Additional ATF may escape from the attachment point. There is no need to disconnect the dipstick tube at the top end unless the engine is to be removed, see Note.

NOTE

If removing the engine, the dipstick tube is removed by unfastening the M8 bolt securing the 'P' clip at the top end of the filler tube.

CAUTION

GEAR SELECTION PROBLEMS. Do not adjust the forward nut (nearest the engine) because this will affect the position of the gear selection lever on re-assembly.

4.28 Working from below the vehicle, disconnect gear box selector linkage by undoing the M6 securing nut. Release the rearmost 24 mm nut located nearest to the gearbox that secures the linkage to the gearbox bell housing.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN DRAINING HOT FLUIDS.

4.29 Working from below the vehicle, cut cable ties (after first noting positions) to allow play on the pipes and disconnect the two oil cooler pipes from the gearbox (with 22 mm spanner) and ensure that they are drained of fluid into a suitable container and the fluid is disposed of in accordance with local health and safety procedures. The hose ends will require blanking off.

4.30 Working from below the vehicle, disconnect the propshaft at both ends and remove the shaft. The M8 fixings (12 off) should be replaced when re-fitting the shaft.

4.31 Remove cap from TDC inspection hole and insert wedge tool for holding torque converter to gearbox 905.336.205.1 that allows a clean separation from the flywheel.

4.32 Working from below the vehicle, cut the cable ties (after first noting positions) and disconnect the gearbox inhibitor loom, which is located on main loom left-hand side on vehicle above the gearbox and remove the starter motor wiring clamp at the rear of the gearbox bell housing.

4.33 Support gearbox and remove securing bolts from the gearbox to the engine. Remove the four M8 fixings (using a 6 mm Allen key) first, followed by the five M12 bolts.

NOTES

- (1) Note the location of each bolt on removal as they vary in length.
- (2) The bolt in the ten-o'clock position secures the earth strap.

4.34 Undo the two M8 bolts that secure the rear gearbox mount to the tail support bracket and undo the four M8 locking nuts that secure the tail support bracket to the chassis tube.

WARNINGS

- (1) **TWO PERSON LIFT. TWO PERSONS ARE REQUIRED TO LIFT THE AUTOMATIC GEARBOX.**
- (2) **PERSONAL INJURY. WHEN REMOVING THE GEARBOX, THE TORQUE CONVERTER IS NOT FIXED WITHIN THE BELL HOUSING. CARE MUST BE TAKEN TO AVOID TIPPING THE GEARBOX FORWARDS OR THE TORQUE CONVERTER MAY FALL OUT.**

CAUTION

EQUIPMENT DAMAGE. Care should be taken to not damage the brake pipes or the chassis on removal of the gearbox.

4.35 The gearbox is now ready to remove from the vehicle. Ensure the following are routed safely away from the gearbox during removal:

- (1) Breather hose
- (2) Kick down cable
- (3) Main earth strap
- (4) Gear selector cable
- (5) Gearbox oil dipstick tube (if still fitted).

Refitting (gearbox)

5 Working from beneath the vehicle, refit of automatic gearbox is as described in the following procedure.

NOTE

Prior to mating the gearbox to the engine clean the torque converter and gearbox to bell housing face.

5.1 Apply silicone RTV to the mating faces of the flywheel housing on the engine and bell housing of the automatic gearbox.

5.2 Apply a small amount of grease to the spigot bush of the new gearbox.

WARNINGS

- (1) **TWO PERSON LIFT. TWO PERSONS ARE REQUIRED TO LIFT THE AUTOMATIC GEARBOX.**

(2) **PERSONAL INJURY. WHEN INSTALLING THE GEARBOX, THE TORQUE CONVERTER IS NOT FIXED WITHIN THE BELL HOUSING. CARE MUST BE TAKEN TO AVOID TIPPING THE GEARBOX FORWARDS OR THE TORQUE CONVERTER MAY FALL OUT.**

CAUTION

EQUIPMENT DAMAGE. Care should be taken not to damage the brake pipes or the chassis on installation of the gearbox.

5.3 Support gearbox and install securing bolts from the gearbox to the engine. Refit the five M12 bolts and washers with Loctite 242, and torque to 75 Nm.

NOTES

(1) Note the correct location of each bolt as they vary in length.

(2) The bolt in the ten-o'clock position secures the earth strap.

5.4 Refit support bracket/mount for gearbox using Loctite 242 and the two M8 bolts (torque to 22 Nm) and four new replacement M8 locking nuts (torque to 18 Nm) that secure the tail support bracket to the chassis tube.

5.5 Refit the remaining four M8 bolts securing the gearbox bell housing to the engine with Loctite 242, and torque to 22 Nm.

5.6 Refit the propshaft between the rear of the gearbox and the transfer gearbox, using 12 new replacement M8 self locking nuts.

5.7 Reconnect gear selector linkage with M6 nut and spring washer.

5.8 Reconnect gearbox inhibitor wiring loom plug and socket and use cable ties to re-route wiring loom as necessary.

5.9 Rotate engine clockwise by turning the crankshaft (with 27 mm socket) until the torque converter securing bolts can be fitted through the starter motor aperture; refit the three M8 securing screws using Loctite 242. This operation must be repeated three times with the engine turned by 1/3 each time to provide access for each bolt.

5.10 Refit gearbox oil dipstick to sump pan (with 27 mm spanner).

NOTE

If engine was removed, the dipstick tube will require fixing with the M8 bolt securing the 'p' clip at the top end of the filler tube.

5.11 Refit the two coolant pipes to the gearbox. The black hose fits on the lower aperture and the blue hose is fitted to the top-left aperture. Tighten the hose and fit cable ties for routing.

5.12 Support the engine using the lifting eye provided on the top and a suitable workshop lifting device.

5.13 Remove the vertical securing bolt from the right-hand engine mount.

5.14 Using the lifting device, to raise the right hand side of engine, check that there is a gap between the right hand engine mount and its mounting bracket.

5.15 Undo the three M10 bolts of the right-hand engine mount bracket. Remove the right-hand engine mount bracket.

- 5.16 Apply silicone RTV to the mating face of the starter motor and fit it in place in the bell housing.
- 5.17 Re-fit the right hand engine mount, use Loctite 242 on the threads of the M10 bolts.
- 5.18 Using Loctite 242 refit the two M12 securing bolts and washers that pass through the gearbox bell housing to secure the starter motor to the engine block, torque to 50 Nm. Refit the M8 power cable/fly lead securing nut on the front of the starter motor.
- 5.19 Lower the engine back into position, refit the vertical securing bolt for the right-hand engine mount to chassis and tighten the three M10 bolts of the right hand engine mount. Torque all bolts to 44 Nm.
- 5.20 Reconnect the fly lead (spade connector) of the starter motor solenoid, fit cable ties and route the wiring loom.
- 5.21 Working in the engine bay, refit gearbox breather hose located rear of the bell housing on the gearbox casing and reconnect the tube to the canister located on the rear bulkhead of the cab. Use cable ties to route hoses.
- 5.22 Working in the engine bay, re-route and reconnect the main intake pipe located over top/front of the engine that connects to the EGR plenum chamber of the inlet manifold. The pipe is held in clamped place with hose (jubilee) clips at each end and is fixed to the cylinder head on the right-hand side with a bracket and M6 bolt and an M8 bolt that passes through the engine lifting eye on the top.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN DRAINING HOT FLUIDS.

- 5.23 Working in the engine bay, carefully undo the hose (jubilee) clip on the coolant pipe/engine breather hose, feed disconnected hose through the eyelet on the main intake pipe and re-connect as quickly as possible, re-tighten hose (jubilee) clip. Coolant may escape and should be collected in a suitable container for correct disposal in accordance with local procedures. Use cable ties as necessary, paying particular attention to retaining the anti-chafing sleeve in place, where the hose passes through the eyelet provided on the main intake pipe.
- 5.24 Working in the engine bay, plug in the connector for the intake manifold pressure / temperature sender (G71 / G72) located on the top of the pipe. Re-route all vacuum hoses and wiring using cable ties secured using the eyelets provided on the main intake pipe. Do not over tighten cable ties as this will crush vacuum pipe.
- 5.25 Working in the engine bay, reconnect kick-down cable to throttle pulley of throttle potentiometer located on the rear bulkhead of the cab. The cable passes through a hole in the rear bulkhead and is held by a rubber grommet.
- 5.26 Using a funnel, re-fill the gearbox, via the dipstick tube, with ATF (approx 5 litres).

Refitting (ancillary items and testing)

- 6 Refit of ancillary items and testing is as the following procedure.
- 6.1 Re-fit the electro magnetic fan clutch blade assembly and shroud on the front of the engine, see Chap 12.
- 6.2 Refit the engine cover left and right sides.

- 6.3 Refit and reconnect the air filter. The profile hose passes through a circular cut-out in the right-hand side of the engine cover. Slide the hose through the hole and tighten hose (jubilee) clip.
- 6.4 Re-check the fluid level of the gearbox oil and top up as required.
- 6.5 Check serviceability of securing bolts and threads in engine cover. **Do not return the vehicle to service without the engine cover in place or with missing or damaged bolts.**
- 6.6 Re-fit the engine cover top plate and re-fit all securing bolts using the 17mm socket and ratchet provided in the vehicle CES.
- 6.7 Using the 17mm socket and pre-set 66 Nm torque wrench provided in the vehicle CES, tighten all bolt engine cover bolts. The bolts are tight when the torque wrench clicks.
- 6.8 [REDACTED]

NOTE

[REDACTED]

- 6.9 Stow tools back onboard vehicle.

WARNING

INJURY TO PERSONNEL. INSTALLATION/REMOVAL OF THE SEATS IS ONLY TO BE CARRIED OUT BY A QUALIFIED VEHICLE MECHANIC AND THE GENERAL CONDITION OF THE SEAT FIXINGS AND MOUNTINGS SHOULD BE INSPECTED PRIOR TO INSTALLATION/REMOVAL.

- 6.10 Refit driver and passenger seats in the vehicle cab. Each is held in place with four M8 fixings (torque to 26 Nm).
- 6.11 Ensure the battery isolation switch in the vehicle cab, located behind the passenger's seat is in the OFF position and the vehicle ignition is switched OFF. Reconnect the vehicle's negative (-ve) battery terminals and tighten up.
- 6.12 Connect the diagnostic software tool (see AESP 2320-D-503-512 Chap 1) and perform the following tests:
- (1) Check fault codes
 - (2) Check throttle potentiometer calibration (see AESP 2320-D-503-512 Chap 9).
- 6.13 If diagnostic tests are OK, carry out road test on vehicle.
- 6.14 Once road test complete, check for any fluid loss (eg coolant leaks) and re-check all vehicle fluid levels: engine and gearbox oil; power steering fluid; coolant etc and top up as required (see AESP 2320-D-503-201 Chap 4 for location of all dipsticks and fillers).

SELECTOR CABLE**Removal**

- 7 The selector cable is removed in the following steps:
- 7.1 Press off selector cable from lever (see Fig 1).

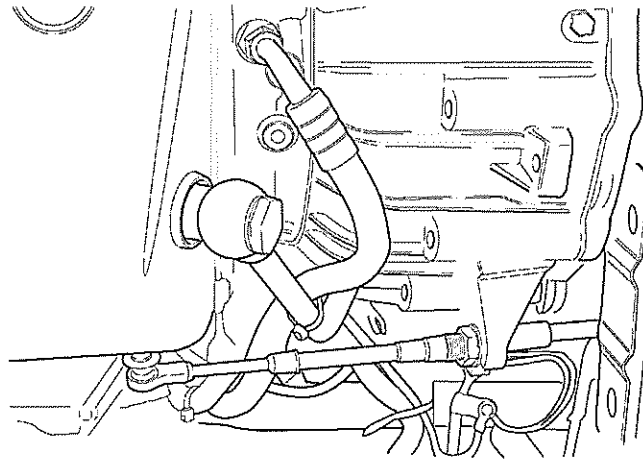


Fig 1 Selector cable

- 7.2 Loosen nut and remove support from housing.
- 7.3 Loosen cable clips.
- 7.4 Loosen 12 screws around gear selector cover.
- 7.5 Lift cover and remove 6 retaining screws, then remove selector plate with brushes.
- 7.6 Remove securing clip from angle joint.
- 7.7 Press off angle joint from ball head bolt. Put selector lever and cover aside.
- 7.8 Loosen large hexagon nut (see Fig 2).

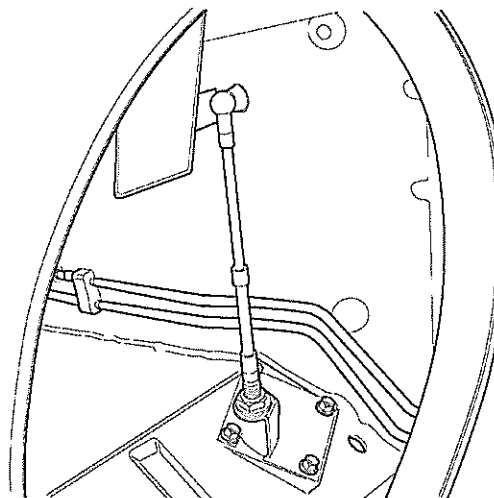


Fig 2 Selector cable retainer

- 7.9 Unscrew nuts from retainer and remove with washers.
- 7.10 Remove retainer.
- 7.11 Pull out selector cable.
- 7.12 Loosen nuts at both cable ends.
- 7.13 Unscrew angle joints at both cable ends.

Refitting

- 8 Refitting the selector cable is the reverse of removal noting the following:
 - 8.1 Screw both angle joints onto thread of selector cable by approximately 10 turns.
 - 8.2 When adjusting selector cable, play must be felt in position 'P' both at selector lever and at gear shift lever. Selector cable adjustment is done via support. Tighten nut.

SELECTOR LEVER**Removal**

- 9 To remove the selector lever, proceed as follows:
 - 9.1 Loosen 12 screws around range selector cover.
 - 9.2 Lift cover and remove six retaining screws, then remove selector plate with brushes.
 - 9.3 Remove securing clip from angle joint.
 - 9.4 Remove cap from bracket and unscrew nut. Pull selector lever with springs and lock out from bracket.

Refitting

- 10 Refitting the selector lever is done in reverse order to removal, observing the following:
 - 10.1 When replacing nuts, secure using Loctite 242.

THROTTLE POTENIOMETER KICKDOWN CABLE**Removal**

- 11 The throttle potentiometer kick-down cable is removed as follows:
 - 11.1 Remove the air filter so that the throttle potentiometer is accessible on the rear bulkhead of the engine bay.
 - 11.2 Remove the driver and passenger seats in the vehicle cab. Each seat is held in place with four M8 fixings.
 - 11.3 Disconnect the kick down cable from the throttle potentiometer pulley by undoing the M8 securing nut and pass back through the grommet that is located on the rear bulkhead of the cab
 - 11.4 Unscrew gearbox sump oil drain plug and drain oil completely.
 - 11.5 Unscrew banjo bolt from oil sump and remove with seal rings.
 - 11.6 Unscrew retaining screws and remove clamps.

- 11.7 Remove oil sump with gasket.
- 11.8 Unscrew oil screen Torx retaining screws with TX 27 (see Table 1, Ser 3) (see Fig 3).

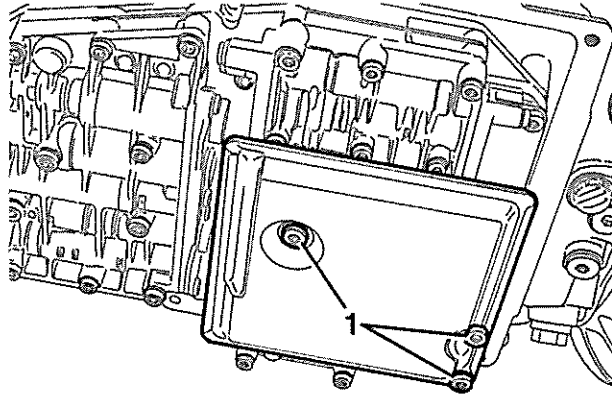


Fig 3 Oil screen retainer

- 11.9 Remove oil screen with O-ring (see Fig 4).

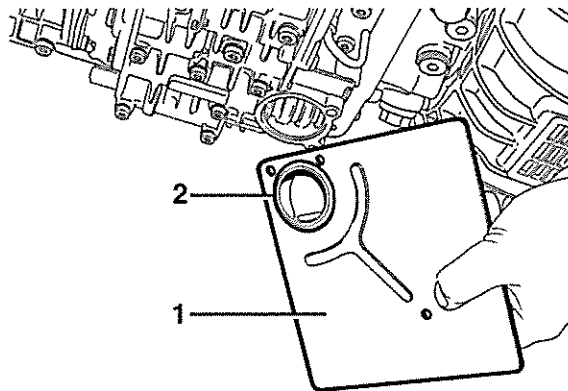


Fig 4 Oil screen

- 11.10 Remove all Torx screws marked in black with TX 27 (see Table 1, Ser 3) and large bit, then completely remove control unit (see Fig 5).

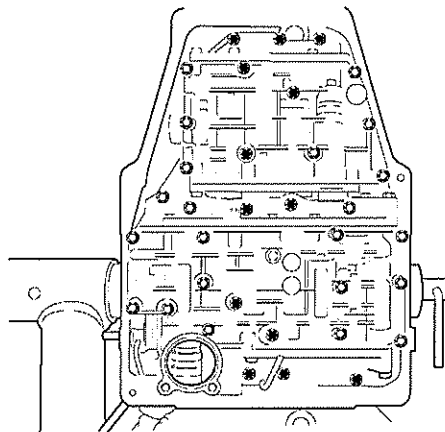


Fig 5 Control unit

- 11.11 Unhook the kick down cable from throttle cam (see Fig 6).

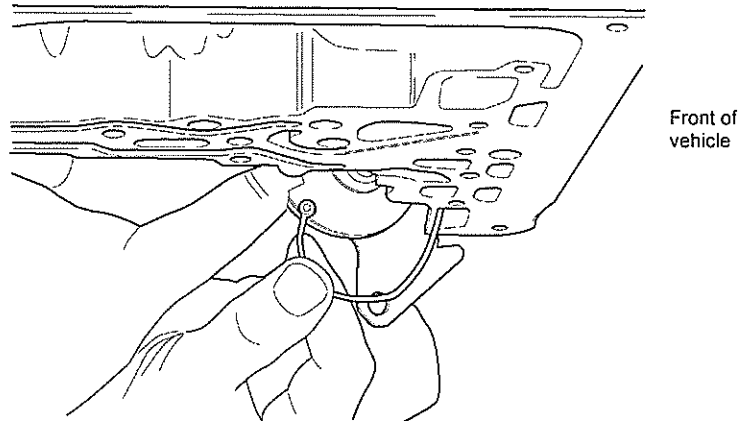


Fig 6 Throttle control cable

- 11.12 Lever out kick down cable at support with screwdriver.

Refitting

- 12 The kick down cable is refitted as follows:
- 12.1 Press kick down cable and support into gearbox housing.
- 12.2 Hook kick down cable into throttle cam.

NOTE

Pre-tension leg spring of throttle cam through one turn.

- 12.3 Screw nut onto support. Insert throttle control cable into support.
- 12.4 Hook kick down cable into cable pulley.
- 12.5 Fit control unit, hook bolt of notched disk into recess of slide selector.

NOTE

When fitting control unit, pull throttle control cable to prevent jamming of throttle cam and throttle lever.

- 12.6 Replace all retaining screws of control unit (except three oil screen screws) but do not tighten.
- 12.7 Screw on adjusting nut fully onto support.
- 12.8 Place control unit gauge (see Table 1, Ser 4) between throttle piston pin and front face of throttle pressure housing (see Fig 7 (1)).

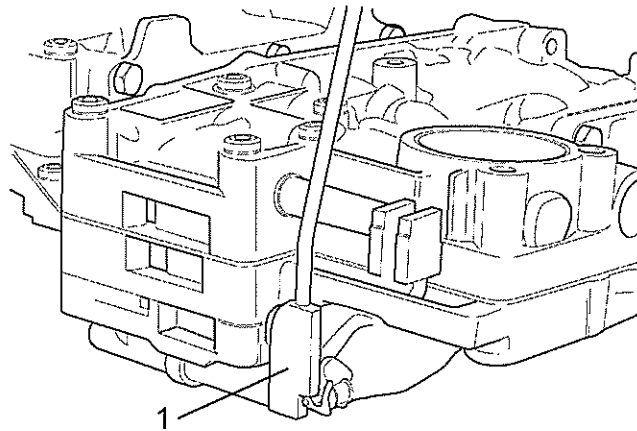


Fig 7 Throttle pressure housing

- 12.9 Press control unit against setting gauge. Tighten screws to correct torque (see Table 2, Ser 8). Start tightening from centre.
- 12.10 Fit new O-ring to suction collar of oil screen and tighten screen to correct torque (see Table 2, Ser 9) (see Fig 4).
- 12.11 Fit new gasket to oil sump and tighten screws to correct torque (see Table 2, Ser 10).
- 12.12 Tighten tube with banjo bolt and new seal rings.
- 12.13 Working in the engine bay remove the throttle control cable from the potentiometer cable pulley.
- 12.14 Route new kick down cable in the same position as the previously removed cable. The cable passes through a hole in the rear bulkhead and is held by a rubber grommet
- 12.15 Tension kick down cable until slight resistance is felt. Fix lead seal 1-2 mm from support end. Connect kick down cable to pulley.
- 12.16 Connect throttle control cable into cable pulley.
- 12.17 Remove oil dip stick from filler tube and fill gearbox with new oil (see 2320-D-503-201 Chap 4 for location of all dipsticks and fillers). Check oil level and top up if necessary.
- 12.18 Perform throttle calibration check (see Chap 11).
- 12.19 If diagnostic tests are OK, carry out road test on vehicle.
- 12.20 Once road test complete, check for any fluid loss (eg coolant leaks) and re-check gearbox oil and top up as required (see AESP 2320-D-503-201 Chap 4 for location of all dipsticks and fillers).

STARTER CUT-OFF SWITCH

Removal

- 13 Removal of the starter cut-off switch is as follows:
 - 13.1 Shift selector lever into position 'P'.
 - 13.2 Loosen screw and remove with spring washer and retaining plate (see Fig 8).

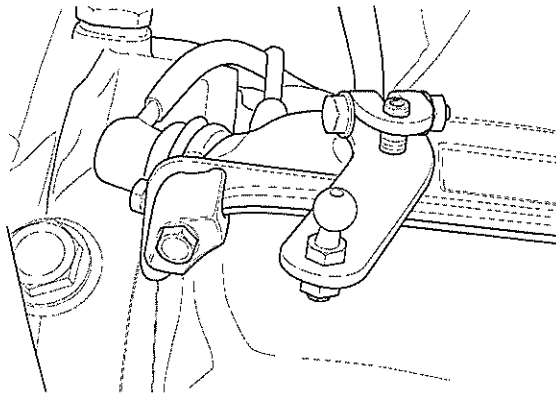


Fig 8 Starter cut-off switch

- 13.3 Loosen cable clip and remove plug connection.
- 13.4 Remove starter cut-off switch.

Refitting

- 14 Refitting the starter cut-off switch is performed in the following way:
 - 14.1 Smear starter cut-off O-ring with rubber anti seize.
 - 14.2 Insert starter cut-off switch into housing and attach retaining plate with spring washer and screw.

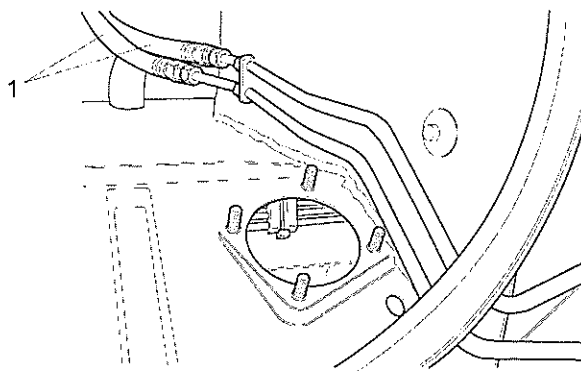
NOTE

Fit retaining plate with bent ends facing gearbox.

OIL HOSES AND CONNECTIONS

Removal

- 15 To remove oil hoses and connections, proceed as follows:
 - 15.1 Remove radiator (see Chap 12).
 - 15.2 Loosen nuts and remove hoses (see Fig 9 (1)).



Note:
Selector cable retainer
not illustrated for clarity

Fig 9 Oil hoses

Refitting

16 Refitting the oil hoses and connections is done as follows:

16.1 Fasten hoses with nuts.

NOTE

Long hose connects to radiator top.

16.2 Fit radiator (see Chap 12).

GEARBOX CONNECTORS

Removal

17 To remove gearbox connectors, proceed as follows:

17.1 Loosen nut and remove hose at converter housing.

NOTE

Collect oil in suitable container.

17.2 Loosen nut and pull off hose from other side of housing.

17.3 Loosen cable clips.

17.4 Unscrew nuts and remove hose.

17.5 Remove connectors with seal rings from converter housing.

Refitting

18 The gearbox connectors are refitted in reverse order, noting the following:

NOTE

Refit connectors with new seal rings.

18.1 Refill gearbox oil (see Para 5).

OIL COOLER HOSES

Removal

19 The oil cooler hoses are removed as follows:

19.1 Remove radiator.

19.2 Remove gearbox (see Para 4).

19.3 Remove fuel tank.

19.4 Loosen nuts and remove hoses (see Fig 10).

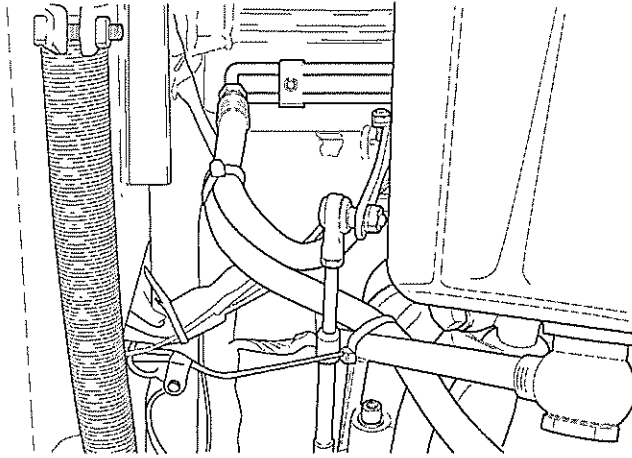


Fig 10 Oil hose connection

- 19.5 Unscrew retainers and remove electrical leads (see Fig 11).

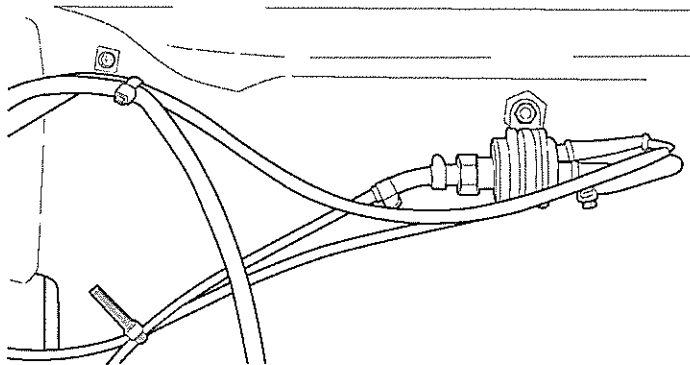


Fig 11 Electrical leads

- 19.6 Loosen cable clips and remove hoses at other end.
19.7 Loosen nuts and remove retaining block. Remove tube mounting from oil pipes.

NOTE

Fasten oil pipes with retaining straps.

- 19.8 Remove screws from water separator bracket.
19.9 Remove cable ties from fuel pipes.
19.10 Loosen water separator screws of fuel pipe to fuel tank. Remove pipe and seal rings.
19.11 Remove front exhaust pipe.
19.12 Remove retaining screws and seal ring at exhaust exit pipe connection flanges.
19.13 Remove guard plate from between flanges.
19.14 Extract rubber grommets.
19.15 Remove oil pipes toward rear.

Refitting

20 Refitting oil hoses is done in reverse order to removal.

ROTARY SHAFT SEAL RING TO OIL PUMP

Removal

21 To remove rotary shaft seal ring, proceed as follows:

21.1 Remove automatic gearbox

21.2 Remove converter retainer (see Table 1, Ser 1) from converter housing. Fit converter extractors (see Table 1, Ser 5) to converter and remove (see Fig 12).

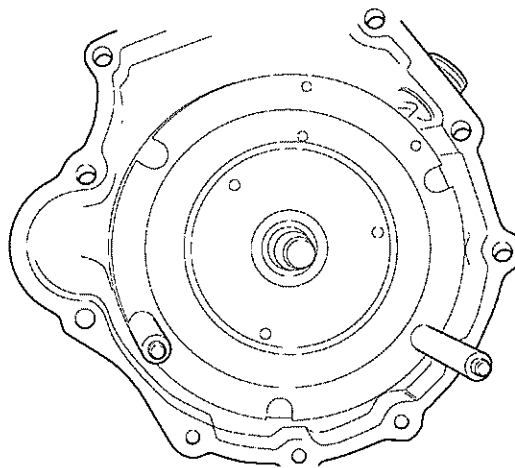


Fig 12 Converter Extraction

NOTE

Take care not to damage converter mounting and seal ring of oil pump.

21.3 Remove rotary shaft seal ring with puller hooks (Table 1, Ser 2) (see Fig 13).

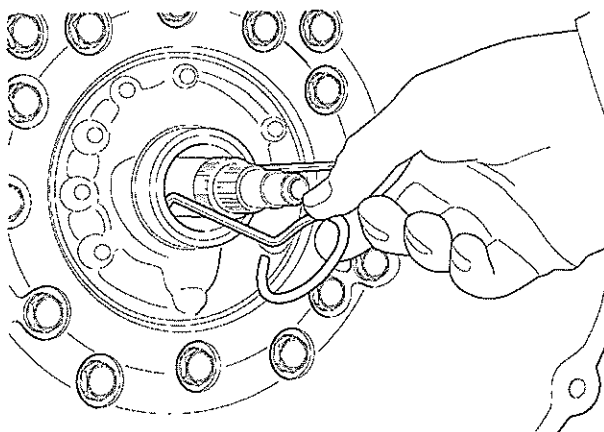


Fig 13 Front rotary shaft seal ring

Refitting

22 To refit rotary shaft seal ring, proceed as follows:

22.1 Slightly oil seal ring and drive in using mounting sleeve (Table 1, Ser 6) (see Fig 14).

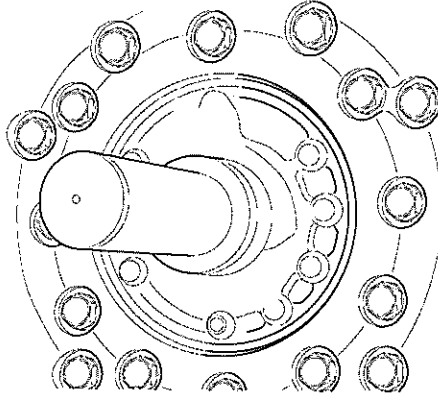


Fig 14 Mounting sleeve

22.2 Carefully insert converter. When pump driving pins are located into recesses, push converter until stop.

22.3 Check installation position of converter; ensure recess is 20 mm (see Fig 15).

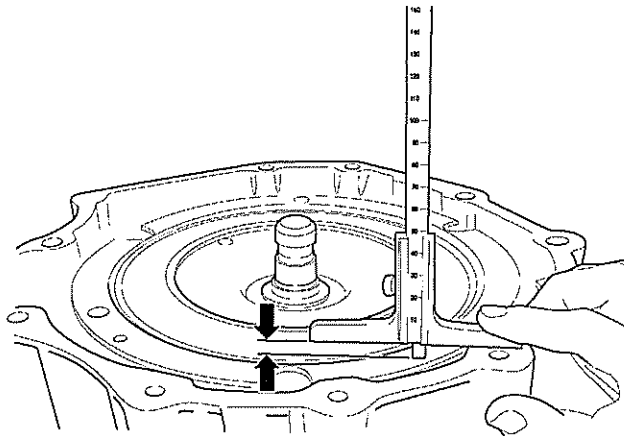


Fig 15 Converter measurement

22.4 Refit gearbox (see Para 5).

ROTARY SHAFT SEAL RING ON DRIVEN SIDE**Removal**

23 To remove rotary shaft seal ring, proceed as follows:

23.1 Loosen propshaft nuts, remove screws and hang propshaft aside.

23.2 Shift automatic gearbox selector into position 'P'.

23.3 Remove securing plate from collar nut and unscrew collar nut.

23.4 Remove driven flange with puller (see Table 1, Ser 9).

- 23.5 Remove rotary shaft seal with screwdriver (see Fig 16).

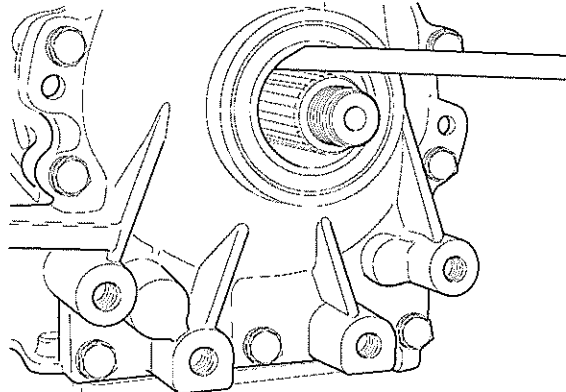


Fig 16 Rear rotary shaft seal ring

Refitting

- 24 To refit rotary shaft seal ring, proceed as follows:

- 24.1 Lightly lubricate seal ring and insert using mounting sleeve (see Table 1, Ser 6) (see Fig 14).
- 24.2 Fit driving flange onto driven shaft and press in until stop.
- 24.3 Tighten collar nut to correct torque (see Table 2, Ser 11).
- 24.4 Shift selector lever into position 'N'.
- 24.5 Tighten propshaft nuts with torque spanner (see Table 1, Ser 7) and spanner socket (see Table 1, Ser 8) to correct torque (see Table 2, Ser 7).
- 24.6 Allow engine to idle with selector lever in position 'P' and check gearbox oil level. Top up if necessary.

CONVERTER

Removal

- 25 To remove converter, proceed as follows:

- 25.1 Remove gearbox.
- 25.2 Remove converter using converter retainer (see Table 1, Ser 1) from housing. Fit converter extractors (see Table 1, Ser 5) to converter and remove (see Fig 12).

NOTE

Take care not to damage converter mounting and seal ring of oil pump.

Refitting

- 26 To refit converter, proceed as follows:

- 26.1 Carefully insert converter. When pump driving pins are located into recesses, push converter until stop. Check that distance is 20 mm (see Fig 15).
- 26.2 Refit gearbox (see Para 5).

RESTRICTED

RESTRICTED

CHAPTER 4

TRANSMISSION REPAIR INSTRUCTIONS

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INTRODUCTION

1 This chapter details the procedures for all work carried out on the transmission and differential and all wheel drive lock control system. For front and rear axle repairs see Chapter 5.

SPECIAL TOOLS AND TEST EQUIPMENT

2 No special tools or test equipment are required for any repairs contained in this chapter.

TORQUE WRENCH SETTINGS

3 Torque wrench settings.

TABLE 1 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Prop shaft self locking nuts	40	5.10 9.6 20.3.
2	Drive shaft flange retaining bolt	35	9.4.

TRANSFER GEARBOX

Removal

- 4 To remove transfer gearbox, proceed as follows:
 - 4.1 Remove rear axle (see Chapter 5-2).
 - 4.2 Select neutral in both five-speed and transfer gearbox.
 - 4.3 Drain oil from transfer gearbox.
 - 4.4 Remove circlip and take off transfer gear selector rod with bush.
 - 4.5 Disconnect prop shaft from transfer gearbox and tie back.

CAUTION

EQUIPMENT DAMAGE. Do not pull apart prop shaft as parts are balanced.

- 4.6 Support transfer gearbox with jack, unscrew cap nut securing gearbox to front chassis tube.
- 4.7 Carefully loosen insulating mat from top of transfer gearbox using a scraper.
- 4.8 Pull transfer gearbox and all wheel drive actuator housing approximately 120-130 mm out of chassis support tube flange. If necessary remove all wheel drive pneumatic actuator and press torque tube off transfer gearbox splines using tyre lever inserted through housing opening. Extract transfer gearbox with all wheel drive actuator housing from support tube flange and lower (see Fig 1).

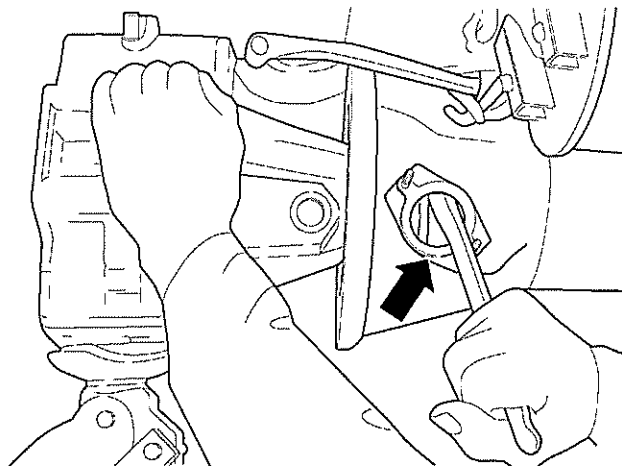


Fig 1 Removing transfer gearbox

CAUTION

EQUIPMENT DAMAGE. Do not pull gearbox too far back whilst still attached to torque tube, as guideways in chassis tube could be damaged.

- 4.9 Remove all wheel drive housing and discard O-ring (see Fig 2).

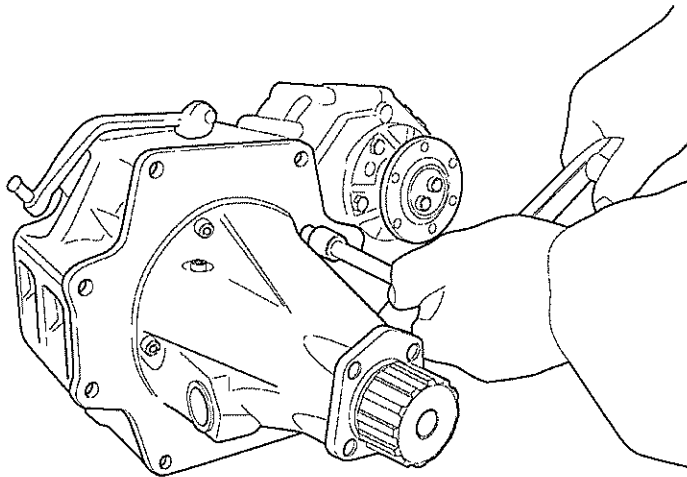


Fig 2 Removing all wheel drive actuator housing

Refitting

- 5 The transfer gearbox is refitted in the following way:

5.1 Put new O-ring on all wheel drive housing. Moisten O-ring and sealing face with Loctite 574. Smear splines moderately with Molykote-Longterm No. 2.

CAUTION

EQUIPMENT DAMAGE. Before fitting new all wheel drive housing, ensure correct splined (quill) shaft has been used. Correct shaft has through hole and bush bearing inserted into smaller end (see Fig 3).

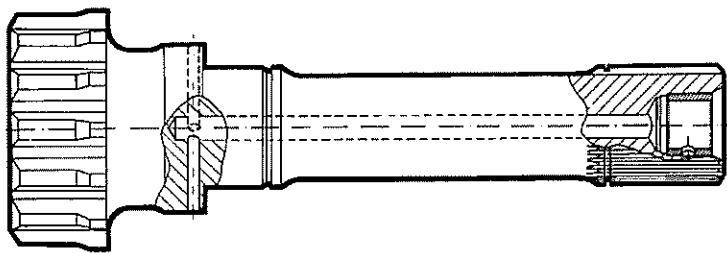


Fig 3 All wheel drive actuator housing quill shaft

5.2 After sliding all wheel drive actuator housing onto shaft, small slot must remain between housing and transfer gearbox. Insert two socket head bolts and washers (across diagonal) to centre housing or assist with slight taps of plastic hammer. Fit remaining socket head bolts with washers. Tighten all bolts equally across diagonals.

CAUTION

EQUIPMENT DAMAGE. Ensure O-ring is correctly seated.

5.3 Slide front prop shaft (torque tube) forward to engage onto splines of front axle differential lock. To do this insert suitable drift or hammer shaft into torque tube. When inserting torque tube, ensure balance plates do not contact top guides of chassis support tube.

5.4 Grease front torque tube splines with Molykote-Longterm No. 2.

5.5 Moisten sealing surface of transfer gearbox and chassis support tube flange with Loctite 574.

CAUTION

EQUIPMENT DAMAGE. Ensure that vent slots and bores in chassis support tube flange are not clogged.

5.6 Use selector lever to engage either high or low gear. Raise gearbox to mounting level and insert into chassis support tube flange. Connect torque tube with splines by rotating drive shaft. Fit dome nut hand tight.

5.7 Check insulating mat for damage (replace if necessary) and fix to top of gearbox and chassis support tube flange.

5.8 Clean gear selector rod bush, grease with standard lubricant inside and out and slide on with collar facing downwards.

5.9 Fit gear selector rod and attach circlip.

5.10 Check arrow markings on prop shaft. Arrows on shaft must face each other. Insert bolts from gearbox side into flanges. Put on new self-locking nuts. Twist shaft so that marking arrows are positioned at top centre and tighten to correct torque (see Table 1, Ser. 1 and Fig 4).

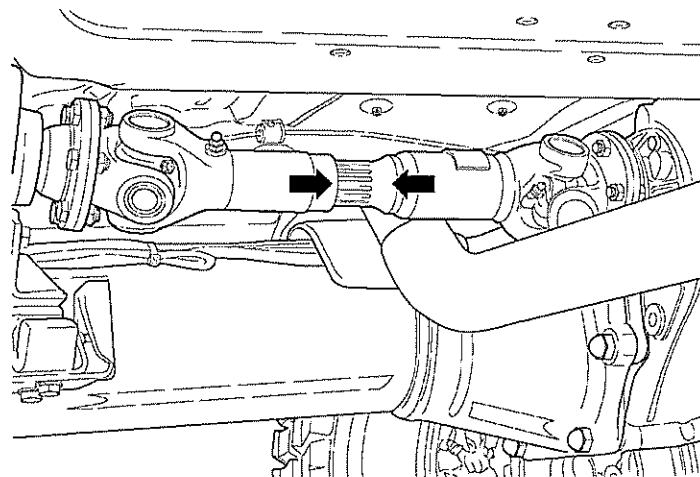


Fig 4 Prop shaft alignment marks

5.11 Fit rear axle (see Chapter 5-2).

5.12 Fill transfer gearbox oil to correct level when vehicle is in horizontal position.

TRANSFER GEARBOX REAR DRIVE SHAFT COVER

Removal

6 To remove rear drive shaft cover, proceed as follows:

6.1 Remove bolts from cover.

- 6.2 Apply suitable drift below cover stiffening rib and remove cover with light hammer taps.
- 6.3 Clean Loctite and sealant residues from sealing faces and retaining bolts.

Refitting

- 7 To refit drive shaft cover, proceed as follows:
 - 7.1 Moisten sealing surface of cover with Loctite 574 and head and thread of retaining bolt with Loctite 242 and fit cover.

TRANSFER GEARBOX DRIVE SHAFT FLANGE AND COVER

Removal

- 8 The drive flange and cover are removed as follows:
 - 8.1 Select neutral in both five-speed and transfer gearbox.
 - 8.2 Disconnect prop shaft from transfer gearbox and tie back.

CAUTION

EQUIPMENT DAMAGE. Do not pull apart prop shaft as parts are balanced.

- 8.3 Remove lock wire from drive flange retaining bolts. Hold drive flange and remove retaining bolts and washers.
- 8.4 Pull off drive flange.
- 8.5 Remove drive flange cover and adjustment shim (see Fig 5).

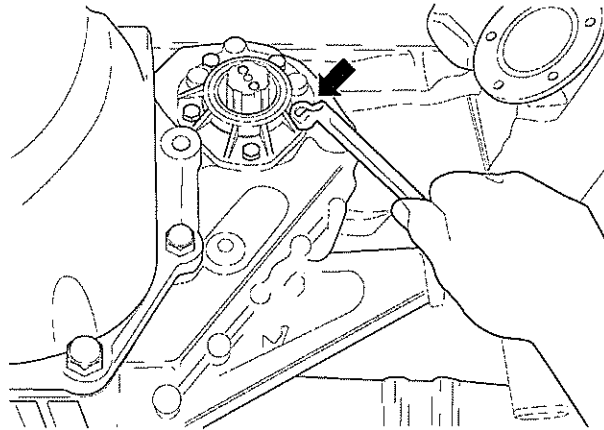


Fig 5 Transfer gearbox drive shaft cover

- 8.6 Press out oil seals backwards.
- 8.7 Clean sealing faces with Loctite sealant remover.

Refitting

- 9 The drive flange and cover are refitted in the following way:
 - 9.1 Press in oil seals until outer seal is flush with outer casing. Fill hollow space between both sealing lips with standard grease (see Fig 6).

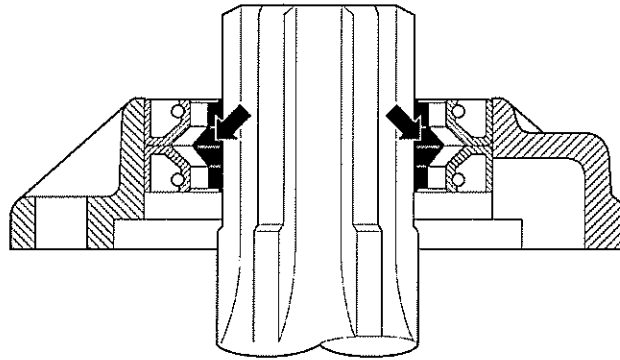


Fig 6 Transfer gearbox drive shaft flange cover

9.2 Moisten sealing face of cover with Loctite 574 and head and threads of bolts with Loctite 242. Fix adjustment shim in cover with standard grease and fit cover.

9.3 Heat drive flange to approximately 80 °C and slide onto splines. If necessary, tap flange lightly until stop, using plastic hammer.

9.4 Moisten rear side of strain washer and head of retaining bolts with Loctite 574 and tighten bolts to correct torque (see Table 1, Ser 2).

9.5 Secure bolts with lock wire (Ø 1.4 mm) in figure of eight pattern.

9.6 Check arrows on prop shaft. Insert bolts from gearbox side into flanges using new self locking nuts. Twist shaft so that arrows are positioned top centre and tighten to correct torque (see Table 1, Ser 1).

CAUTION

EQUIPMENT DAMAGE. When re-fitting ensure that arrows are on upper side of prop shaft.

TRANSFER GEAR LEVER**Removal**

- 10 The transfer gear lever is removed as follows:
 - 10.1 Drive out stoppers of body-bound rivets and remove transfer gear lever plastic cover.
 - 10.2 Remove lock clip and press off ball joint from gear lever.
 - 10.3 Unscrew gear lever retaining nut.
 - 10.4 Remove gear lever with bush and sleeve.

Refitting

- 11 To refit the gear lever, proceed as follows:
 - 11.1 Insert bush and sleeve into gear lever fixing point and grease.
 - 11.2 Fit gear lever and secure with nut and washer.
 - 11.3 Refit lock clip and press on ball joint to gear lever.
 - 11.4 Refit gear lever plastic cover using new body-bound rivets.
 - 11.5 Check adjustment of remote control cable.

TRANSFER GEARBOX REMOTE CONTROL CABLE OIL SEAL AND BELLOWS**Removal**

- 12 To remove the transfer gearbox remote control cable oil seal and bellows proceed as follows:
 - 12.1 Loosen adjuster lock nut on gear selector rod (see Fig 7).

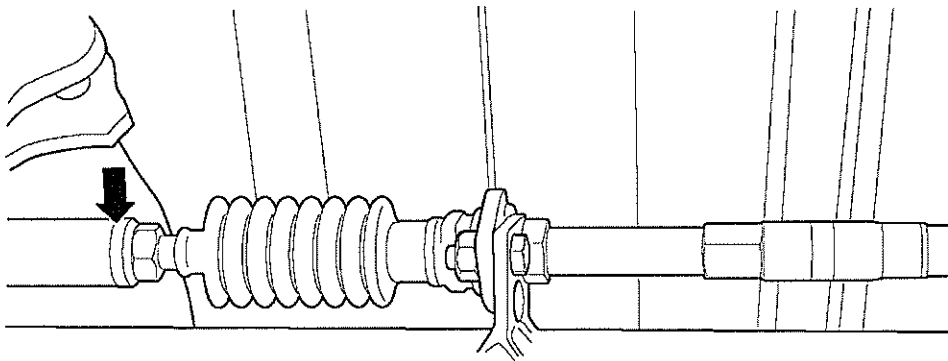


Fig 7 Transfer gearbox remote control cable

- 12.2 Remove circlip from gear selector arm and detach gear selector rod with bush.
- 12.3 Unscrew gear selector rod and lock nut.
- 12.4 Remove rubber bellows.
- 12.5 Unscrew sealing nut, remove and discard O-ring.

Refitting

- 13 The transfer gearbox remote control cable oil seal and bellows are refitted in the following way:
 - 13.1 Insert O-ring carefully into sealing nut and grease with standard lubricant.
 - 13.2 Refit sealing nut, bellows and selector rod.
 - 13.3 With lock nut fitted, gear selector rod reach should be approximately 12-15 mm.
 - 13.4 Smear gear lever bush inside and out with standard lubricant and slide on collar first.
 - 13.5 Check adjustment of remote control cable (see Para 16).

TRANSFER GEARBOX REMOTE CONTROL CABLE

Removal

- 14 The transfer gearbox remote control cable is removed as follows:
 - 14.1 Extract stoppers of body-bound rivets and remove transfer gear lever cover.
 - 14.2 Loosen remote lock nut at base of transfer gear lever.
 - 14.3 Remove lock clip and press off ball joint from base of gear lever.
 - 14.4 Unscrew ball joint with lock nut and remove grommet.
 - 14.5 Loosen lock nut on gear selector rod, adjacent to transfer gearbox.
 - 14.6 Remove circlip and detach gear selector rod and bush from transfer gearbox selector arm.
 - 14.7 Unscrew rear ball and socket joint from bracket on chassis support tube.
 - 14.8 Loosen supporting clip on central cable.
 - 14.9 Loosen supporting clip on cross member.

14.10 Remove cable clips holding handbrake cable and throttle cable to remote gear cable (see Fig 8).

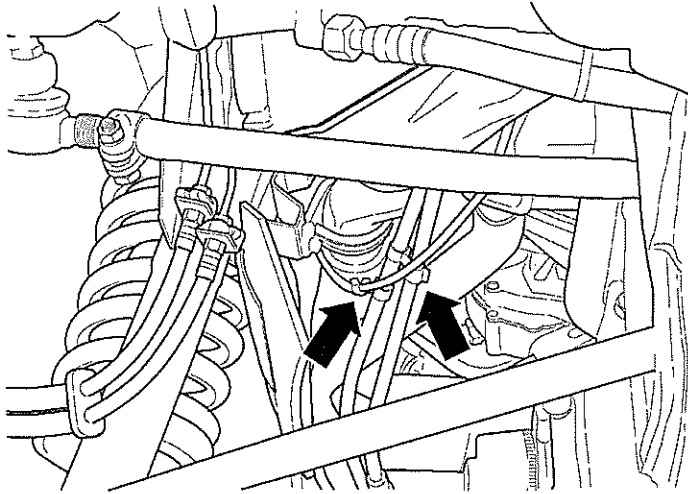


Fig 8 Position of cable clips

14.11 Unscrew front ball and socket joint at footwell.

14.12 Remove remote control cable backwards.

14.13 Remove mounting brackets with grommets, unscrew gear selector rod and lock nut.

Refitting

15 Refitting the transfer gearbox remote control cable is as follows:

15.1 Carry out basic adjustment of remote control cable (see Fig 9).

Front measurement 'A'	45 mm
Rear measurement 'B'	50 mm
Screwed in depth of front ball socket and gear selector rod	
Measurement 'C'	12-15 mm

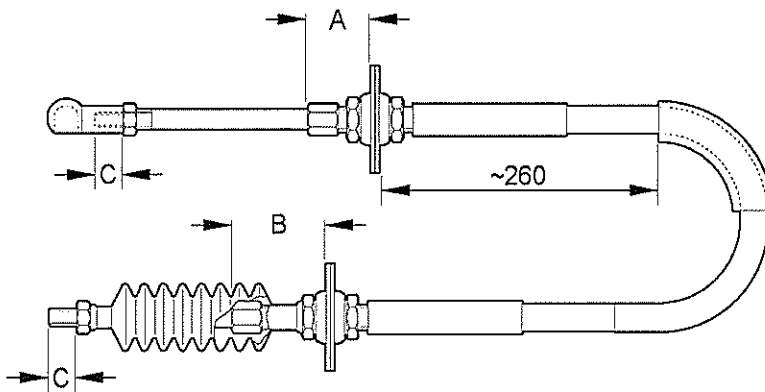


Fig 9 Transfer gearbox remote control cable

15.2 Screw on gear selector rod with lock nut. Ensure measurement 'C' is correct (see Fig 9).

15.3 Fit ball and socket joints to bracket on chassis support tube and to footwell.

- 15.4 Fit support clips and protective rubber sleeve.
- 15.5 Fit cable clips on handbrake cable and throttle cable.
- 15.6 Smear gear selector rod bush inside and out with grease and slide on, collar pointing downwards.
- 15.7 Hook on gear selector rod to transfer gearbox selector arm and attach retaining clip. Tighten lock nut.
- 15.8 Fit rubber grommet in footwell.
- 15.9 Screw on ball joint with lock nut. Observe measurement 'C' (see Fig 9). Grease ball joint inside moderately and press onto gear lever. Attach lock clip. Ensure ball joint is in centre position when tightening lock nut.
- 15.10 Fit gear lever cover using new body-bound rivets.
- 15.11 Check adjustment of remote control cable (see Para 16).

Check and adjust

- 16 To check remote gear control cable, proceed as follows:

16.1 Place transfer gear lever in neutral position. Gauge free movement of lever in this position then move lever to centre point of free travel. If centre of gear lever knob is approximately 40 mm from bead at air duct channel, adjustment is correct (see Fig 10).

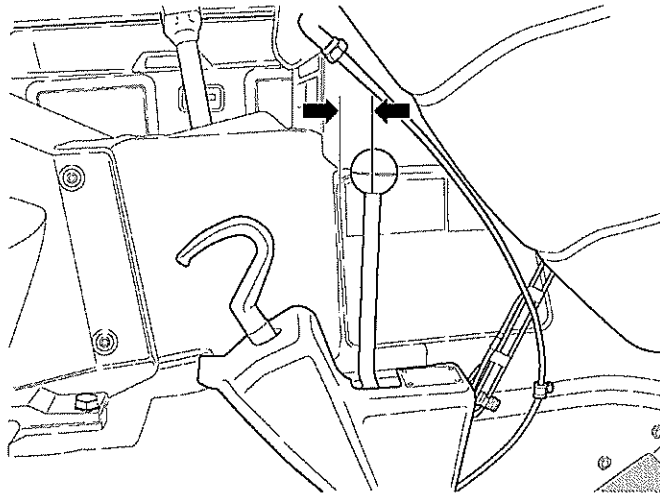


Fig 10 Transfer gear lever adjustment

NOTE

Adjustment is made by movement of two lock nuts at rear ball and socket joint (adjacent to transfer gearbox) (see Fig 9).

- 16.2 Engage low gear and check there is sufficient distance between lock nut of gear selector rod and sealing nut of control cable.
- 16.3 Turn key of steering lock into position '2'. Control lamp 'All-wheel-drive' must light up. If not, move vehicle back and forwards several times. If lamp fails to illuminate, check bulb and electrical supply or adjust micro-switch.
- 16.4 Turn key of steering lock into position '0'.

AXLE (RUBBER) GAITERS**Removal**

- 17 To remove axle gaiter proceed as follows:
- 17.1 Remove respective portal hub (see Chapter 5-1 and Chapter 5-2).

NOTE

When removing rear portal hub only, loosen brake hose from inner brake hose bracket.

- 17.2 Mark position of brake hose bracket on half axle. Loosen retaining bolt and remove bracket.
- 17.3 Remove fastening straps and rubber gaiter (see Fig 11).

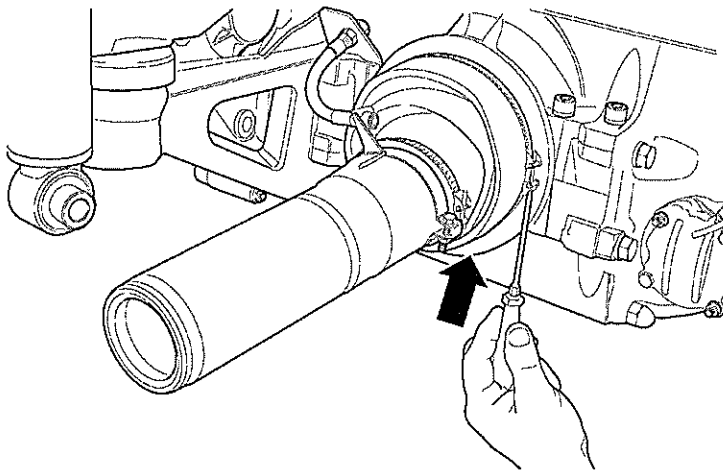


Fig 11 Removing axle rubber gaiter

- 17.4 Check stop ring and differential casing for damage. Clean half axle ball cup and check for traces of wear.

Refitting

- 18 To refit axle gaiter proceed as follows:
- 18.1 Grease half axle ball cup with Alfalub LGEM2.
- 18.2 Slip on gaiter. Mount fastening straps pointing backwards with screw heads pointing downwards. Ensure end of gaiter is in line with cylindrical neck of half axle.
- 18.3 Align rear half axle brake hose bracket on cylindrical neck of gaiter with mark made during dismounting. Ensure brake hose is not under tension, to allow mobility of axle, before tightening.
- 18.4 Refit portal hub (see Chapter 5-1 or 5-2).

PROP SHAFT (BETWEEN GEARBOXES)**Removal**

- 19 To remove the prop shaft proceed as follows:
- 19.1 Select neutral in both five-speed and transfer gearbox.

- 19.2 Unscrew fastening nuts at prop shaft flanges.
- 19.3 Remove prop shaft.

CAUTION

EQUIPMENT DAMAGE. Do not pull apart prop shaft as parts are balanced.

Refitting

- 20 To refit the prop shaft proceed as follows:

CAUTION

EQUIPMENT DAMAGE. When re-fitting ensure that arrows are on upper side of prop shaft.

- 20.1 Check arrow marking on prop shaft. Arrows on shaft must face each other.

CAUTION

EQUIPMENT DAMAGE. Use only class 10.9 nuts and bolts.

- 20.2 When inserting prop shaft make sure that flange is pointing to gearbox. Always insert bolts from gearbox side into flanges. Use new self locking nuts.
- 20.3 To ensure correct balance, turn prop shaft so that marking arrows are positioned top centre, before tightening to correct torque (see Table 1, Ser. 1).
- 20.4 Grease prop shaft joints and spline end.

PROP SHAFT (TORQUE TUBE) FRONT WHEEL DRIVE

Removal

- 21 To remove the prop shaft (torque tube) proceed as follows:
 - 21.1 Remove transfer gearbox (see Para 4).

NOTE

Do not drain oil out of transfer gearbox

- 21.2 Remove prop shaft from chassis support tube. If the prop shaft is to be re-used ensure direction of mounting is clearly marked before removal.

Refitting

22 To refit prop shaft proceed as follows:

- 22.1 Grease splines with Molykote Longterm No. 2.
- 22.2 Slip prop shaft onto splines of differential lock actuator housing of front axle using suitable drift.
- 22.3 Fit transfer gearbox (see Para 5).

PROP SHAFT (TORQUE TUBE) REAR WHEEL DRIVE**Removal**

23 To remove rear prop shaft proceed as follows:

- 23.1 Remove rear axle (see Chapter 5-2).
- 23.2 Pull out anchor bolts and unscrew chassis tube/distance piece. Remove chassis cross member with bearing covers and rubber pads.
- 23.3 Release circlip from inner groove of prop shaft. Insert press off tool into prop shaft. Refit circlip to secure press off tool and remove prop shaft.

NOTE

Prop shaft has been joined with Loctite. If removal is difficult,, heat splines to approximately 110 °C.

Refitting

24 To refit rear prop shaft proceed as follows:

- 24.1 Oil or grease new O-ring and insert into groove at centring ring.
- 24.2 Moisten splines of prop shaft with Loctite 270 and slip prop shaft onto splines of differential lock actuator housing until stop. Remove excess Loctite.

NOTE

Fit axle while Loctite has hand firm consistency:

Hand firmness	15-30 minutes
Final firmness	approximately 12 hours

- 24.3 Moisten sealing surfaces of axle casing and distance piece, (side facing axle casing) with surface sealant Loctite 574. Put chassis cross member onto centring ring. Fasten distance piece provisionally with two bolts (do not tighten bolts before axle has been fitted). Put rubber pad and bearing cover on both sides. Insert anchor bolts.

CAUTION

EQUIPMENT DAMAGE. Centre offset platform supports (bearing cover with rubber pad) of cross member must point forwards.

- 24.4 Fit rear axle (see Chapter 5-2).

ALL WHEEL DRIVE/DIFFERENTIAL LOCK ACTUATOR HOUSING

Strip

25 Although there are slight variations in components used in all wheel drive and differential lock actuator housings the method of stripping is the same in all cases.

- 25.1 Remove housing from axle or transfer gearbox.
- 25.2 Remove selector fork spindle by lifting with screwdriver at circlip groove.
- 25.3 Remove selector sleeve and selector fork (see Fig 12).

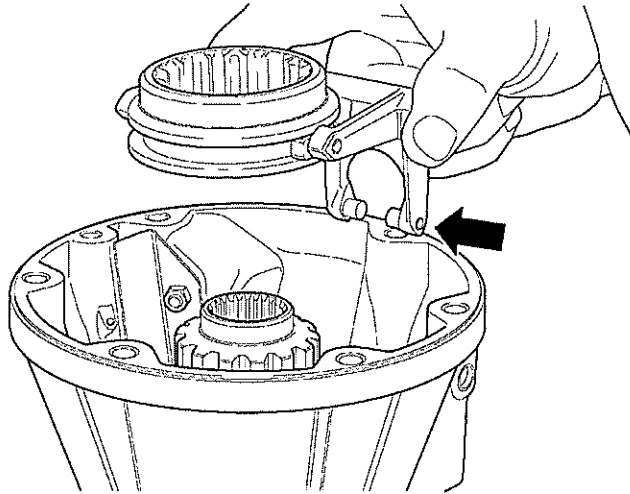


Fig 12 All wheel drive actuator housing selector

- 25.4 Clamp housing into vice and remove screws securing end cover.
- 25.5 Using soft hammer drift back drive shaft from within housing to gain access to circlip fixed under end cover. Release circlip and remove drive shaft and dog clutch.
- 25.6 Remove guide bolt securing actuator shaft and remove shaft with return spring (see Fig 13).

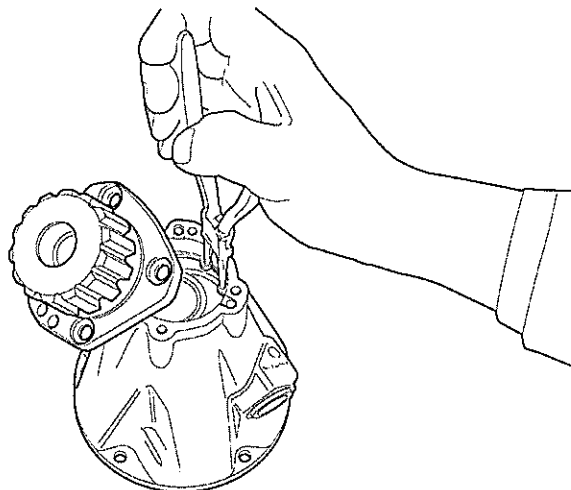


Fig 13 All wheel drive actuator housing assembly

- 25.7 Heat dog clutch to approximately 130 °C and press off drive shaft.

- 25.8 Remove remaining circlips from drive shaft.
- 25.9 Remove bearing from drive shaft using suitable puller.
- 25.10 Remove end cover from drive shaft and press oil seal from cover.

NOTE

Remove oil sheet only when changing housing.

Inspect

- 26 To check all wheel drive/differential lock actuator housing proceed as follows:
 - 26.1 Visually check all parts for serviceability. Remove Loctite residues at drive/brake shaft. Remove coupling piece, check bearing bush (see Para 28).
 - 26.2 Check selector sleeve splines in meshing area for damage.
 - 26.3 Check axial play of sliding blocks in selector sleeve. Wear limit is 0.5 mm. Replace any worn or damaged sliding blocks.
 - 26.4 Check bolts in selector fork for traces of wear and secure fit.
 - 26.5 Check selector fork axle and bore for traces of friction.

Re-assemble

- 27 Although there are slight variations in components used in all wheel drive and differential lock actuator housings the method of assembly is the same in all cases (see Fig 14, and 15).

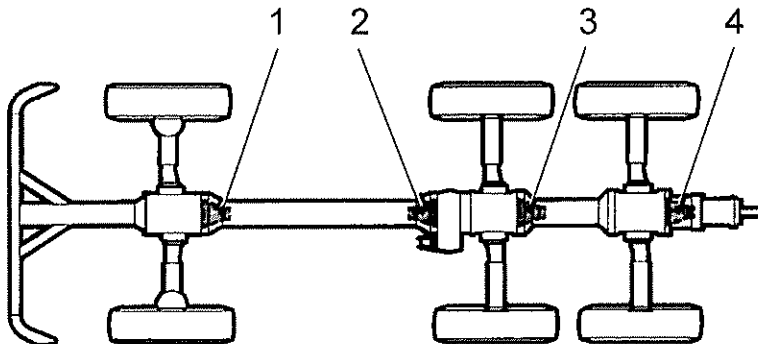


Fig 14 All wheel drive and differential lock actuator housing
(see Table 3)

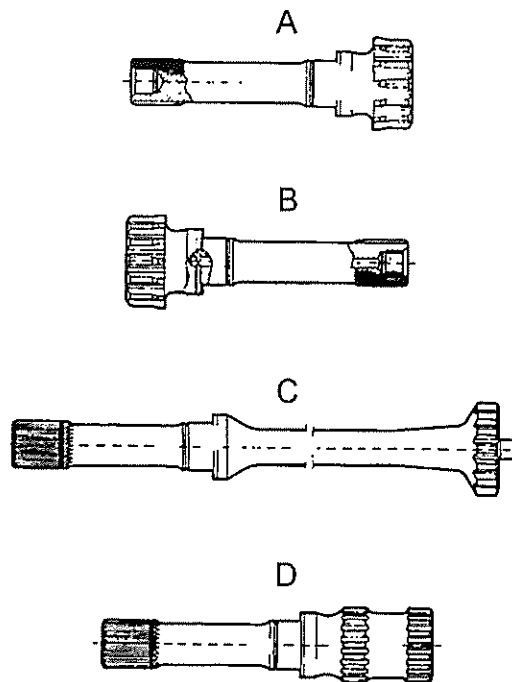


Fig 15 All Wheel Drive and Differential Lock Quill Shafts

- A = Front
- B = All Wheel Drive
- C = Rear Axle Drive
- D = Rear

27.1 When fitting drive shaft B, observe that only all wheel drive actuator housing with closed oil return bores and one-sided covered deep groove ball bearing is used.

TABLE 2 SHAFT FEATURES (6X6)

Shaft	Denomination, Features	Fitted in actuator housing
A	Drive shaft 180 mm long, without oil bores	1
B	Drive shaft 180 mm long, without oil bores for bearing bush	2
C	Drive shaft to 2 nd rear axle, 594 mm long, with 14 connection teeth	3
D	Brake shaft, 216 mm long, with interrupted external spline for brake disc of parking brake	4

27.2 Ensure end cover and bush seat securely. If necessary, apply Loctite 242.

27.3 Fit oil collector plate approximately 0.5 mm below edge of housing sealing surface. Secure bolt with Loctite 242 (see Fig 16).

CAUTION

EQUIPMENT DAMAGE. When assembling all wheel drive actuator housing ensure two balls are securely fitted into drillings under cover plate. There must be no oil return bore in the all wheel drive housing.

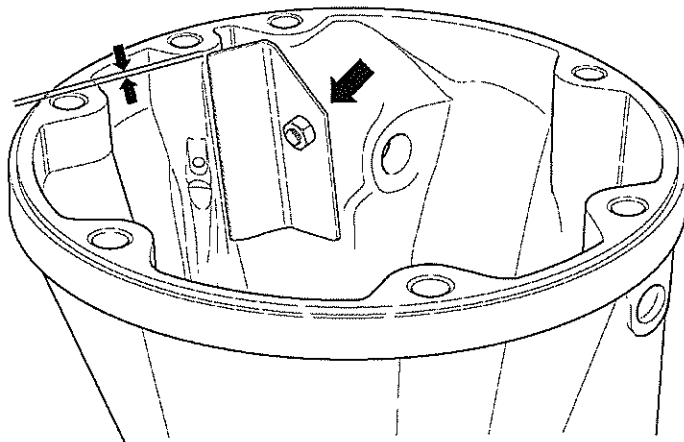


Fig 16 Oil collector plate

27.4 Renew selector shaft V-ring.

27.5 Insert selector shaft with return spring. Smear thread and head of guide bolt with Loctite 242, then tighten (see Fig 17).

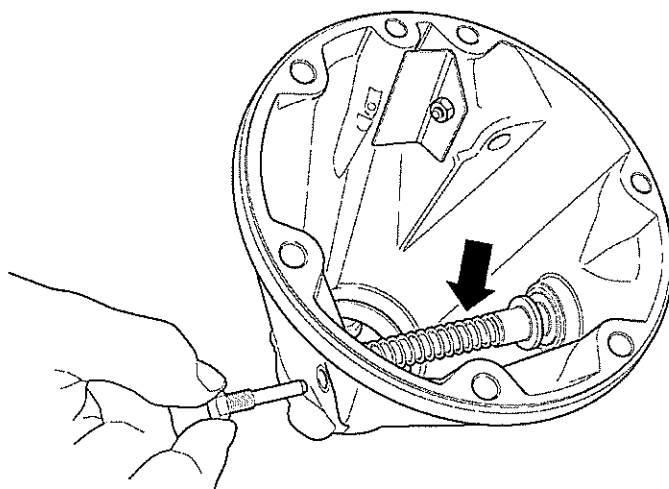


Fig 17 Refitting selector shaft

27.6 Moisten sealing surface of housing with Loctite 574.

27.7 Press new oil seal into all wheel drive/differential lock actuator housing cover. Lubricate oil seal lip and refit end cover to drive shaft.

27.8 Heat deep groove ball bearing to 80 °C and slip on until stop. When cool, check for free play, repress or reset if necessary.

CAUTION

EQUIPMENT DAMAGE. Only the one sided covered bearing (covered side facing housing) must be mounted to all wheel drive actuator housing.

27.9 Fit circlip.

NOTE

Only apply Loctite 641 to fitting surfaces. Remove excess Loctite after approximately half an hour. Observe hardening times:

Hand firmness	10-20 minutes
Final firmness	10 hours

27.10 Place housing with bearing bore on heating plate, heat to approximately 80 °C and insert drive shaft.

27.11 Fit circlip and insert drive shaft until bearing stops at circlip.

CAUTION

EQUIPMENT DAMAGE. Ensure end cover is correctly located to oil bore.

27.12 Clamp housing into vice. Cover thread and head of socket head fixing bolts with Loctite 242 and tighten.

27.13 Fit sliding blocks into selector fork and fit operating sleeve with collar pointing upwards. Slip onto splines of drive shaft. Ensure that pins of selector fork engage into V-ring of spring loaded bolt.

27.14 Fit new O-ring to selector fork spindle, lubricate spindle and insert until stop.

27.15 Check V-ring is correctly positioned on bush.

DRIVE (QUILL) SHAFT BEARING BUSH – (ALL WHEEL DRIVE ACTUATOR HOUSING)

Removal

28 To remove drive shaft bearing bush proceed as follows:

NOTE

Bearing bush is only mounted in drive shaft of all wheel drive actuator housing.

28.1 Check bearing bush; specified value (diameter) is 12.027 mm, wear limit (diameter) is 12.3 mm.

28.2 If the plain shank of a 12.3 mm twist drill can be inserted into bearing bush, replace bearing bush (see Fig 18).

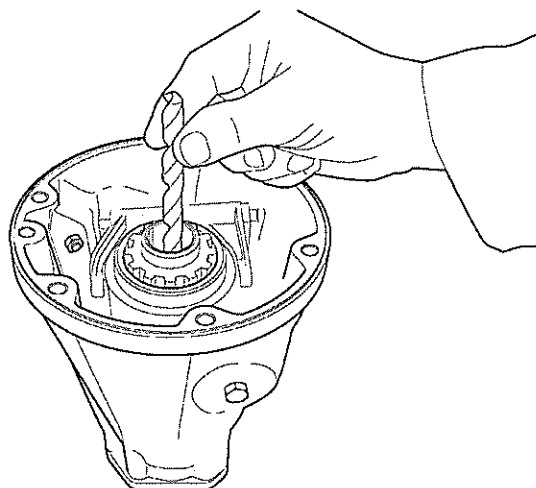


Fig 18 Checking bush bearing wear

- 28.3 Pull out bearing bush with suitable puller.

Refitting

- 29 To refit drive shaft bearing bush proceed as follows:

29.1 Clean bore of bearing bush in drive shaft.

29.2 Grease bearing bush and press in.

TRANSMISSION AND DIFFERENTIAL LOCK CONTROL SYSTEM

SPRING LOADED BOLT V-RING IN ALL WHEEL DRIVE ACTUATOR HOUSING

Removal

- 30 To remove spring loaded bolt V-ring proceed as follows:
- 30.1 Remove selector fork spindle by lifting with screwdriver at circlip groove.
- 30.2 Remove selector sleeve with selector fork.
- 30.3 Remove guide bolt and actuator shaft with return spring.
- 30.4 Visually check all parts for re-usability.

Refitting

- 31 To refit selector shaft and V-ring proceed as follows:
- 31.1 Renew V-ring, insert actuator shaft with return spring. Cover thread and head of guide screw with Loctite 242 and tighten.
- 31.2 Check actuator housing (see Para 26).

REPLACE PNEUMATIC CONTROL SYSTEM AIR FILTER AND DRYER

- 32 To replace the air filter and dryer for all wheel drive pneumatic system proceed as follows:
- 32.1 Remove knee guard from below steering column.
- 32.2 Renew air filter and dryer (see Fig 19).

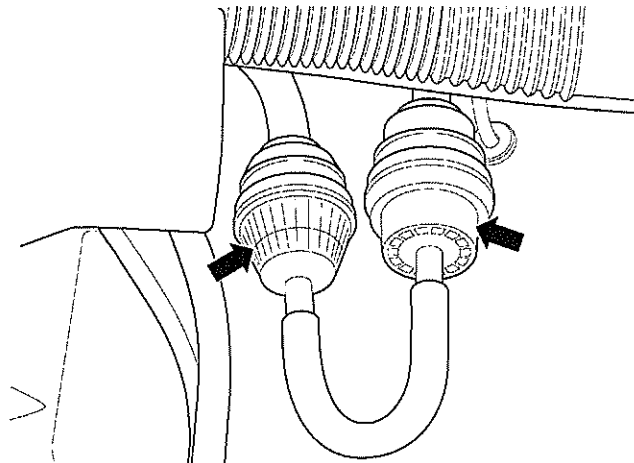


Fig 19 Pneumatic system filter/dryer

- 32.3 Replace knee guard.

PNEUMATIC ACTUATOR ASSEMBLY

Removal

- 33 To remove the pneumatic actuator assembly proceed as follows:

NOTE

The pneumatic actuators for differential locks and all wheel drive are identical. Changing and checking procedures are the same for both systems.

- 33.1 Before removing, check assembly in fitted position.

33.1.1 Pull off vacuum tube and connect vacuum pump. Actuate pump until it reaches 500- 600 mbar. If vacuum is not produced or maintained, remove pneumatic actuator assembly and continue checking (see Fig 20).

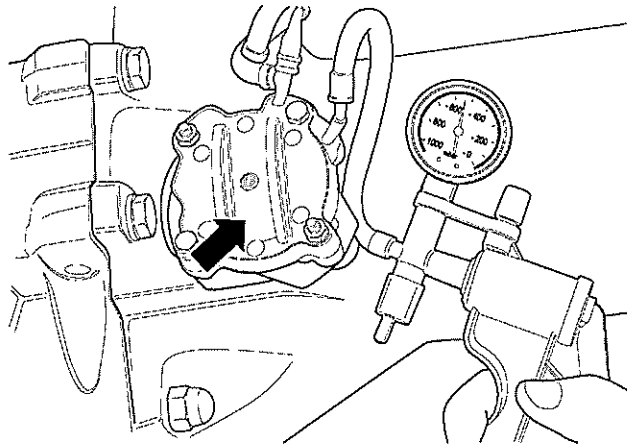


Fig 20 Testing pneumatic actuator

33.2 Cut through cable clip and separate electrical connector. Mark pipes and actuator body to assist in re-assembly and remove vacuum and vent pipes. Take off nuts and washers and remove pneumatic actuator.

CAUTION

EQUIPMENT DAMAGE. Two bolts secure assembly casing of pneumatic actuator. These must not be loosened.

Refitting

- 34 To refit pneumatic actuator proceed as follows:

34.1 Before re-fitting test pneumatic actuator and replace if necessary.

34.2 Smear assembly and new gasket with Loctite 574 and mount onto selector shaft.

34.3 Secure assembly with nuts and washers.

34.4 Replace pneumatic tubes, cable clips and electrical plugs, ensure that tubes and plugs are fitted to their original position.

CHECK SOLENOID VALVE**NOTE**

To enable electro pneumatic selection of all wheel drive and differential locks, three identical solenoid valves are used. These are fitted adjacent to the air duct below the central cover of the instrument panel. Correct tube connection pattern is engraved on right hand of solenoid valve body. Checking procedure of each solenoid valve is dependent upon position in pneumatic system. Checks refer to both opening and secure closing of valves (see Fig 21).

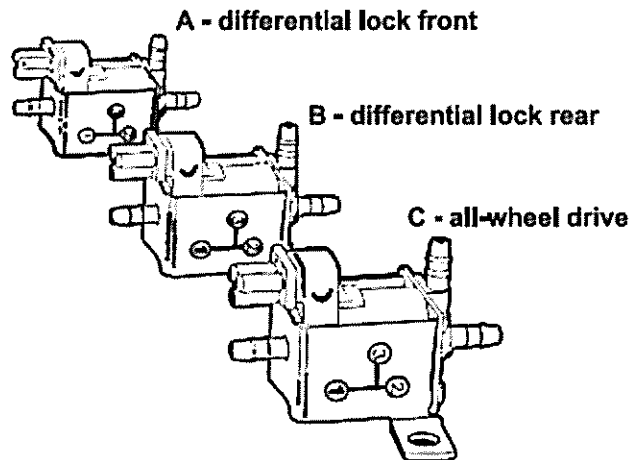


Fig 21 Vacuum solenoid valves

Rear differential lock

35 To check rear differential lock solenoid valve proceed as follows:

35.1 Remove central cover.

35.2 Pull off pneumatic tube at connection No. 2 and connect vacuum pump. Produce vacuum of 500 - 600 mbar. If vacuum drops, replace solenoid valve.

35.3 Pull off pneumatic tube at connection No. 1 and connect vacuum pump.

35.4 Turn ignition lock to position 2 and switch on rear differential lock. Solenoid valve must switch audibly. If not, refer to AESP 2320-D-503-512, Chapter 13. Actuate vacuum pump until vacuum has reached 500-600 mbar. If vacuum drops, replace solenoid valve (see Para 38).

35.5 Reconnect pneumatic tube and fit central cover.

Front differential lock

36 To check the front differential lock solenoid valve, proceed as follows:

36.1 Access solenoid valve (see Para 35.1 to 35.3).

36.2 Turn ignition lock to position 2. Engage rear differential lock. Toggle control lamp must light up. If not, start engine, run for 10-20 seconds and move vehicle. If no change start fault finding.

36.3 Switch on front differential lock. Solenoid valve must switch audibly, if not see electrical fault finding. Actuate pump until vacuum reaches 500-600 mbar. If vacuum drops, replace solenoid valve (see Para 38).

36.4 Reconnect all pneumatic tubes. Fit central cover.

All wheel drive

37 To check all wheel drive solenoid valve proceed as follows:

37.1 See Para 35.1 to 35.3.

37.2 Select high range in transfer gearbox.

37.3 Turn ignition lock into position 2 and actuate vacuum pump until it reaches 500-600 mbar. If vacuum drops, replace solenoid valve (see Para 38).

37.4 Reconnect pneumatic tubes. Fit central cover.

REPLACE SOLENOID VALVE

38 To replace solenoid valve, proceed as follows:

38.1 Remove central cover.

38.2 Disconnect electrical plug.

38.3 Remove pneumatic tubes and moulded parts.

38.4 Loosen both nuts, remove washer and solenoid valve.

38.5 Fitting is done in reverse sequence. Mount clamping ring at connection No. 3.

38.6 Fit central cover.

CHECK VACUUM RESERVOIR

39 To check vacuum reservoir for all wheel drive and differential locks proceed as follows:

39.1 Remove left floor plate.

39.2 Pull off distributor piece and tube at vacuum reservoir.

39.3 Connect vacuum pump to reservoir. Actuate pump to produce a vacuum of 500-600 mbar. If vacuum drops, replace reservoir (see Fig 22).

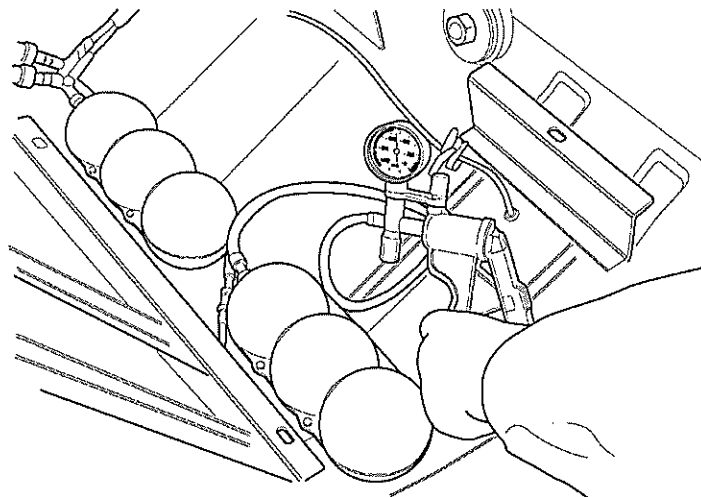


Fig 22 Testing vacuum reservoir

39.4 Fit distributor piece and tube.

CHECK NON-RETURN VALVES

40 To check non-return valves for all wheel drive and differential locks proceed as follows:

40.1 Remove left floor plate.

40.2 Depending on which vacuum unit is being checked, pull off distributor piece (differential locks) or moulded hose (all-wheel drive) at vacuum reservoir.

40.3 To check non-return valves, seal respective tube from vacuum reservoir to solenoid valves at distributor piece with a clamp.

40.4 Connect hand pump to distributor piece or moulded hose and produce vacuum of 500-600 mbar. Actuate brake pedal about 5 to 10 times. If vacuum drops replace non-return valve.

40.5 When fitting new non-return valves, ensure valve operates in correct direction. Air must flow into engine (engine mounted vacuum pump), valve must close when air flow is in opposite direction (towards vacuum reservoir).

40.6 Fit distributor pieces and tubes.

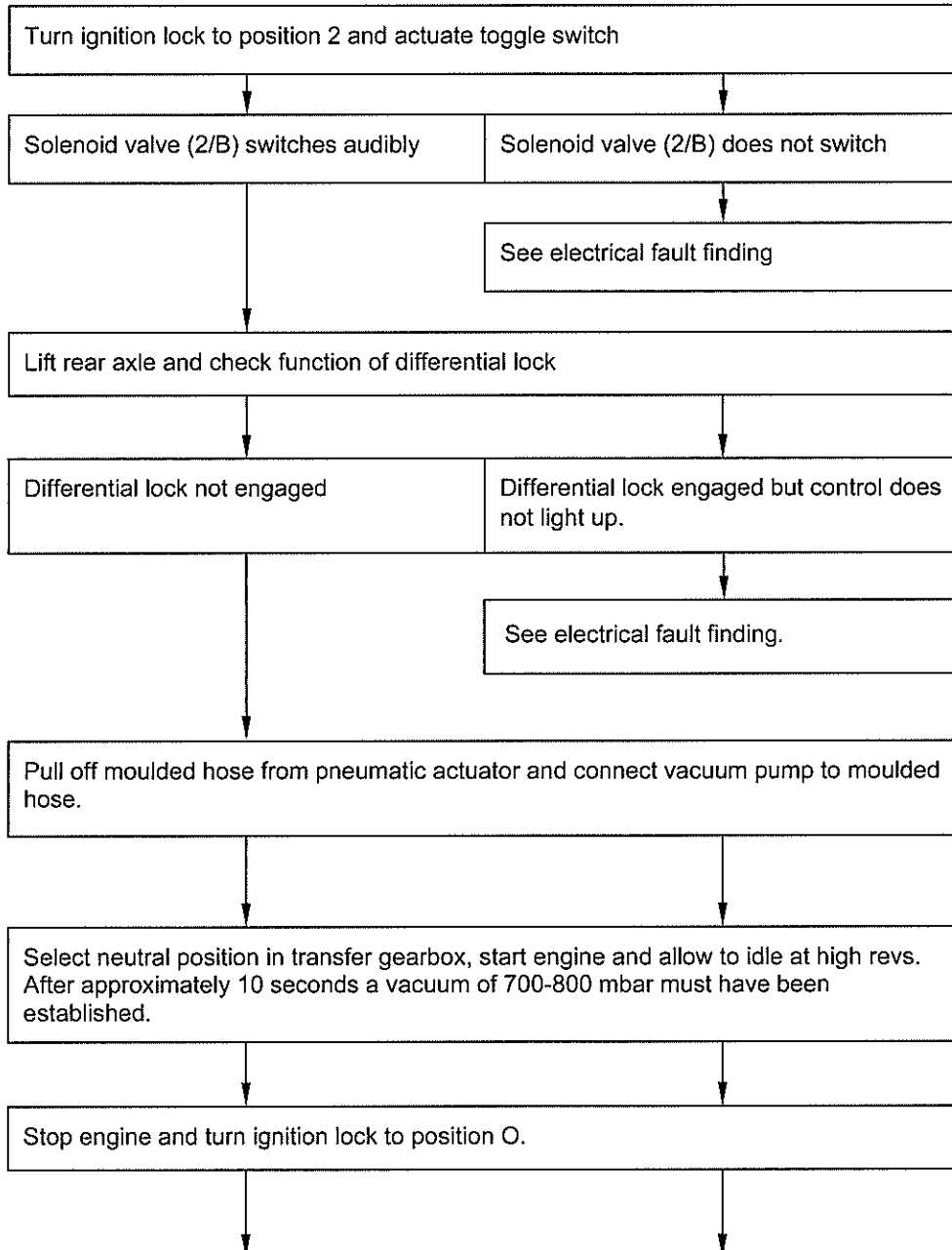
CHECK DIFFERENTIAL LOCK ENGAGEMENT

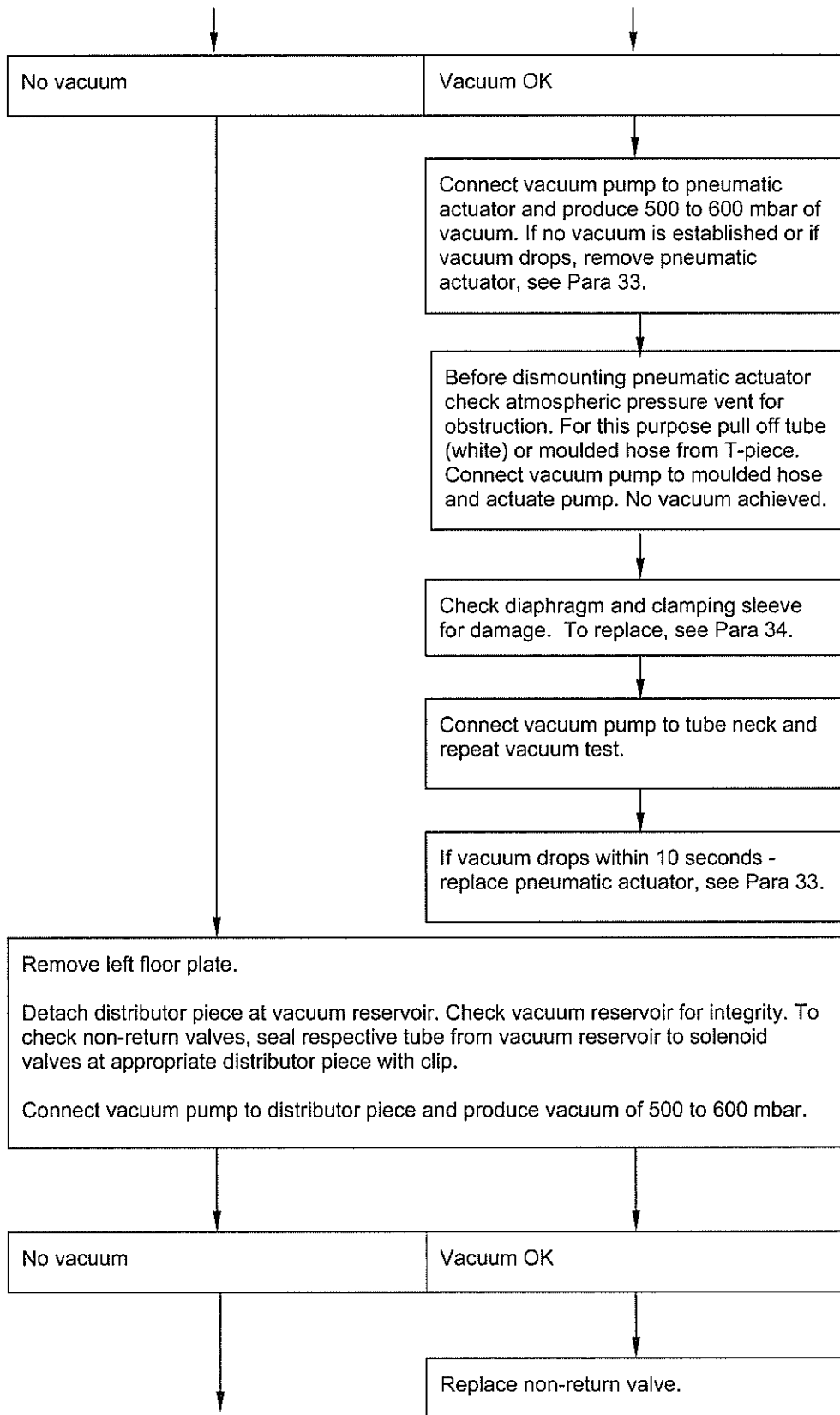
Rear differential lock

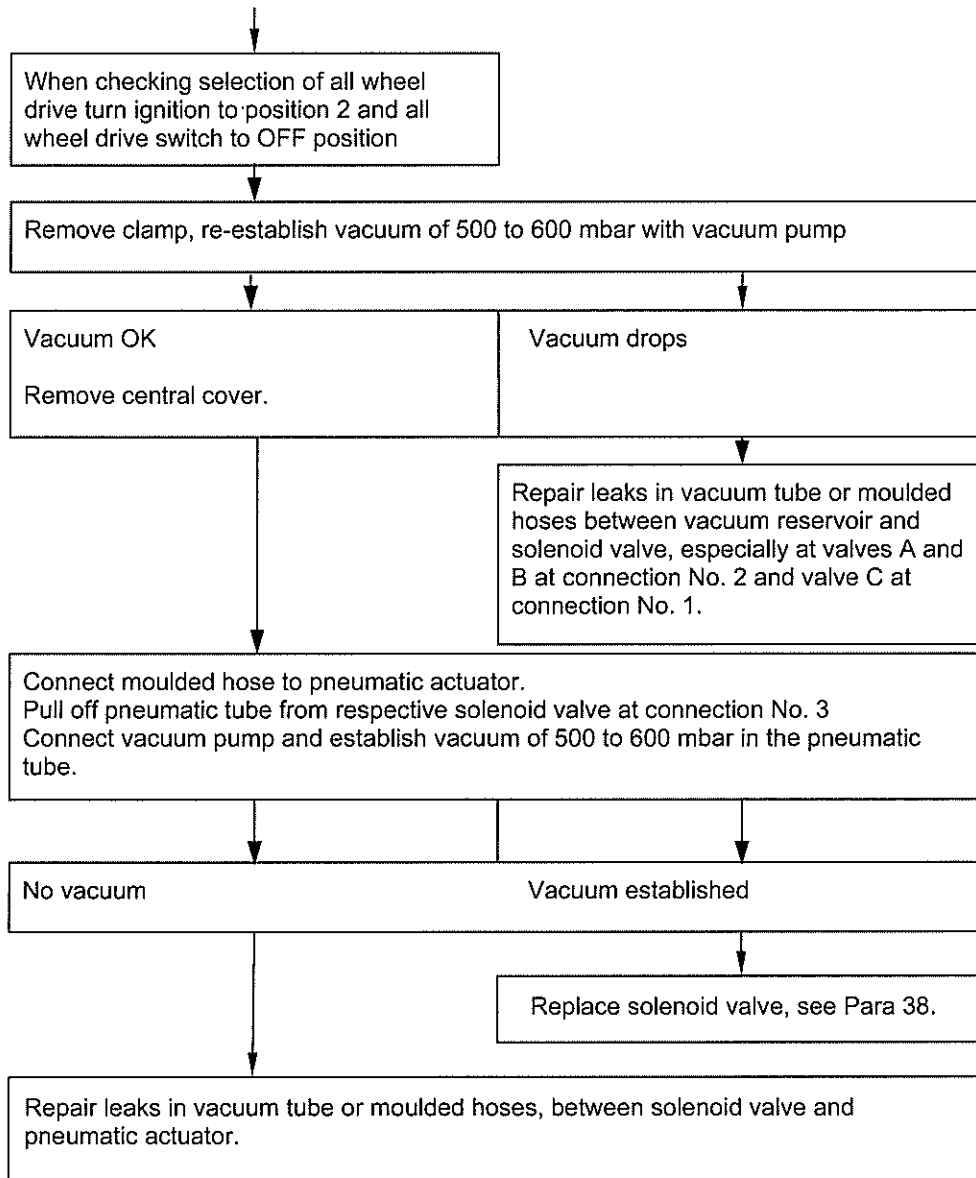
WARNING

DANGER TO LIFE AND LIMB. DO NOT RUN ENGINE IN CLOSED ROOMS WITHOUT VENTILATION.

41 To check the rear differential lock engagement proceed as follows:







Front Differential Lock

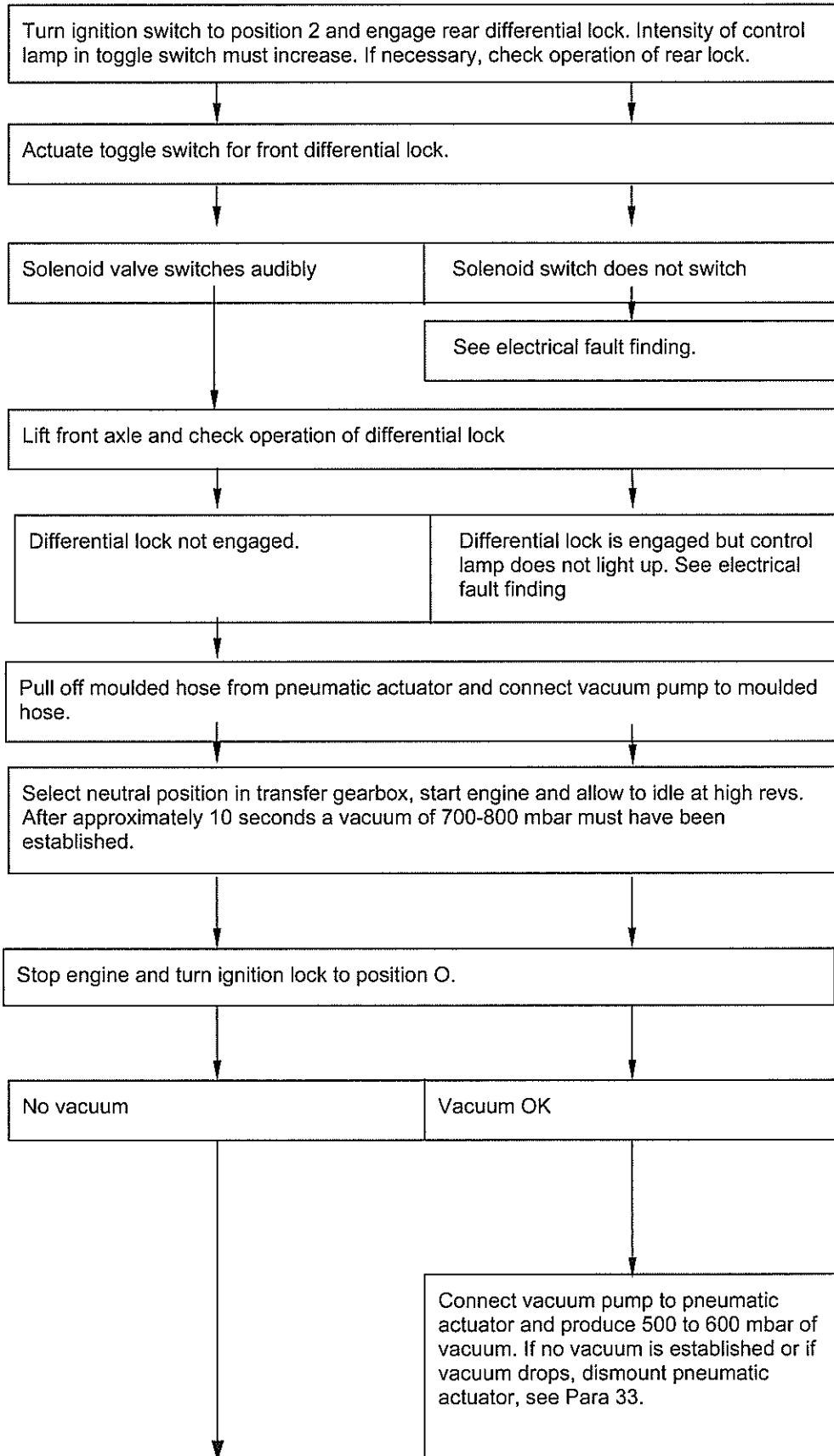
42 To check the front differential lock engagement proceed as follows:

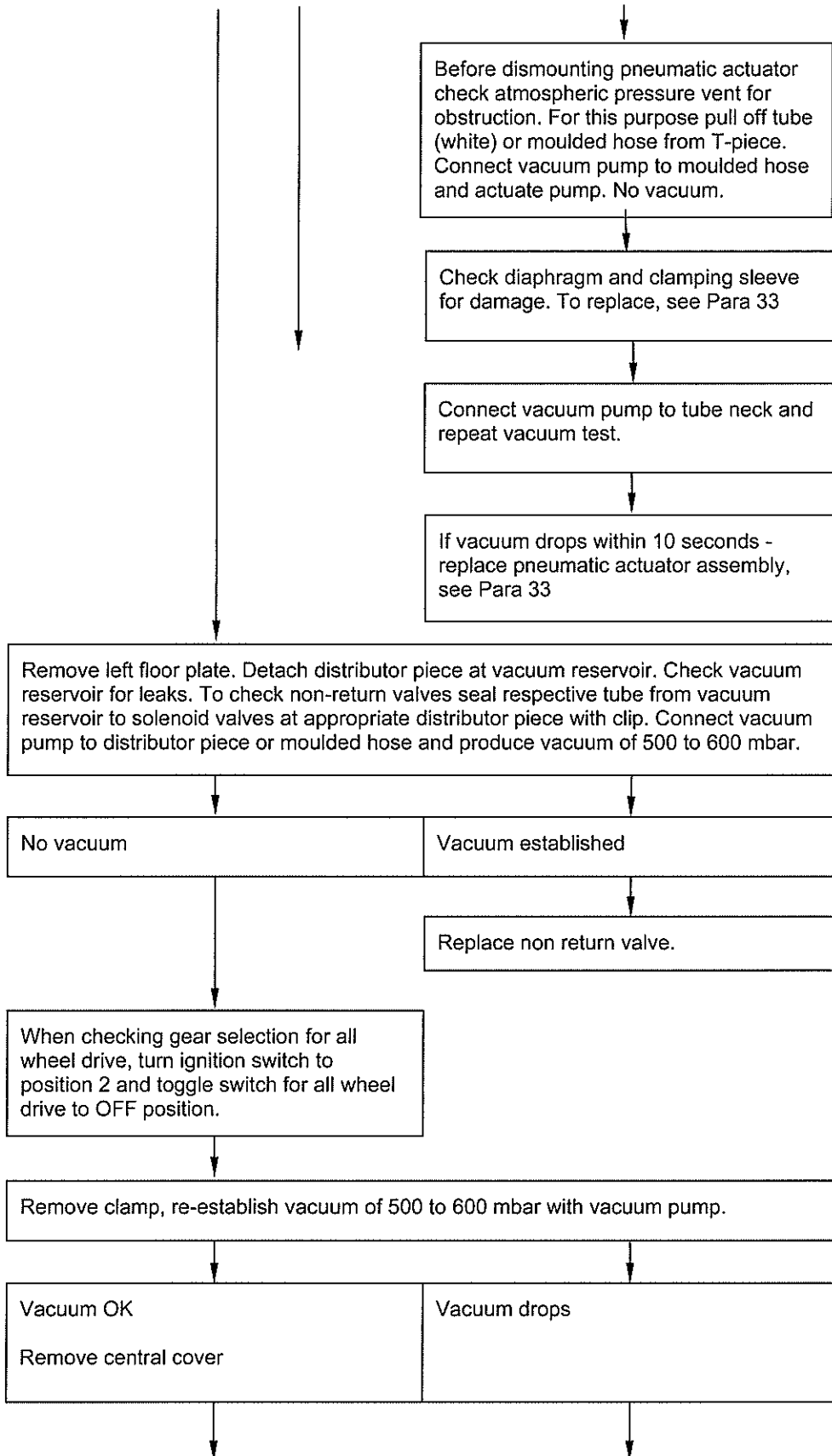
WARNING

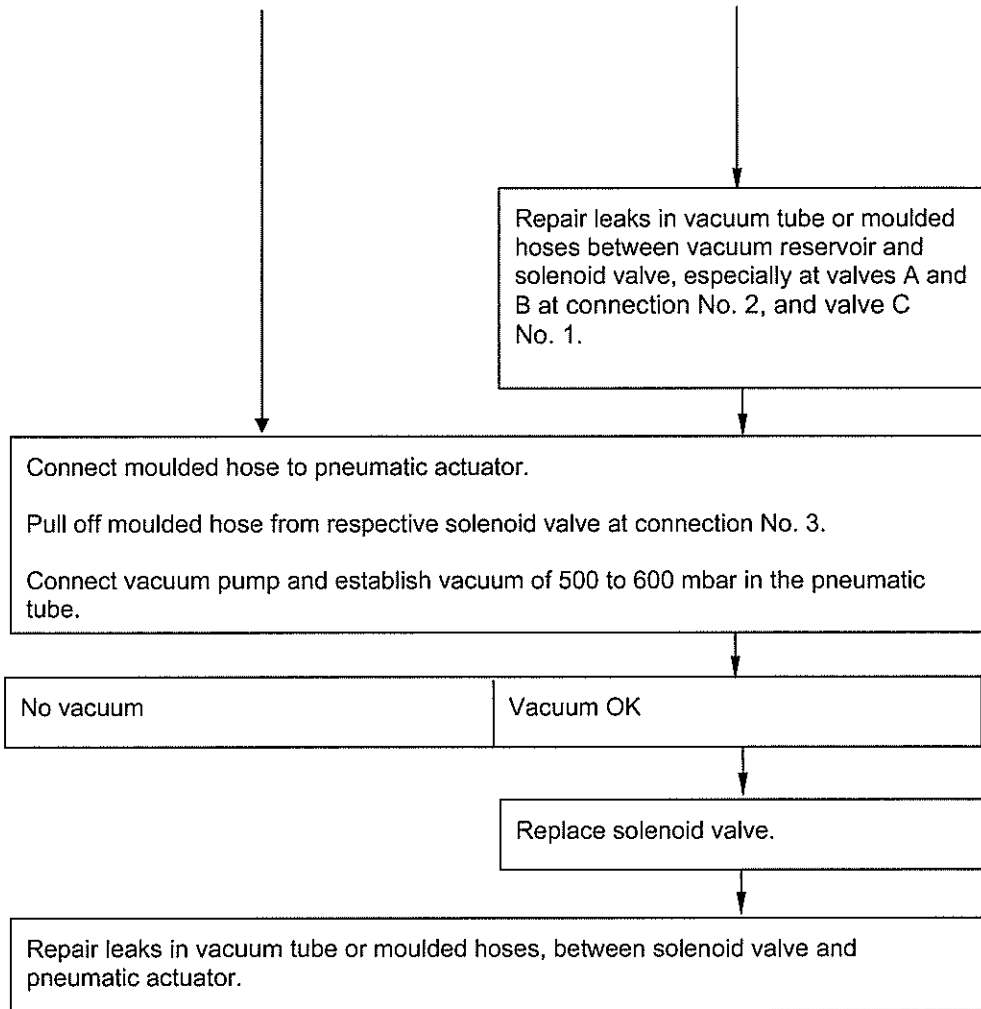
DANGER TO LIFE AND LIMB. DO NOT LET ENGINE RUN IN CLOSED ROOMS WITHOUT VENTILATION.

NOTE

Front differential lock will not be actuated unless rear differential lock is already engaged. Intensity of control lamp in switch increases when differential lock selection is complete.



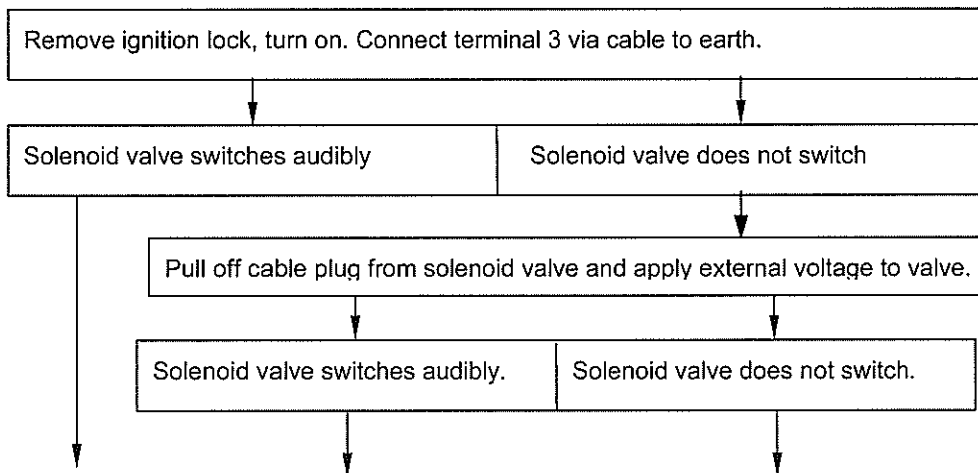


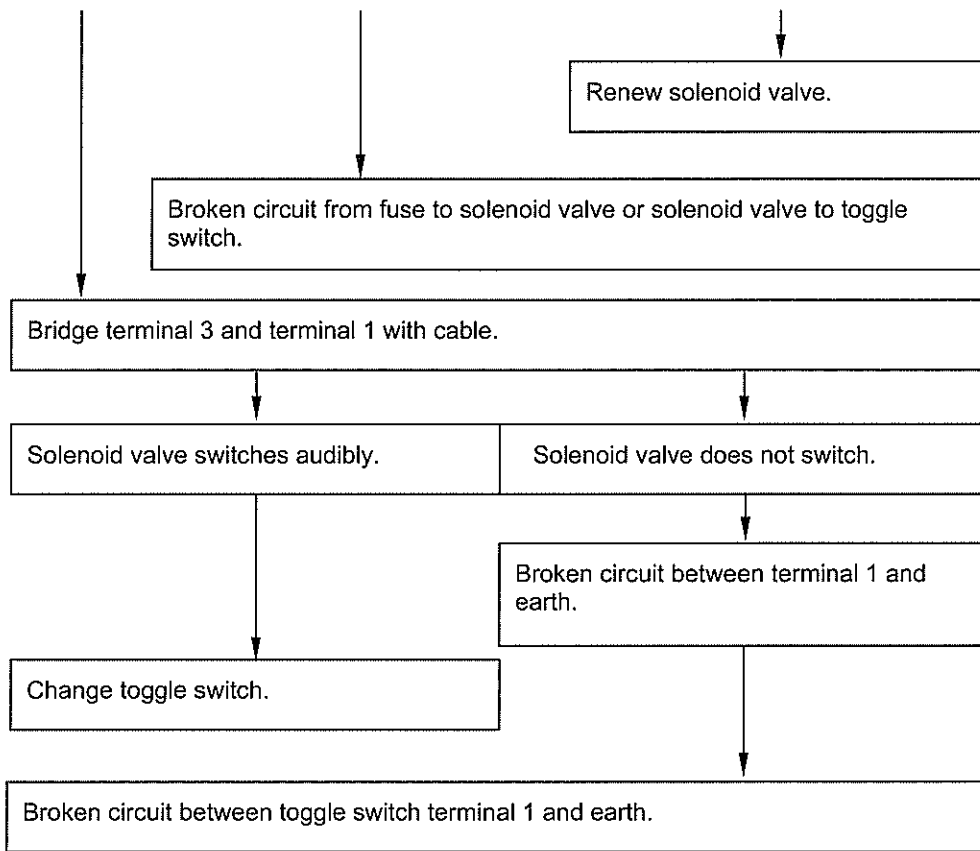


42.1 Front differential lock control lamp in toggle switch does not illuminate when front differential lock selected with rear differential lock switched on.

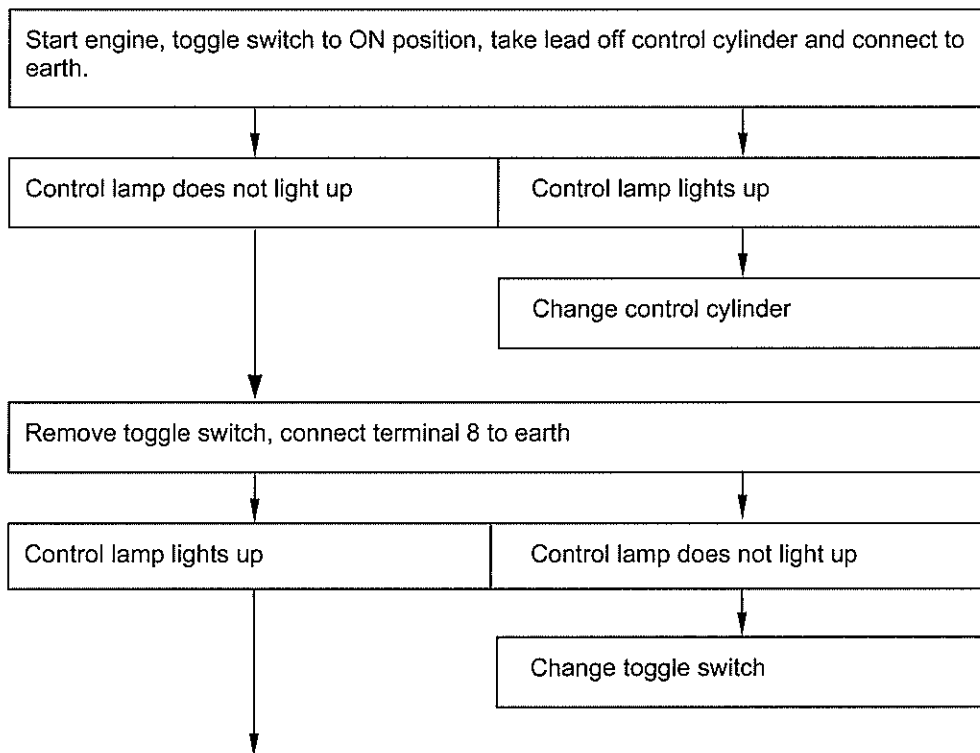
CAUTION

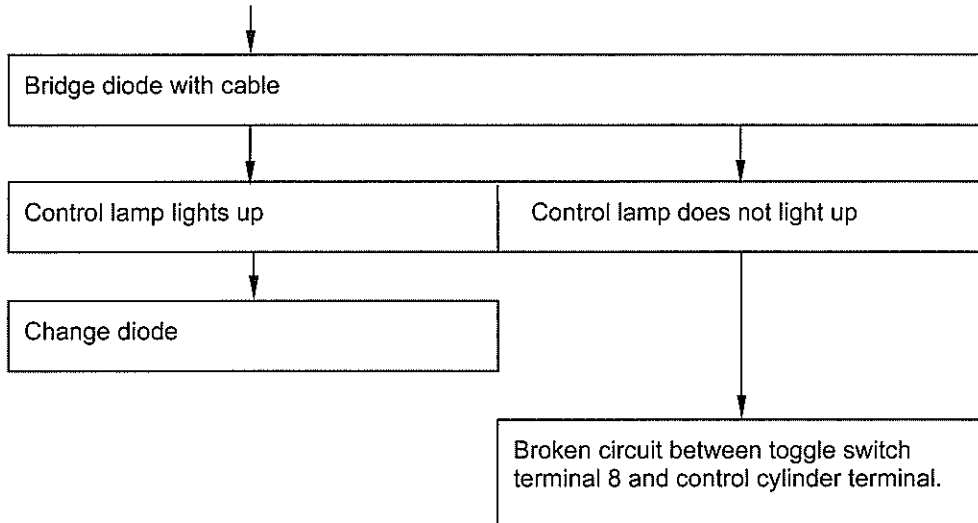
EQUIPMENT DAMAGE. Observe polarity. In the event of reversing poles diode in solenoid valve will be destroyed.





42.2 Differential lock control lamp of rear axle does not light up despite audible switching of solenoid valve.



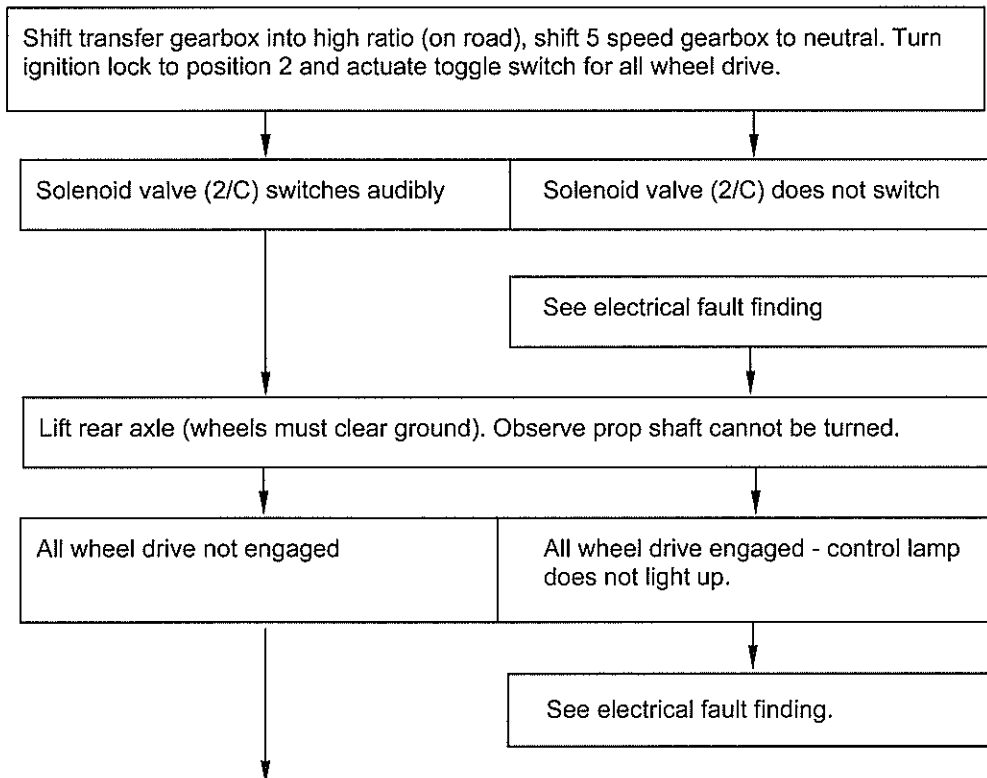


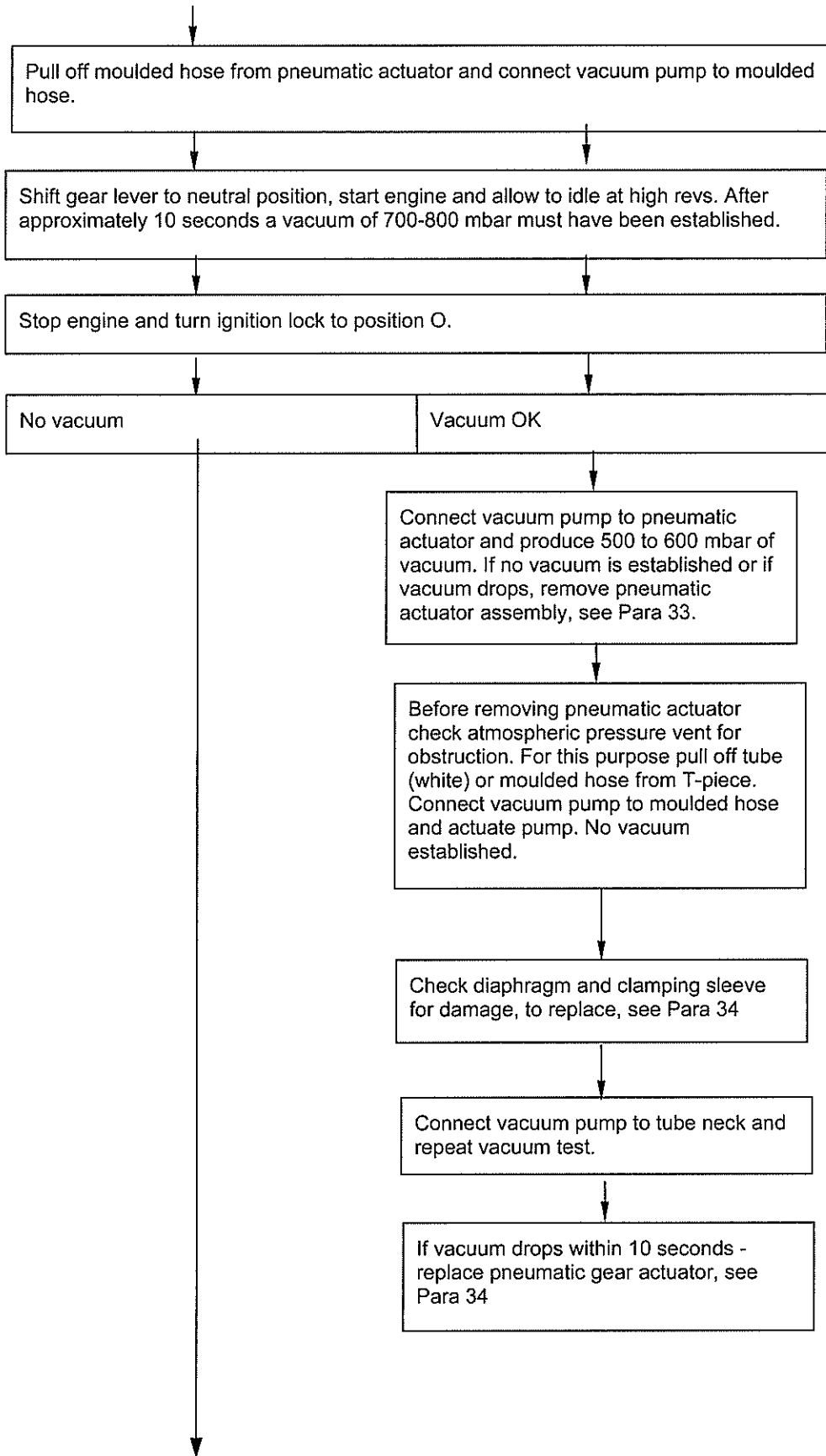
CHECK ALL WHEEL DRIVE SELECTION

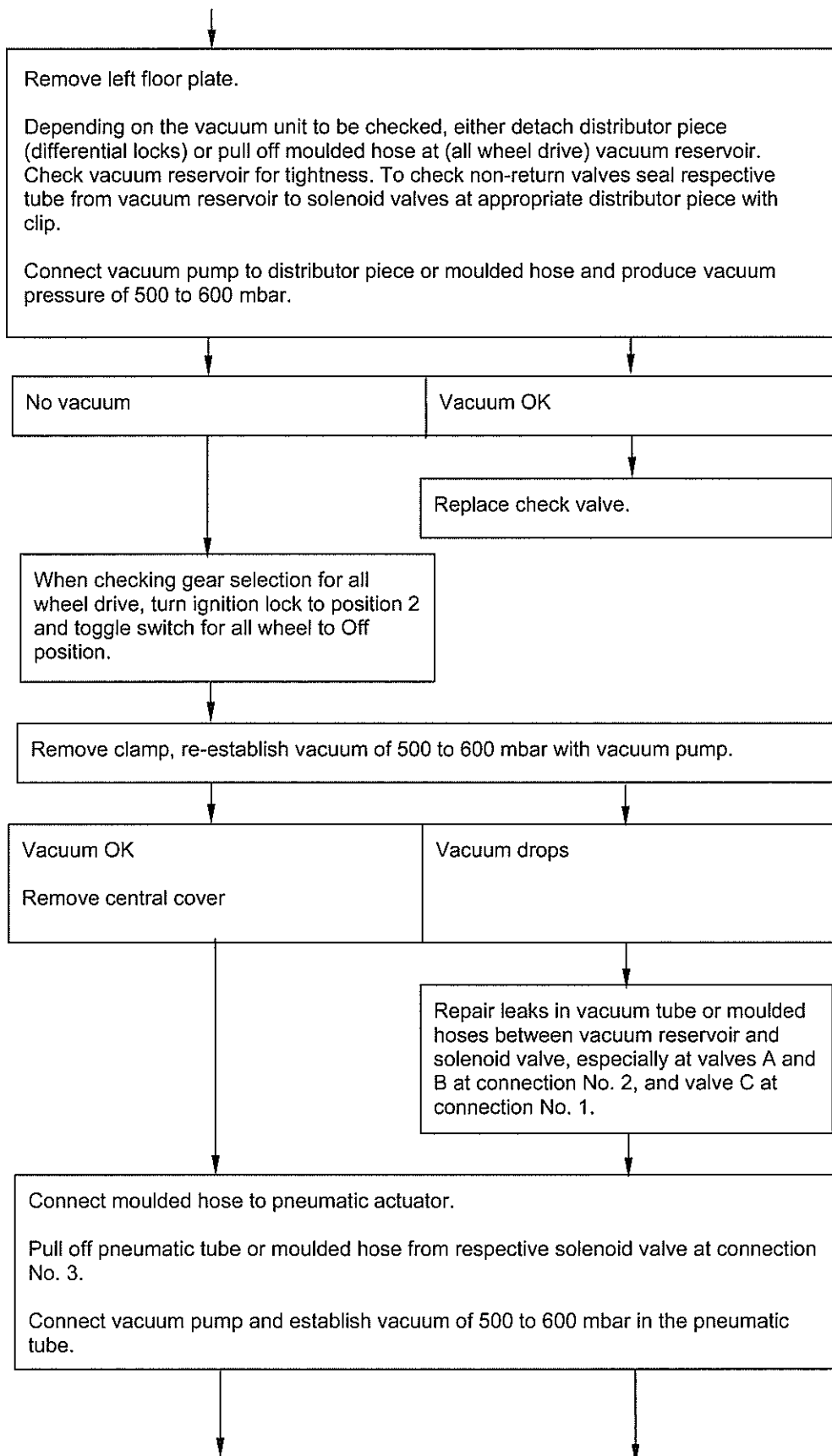
43 To check the all-wheel drive selection proceed as follows:

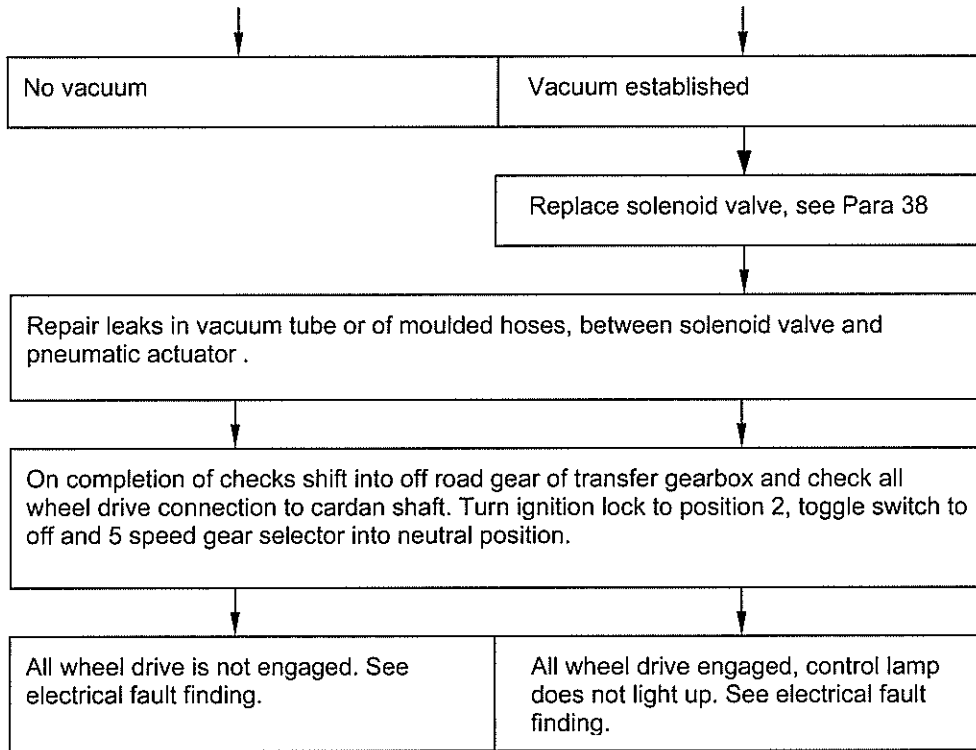
WARNING

TOXIC FUME HAZARD. DO NOT RUN ENGINE IN CLOSED OR POORLY VENTILATED BUILDING.

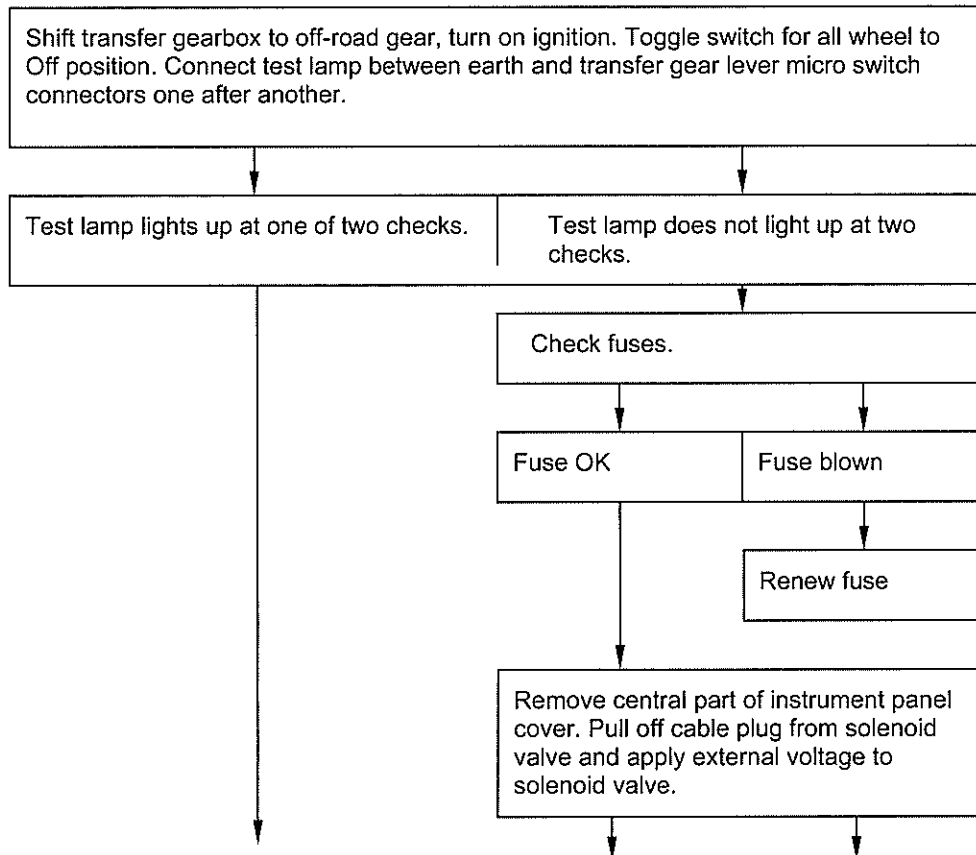


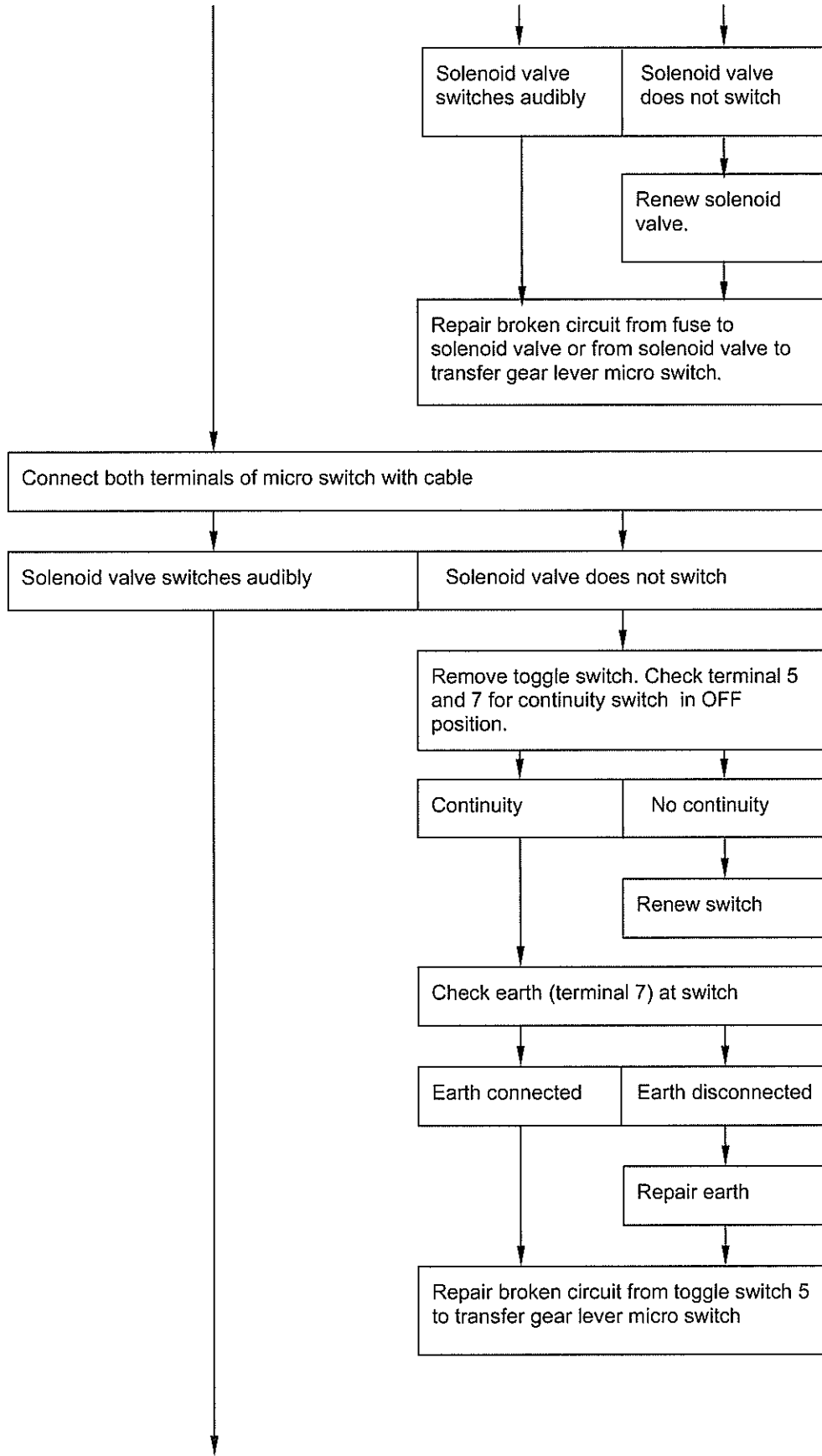


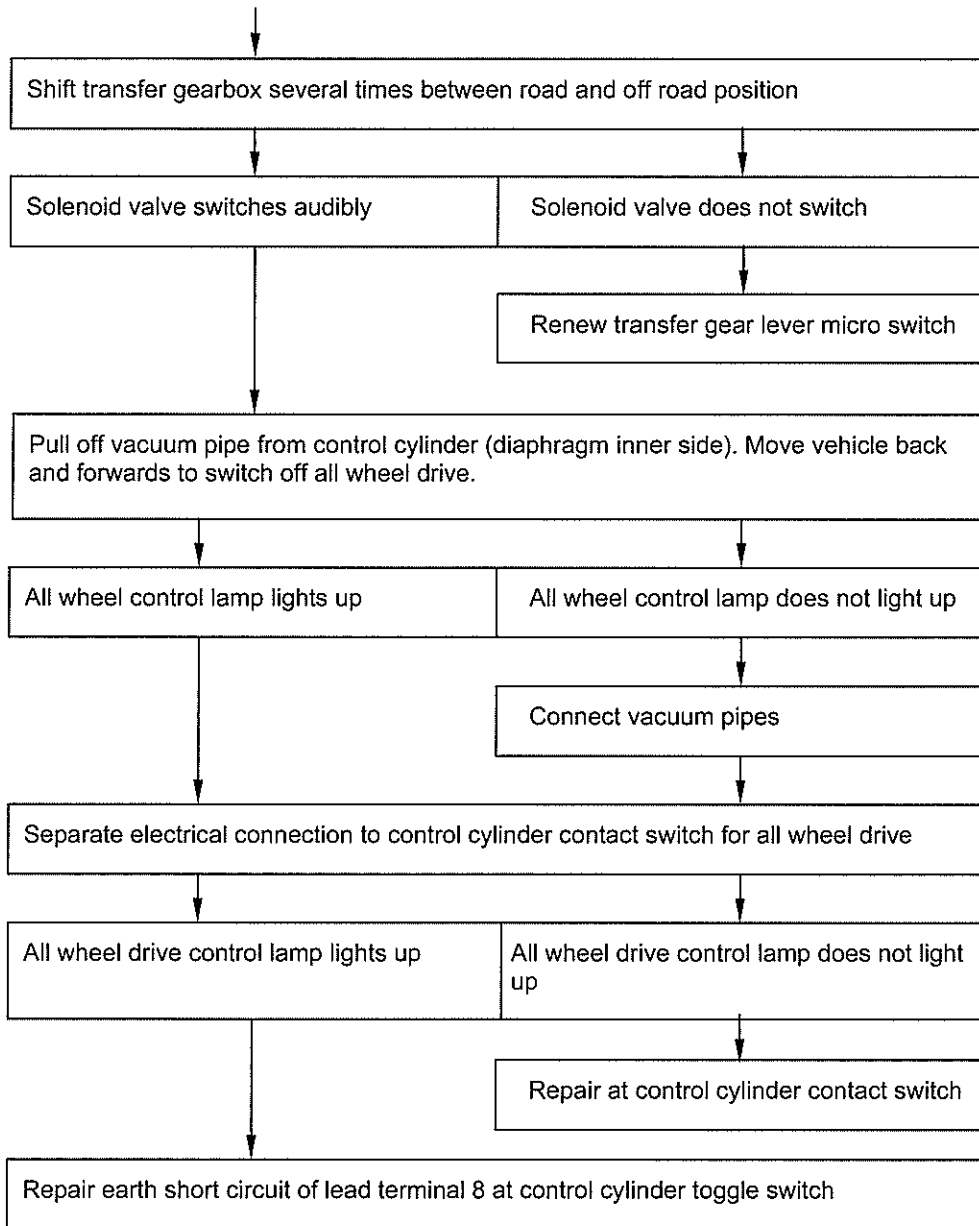




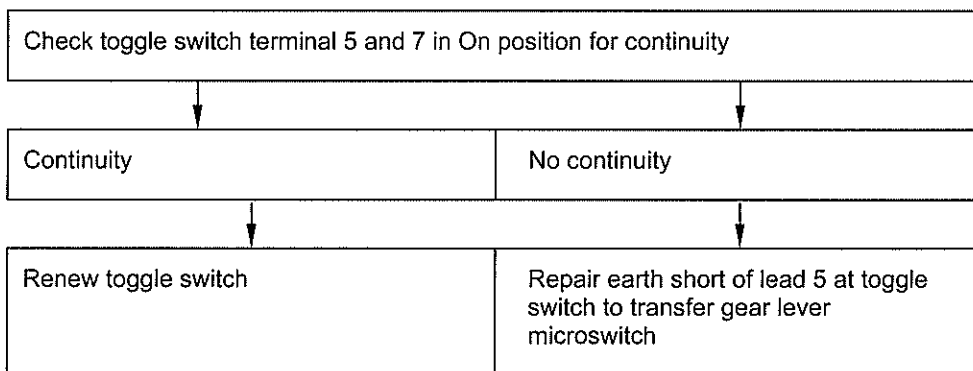
43.1 All wheel control lamp lights up during driving (toggle switch position 0, all wheel drive switched off, road gear on).







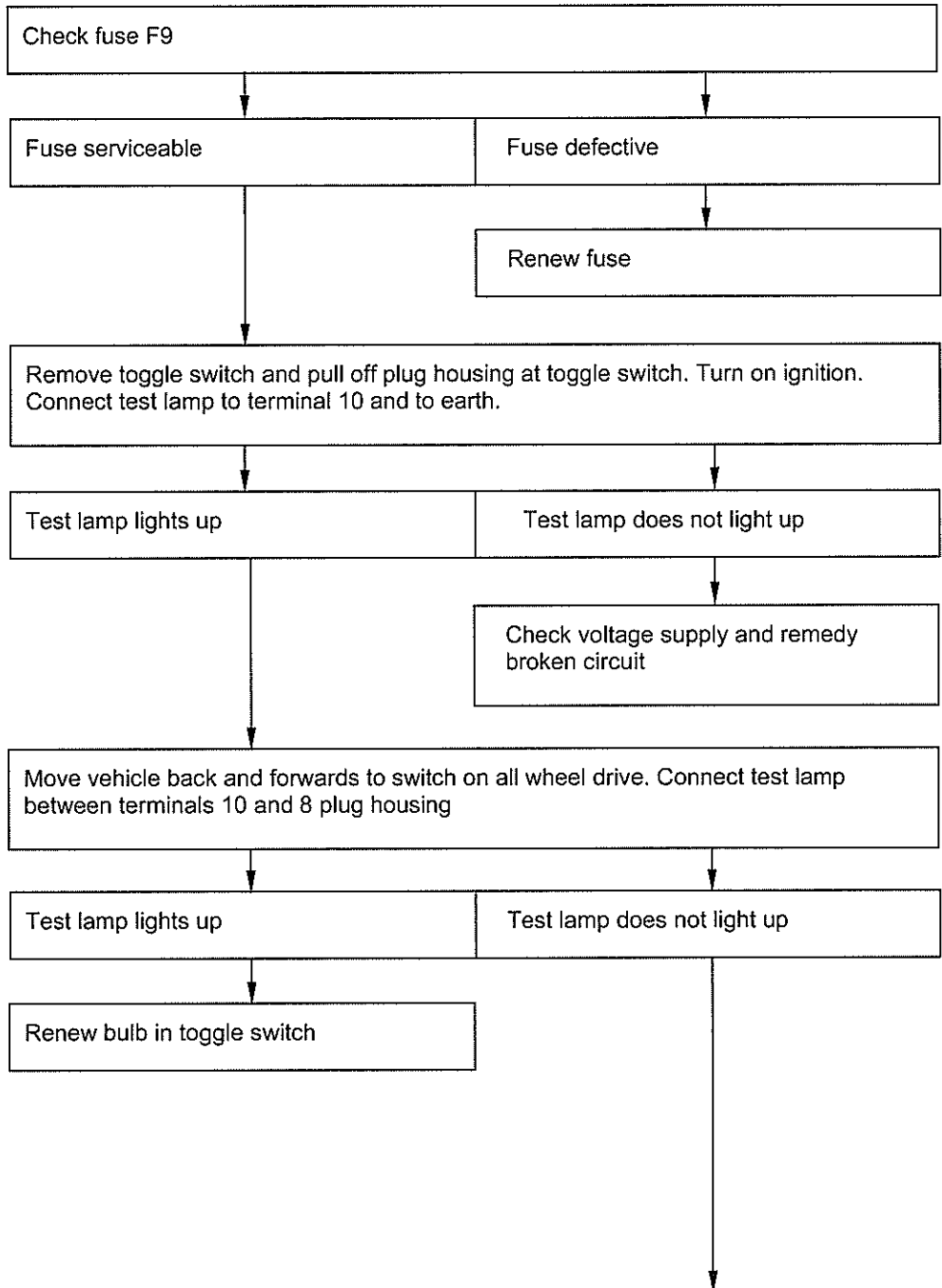
43.2 All wheel control lamp does not light up during driving. Toggle switch in ON position (all wheel drive switched on) but lights up when transfer gearbox low range is selected.

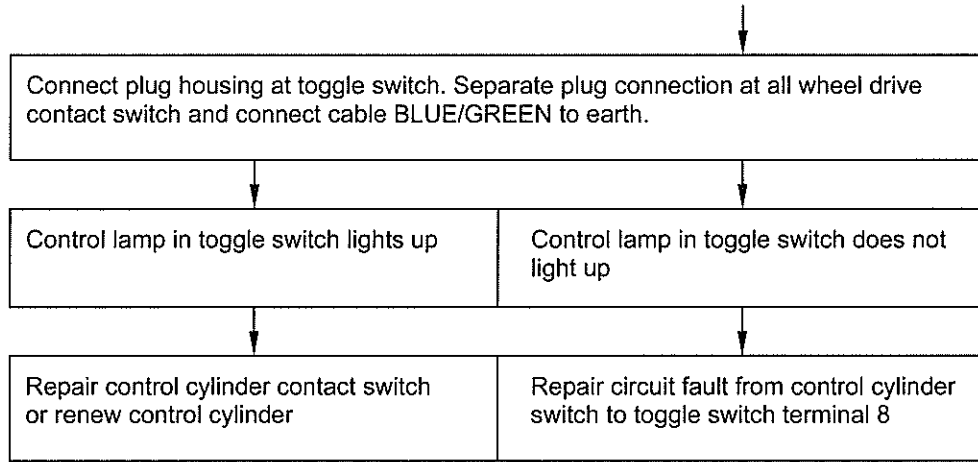


43.3 All wheel drive control lamp lights up during driving, toggle switch ON (all wheel drive switched on), but does not light up when off road gear is selected.

43.4 Renew transfer gear lever microswitch.

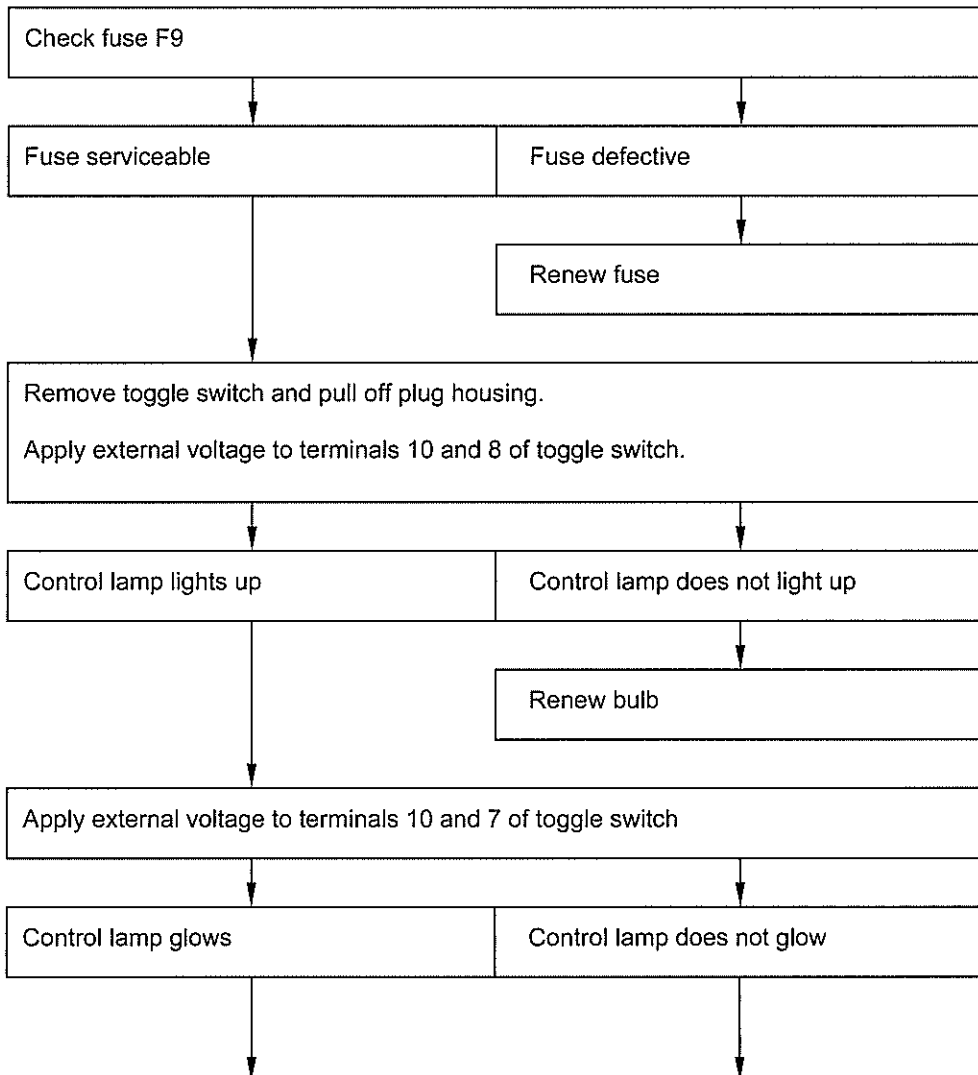
43.5 Control lamp does not light up during driving, toggle switch ON and off road gear is selected.

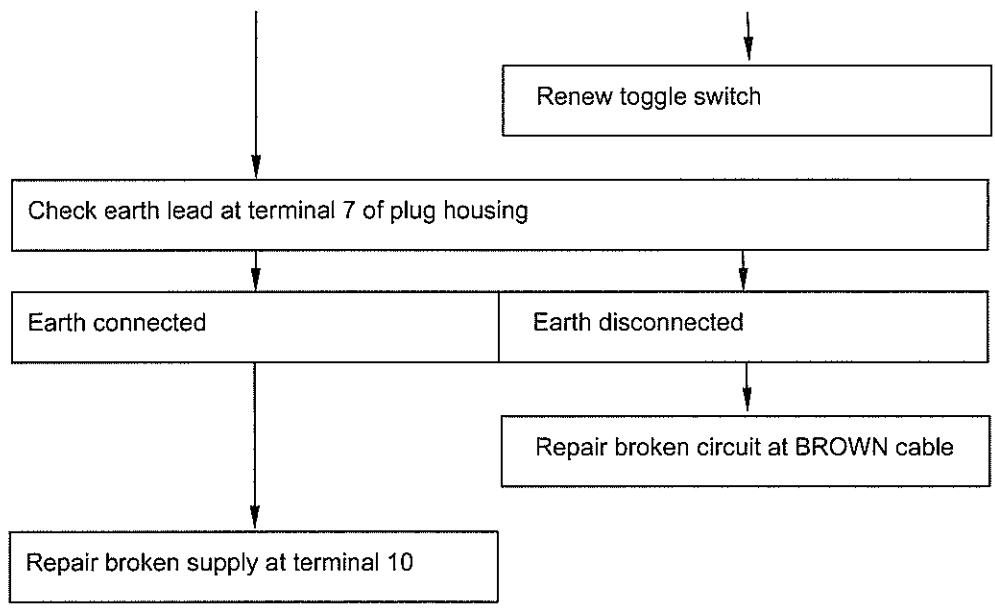




43.6 When no electrical defect can be found, check vacuum pipes.

43.7 Control lamp does not glow after turning on ignition.





CHAPTER 5

AXLES

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Chap

- 5 Axles
- 5-1 Front axle
- 5-2 Rear axles

RESTRICTED

RESTRICTED

CHAPTER 5-1

FRONT AXLE

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- 3 Torque wrench settings
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INTRODUCTION

1 This chapter details the procedure for all repairs to be carried out on the front axle.

WARNINGS

- (1) **DANGER TO LIFE AND LIMB. NEVER WORK UNDER A VEHICLE SUPPORTED ONLY BY A JACK. ALWAYS USE AXLE STANDS WHICH ARE SUITABLE FOR USE.**
- (2) **DANGER TO LIFE AND LIMB. AFTER JACKING UP, SUITABLE WHEEL CHOCKS SHOULD BE USED ON WHEELS REMAINING ON THE GROUND.**
- (3) **DANGER TO LIFE AND LIMB. LOCTITE AND OTHER SEALANTS MUST BE HANDLED WITH CAUTION AND IN ACCORDANCE WITH THE APPROPRIATE SAFETY DATA SHEET.**
- (4) **DANGER TO LIFE AND LIMB. ENSURE ALL TOOLS ARE IN GOOD CONDITION AND ALWAYS USE THE CORRECT TOOL FOR THE JOB.**

CAUTION

EQUIPMENT DAMAGE. Before operating vehicle, ensure all oils and lubricants are filled to the correct level and with the correct specification liquid.

SPECIAL TOOLS AND TEST EQUIPMENT

2 The only special tool required in this chapter is shown below.

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Ser (1)	NSN (2)	Manfr No. (3)	Designation (4)
1	4910-99-930-7037	905.3.33.404.2	Press-off device

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings contained in this chapter are listed below.

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para. (4)
1	Axle to chassis mounting bolts	80	5.4
2	Brake power control bracket bolts	85	5.5
3	Centre beam lateral bolts	60	5.10
4	Body support bolts	250	5.16
5	Axle to centre beam anchor bolts	80	5.11 5.12
6	Towing coupling	85	5.16
7	Panhard rod nut	135	5.18
8	Ball joints crown nut	80	5.20 9.12
9	Steering rod, piston rod clamping bolt	25	5.21
10	Brake pipes	15	5.24 12.3 9.11
11	Shock absorber	200	9.9
12	Wheel bolts	260	5.30 9.15 12.6 14.13 16.9 27.14
13	Track arm nut and bolts	45	24.8 8.18 14.11 24.5 27.11
14	Brake disc counter sunk screws	28	8.19 16.4 24.6 27.12
15	Brake calliper bolts	125	8.19 27.12
16	Spring support bolt	200	8.21 10.9 27.10

(continued)

TABLE 2 TORQUE WRENCH SETTINGS (continued)

Ser (1)	Item (2)	Torque (Nm) (3)	Para. (4)
17	Portal hub centring bolt and anti-fatigue bolts	250	9.8
18	Brake pipe bracket bolts (cheese)	40	9.10 12.2
19	Swivel pin retaining bolts	40	14.8
20	Brake anchor plate bolts	40	24.4 27.4
21	Wheel flange anti-fatigue bolt	250	23.15

FRONT AXLE**Removal**

4 The front axle is removed as follows:

4.1 Drain oil from differential housing.

CAUTION

EQUIPMENT DAMAGE. Use suitable pad (e.g. felt) between trestle and floorpan in order to avoid damage to paintwork or under-seal.

4.2 Lift vehicle with jack on front axle casing until wheels just clear ground. Support vehicle using suitable stands placed under floorpan support rails (see Fig 1).

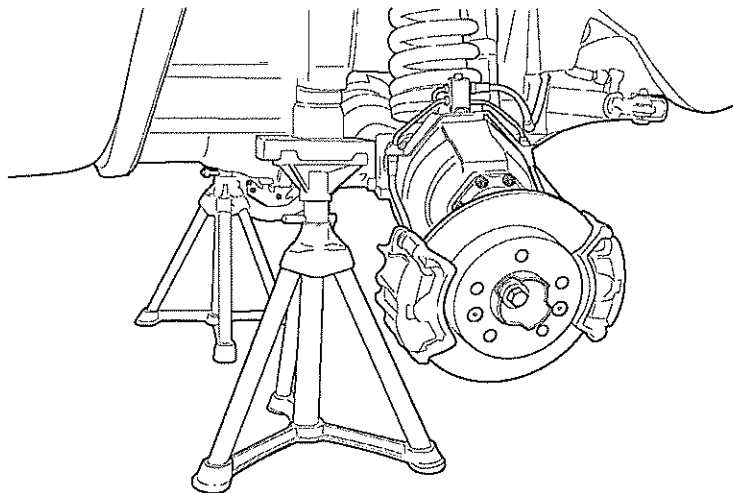


Fig 1 Supporting front body

4.3 Remove wheels.

4.4 Remove coil springs on right and left side of vehicle (see Chapter 8-1).

4.5 Remove split pin from steering drop arm ball joint, remove nut and press out ball joint from drop arm.

4.6 Loosen right and left brake pipes from bracket on body and disconnect brake hoses. Ensure pipe and hose ends are plugged to prevent ingress of dirt (see Fig 2).

NOTE

Mark brake pipes and hoses so that they can be correctly refitted. Collect brake fluid in suitable container.

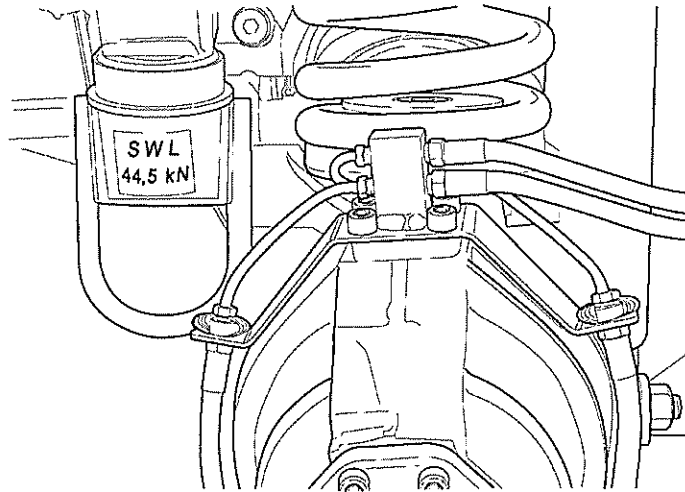


Fig 2 Front brake pipe fittings

- 4.7 Where fitted, disconnect ABS sensor leads from main ABS harness.
- 4.8 Loosen speedometer cable crown nut and remove cable from extension piece at front left of axle. Unscrew extension piece and remove with shaft and thrust washer.
- 4.9 Turn steering wheel to full left hand lock and loosen power steering piston rod clamping bolt, remove piston rod from joint eye.
- 4.10 Extract split pin and remove castle nut from right track rod end. Press out ball joint.
- 4.11 Extract split pin and remove nut from left track rod at drag link arm, adjacent to power steering piston rod. Press out ball joint.
- 4.12 Loosen hydraulic steering hose union nuts at bulkhead glands on foot pan. Collect leaking hydraulic oil in a suitable container. Ensure pressure lines and bulkhead glands are plugged to prevent ingress of dirt and tie back hoses.

NOTE

Mark connection points (bulkhead glands) and pressure lines so that they can be correctly refitted.

- 4.13 Remove front tow-bar coupling bolts and nuts from front centre beam.
- 4.14 Remove left hand floor plate from inside.
- 4.15 Loosen centre beam support bearing from foot pan. To do this remove rubber grommets from front bumper and insert socket through bores. The nut must be removed from inside floorpan. Remove centre beam bearing, bumper, bolt, shim, distance shim(s), distance piece, internal shim and nut.
- 4.16 Loosen but do not remove hexagon nut on Panhard rod (see Fig 3).

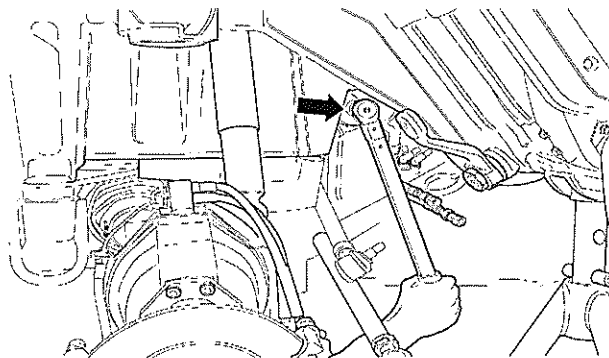


Fig 3 Panhard rod location

- 4.17 Unscrew dome nuts of upper and lower anchor bolts from axle/centre beam joint.
- 4.18 Remove dome nuts from chassis support tube flange. Support front centre beam, loosen lateral fastening bolts and lower centre beam.
- 4.19 Unscrew mounting bracket with Panhard rod from centre beam. Move centre beam forwards, taking care not to damage ball joint rubber boots and remove.
- 4.20 Remove engine cover (see Chapter 16-2).
- 4.21 Remove lower anchor bolts and dome nuts from rear side of axle housing. Unscrew dome nuts of both upper anchor bolts. Push anchor bolts forward so they no longer protrude into chassis support tube flange.

CAUTION

EQUIPMENT DAMAGE. Two bolts secure assembly casing of pneumatic actuator. These must not be loosened.

- 4.22 Unscrew nuts fastening pneumatic differential lock actuator (see Fig 4).

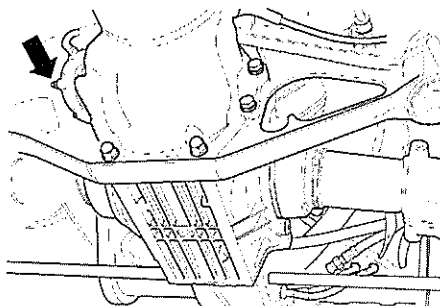


Fig 4 Pneumatic differential lock actuator

- 4.23 Support front axle with jack and loosen side fastening bolts (see Fig 5).

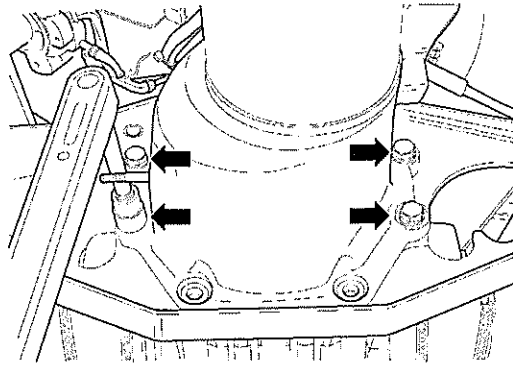


Fig 5 Front axle side fastening bolts

CAUTION

EQUIPMENT DAMAGE. Do not pull front axle too far forward whilst differential lock housing is still engaged with torque tube, as guideways in chassis support tube could be damaged.

4.24 Loosen axle by moving to and fro but do not lower fully as differential lock actuator housing is still meshed with drive shaft. Pull front axle and differential lock housing approximately 120-130 mm out of chassis support tube flange. If necessary, press off torque tube from differential lock housing using tyre lever inserted through pneumatic differential lock bore. When pulling out axle take care not to damage tied back pipes or hoses.

Refitting

5 Refit the front axle as follows:

5.1 Grease torque tube splines with Molycote Long-term No. 2 and slide splines onto transfer gearbox all wheel drive actuator housing. To do this, insert suitable drift or hammer shaft into torque tube. When inserting tube ensure balance weights are on upper side.

5.2 Moisten axle housing sealing surface with Loctite 574.

5.3 Lift axle with jack and insert differential lock housing into chassis support tube flange. Move axle housing onto same level as support tube flange. Smear thread of bolts with Loctite Anti-seize and screw in by hand to centre axle, then push in axle completely.

CAUTION

EQUIPMENT DAMAGE. When fixing axle, ensure bolts are tightened across diagonals, to prevent distortion.

5.4 Spray thread of anchor bolts with Loctite Anti-seize. Insert bolts into tube support flange and axle housing and secure using dome nuts; tighten to correct torque (see Table 2, Ser 1).

5.5 Tighten brake power control bracket bolts to correct torque (see Table 2, Ser 2).

5.6 Slide pneumatic pipe bracket forward into position on axle housing upper side. Attach brake power control and insert bolt several turns. Fix brake power control and tighten all bracket bolts.

5.7 Check condition of rubber seals, diaphragm and clamping sleeve of differential lock pneumatic actuator and ensure they are positioned correctly.

5.8 Fit pneumatic differential lock unit using a new gasket, moistened on both sides with Loctite 574. The unit should be floated into central position on studs so that diaphragm fits evenly within bush in differential lock housing.

5.9 Move centre beam into fitting position (this requires two men). Insert right track rod and drag link (right) through recess in centre beam. Take care not to damage ball joint rubber boots.

NOTE

Do not tighten centre beam yet, this enables the bolts to be fitted to Panhard rod support.

5.10 Spray thread of centre beam lateral bolts with Loctite Anti-seize and screw on bracket to correct torque (see Table 2, Ser 3), at centre beam.

5.11 Fix centre beam to axle housing with hexagon bolts and special lock washers (case ring version). Before tightening to correct torque (see Table 2, Ser 5) align centre beam horizontally by moving to centre of free movement.

NOTE

Spray threads of hexagon bolts with Loctite Anti-seize before fitting.

5.12 Spray thread of anchor bolts with Loctite Anti-seize, attach dome nuts and tighten to correct torque (see Table 2, Ser 5).

5.13 Insert distance piece with recess pointing to inside and with required number of adjusting shims (alternatively 2.0, 3.0 and 5.0 mm) ensuring no play between body mountings and centre beam.

5.14 Spray thread of bolts with Loctite Anti-seize and insert with washers through bore in bumper. Fit shim with recess pointing to body mounting and tighten self-locking nut just enough to keep bumpers horizontal.

NOTE

To insert hexagon bolt, lift front axle with jack.

5.15 Spray thread of towing coupling retaining bolts with Loctite Anti-seize and attach washers. Fit towing coupling with bolt heads pointing forwards and new self-locking nuts but tighten only moderately so bumper halves can be aligned horizontally.

5.16 Tighten towing coupling and body support bolts to correct torque (see Table 2, Ser 6 and 4) respectively. Fit towing jaw.

5.17 Fit rubber grommets into bumper and fix left side floor plate.

CAUTION

EQUIPMENT DAMAGE. Take care to fit Panhard rod tension free.

5.18 Tighten outer nut of Panhard rod to correct torque, (see Table 2, Ser 7) while holding inner nut.

5.19 Remove plugs fitted to hoses and refit to bulkhead glands in accordance with markings made during removal.

5.20 Degrease taper of right track rod ball joint, cone in steering lever and taper and cone of steering rod. Attach crown nut and tighten ball joints, to correct torque (see Table 2, Ser 8). Fit split pin.

5.21 Spray steering ram piston rod thread with Loctite Anti-seize and screw into joint eye so that 8 mm of thread remains visible. Clean thread of clamping bolt, spray with Loctite 242 and tighten to correct torque (see Table 2, Ser 9).

- 5.22 Screw on speedo drive extension piece, insert extension shaft and stop disc. Fit speedo cable and tighten crown nut.
- 5.23 Where fitted, connect ABS sensor leads to main ABS harness.
- 5.24 Remove plugs from brake pipes and brake hoses, insert retaining springs and tighten brake pipes to correct torque (see Table 2, Ser 10).

NOTE

When tightening brake hoses, observe markings made during removal to avoid mixing up brake circuits.

- 5.25 Fit coil springs (see Chapter 8-1).
- 5.26 Bleed brakes (see Chapter 10).
- 5.27 Grease joint head and joint eye of servo-steering working cylinder using standard grease and grease gun until grease can be seen escaping from sides.
- 5.28 Refill hydraulic steering fluid and bleed in accordance with Chapter 7.
- 5.29 Fit wheels.
- 5.30 Lower vehicle to floor and tighten wheel nuts to correct torque (see Table 2, Ser 12).
- 5.31 Check and adjust toe in (see Chapter 7).
- 5.32 Ensure vehicle is in horizontal position and check oil level in axle drive housing is up to level bolt. Top up with oil of correct specification if required.

CAUTION

EQUIPMENT DAMAGE. It is important to run the vehicle for approximately 1 km before re-checking oil level in portal hub housings as oil is displaced into swivel head and drive shaft. Top up if necessary.

- 5.33 Check oil level in portal hub housings. Top up with oil of correct specification if required.
- 5.34 Fit engine cover (see Chapter 16-2).

DIFFERENTIAL LOCK HOUSING

Removal

- 6 To remove differential lock housing proceed as follows:
 - 6.1 Remove front axle (see Para 4).
 - 6.2 Place oil drip tray below differential lock housing. Remove socket head bolts and washers. Loosen housing by lightly tapping with a plastic hammer and remove from differential shaft. Discard O-ring.
 - 6.3 Check grooved ball bearing, shaft oil seal and selector mechanism. In case of wear, replace complete differential lock housing.

Refitting

- 7 To refit differential lock housing proceed as follows:

7.1 Put new O-ring onto differential lock housing. Moisten O-ring and sealing surface with Loctite 574. Smear connection splines moderately with Molycote-Long-term No. 2.

7.2 Slip differential lock housing onto shaft so that small slot remains between differential lock housing and axle drive. Insert two socket head bolts and washers across diagonals to centre housing and slide it to mate with differential casing. Fit remaining socket head bolts with washers and tighten all bolts across diagonals.

7.3 Fit front axle (see Para 5).

PORTAL HUB

Removal

8 To remove portal hub proceed as follows:

8.1 Lift vehicle with jack on front differential casing until wheels just clear ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable pad (e.g. felt) between trestle and floorpan in order to avoid damage to paintwork or under-seal.

8.2 Place supports under floorpan stiffeners.

8.3 Remove wheel.

8.4 Remove split pin from ball joint unscrew nut and press out track rod end ball joint.

8.5 Loosen brake pipes and detach brake hoses. Remove retaining springs and release brake pipe from bracket and swivel upwards. Plug brake pipes and brake hoses to prevent ingress of dirt.

NOTE

Collect brake fluid in suitable container.

8.6 Remove socket head bolts and brake pipe. Tie back track rod end and bracket.

8.7 Remove coil spring (see Chapter 8-1).

NOTE

To remove lower shock absorber bolt, compress coil spring with spring clamp and support weight of portal hub using jack.

8.8 Raise portal hub/half axle into horizontal position using jack and remove anti-fatigue bolts clamping portal hub to axle. Unscrew portal hub centring bolt (see Fig 6).

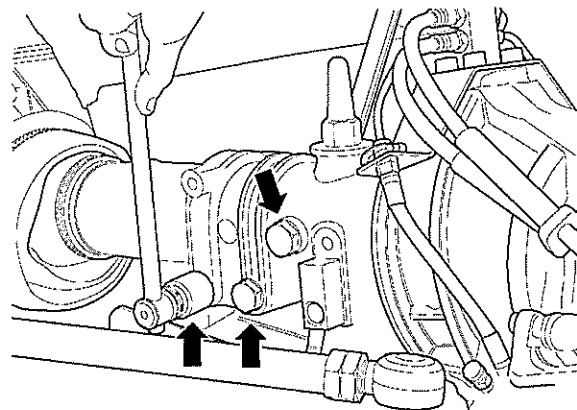


Fig 6 Portal hub anti-fatigue and axle centring bolts

8.9 Drive wedge of press-off device (see Table 1, Ser 1) into area of anti-fatigue clamping bolts until stop. Mount other end of tool onto ball head of axle and fix securely (see Fig 7).

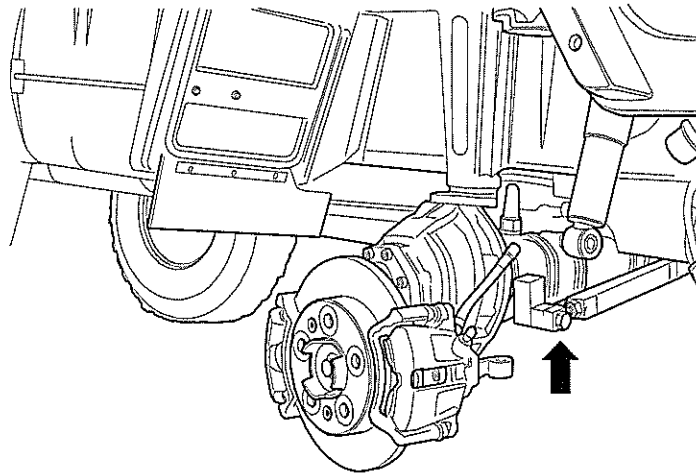


Fig 7 Portal hub removal tool

8.10 Press off portal hub from half axle by tightening nuts of press-off device evenly.

NOTE

Do not tilt, put down or work on portal hub assembly as oil will leak out.

8.11 Remove and discard O-ring at end of half axle.

8.12 Check drive shaft splines for wear or damage. In case of heavy wear, change portal hub assembly and differential assembly.

8.13 Check oil seal and chromium plating of swivel housing in area of oil seal. Change portal hub if chromium plating shows signs of damage or excessive pitting (see Para 10 to change oil seal).

8.14 Check swivel pin for excessive free play. For adjustment and replacement of upper and lower swivel pin see Para 11 - 14.

WARNING

DANGER TO LIFE AND LIMB. CHECK BRAKE DISC, BRAKE PADS AND CALLIPERS FOR SERVICEABILITY (SEE CHAPTER 10).

NOTE

Carry out Para 8.15 to 8.20 only when replacement assembly is to be fitted. Note that parts of the brake unit, steering and suspension system must be transferred to new assembly also oil must be drained before starting work.

- 8.15 Remove brake callipers (see Chapter 10).
- 8.16 Remove spring support bolt (see Fig 8).

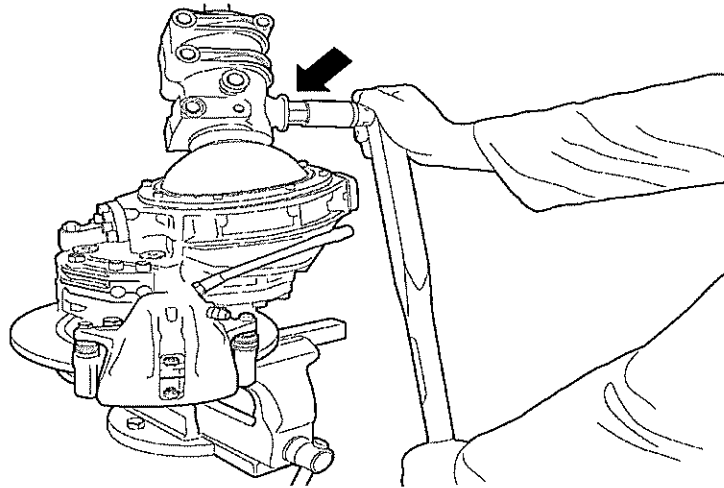


Fig 8 Removing spring centring bolt

- 8.17 Remove brake disc (see Chapter 10).
- 8.18 Remove two socket head bolts and nut securing track arm. Refit arm, bolts and nut to new portal hub and tighten to correct torque (see Table 2, Ser 13 and Fig 9).

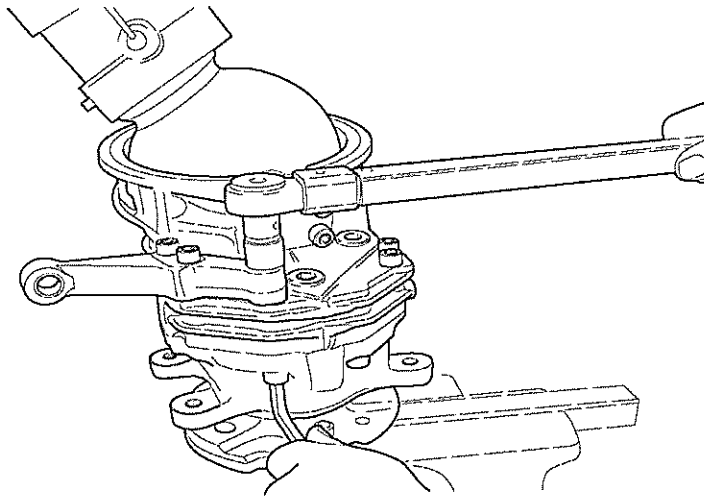


Fig 9 Removing steering track arm

NOTE

Depending upon portal hub (right or left) attach track arm right or left from drain plug so that track arm is pointing forwards when portal hub is re-fitted.

8.19 Fit brake disc and callipers (see Chapter 10)

NOTE

Calliper should be fitted with bleed nipple at top.

8.20 Attach intermediate piece. Smear thread of spring support bolt with Loctite Anti-seize, refit bolt and tighten to correct torque (see Table 2, Ser 16).

Refitting

9 To refit portal hub proceed as follows:

9.1 Insert clean rag deep into portal hub axle tube to prevent ingress of dirt and cover chrome surface of swivel housing. Remove Loctite residues from bore (or de-preserve replacement assembly). Remove rag and degrease cleaned surface (see Fig 10 and 11).

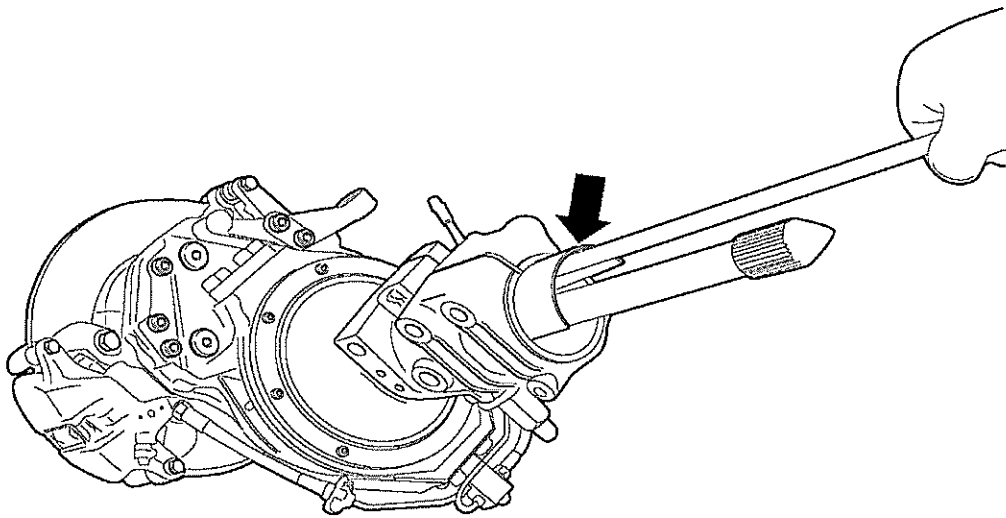


Fig 10 Cleaning portal hub inner bore

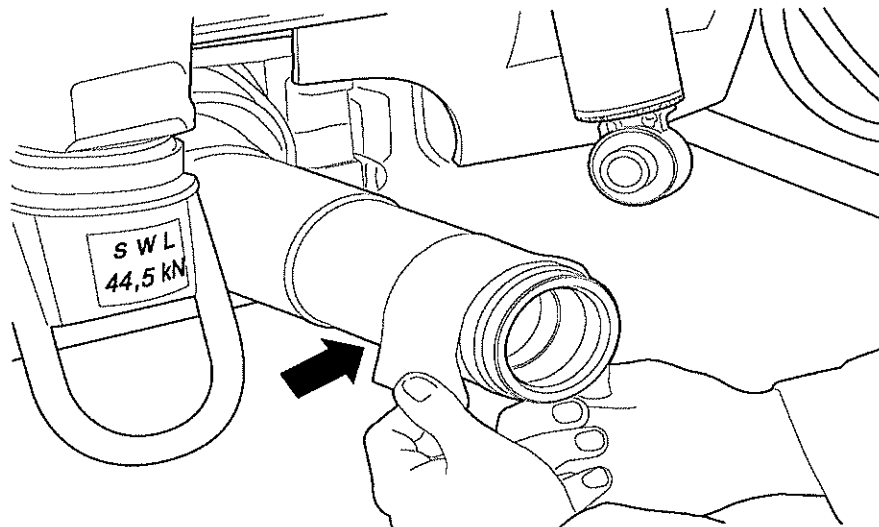


Fig 11 Cleaning differential axle tube

CAUTION

EQUIPMENT DAMAGE. Clean and degrease axle tube up to start of paint.

- 9.2 Key up (scuff) cleaned and degreased portal hub in area of anti-fatigue bolt bores with wedge of press off device (see Table 1, Ser 1).
- 9.3 Smear drive shaft splines with Molycote-Long-term No. 2.
- 9.4 Apply Loctite 270 evenly to unpainted axle tube end.
- 9.5 Oil or grease new O-ring and insert into groove on end of half axle tube.

CAUTION

EQUIPMENT DAMAGE. Soft faced material must be used to prevent equipment damage.

9.6 Slip on portal hub as far as possible. If necessary, tap assembly onto axle tube using a soft wooden block to protect portal hub. Portal hub is fully engaged when centring bolt can be screwed in easily. Insert **new** anti-fatigue bolts with thread pointing backwards and screw on new nuts.

NOTES

(1) Do not re-use anti-fatigue bolts and nuts.

(2) After applying Loctite to half axle, fit portal hub immediately. Smear centring bolt and collar and thread of anti-fatigue bolts, before fitting, with Loctite Anti-seize. Remove wedge only after centring bolt has been screwed fully home.

9.7 Place jack under portal hub and lift half axle.

9.8 Tighten centring bolt first, then anti-fatigue bolts to correct torque (see Table 2, Ser 17).

9.9 Refit coil spring (see Chapter 8-1).

NOTE

Attach lower shock absorber mounting bolt with coil spring compressed. Ensure fixing bolt is fitted with threads pointing forwards. Bring half axle into horizontal position by lifting portal hub on jack and tighten shock absorber retaining bolt to correct torque (see Table 2, Ser 11).

9.10 Screw on brake pipe bracket to upper pivot. Tighten socket head bolts across diagonals to correct torque (see Table 2, Ser 18).

CAUTION

EQUIPMENT DAMAGE. Take care not to distort hoses when tightening brake pipes.

9.11 Remove plugs from brake pipes. Insert retaining springs and tighten brake pipes to correct torque, (see Table 2, Ser 10 and Fig 12).

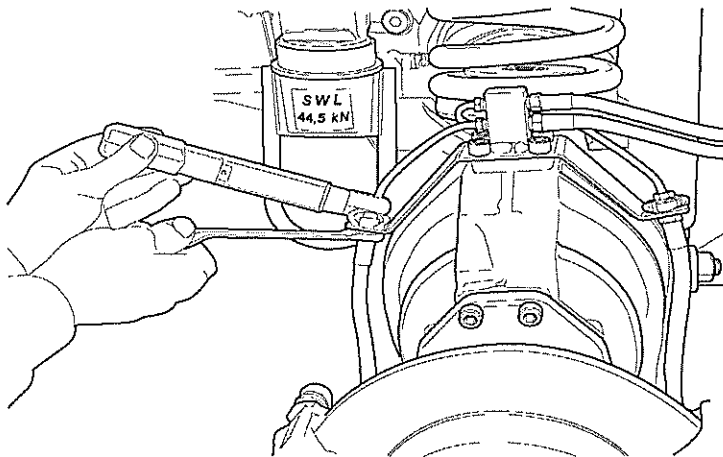


Fig 12 Refitting brake pipes

9.12 Degrease track arm and ball joint taper pin. Fit and tighten castle nut to correct torque, (see Table 2, Ser 8) and fix split pin.

9.13 Bleed brakes (see Chapter 10).

9.14 Fit wheel.

9.15 Lower vehicle onto wheels and tighten wheel bolts to correct torque (see Table 2, Ser 12).

CAUTION

EQUIPMENT DAMAGE. It is important to run the vehicle for approximately 1 km before re-checking oil level in portal hub housings as oil is displaced into the swivel head and drive shaft. Top up if necessary.

9.16 Ensure vehicle is horizontal and check oil level in portal hub housing. If necessary top up with Mobil Glygoyle 30.

SWIVEL

Change swivel oil seal

10 To change the swivel oil seal proceed as follows:

10.1 Remove portal hub (see Para 8).

10.2 Clamp portal hub into vice.

10.3 Loosen spring support bolt.

10.4 Remove socket head bolts and washers retaining scraper ring and seal and remove. Discard old seal.

10.5 Inspect swivel chromium plating for excessive pitting and damage.

10.6 Check for free play by moving portal hub to and fro, there should only be negligible play. If excessive play is detected, re-adjust as detailed in Para 14.

CAUTION

EQUIPMENT DAMAGE. No other grease should be used.

10.7 Insert new seal into scraper ring and grease sealing lips liberally with Alfabub-LGEM2 (SKF).

CAUTION

EQUIPMENT DAMAGE. Do not damage scraper ring when tightening bolts.

10.8 Place oil seal with scraper ring onto swivel housing and tighten bolts across diagonals.

10.9 Smear thread of spring support bolt with Loctite Anti-seize, screw in and tighten to correct torque (see Table 2, Ser 16).

10.10 Remove portal hub from vice.

10.11 Refit portal hub (see Para 9).

Removal upper swivel pin

11 To remove upper swivel pin proceed as follows:

11.1 Lift vehicle with jack on front axle case until wheels clear ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable pad (eg felt) between trestle and floorpan to avoid damages on paintwork.

11.2 Arrange trestle at floorpan.

11.3 Remove wheel.

11.4 Loosen brake pipes and detach brake hoses. Remove retaining springs and release brake pipe from bracket and swivel upwards. Plug brake pipes and brake hoses, to prevent ingress of dirt.

NOTE

Collect brake fluid in suitable container.

11.5 Remove socket head bolts retaining spring bracket and remove

11.6 Pull out swivel pin. If pin is excessively tight, apply drift laterally (see Fig 13) and remove by rotating from side to side.

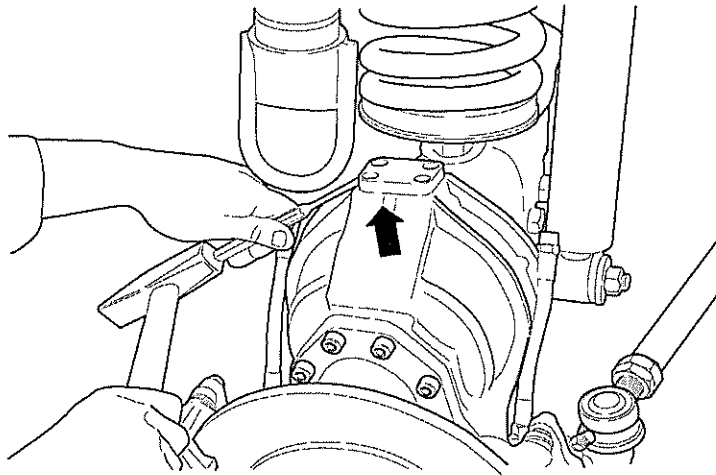


Fig 13 Removing top swivel pin

11.7 Check bush in swivel pin housing and replace if necessary (see Para 15).

Refitting upper swivel pin

12 The upper swivel pin is refitted as follows:

12.1 Lubricate swivel pin with oil, coat swivel pin flange with RTV liquid sealant and insert into portal hub with gentle turning movements.

CAUTION

EQUIPMENT DAMAGE. Take care not to distort hoses when tightening brake pipes.

12.2 Place brake pipe bracket to top of swivel pin and secure with socket head bolts. Tighten bolts across diagonals to correct torque (see Table 2, Ser 18).

12.3 Remove plugs from brake pipes. Insert retaining springs and tighten brake pipes to correct torque (see Table 2, Ser 10).

12.4 Bleed brakes (see Chapter 10).

12.5 Fit wheel.

12.6 Lower vehicle onto wheels and tighten wheel bolts to correct torque (see Table 2, Ser 12).

Removal lower swivel pin

13 The lower swivel pin is removed as follows:

CAUTION

EQUIPMENT DAMAGE. Use suitable pad (e.g. felt) between trestle and floorpan to avoid damage to paintwork.

13.1 Lift vehicle with jack on front axle casing until wheels just clear ground. Support vehicle using suitable stands placed under floorpan support rails.

13.2 Remove two socket head bolts and nut securing track arm and remove.

13.3 Remove socket head bolts securing lower swivel pin and remove.

13.4 Pull out swivel pin. If pin is excessively tight, apply drift laterally and remove by rotating from side to side.

13.5 Collect oil in a suitable container.

13.6 Unscrew scraper and oil seal ring.

Refitting lower swivel pin

- 14 To refit lower swivel pin proceed as follows:
 - 14.1 Check bush in portal hub housing and replace if necessary (as in Para 15).
 - 14.2 Fix ball and ball cup in new swivel pin using standard grease, (see Fig 14).

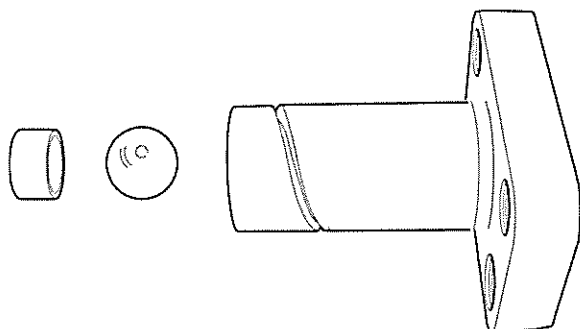


Fig 14 Lower swivel pin, ball and cup

14.3 Insert swivel pin into swivel pin housing and tighten using two bolts across diagonals. Check for free play by moving to and fro. There must be negligible free play but swivel should be easy to move. If not lift up portal hub with a jack and measure existing play between swivel head and thrust washer with feeler gauge. Remove pivot and measure thickness of ball cup with inserted ball (see Fig 15 and 16).

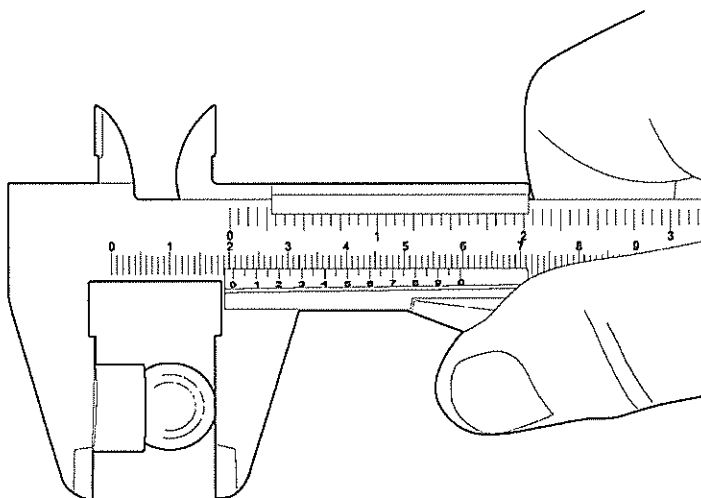


Fig 15 Measuring lower swivel pin, ball and cup

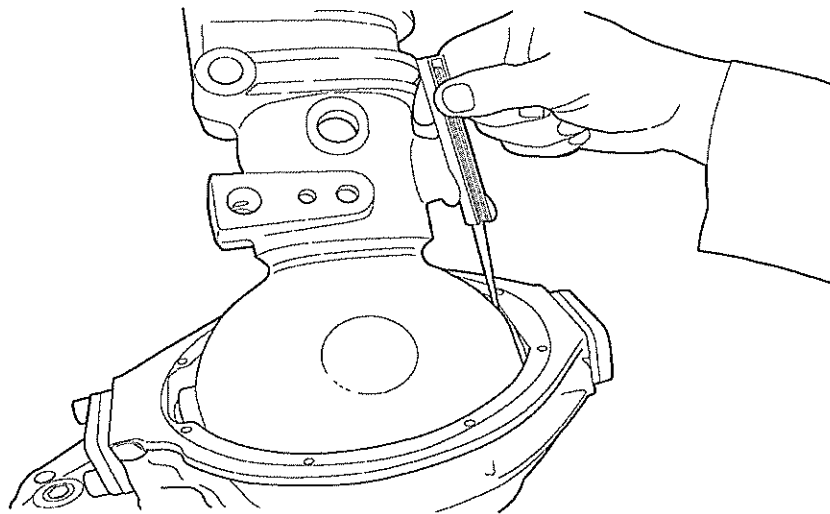


Fig 16 Measuring swivel clearance

- 14.4 If excessive free play is evident, select bigger sized ball cup.
- 14.5 If there is jamming or movement is difficult, select smaller sized ball cup.

NOTE

Ball cups are available in sizes between 4.6 to 5.6 mm in intervals of 0.2mm.

- 14.6 Fit swivel pin with new ball cup, and check swivel pin has negligible free play and moves without stiffness (see Para 14.3).
- 14.7 After having determined correct size of ball cup, remove swivel pin and oil well.
- 14.8 Coat swivel pin flange with RTV liquid sealant, fit to housing and secure with four socket head bolts. Tighten across diagonals to correct torque (see Table 2, Ser 19).
- 14.9 Grease lips of cleaned seal sufficiently with Alfalub grease LGEM2 (SKF).
- 14.10 Fit seal and scraper ring and tighten bolts across diagonals.
- 14.11 Fit track arm and tighten bolts and nut to correct torque (see Table 2, Ser 13).
- 14.12 Fit wheel.
- 14.13 Lower vehicle onto wheels and tighten wheel bolts to correct torque (see Table 2, Ser 12).

CAUTION

EQUIPMENT DAMAGE. It is important to run the vehicle for approximately 1 km before re-checking oil level in portal hub housings as oil is displaced into the swivel head and drive shaft. Refill if necessary.

- 14.14 Ensure vehicle is horizontal and check oil level in portal hub housing. If necessary top up with Mobil Glygoyle 30.

Check/replace pivot bushes

15 The pivot bushes are checked and replaced as follows:

15.1 Remove upper and lower swivel pins (see Paras 11 and 13).

15.2 Measure pivot bushes and compare with the following:

Pivot dia (mm)	27.979 -28.000
Bush for pivot (mm)	28.065 -28.098
Play (mm)	0.065 -0.119
Wear limit (mm)	0.35

CAUTION

EQUIPMENT DAMAGE. Always change bushes in pairs.

15.3 Clamp swivel housing in area of shock absorber mounting and drive out bushes with suitable drift (see Fig 17).

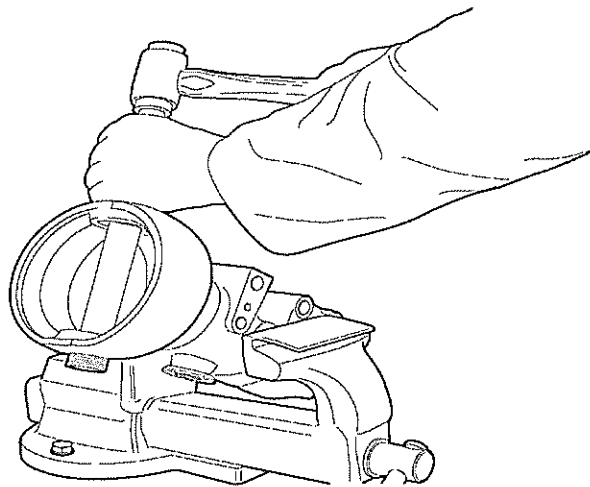


Fig 17 Replacing portal hub pivot bushes

WARNING

DANGER TO LIFE AND LIMB. EYE PROTECTION SHOULD BE WORN WHEN USING COMPRESSED AIR

CAUTION

EQUIPMENT DAMAGE. After fitting bushes, blow out with compressed air to prevent Loctite blocking lubricating holes.

15.4 Smear lower bush outer surface with Loctite 307 and press in.

15.5 Smear upper bush outer surface with Loctite 307 and press in.

WHEEL BEARING

Check play

16 Wheel bearing play is checked as follows:

CAUTION

EQUIPMENT DAMAGE. Use suitable pad (e.g. felt) between trestle and floorpan to avoid damages to paintwork.

16.1 Lift vehicle with jack on front axle casing until wheels just clear ground. Support vehicle using suitable stands placed under floorpan support rails.

16.2 Remove wheel.

CAUTION

EQUIPMENT DAMAGE. Before pushing back piston, drain off a small amount of brake fluid from master cylinder reservoir to prevent fluid over-flowing.

16.3 Push back brake pads and brake piston by pressing case of calliper firmly outwards.

16.4 Check countersunk screws are securely seated and tighten to correct torque (see Table 2, Ser 14). Clean surfaces in area where measurements are to be made. Fit magnetic support with dial gauge 1/100 and extended feeler. Determine radial play of wheel bearings by tilting brake disc up and down (see Fig 18).

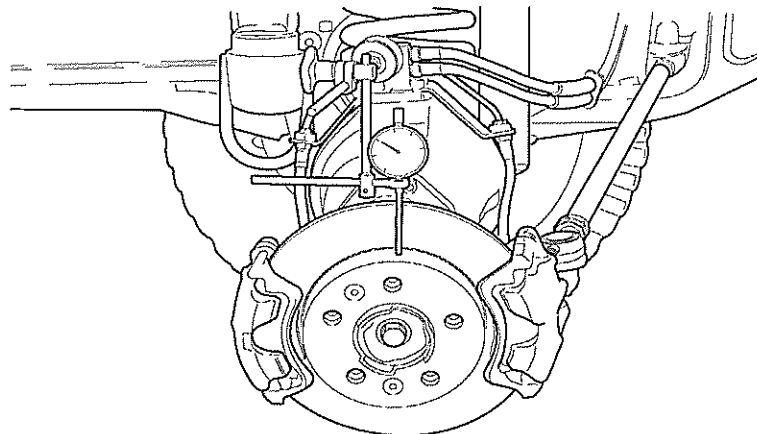


Fig 18 Measuring wheel bearing radial clearance

16.5 Maximum admissible radial play is 0.15 mm.

16.6 Re-arrange magnetic support with dial gauge 1/100 and determine axial play of wheel bearing by pressing in and pulling out brake disc (see Fig 19).

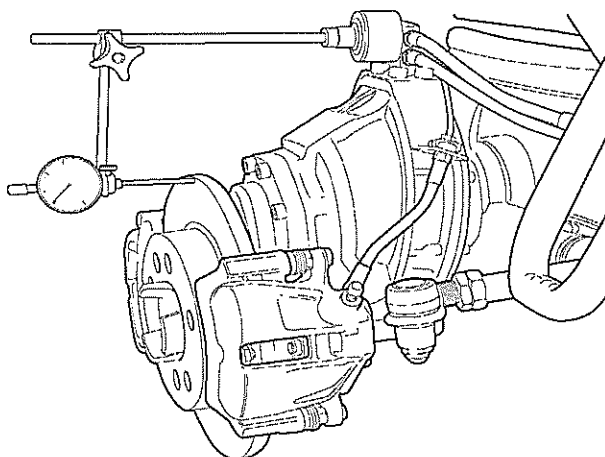


Fig 19 Measuring wheel bearing axial clearance

16.7 Maximum admissible axial play is 0.4 mm.

NOTE

If admissible play is exceeded, replace wheel bearing (see Para 17).

16.8 Fit wheel.

16.9 Lower vehicle onto wheels and tighten wheel bolts to correct torque (see Table 2, Ser 12).

Change

17 To change wheel bearing proceed as follows:

CAUTION

EQUIPMENT DAMAGE. Always change both bearings in portal hub housing and in brake anchor plate as a pair.

17.1 Remove brake anchor plate (see Para 21).

CAUTION

EQUIPMENT DAMAGE. Ensure that adequate packing is used to protect portal hub housing from damage.

17.2 Pull out roller bearing from portal hub housing.

17.3 Strip brake anchor plate (see Para 22).

17.4 Re-assemble brake anchor plate (see Para 23).

17.5 Gently heat bearing bore of portal hub housing to approximately 100 °C and insert bearing, ensuring that writing is facing outwards.

17.6 Refit brake anchor plate (see Para 24).

17.7 Further refitting is done in reverse order to stripping.

CAUTION

EQUIPMENT DAMAGE. It is important to run the vehicle for approximately 1 km and then re-check oil levels in portal hub housings as oil is displaced into the swivel head and drive shaft. Refill if necessary.

17.8 On completion of refitting, ensure vehicle is in horizontal position and check oil level in portal hub housing. If necessary top up with Mobil Glygoyle 30.

CHANGE SPEEDOMETER DRIVE

18 The speedometer drive is replaced as follows:

18.1 Loosen crown nut at front left of front axle and disconnect speedometer cable (see Fig 20).

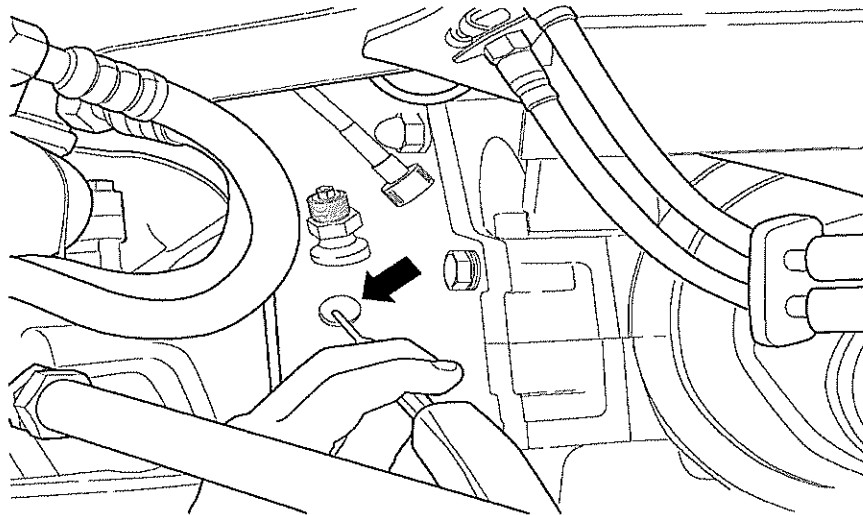


Fig 20 Disconnecting speedo cable

18.2 Drive out locking pin using suitable punch.

18.3 Pull out speedometer drive from drag link arm casing and clamp carefully into vice.

NOTE

If there is insufficient tension on chevron oil seal, helical gear may remain in drag link arm case. If so, remove helical gear separately.

18.4 Pull out helical gear, loosen extension piece and remove with extension shaft and thrust washer.

18.5 Clean all parts and check for serviceability.

18.6 Take out chevron type oil seal with blunt drift and replace with new one. Seal should point inwards with outside of seal fitting flush to housing. Replace O-ring taking care to ensure O-ring is inserted into middle groove (see Fig 21).



Fig 21 Speedo drive components

- 18.7 Oil helical gear, extension shaft, sealing elements and bearing bores in housings.
- 18.8 Screw extension piece onto bearing bush.
- 18.9 Insert helical gear and extension shaft so that both parts mesh, then fit thrust washer.
- 18.10 Insert complete drive into drag link arm casing. Turn extension shaft slightly until helical gear meshes. When drive is inserted, bearing bush collar rests on drag link arm casing. Collar face must also sit close to casing and be securely fastened
- 18.11 Drive in locking pin and peen bore outside slightly so that pin cannot move outwards.
- 18.12 Insert speedometer cable into extension shaft and tighten crown nut.

DRIVE SHAFT AND CV JOINT

Removal

- 19 The drive shaft and CV joint are removed as follows:
 - 19.1 Remove portal hub (see Para 8).
 - 19.2 Strip portal hub (see Para 26).
 - 19.3 Strip portal hub housing (see Para 28).
 - 19.4 Remove drive shaft.

Refitting

- 20 The drive shaft and CV joint are refitted as follows:
 - 20.1 Re-assemble portal hub housing (see Para 29).
 - 20.2 Re-assemble portal hub (see Para 27).
 - 20.3 Refit portal hub (see Para 9).

BRAKE ANCHOR PLATE

Removal

21 The brake anchor plate is removed as follows:

21.1 Lift vehicle with jack on front axle case until wheels are just clear of ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable pad (e.g. felt) between stand and floorpan to avoid damage to paintwork.

21.2 Place axle stands under floorpan ridges.

21.3 Remove wheel.

21.4 Remove brake calliper and disc (see Chapter 10).

21.5 Remove ABS sensor mounting bracket (see Chapter 10).

21.6 Remove steering track arm from inside lower housing.

21.7 Remove brake anchor plate (socket head) bolts.

21.8 Place oil drip tray below portal hub and gently tap off brake anchor plate using plastic hammer.

Strip

22 To strip brake anchor plate, proceed as follows:

22.1 Secure wheel flange (see Fig 22 (1)) in vice.

22.2 Unscrew central anti fatigue bolt (4) which secures main gear wheel until end threads are flush with washer (5).

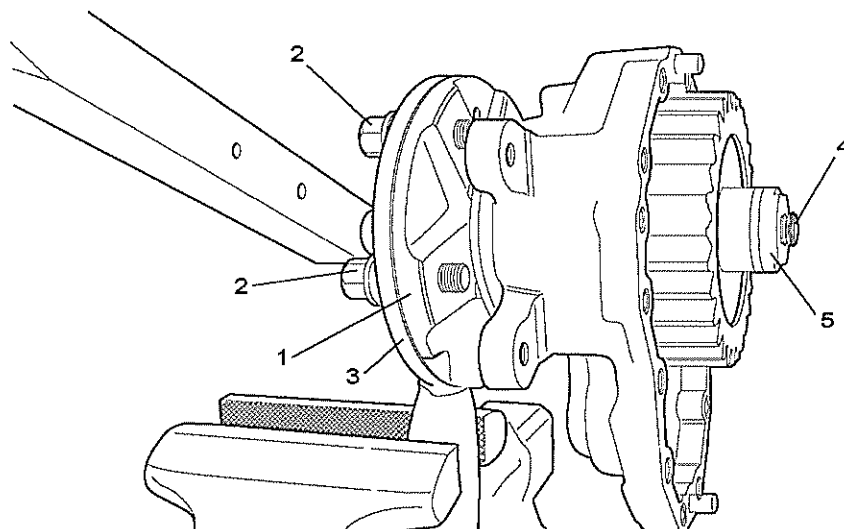


Fig 22 Brake anchor plate showing anti-fatigue bolt threads

- 22.3 Gently tap head of central retaining bolt to push inner washer free from bearing inner race and remove bolt and washer completely.
- 22.4 Remount wheel flange centrally in vice.
- 22.5 Pull off gear wheel and remove inner distance ring and bearing inner race.
- 22.6 Remove brake anchor plate from wheel flange.
- 22.7 Remove bearing from wheel flange stub axle using suitable drift taking care not to damage stub axle.
- 22.8 Remove O-ring from stub axle.
- 22.9 Clamp brake anchor plate in vice and remove wheel flange oil seal.
- 22.10 Remove wheel bearing retaining circlip and press out wheel bearing (into brake anchor plate).
- 22.11 Remove needle roller bearing from brake anchor plate.
- 22.12 If required, remove ABS pole wheel (see Chapter 10).

Re-assemble

- 23 The brake anchor plate is re-assembled as follows:
 - 23.1 Check all components for signs of damage or wear and replace if necessary. See Chapter 10 for ABS pole wheel fitting instructions.
 - 23.2 Press needle roller bearing into brake anchor plate.
 - 23.3 Press wheel bearing into brake anchor plate and refit circlip and oil seal.
 - 23.4 Clamp wheel flange in vice and refit O-ring using Loctite 574.
 - 23.5 Press on bearing inner race.
 - 23.6 Fit oil seal to stub axle of wheel flange and grease seal thoroughly with Bosch silicon grease no. 5700 083 000 or equivalent.
 - 23.7 Press brake anchor plate onto wheel flange.
 - 23.8 Heat gear wheel to approximately 140 °C and fit to wheel flange ensuring collar faces inwards.
 - 23.9 Fit distance piece to stub axle at back of gear wheel.
 - 23.10 Heat stub axle bearing inner race to approximately 100 °C and refit to stub axle with collar facing gear wheel.
 - 23.11 Gently drive in washer on end of stub axle.
 - 23.12 Fit new O-ring to central anti-fatigue bolt and refit using Loctite anti seize on threads and Loctite 242 on bolt head under surface.

CAUTION

EQUIPMENT DAMAGE. Tightening must be carried out in sequence without pausing.

23.13 Clamp brake anchor plate/wheel flange and tighten central anti-fatigue bolt (see Table 2). Remove anti-fatigue bolt and re-coat head under surface with Loctite 242. Mark position of end strain washer relative to bearing inner race with felt tip pen (to check for slipping during tightening) then re-tighten anti fatigue bolt to 100 Nm. Mark position of bolt head relative to wheel flange then tighten through further 180° then further 20°.

23.14 Ensure no movement between strain washer and wheel flange. If necessary repeat above procedure.

23.15 Fully tighten anti-fatigue bolt to correct torque (see Table 2, Ser 21).

Refitting

24 The brake anchor plate is refitted as follows:

24.1 Check all components for signs of wear or damage and ensure brake parts are within wear limits (see Chapter 10).

24.2 Clean joint surfaces of portal hub housing and brake anchor plate and apply Loctite 574.

24.3 Mount brake anchor plate gently tapping with plastic hammer to align bolt holes.

24.4 Apply Loctite 7471 activator to threaded section of anchor plate bolts, allow activator to dry then apply Loctite 243 to threaded section of the securing bolts. Gradually tighten brake anchor plate retaining bolts across diagonals to correct torque (see Table 2, Ser 20).

24.5 Refit steering track arm and tighten bolts and nut to correct torque (see Table 2, Ser 13).

24.6 Refit brake disc and calliper (see Chapter 10).

24.7 Refit wheel.

24.8 Lower vehicle to ground and tighten wheel bolts to correct torque (see Table 2, Ser 12).

CAUTION

EQUIPMENT DAMAGE. It is important to run the vehicle for approximately 1 km and then re-check oil levels in portal hub housings as oil is displaced into the swivel head and drive shaft. Refill if necessary.

24.9 On completion of refitting, ensure vehicle is in horizontal position and check oil level in portal hub housing. If necessary top up with Mobil Glygoyle 30.

CHANGE WHEEL FLANGE OIL SEAL

25 The wheel flange oil seal is replaced as follows:

25.1 Remove brake anchor plate (see Para 21).

25.2 Strip brake anchor plate (see Para 22).

25.3 Re-assembly is done in reverse order to stripping.

PORTAL HUB**Strip**

- 26 To strip the portal hub, proceed as follows:
- 26.1 Drain oil from portal hub housing and ensure magnetic oil drain plug is thoroughly cleaned.
 - 26.2 Mount portal hub in suitable carrier.
 - 26.3 Remove brake anchor plate (see Para 21).
 - 26.4 Remove swivel oil seal backing ring bolts.

CAUTION

EQUIPMENT DAMAGE. Do not attempt to exchange upper and lower swivel pins as these are of different types.

- 26.5 Remove upper and lower swivel pins (see Para 11 and 13).
- 26.6 Detach portal hub housing taking care to remove CV joint plastic cover and ensuring swivel pin thrust washer is retrieved.
- 26.7 Remove spring support bolt from axle tube.
- 26.8 Thoroughly clean all traces of Loctite from components paying particular attention to inner bore that mounts to axle drive assembly.

Re-assemble

- 27 The portal hub is re-assembled as follows:
- 27.1 Check all components for signs of damage or wear and ensure all brake parts are within wear limits (see Chapter 10).
 - 27.2 Mount wheel flange in vice, ensuring brake anchor plate is facing up.
 - 27.3 Smear joint surface of brake anchor plate with Loctite 574 and refit portal hub housing using gentle taps with plastic hammer to align bolt holes.
 - 27.4 Refit brake anchor plate retaining bolts and tighten to correct torque (see Table 2, Ser 20). If necessary restrain portal hub housing with M10 bolt inserted into swivel pin area whilst tightening bolts.

NOTE

Do not mount steering track arm as this prevents lower pivot being refitted.

- 27.5 Insert upper swivel pin plastic thrust washer, using grease to hold in position.
- 27.6 Refit CV joint plastic cover ensuring that it fits into undercut of CV joint.
- 27.7 Insert portal hub swivel housing ensuring wheel bearing bush faces downwards.
- 27.8 Refit upper and lower swivel pivot pins (see Para 12 and 14), ensure adjustment is correct.

CAUTION

EQUIPMENT DAMAGE. Only this grease is to be used.

27.9 Insert new swivel oil seal into backing ring with ALFALUB grease LGEM2 (SKF), refit and tighten bolts gradually across diagonals.

27.10 Refit spring support bolt using Loctite anti-seize and tighten to the correct torque (see Table 2, Ser 16).

27.11 Refit steering track arm and tighten bolts and nut to correct torque (see Table 2, Ser 13).

NOTE

Steering track arm fits facing forwards.

27.12 Refit brake disc and calliper (see Chapter 10).

27.13 Refit wheel.

27.14 Lower vehicle to ground and tighten wheel bolts to correct torque (see Table 2, Ser 12).

CAUTION

EQUIPMENT DAMAGE. It is important to run the vehicle for approximately 1 km and then re-check oil levels in portal hub housings as oil is displaced into the swivel head and drive shaft. Refill if necessary.

27.15 Ensure vehicle is in horizontal position and check oil level in portal hub housing. If necessary top up with Mobil Glygoyle 30.

PORTAL HUB GEARBOX HOUSING

Strip

28 To strip the portal hub housing, proceed as follows:

28.1 Remove portal hub (see Para 8).

28.2 Fit drive shaft into vice ensuring soft faced jaws are used to prevent damage.

28.3 Release circlip from drive shaft end and remove shim.

28.4 Remove gear wheel and bearing inner race together using suitable puller.

NOTE

If gear wheel is excessively tight, remove gear wheel and bearing inner race separately. Follow the above procedure until the gear wheel and bearing race have moved out approximately 2-3 mm. Using a soft drift gently tap the gear wheel back until there is a 2-3 mm gap between bearing race and gear wheel. Once there is sufficient clearance between gear and bearing race, dismount gear wheel. If necessary, heat bearing race to approximately 100 °C to reduce resistance.

28.5 Remove shim from below gear wheel and take off portal hub housing.

28.6 Remove bearing inner race from drive shaft.

28.7 Secure portal hub housing in vice and remove two roller bearings from aluminium casing.

Re-assemble

29 The portal hub housing is re-assembled as follows:

29.1 Check all components for signs of damage or wear and replace if necessary. Ensure all brake parts are within wear limits (see Chapter 10).

29.2 Secure drive shaft in vice using soft faced jaws to prevent damage.

CAUTION

EQUIPMENT DAMAGE. Ensure bearings are driven fully home and observe these fit to different depths in the casing.

29.3 Heat drive shaft support bearing inner race to approximately 100 °C and refit to drive shaft with collar fitting to shoulder of CV joint.

29.4 Heat portal hub housing to approximately 100 °C and refit two cylindrical roller bearings with writing facing out.

29.5 Refit drive shaft bearing retaining circlip with opening facing downwards.

29.6 Fit portal hub casing onto drive shaft and fit thrust washer onto drive shaft.

29.7 Heat pinion gear wheel to approximately 140 °C and refit to drive shaft with collar innermost, ensure drive shaft is prevented from sliding back into housing.

29.8 Heat outer bearing (inner) race to approximately 100 °C and refit with writing facing out.

29.9 Refit circlip to drive shaft and measure clearance between circlip and pinion gear wheel (see Fig 23).

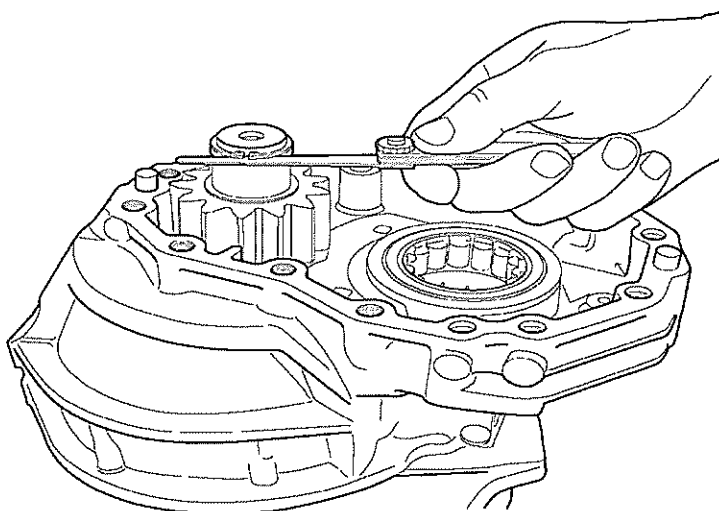


Fig 23 Measuring clearance between drive shaft circlip and pinion gear

29.10 Remove circlip and fit an appropriate shim to take up all clearance. Shims are available from 0.5 mm to 0.9 mm in steps of 0.1 mm.

29.11 Refit circlip and ensure it fits securely into the undercut of drive shaft. Adjust shims if necessary to ensure there is no clearance.

CHAPTER 5-2

REAR AXLES

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INTRODUCTION

- 1 This chapter details the procedure for all repairs to be carried out on the 6x6 variant rear axles.

WARNINGS

- (1) **DANGER TO LIFE AND LIMB. NEVER WORK UNDER A VEHICLE SUPPORTED ONLY BY A JACK. ALWAYS USE AXLE STANDS WHICH ARE SUITABLE FOR USE.**
- (2) **DANGER TO LIFE AND LIMB. AFTER JACKING, SUITABLE WHEEL CHOCKS SHOULD BE USED ON WHEELS REMAINING ON THE GROUND.**
- (3) **TOXIC SUBSTANCES. LOCTITE AND OTHER SEALANTS MUST BE HANDLED WITH CAUTION AND IN ACCORDANCE WITH THE APPROPRIATE SAFETY DATA SHEET.**

CAUTION

EQUIPMENT DAMAGE. Before operating vehicle, ensure all oils and lubricants are filled to the correct level and with the correct specification liquid.

SPECIAL TOOLS AND TEST EQUIPMENT

- 2 The only special tools required in this chapter are shown in Table 1:

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Ser (1)	NSN (2)	Manfr No. (3)	Designation (4)
1	5120-99-663-8043	001.589.752.100	Torque wrench
2	5120-99-811-1549	000.589.750.300	Socket spanner
3	5120-99-024-7083	905.0.15.003.1	Spanner
4	5306-99-062-6283	710.1.32.386.1	Lifting eye
5	4910-99-930-7037	905.3.33.404.2	Press-off device
6	5120-99-597-5664	905.3.34.301.1	Distance piece
7	5120-99-052-1680	905.0.14.501.0	Steering drop arm puller
8	4910-99-225-6610	905.3.38.301.0	Cleaning device

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings contained in this chapter are listed in Table 2:

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Axle mount hexagon screws	80	5.4
2	Spring support bolts	200	5.5 9.8.3
3	Brake pipe	15	5.6 5.20.3 7.14 9.8.5 11.24 13.12
4	Differential housing cap nuts	80	5.16 9.5
5	Body support hexagon screws	80	5.16 7.15 9.5 28.2
6	Shock absorber screws	200	5.20.1 9.8.1
7	Body support screws	250	5.20.7 9.8.11
8	Wheel bolts	260	5.20.8 9.8.12 13.17 18.8
9	Half axle anti fatigue screws	250	7.11 11.12
10	Handbrake flange bolts	80	11.19
11	Towing flange nuts	80	11.22
12	Brake disc screws	28	13.3 18.5
13	Brake calliper carrier bolts	125	13.3 18.5
14	Portal hub centring and anti-fatigue bolts	250	13.9
15	Anchor plate bolts	40	18.4
16	Spring bracket	160	28.6

FIRST REAR AXLE**Removal**

- 4 To remove the first rear axle, proceed as follows:
 - 4.1 Drain oil from axle housing.
 - 4.2 Remove safety lock at hand brake linkage and pull out bolt (see Fig 1).

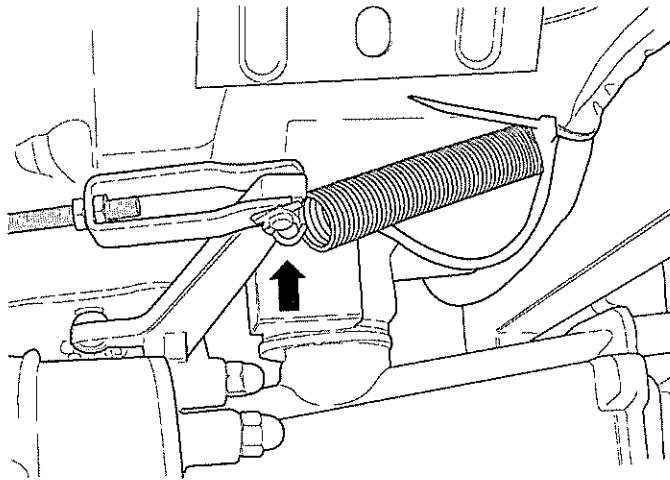


Fig 1 Handbrake linkage

- 4.3 Disconnect release spring.
- 4.4 Disconnect both brake lines at brake power control and seal with rubber caps of bleeder screws (see Fig 2) – non ABS variants only.

NOTE

Collect leaking brake fluid in suitable container.

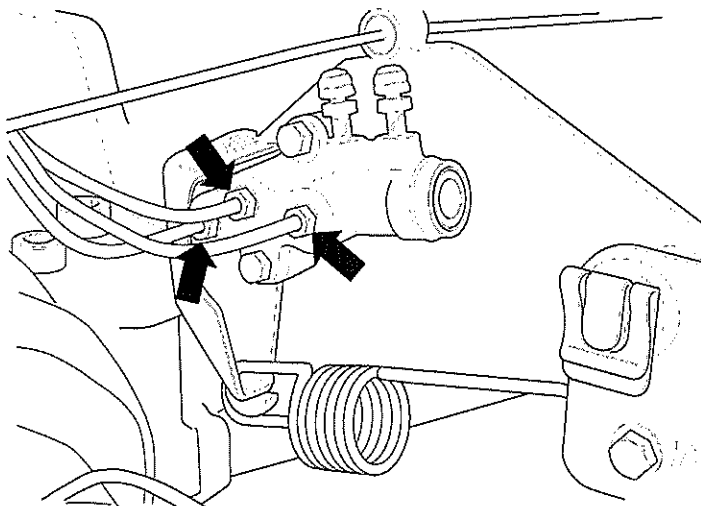


Fig 2 Brake apportioning valve (non ABS variants only)

- 4.5 Disconnect all brake lines from top of first rear axle and secure to platform.
- 4.6 Where fitted, disconnect ABS sensor leads from main ABS harness.
- 4.7 Remove all wheel drive and differential lock actuators.

NOTE

The two hexagon screws hold the pneumatic gearshift unit shut and should not be removed (see Fig 3).

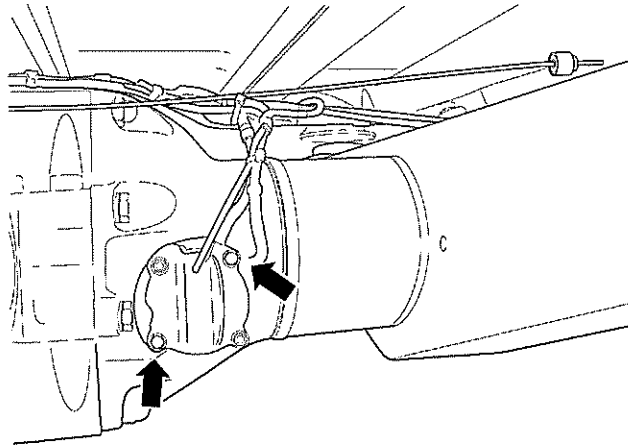


Fig 3 Pneumatic actuator

- 4.8 Remove shock absorbers (see Chapter 8-2)
- 4.9 Loosen rear body support screw at towing flange. Remove nut, support shim and rubber pad.
- 4.10 Remove body support screws, support shim and rubber pad from cross members.
- 4.11 Place suitable container under distance piece. Remove cap nuts, then anchor bolts from support tube flange (see Fig 4).

NOTE

Do not loosen cap nut as transfer gearbox should remain mounted.

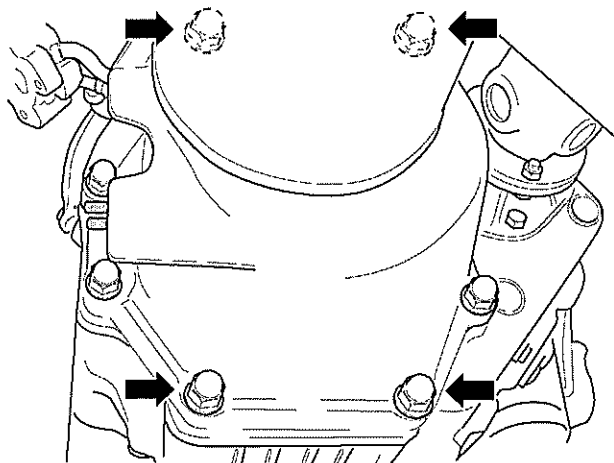


Fig 4 Chassis support tube

- 4.12 Remove lateral anchor bolt with puller.
- 4.13 Unscrew cap nut from distance piece.
- 4.14 Put blocks in front and behind front wheels. Attach suitable lifting strap to vehicle rear and lift body slightly.
- 4.15 Disconnect actuating lever from transmission brake housing (see Fig 5).

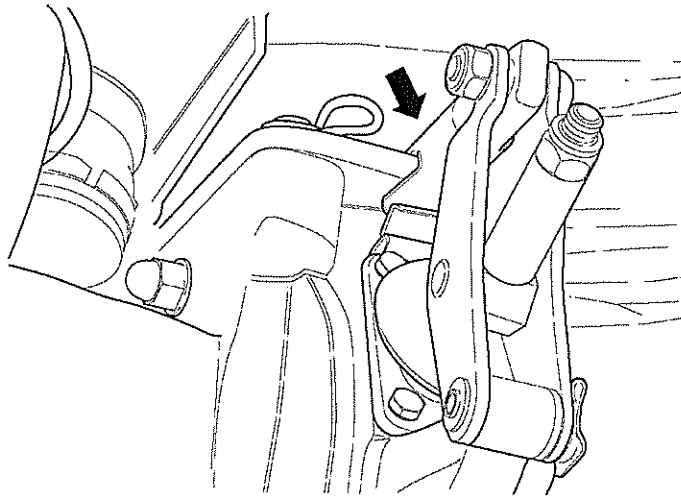


Fig 5 Handbrake actuator

- 4.16 Detach support shim with rubber pad from towing flange.
- 4.17 Pull out double axle from transfer gearbox and remove from under vehicle body.

NOTE

Pull out axle slowly ensuring all pipes and connectors are disconnected.

- 4.18 Put second rear axle and support tube on support trestles. Support first rear axle with moveable jack and unscrew wheels.
- 4.19 Loosen axle location spring support bolts on leaf springs.
- 4.20 Unscrew brake pipe at distributor.
- 4.21 Remove left and right hexagon screws securing axle to carrier tube.
- 4.22 Loosen first rear axle from support tube and remove.

Refitting

5 Refitting the first rear axle is as follows:

5.1 Smear sealing surface of support tube flange with Loctite 574.

NOTE

Vent slots and bores must not be clogged (see Fig 6).

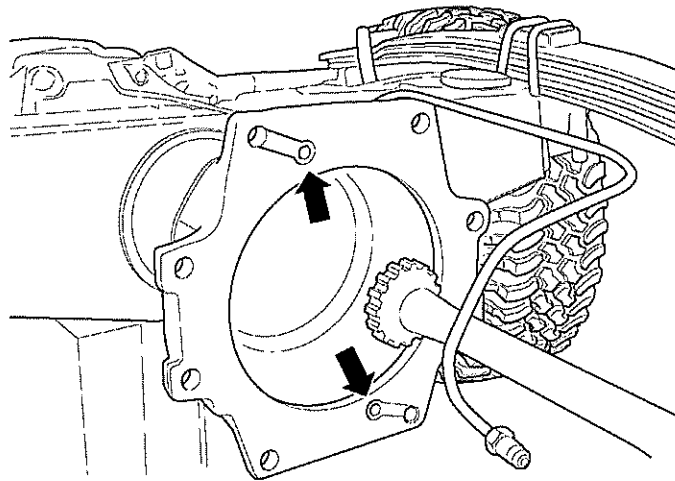


Fig 6 Support tube flange

5.2 Smear drive shaft teeth with XG 305.

5.3 Lift first rear axle level with support tube flange, lift both leaf springs and insert front axle completely into support tube whilst turning centre shaft.

5.4 Smear thread of hexagon screws with Loctite Anti Seize compound and refit with spring washers, tightening to correct torque (see Table 2, Ser 1).

NOTE

When tightening screws, ensure axle and support tube are perfectly aligned.

5.5 Smear support shell in spring bearing with grease. Spray thread of spring support bolts with Loctite Anti Seize compound and tighten to correct torque (see Table 2, Ser 2).

5.6 Screw brake pipe onto distributor and tighten with torque wrench (Table 1, Ser 1) and spanner (Table 1, Ser 3) to correct torque (see Table 2, Ser 3).

5.7 Refit wheels.

NOTE

Before refitting double axle, remove transfer gearbox (see Chapter 4). Clean sealing surfaces of transfer gearbox and central tube flange and smear one surface with Loctite 574. Refit transfer gearbox back into position.

5.8 Smear sealing surfaces of centre tube distance piece with Loctite 574. Grease coupling sleeve teeth with XG 305.

NOTE

Vent slots and bores must not be clogged.

- 5.9 Smear thread of anchor bolts with Loctite Anti Seize compound and insert at support tube flange. Push in until flush with distance piece.
- 5.10 Smear new O-ring with Loctite 574 and fit onto transfer gearbox.
- 5.11 Check condition of insulating mat and underside for adhesive ability. If necessary, reapply suitable adhesive.
- 5.12 Refit double axle carefully supporting second rear axle with moveable jack.
- 5.13 Lower body until gap between cross member bearing cap and platform support is approximately 2 mm.
- 5.14 Push axle against transfer gearbox until drive teeth mesh and surfaces are flush. If this is not possible, put gearbox into neutral position and change range on auxiliary gearbox selector lever. Turn joint shaft and push double axle towards transfer box until teeth drive mesh.
- 5.15 Pre-tighten upper and lower anchor bolts, distance piece hexagon screw and cap nuts. Smear thread of lateral anchor bolts with Loctite Anti Seize compound and refit. Screw on cap nuts but do not tighten.

NOTE

Ensure that hexagon screw is refitted with spring washer.

- 5.16 Tighten cap nuts and hexagon screw to correct torque (see Table 2, Ser 4 and 5).

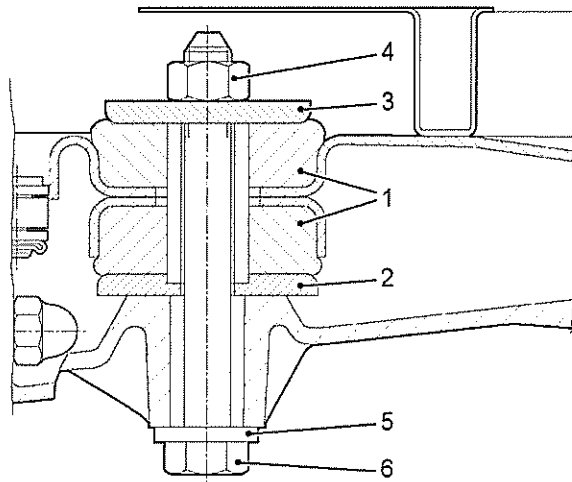
NOTE

When tightening screws; ensure that all supports and housings are aligned.

- 5.17 Refit insulation.
- 5.18 Refit transmission brake linkage.
- 5.19 Smear body support screws with Loctite Anti Seize compound. Refit body supports at towing flange and cross member, insert screws but do not tighten (see Fig 7).

NOTE

Fit support shims with rounded side facing rubber pad.



- | | | |
|----------------------|----------------------|----------|
| 1 Rubber supports | 3 Upper support shim | 5 Washer |
| 2 Lower support shim | 4 Nut | 6 Bolt |

Fig 7 Body support mounting

5.20 Further refitting should be carried out according to Para 22.1 - 22.9 in reverse order, noting the following:

5.20.1 Smear shock absorber screw threads and shafts with Loctite Anti Seize compound before refitting. Tighten screws when shock absorber is in extended position to correct torque (see Table 2, Ser 6) (see Fig 8).

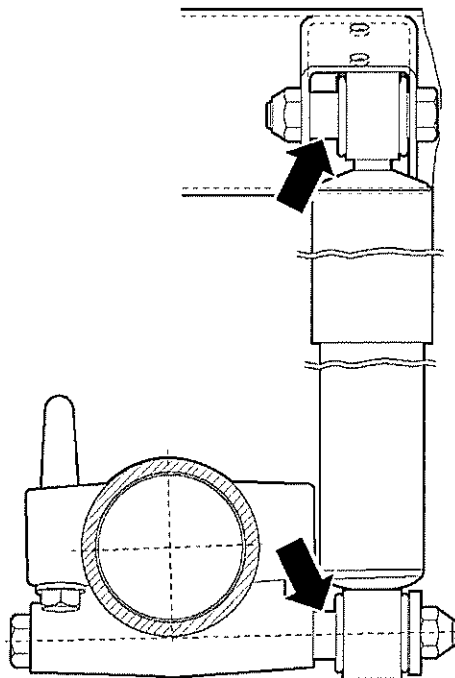


Fig 8 Shock absorber

5.20.2 Smear new seal rings with Loctite 574, then refit with actuators (see Fig 9).

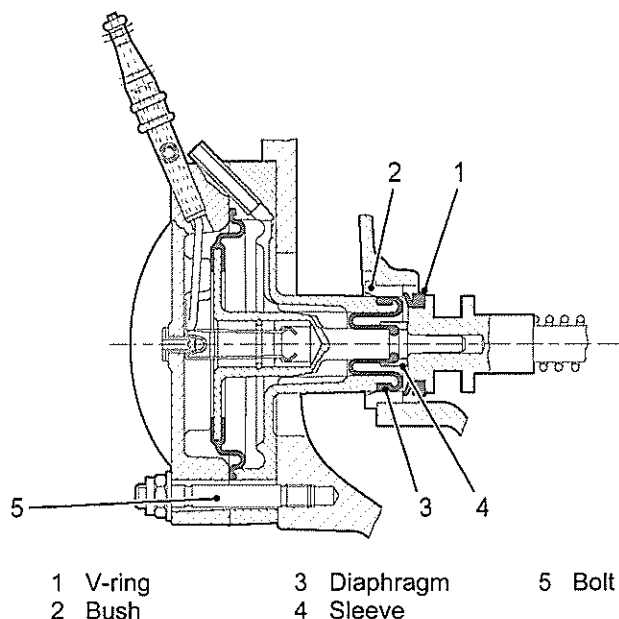


Fig 9 Differential lock actuator

5.20.3 Tighten brake pipes with torque wrench (Table 1, Ser 1) and socket spanner (Table 1, Ser 2) to correct torque (see Table 2, Ser 3).

5.20.4 Where fitted, disconnect ABS sensor leads from main ABS harness

5.20.5 Refit hand brake cable and adjust if necessary.

5.20.6 Bleed brake system (see Chapter 10).

5.20.7 Lower vehicle to ground and tighten body support bolts to correct torque (see Table 2, Ser 7).

5.20.8 Tighten wheel bolts to correct torque (see Table 2, Ser 8).

5.20.9 Ensure vehicle is in horizontal position and fill axle housing with oil. Top up to overflow level.

Strip

6 To strip the first rear axle, proceed as follows:

6.1 Remove first rear axle (see Para 4).

6.2 Replace screw plug in differential housing with lifting eye (Table 1, Ser 4). Using suitable lifting equipment move axle onto suitable work surface.

6.3 Unscrew brake pipe distributor from cross member.

6.4 Remove distance piece and cross member with body supports.

6.5 Mark position of brake hose retainer on left and right half axle. Remove hose retainer fastening screws and unscrew left and right brake pipes at wheel drive retainers. Detach brake pipes and inner brake pipe retainers. Fit brake hoses to callipers temporarily (see Fig 10).

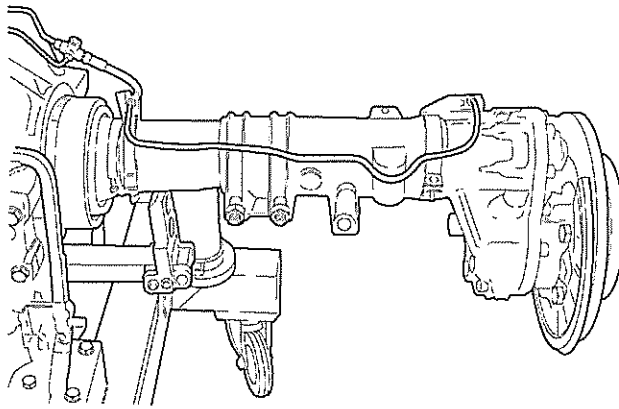


Fig. 10 Brake Hose Connections

NOTE

Only remove brake hose bracket at portal hub housing when completely changing axle or hub.

6.6 Place suitable container under axle journal. Remove axle journal retaining screws, then tap off journal using plastic mallet.

6.7 Loosen anti fatigue screws and centring bolts on half axles.

6.8 Insert wedge of press off device (Table 1, Ser 5) into slot adjacent to anti fatigue bolts until stop in portal hub housing. Bolt on device when axle is in extended position and remove wheel drive. Carry out procedure on other side (see Fig 11).

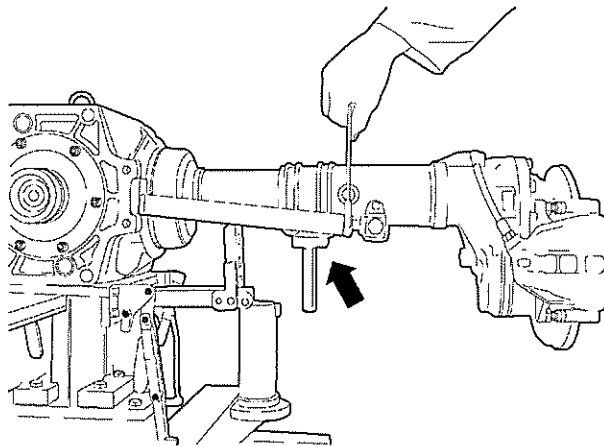


Fig 11 Wheel drive removal

6.9 Insert distance piece (Table 1, Ser 6) at compensator shaft, fit steering drop arm puller (Table 1, Ser 7) centrally and pull off coupling sleeve (see Fig 12).

NOTE

Coupling sleeve is stuck on with Loctite, if difficult to remove, heat sleeve to 110 °C.

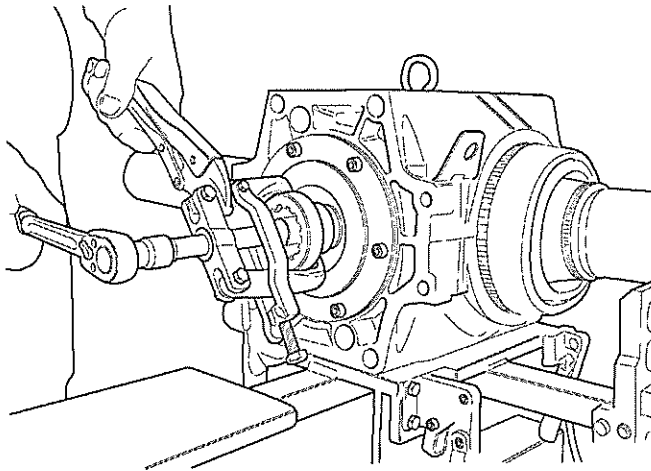


Fig 12 Coupling sleeve removal

- 6.10 Remove centring ring.
- 6.11 Strip wheel drives (see Para 22).

Re-assemble

7 To re-assemble the first rear axle, proceed as follows:

- 7.1 Re-assemble wheel drives (see Para 23).
- 7.2 Smear sealing surface of centring ring and O-ring with Loctite 574. Mount centring ring and tighten screws crosswise.
- 7.3 Remove Loctite and grease from compensator shaft and coupling sleeve teeth. Apply Loctite 641 to teeth and slip on coupling sleeve until stop. Remove excess Loctite.

NOTE

Do not move coupling sleeve after mounting. Wait for Loctite to harden (approximately 20 minutes) before further assembly. Check Loctite is hand firm before proceeding.

- 7.4 Grease new O-ring and fit into centring ring groove.
- 7.5 Remove excess Loctite from half axle ends.
- 7.6 Push clean rag deep into half axle to stop ingress of dirt and cover chrome surface of swivel housing. Use abrasive cloth to clean residual Loctite from inside axle casing. Remove rag and degrease cleaned surface (see Fig 13).

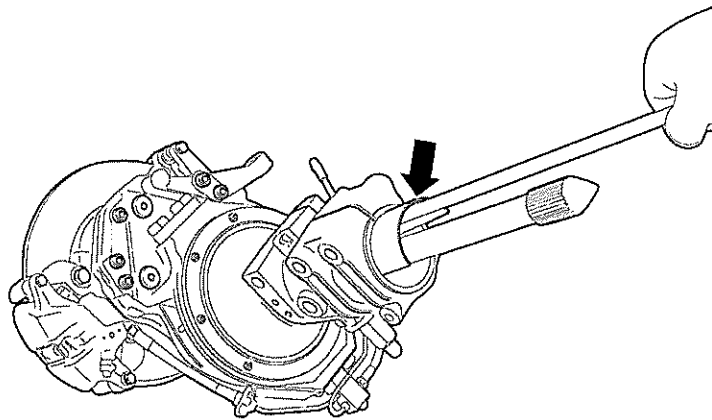


Fig 13 Cleaning portal hub inner bore

7.7 Open wheel drive housing at screw bores with wedge of press off device (Table 1, Ser 5). Check half axle shaft teeth for wear then smear with XG 305.

7.8 Smear half axle ends with Loctite 648.

7.9 Grease new O-rings and insert into grooves on half axle ends.

7.10 Fit wheel drives with spring support bolt thread facing rearwards. If necessary, use hammer and wood until centring bolt can be screwed in easily. Refit new anti fatigue bolts with thread facing rearwards and screw on new nuts.

NOTES

(1) Do not re-use anti-fatigue bolts and nuts.

(2) Fit wheel drive immediately after applying Loctite. Apply Loctite Anti Seize compound to centring bolt, collar and thread of anti fatigue screws. Remove wedge only when centring bolt is screwed in fully.

7.11 Tighten centring bolt then anti fatigue screws to correct torque (see Table 2, Ser 9).

7.12 Fit new O-ring onto axle journal. Apply Loctite 574 to O-ring and journal sealing surface. Apply XG 305 to journal teeth.

7.13 Fit axle journal until only small gap remains between journal and differential. Fit screws with washers crosswise.

7.14 Fit brake pipes. Lead inner brake hose retainer right to cylindrical neck of collar and to marking made during dismounting (so that brake hose remains tension free when axle swings). Insert fastening screws from above. Tighten brake pipes using socket spanner (see Table 1, Ser 2) and torque wrench (see Table 1, Ser 1) to correct torque (see Table 2, Ser 3).

NOTE

Ensure brake hoses are not twisted.

7.15 Apply Loctite 574 to both sides of cross member and mount with carrier tube. Tighten fastening screw only when axle is mounted. Tighten to correct torque (see Table 2, Ser 5).

NOTE

Cross member should be fitted facing forwards.

7.16 Screw brake pipe distributor onto cross member.

7.17 Lift axle and check that brake hoses are tension free with axles hanging down. Replace lifting eye (see Table 1, Ser 4) with screw plug.

7.18 Check oil level in differential and wheel drives when axle is in horizontal position. Top up to overflow level if necessary.

SECOND REAR AXLE

Removal

8 To remove the second rear axle, proceed as follows:

8.1 Drain rear axle oil.

8.2 Lift vehicle with jack placed under rearmost axle casing until wheels just clear ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable padding (eg felt) on stands to avoid damage to paintwork.

8.3 Place support stands under tubular rear bumper quarters and lower jack.

8.4 Remove second rear axle wheels.

8.5 Remove safety lock and pull out bolt at handbrake linkage. Disconnect release spring (see Fig 1).

8.6 Remove nuts securing pneumatic differential lock actuators to rear axle and transfer gearbox. Also remove heat shield from transfer gearbox actuator.

NOTE

The two hexagon screws hold the pneumatic gearshift unit together; these should not be removed (see Fig 3).

8.7 Detach pneumatic actuators and tie back.

8.8 Unscrew spring support bolt of second rear axle by approximately 15 - 20 mm (see Fig 14).

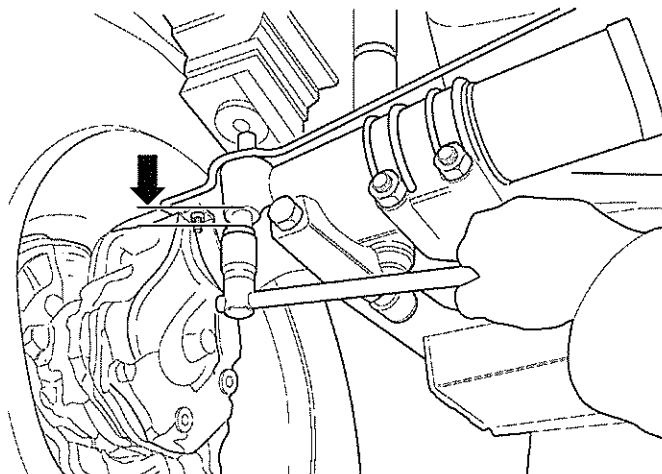


Fig 14 Leaf spring support bolt

- 8.9 Press off joint rod from adjusting lever using spanner (see Fig 15) – non ABS variants only.

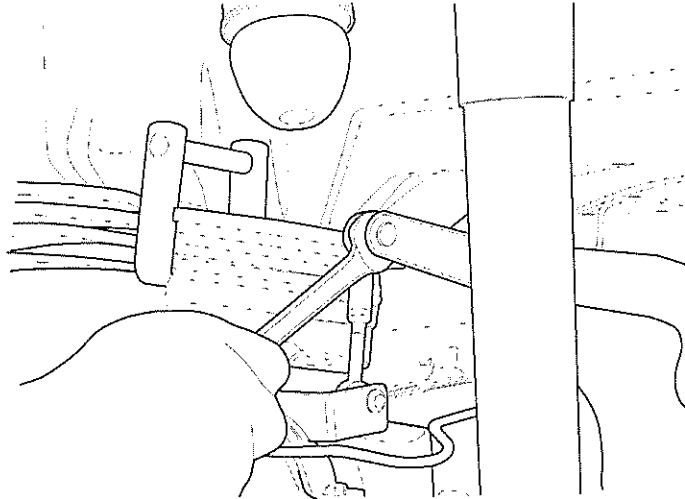


Fig 15 Adjusting lever support rod (non ABS variants only)

- 8.10 Disconnect brake lines at brake power control and seal with rubber caps from bleeder screws (see Fig 2).

NOTE

When removing brake lines collect fluid in suitable container.

- 8.11 Unscrew brake pipe to first rear axle at distributor (see Fig 16).

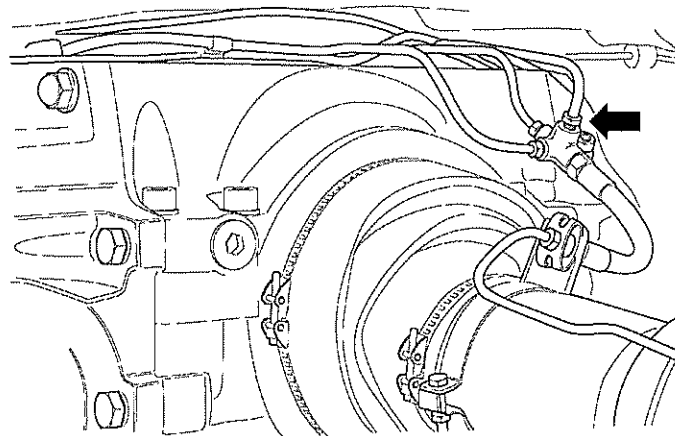


Fig 16 Brake pipe distributor

- 8.12 Disconnect brake pipe from distributor to brake power control at connection piece.

- 8.13 Where fitted, disconnect ABS sensor leads from main ABS harness.

- 8.14 Place jack slightly offset to rear of axle drive and take weight of assembly.

- 8.15 Loosen body support bolt at towing flange then remove nut, support shim and rubber pad.

NOTE

When loosening support bolt it is necessary to hold nut (not captive).

- 8.16 Loosen body support screws at cross member of first rear axle by 6-8 turns. Remove body support screws from cross member of second rear axle, then remove shim and rubber pad.
- 8.17 Remove hexagon screws from carrier tube.
- 8.18 Loosen cap nuts of anchor bolts at distance piece.
- 8.19 Lower vehicle by approximately 30 -50 mm and release circlip. Detach angle lever and shim from cut thread bolt and put angle lever down (see Fig 5).
- 8.20 Remove axle, detach support shim and rubber pad from towing flange.

NOTE

Use suitable supports when lowering axle to prevent damage to brake disc splash guards. Also lift brake power control to prevent damage.

- 8.21 Remove axle completely.

Refitting

- 9 The second rear axle is refitted as follows:

- 9.1 Smear coupling sleeve teeth and drive shaft with XG 305.
- 9.2 Smear sealing surface of support tube with Loctite 574.

NOTE

Vent slots and bores should not be clogged (see Fig 6).

- 9.3 Carefully fit second rear axle onto support tube. Screw in centring screws at least 10 mm by hand.
- 9.4 Insert axle completely, taking care to mate flanges of distance piece and body support parallel to each other. If drive shaft splines do not engage, turn both wheels of first rear axle in same direction to mesh drive shaft and coupling sleeve then remove centring screws.
- 9.5 Smear thread of hexagon screws and cap nuts with Loctite Anti-Seize compound and tighten to correct torque (see Table 2, Ser 4 and 5).

NOTE

Ensure hexagon screws are fitted with spring washers. When tightening axle, ensure that support tube and axle are level.

- 9.6 Refit angle lever (see Fig 5).
- 9.7 Smear body support fastening screws with Loctite Anti Seize compound and fit body supports at towing flange, but do not tighten.

NOTE

Fit support shims with rounded side facing rubber pad.

- 9.8 Further refitting is carried out following Para 6 in reverse order, noting the following points:

- 9.8.1 Smear thread and shaft of lower shock absorber screw with Loctite Anti Seize compound before mounting. Lift wheel drive and fit shock absorber in extended position, tighten to correct torque (see Table 2, Ser 6) (see Fig 8).
- 9.8.2 Apply grease to spring bearing support shell.
- 9.8.3 Apply Loctite Anti Seize compound to thread of spring support bolts then tighten to correct torque (see Table 2, Ser 2).
- 9.8.4 Check stop position of V-ring facing bush in axle journal. Check diaphragm and clamping sleeve are intact and correctly seated. Smear both sides of pneumatic gearshift assembly gasket with Loctite 574 and mount assembly (see Fig 9).
- 9.8.5 Tighten brake pipes with torque wrench (Table 1, Ser 1) and socket spanner (Table 1, Ser 2) to correct torque (see Table 2, Ser 3).
- 9.8.6 Where fitted, connect ABS sensor leads to main ABS harness.
- 9.8.7 Twist brake cable by 3-4 turns before hooking into angle lever.
- 9.8.8 Check setting of hand brake, adjust if necessary (see Chapter 10).
- 9.8.9 Bleed brake system (see Chapter 10).
- 9.8.10 Check setting of brake power control, adjust if necessary (see Chapter 10).
- 9.8.11 Put vehicle on wheels and tighten body support fastening screws, starting at first rear axle. Tighten to correct torque (see Table 2, Ser 7).
- 9.8.12 Tighten wheel bolts to correct torque (see Table 2, Ser 8).
- 9.8.13 Place vehicle in horizontal position and fill axle drive with oil. Check oil level in portal hubs and top up to maximum level.

CAUTION

EQUIPMENT DAMAGE. Observe different specifications of oils in differential and wheel drives.

Strip

- 10 To strip the second rear axle, proceed as follows:
 - 10.1 Remove second rear axle (see Para 8).
 - 10.2 Remove bolt plug in top centre of axle housing. Fix lifting eye (see Table 1, Ser 4) and lift complete rear axle using suitable lifting equipment onto suitable work bench or axle mounting trestle.
 - 10.3 Remove anchor bolts from distance piece on front side of axle, then remove distance piece and cross member with bearing cups.
 - 10.4 Mark position of brake hose bracket on right and left portal hub (to show position on axle). Loosen bolts and remove bracket (see Fig 10).
 - 10.5 Remove right and left brake pipe from brake hose bracket at outside end of portal hub, from axle housing, ensuring spring retainers are not removed from hose brackets.
 - 10.6 Plug brake pipes and hoses to prevent ingress of dirt.

NOTE

Unbolt brake hose bracket at portal hub housing only when completely changing axle or portal hub.

- 10.7 Detach angle lever from bolt on top of towing flange and put aside on axle housing.
- 10.8 Remove towing flange with special spring washers (case ring version).
- 10.9 Detach rear handbrake disc and brake housing (see Fig 17).

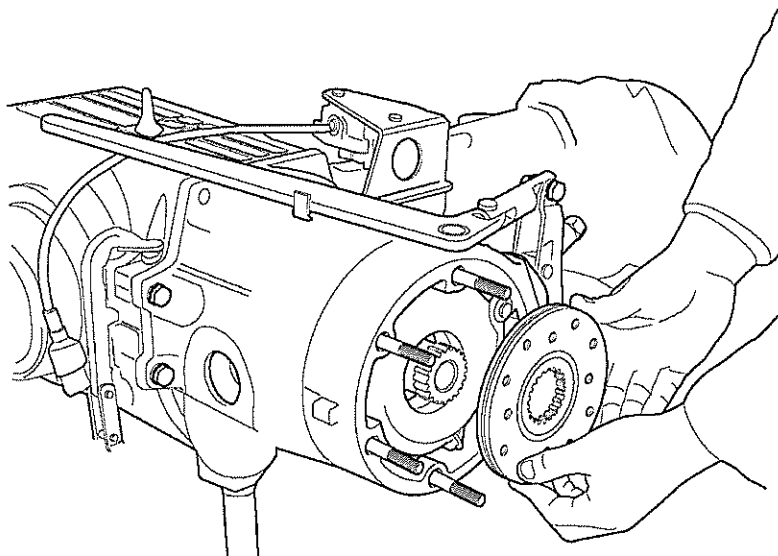


Fig 17 Handbrake disc removal

- 10.10 Detach front handbrake disc from splines of brake shaft. Unbolt handbrake actuating rod from lever at right hand side of axle drive. Loosen bracket bolts and remove bracket and actuating rod from right hand portal hub.
- 10.11 Loosen bolts from right and left side of handbrake housing and remove with special spring washers (case ring version) along with support plate with brake power control and distance shims.
- 10.12 Loosen handbrake flange with gentle taps from a plastic hammer, then remove.
- 10.13 Place oil drip tray under rear axle differential lock housing, loosen socket head retaining bolts and remove with washers. Loosen differential lock housing with gentle taps from plastic hammer and remove from differential shaft.
- 10.14 Loosen anti-fatigue bolts and centring bolt from both half axle tubes.
- 10.15 Drive in wedge of press off device (see Table 1, Ser 5) into slot adjacent to anti-fatigue bolts until stop in portal hub housing. Bolt on device when axle is in extended position and press off portal hub assembly. Discard O-ring (see Fig 11).
- 10.16 Carry out same procedure on other half axle.
- 10.17 Insert distance piece (see Table 1, Ser 6) at compensator shaft, fit steering drop arm puller (see Table 1, Ser 7) centrally, back up with collet and remove coupling sleeve (see Fig 12).

NOTE

Coupling sleeve is fixed using Loctite. If removal proves difficult, heat area around splines to approximately 110 °C. Do not use excessive heat.

- 10.18 Remove centring ring from forward face of axle drive.

Re-assemble

11 The rear axle is re-assembled as follows:

11.1 Check condition of handbrake linings. If contaminated with oil replace both handbrake linings and differential lock housing oil seal (see Chapter 4).

11.2 Check condition of splines on handbrake shaft and handbrake disc and replace if necessary.

11.3 Check handbrake lining thickness, minimum thickness 0.5 mm above rivet heads. Renew if necessary.

11.4 Check handbrake disc spring tension, replace if necessary.

11.5 Check handbrake flange for traces of wear or scoring, replace if necessary.

11.6 Check towing flange for traces of wear or scoring, replace if necessary.

11.7 Remove Loctite residue from bright metallic half axle ends using emery paper.

11.8 Insert clean rag deep into bore of portal hub and remove Loctite residue from inside surface. Remove rag and degrease cleaned surface (see Fig 13).

NOTE

Check half shaft splines for wear or damage before greasing.

11.9 Moisten right half axle bright end with Loctite 648.

NOTE

Right side of axle housing holds oil filler and oil level plugs.

11.10 Moderately oil or grease new O-ring and insert into groove on end of axle tube.

11.11 Slip on right portal hub (bore for spring support bolt facing forwards) as far as possible. If necessary, use several hammer taps on end of portal hub, ensuring wooden packing piece is used to protect flange. Screw in centring bolt and insert anti-fatigue bolts with thread pointing backwards, then fit nuts.

NOTES

(1) After applying Loctite to half axle, fit portal hub immediately. Apply Loctite Anti-Seize compound to centring bolt and collar and thread of anti-fatigue bolts. Do not remove wedge before centring bolt is fully tightened.

(2) Original portal hub housing has only one threaded hole for spring support bolt (left or right) and must be assigned to respective half axle. Replacement portal hub housings have two threaded holes and may be used on either side of axle (see Fig 18).

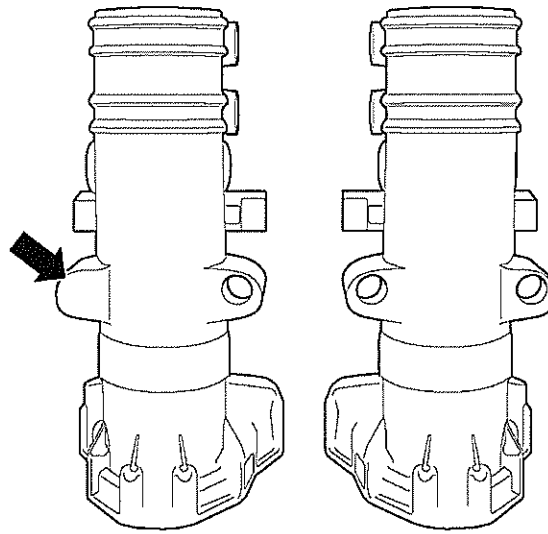


Fig 18 Portal hub assemblies

11.12 Tighten portal hub centring bolt first, then both anti-fatigue bolts to correct torque (see Table 2, Ser 9).

11.13 Fit left portal hub in same way.

11.14 Remove Loctite residues from splines of torque tube and axle input shaft and degrease. Torque tube must move easily until stop.

NOTE

Fit centring ring and torque tube to axle front side, this has small splines of input shaft (rear side has large differential lock splines).

11.15 Smear new O-ring and centring ring with surface sealant Loctite 574. Insert centring ring carefully ensuring O-ring does not slip. Tighten socket head bolts with washers across diagonals.

11.16 Slip on differential lock housing leaving only small gap between housing and axle casing. Insert two socket head bolts and washers across diagonals to centre and bolt differential lock housing fully home. Fit remainder of socket head bolts with washers. Tighten evenly across diagonals.

11.17 Smear sealing surface of handbrake flange with surface sealant Loctite 574 and refit.

NOTE

Vent slots and bores must not be clogged (see Fig 19).

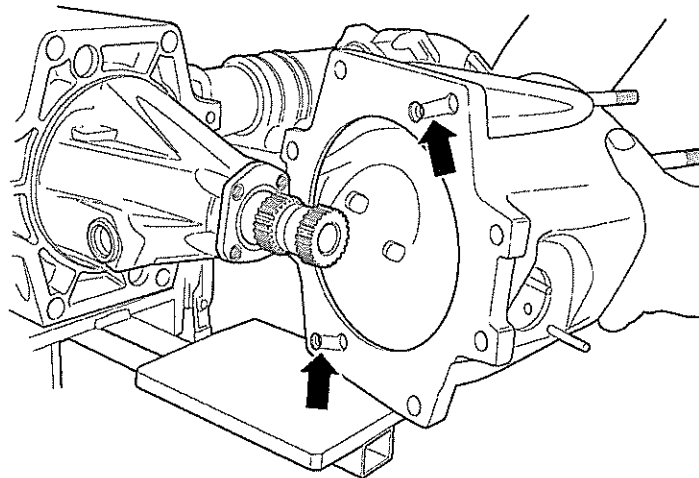


Fig 19 Distance piece vents and bores

11.18 Fix distance shims with grease to enable brake power control bracket to be mounted directly (see Fig 20).

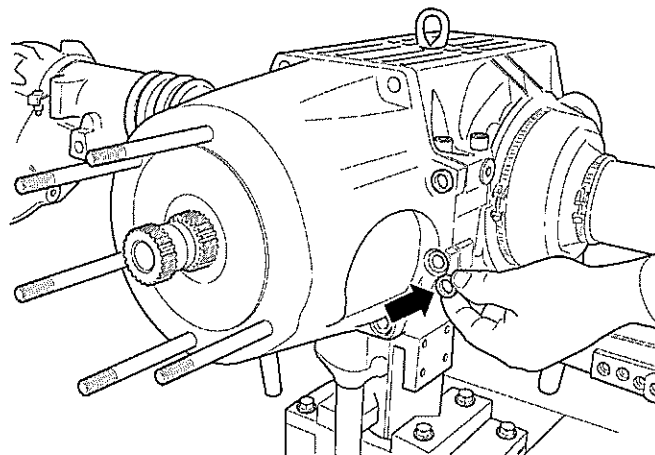


Fig 20 Fixing distance shims with grease

11.19 Smear threads of bolts for fastening handbrake flange with Loctite Anti-Seize compound and tighten to correct torque (see Table 2, Ser 10).

11.20 Refit brake power control support plate with hexagon bolts.

11.21 Slip front handbrake disc onto brake shaft. Moisten sealing surfaces of handbrake housing on both sides with surface sealant Loctite 574 and slip on until stop. Insert rear handbrake disc.

11.22 Fit towing flange. Smear thread of studs or dome nuts with Loctite Anti-Seize compound and tighten to correct torque (see Table 2, Ser 11).

11.23 Put angle lever onto bolt of towing flange, fit washer and retaining spring.

11.24 Refit brake pipes and brackets in same order as removed. Place inner brake hose bracket as close to axle cuff as possible to allow full axle deflection without tensioning hose. Insert bolts from above. Tighten brake pipes to correct torque (see Table 2, Ser 3).

11.25 Moisten torque tube splines with Loctite 270 and slip onto differential shaft until stop. Remove excess Loctite.

NOTE

Fit axle before Loctite hardens and align with transfer gearbox.

hand firmness 15-20 mins
final firmness approx 12 hrs

11.26 Moisten sealing surfaces of axle drive and distance piece (side facing axle drive) with surface sealant Loctite 574. Fit cross member centring ring. Fasten distance piece provisionally with two bolts but do not fully tighten.

CAUTION

EQUIPMENT DAMAGE. Cross member end bearing cover with rubber pad must point forwards, seen from driving direction.

11.27 Put rubber pad and bearing cover on cross member ends, (both sides) and insert anchor bolts.

CAUTION

EQUIPMENT DAMAGE. With portal hubs hanging downwards, check brake hoses between axle casing and portal hub to ensure they are not under tension.

11.28 Lower axle and replace lifting eye with standard plug.

11.29 Refit second rear axle (see Para 9).

REAR PORTAL HUB

Removal

12 The rear portal hub is removed in the following way:

12.1 Lift vehicle with jack placed under axle casing until wheels are off ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable padding (eg felt) on stands to avoid damage to paintwork.

12.2 Place support stands under tubular rear bumper quarters and lower jack.

12.3 Remove wheel.

12.4 When removing right hand portal hub, remove handbrake actuating rod bracket from axle tube.

12.5 Remove leaf spring (see Chapter 8-2).

CAUTION

(1) **EQUIPMENT DAMAGE.** When removing brake pipe, ensure hydraulic hose is adequately restrained to prevent twisting. Collect fluid in suitable container.

(2) **EQUIPMENT DAMAGE.** Plug brake lines and brake hoses to prevent ingress of dirt.

12.6 Remove brake pipe from hydraulic hoses at inboard and outboard brackets on axle.

- 12.7 Remove anti-fatigue bolts that clamp portal hub onto axle.
- 12.8 Remove centring bolt.
- 12.9 Using jack, raise portal hub into horizontal position and drive wedge into slot adjacent to anti-fatigue bolts. Fix press off device, (see Table 1, Ser 5) and press off portal hub assembly.

NOTE

Do not tilt or invert portal hub once removed, it is filled with oil.

- 12.10 Remove and discard O-ring.

NOTE

Carry out Para 12.11 to 12.12 only when replacement assembly is to be fitted. Transfer parts of brake unit onto new assembly.

- 12.11 Drain portal hub oil before starting work.
- 12.12 Remove brake calliper and disc (see Chapter 10)
- 12.13 Unbolt brake hose bracket and remove brake power control bracket.

Refitting

- 13 To refit rear portal hub, proceed as follows:
 - 13.1 Check half shaft splines for damage or wear. If necessary, replace both portal hub and axle drive assemblies.
 - 13.2 Bolt on brake hose bracket and refit brake power control bracket (without fastening bolt) in same position.
 - 13.3 Fit brake disc and calliper (see Chapter 10).

NOTE

Calliper should be fitted with bleed nipple at top.

CAUTION

EQUIPMENT DAMAGE. Check brake disc, brake pads and calliper for serviceability (see Chapter 10).

- 13.4 Insert clean rag deep into bore of portal hub axle tube and remove Loctite residue from inside surface. Remove rag and degrease cleaned surface.

NOTE

Check half shaft splines for wear or damage before greasing.

- 13.5 Moisten half axle bright end with Loctite 270.
- 13.6 Moderately oil or grease new O-ring and insert into groove on end of axle tube.
- 13.7 Slip on portal hub (bore for spring support bolt facing forwards) as far as possible. If necessary, use hammer taps on end of portal hub, ensuring wooden piece is used to protect flange. Fit centring bolt and insert anti-fatigue bolts with thread pointing backwards, then fit nuts.

NOTES

(1) After applying Loctite to half axle, fit portal hub immediately. Before fitting, apply Loctite Anti-Seize compound to centring bolt and collar and thread of anti-fatigue bolts. Do not remove wedge until centring bolt has been fully tightened.

(2) Original portal hub housing has only one threaded hole for spring support bolt (left or right) and must be assigned to respective half axle. Replacement portal hub housings have two threaded holes and may be used on either side of axle.

13.8 Tighten portal hub centring bolt first, then both anti-fatigue bolts to correct torque (see Table 2, Ser 14).

13.9 Fit handbrake actuating rod bracket back onto right hand portal hub. When tightening bolt, press ball head downwards. Refit actuating rod onto angle lever.

13.10 Refit inboard and outboard brake hoses and fit into brake hose retainer with retaining springs.

CAUTION

EQUIPMENT DAMAGE. Restrain brake hoses when tightening brake pipe to prevent twisting.

13.11 Tighten brake pipes to correct torque (see Table 2, Ser 3).

13.12 Fit leaf spring (see Chapter 8-2).

13.13 Replace shock absorber pneumatic line, O-ring, ensuring it is placed at least 8 mm from end of pipe. Clean thread of union nut, reconnect pressure line and tighten hand tight only.

13.14 Bleed brakes (see Chapter 10).

13.15 Fit wheel and lower vehicle to ground.

13.16 Tighten wheel bolts to correct torque (see Table 2, Ser 8).

CAUTION

EQUIPMENT DAMAGE. Observe different specifications of oils in axle/portal hub.

13.17 Place vehicle in horizontal position and fill axle drive with oil. Check oil level in portal hubs and top up to maximum level.

WHEEL BEARINGS

Check Play

14 To check play in wheel bearings see Chapter 5-1.

Change

15 To change the wheel bearings see Chapter 5-1.

BRAKE ANCHOR PLATE

Removal

16 The brake anchor plate is removed as follows:

16.1 Lift vehicle with jack placed under axle body until wheels are off ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable padding (eg felt) on stands to avoid damage to paintwork.

16.2 Place support stands under tubular rear bumper quarters and lower vehicle.

16.3 Remove appropriate wheel.

16.4 Remove brake calliper and disc (see Chapter 10).

NOTE

Do not remove brake hydraulic hose.

16.5 Remove brake disc retaining screws and remove disc.

16.6 Loosen socket head bolts retaining the flange to housing.

NOTE

Recess in flange provides clearance for socket and extension when loosening lower bolts (see Fig 21).

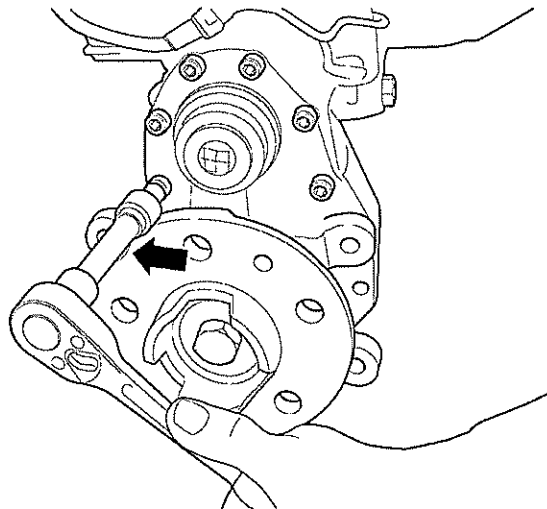


Fig 21 Brake anchor plate bolt access

16.7 Place oil drip tray below portal hub housing and remove brake anchor plate using two M10 x 50 (fully threaded) set screws to push against portal hub housing.

NOTE

To prevent anchor plate from canting, it may be necessary to gently tap flange with plastic hammer whilst inserting M10 set bolts.

Strip

- 17 To strip the brake anchor plate see Chapter 5-1.

Refitting

- 18 The anchor plate is refitted as follows:

18.1 Visually inspect all components for signs of wear or damage and check brake components are within wear limits (see Chapter 10).

18.2 Clean mating surfaces of brake anchor plate and portal hub housing and moisten with Loctite 574.

18.3 Mount brake anchor plate and drive fully home using gentle taps from plastic hammer.

18.4 Moisten threads of socket head bolts with Loctite Anti-Seize compound and gradually tighten across diagonals to correct torque (see Table 2. Ser 15).

18.4 Apply Loctite 7471 activator to threaded section of anchor plate bolts, allow activator to dry then apply Loctite 243 to threaded section of the securing bolts. Gradually tighten across diagonals to correct torque (see Table 2. Ser 15).

18.5 Fit brake disc and calliper (see Chapter 10).

NOTE

Calliper should be fitted with bleed nipple at top.

CAUTION

EQUIPMENT DAMAGE. Check brake disc, brake pads and calliper for serviceability (see Chapter 10).

18.6 Refit wheel and lower vehicle to the ground

18.7 Tighten wheel bolts to correct torque (see Table 2 Ser 8).

18.8 Refill portal hub to correct level using correct specification oil (see AESP 2320-503-601). Ensure vehicle is horizontal.

CHANGE WHEEL FLANGE OIL SEAL

- 19 To change the wheel flange oil seal see Chapter 5-1.

DRIVE SHAFT**Removal**

- 20 The drive shaft is removed as follows:

20.1 Remove brake anchor plate (see Para 16).

20.2 Remove circlip retaining inner bearing race and gear wheel onto drive shaft end and remove shim.

20.3 Remove gear wheel and bearing inner race together.

NOTE

If gear wheel is excessively tight, remove gear wheel and bearing inner race separately. Follow above procedure until gear wheel and bearing race have moved out approximately 2-3 mm. Restrain drive shaft from being pushed in. Ensure soft metal packing pieces are placed between puller and flange to prevent damage. Using soft drift, tap gear wheel back until 2-3 mm gap forms between bearing race and gear wheel. When there is sufficient clearance between gear wheel and bearing race, insert puller and remove bearing race, then dismount gear wheel. If necessary heat bearing race to approximately 100 °C to reduce resistance (see Fig 22).

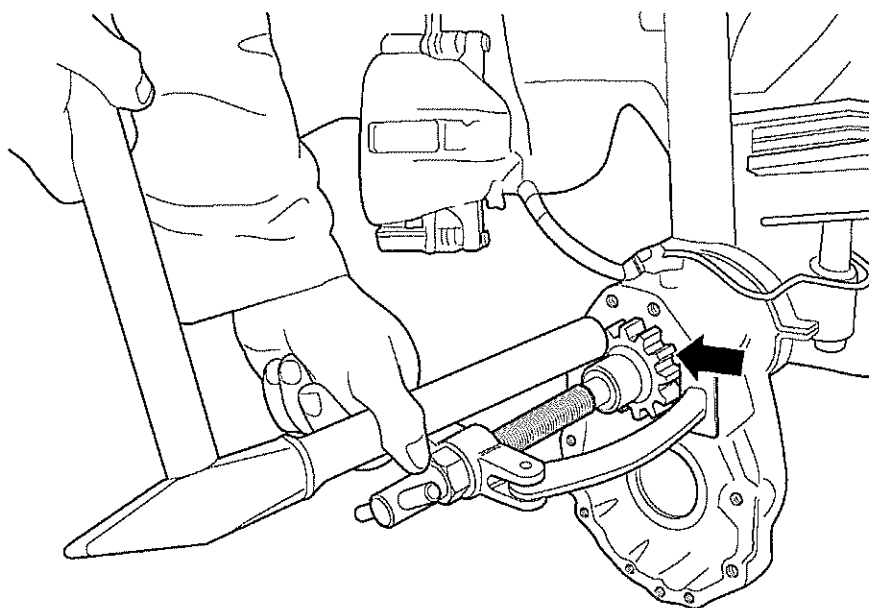


Fig 22 Gear wheel removal

20.4 Remove circlip retaining drive shaft support bearing in housing inner bore.

20.5 Pull out drive shaft and bearing from portal hub housing. Ensure soft metal packing pieces are placed between puller and portal hub flange to prevent damage.

20.6 Remove bearing outer race and then mount drive shaft in vice, ensuring soft faced jaws are used, then remove bearing inner race from drive shaft.

Refitting

21 To refit drive shaft, proceed as follows:

21.1 Visually inspect all components for signs of wear or damage, paying particular attention to drive shaft splines and circlip undercuts. Run drive shaft between centres to check run out tolerance of 0.5 mm.

21.2 Heat inner bearing inner race to approximately 80 °C and place onto drive shaft with bearing collar fitted adjacent to drive shaft collar.

21.3 Refit drive shaft (inner) bearing outer race to drive shaft and fix spacer to drive shaft end. Fit shim with writing outer most and secure with circlip. This prevents bearing from sliding off drive shaft as it is inserted into portal hub housing.

21.4 Smear drive shaft inner splines with XG 305 and insert shaft into crown wheel of axle, until drive shaft bearing starts to engage in portal hub housing.

- 21.5 Push drive shaft bearing fully home into portal hub housing.
- 21.6 Refit circlip to bore of portal hub housing, with circlip opening facing downwards.

CAUTION

EQUIPMENT DAMAGE. Care should be taken to ensure drive shaft bearing does not slide allowing drive shaft to enter too deep into axle.

- 21.7 Heat gear wheel to approximately 100 °C and refit to drive shaft with collar facing inwards.
- 21.8 Ensure gear wheel is fully home.
- 21.9 Refit (outer) bearing inner race after heating to approximately 100 °C. Ensure writing faces out and is visible and race is pressed against gear wheel.
- 21.10 Refit circlip to retain bearing.
- 21.11 Measure clearance between circlip and bearing inner race using feeler gauge.
- 21.12 Remove circlip and fit appropriate shim to take up clearance. Shims are available from 0.5 mm to 0.9 mm in 0.1 mm steps.
- 21.13 Refit circlip and ensure it fits securely without any clearance to shim. If necessary, adjust shim size.
- 21.14 Further refitting is done in reverse order to stripping.

PORTAL HUB**Strip**

- 22 To strip the portal hub, proceed as follows:
 - 22.1 Drain oil from portal hub housing.
 - 22.2 Insert complete portal hub into suitable carrier.
 - 22.3 Remove brake anchor plate (see Para 16).

Re-assemble

- 23 The portal hub is re-assembled as follows:
 - 23.1 Refit brake anchor plate (see Para 18).
 - 23.2 Further re-assembly is done in reverse order to stripping.
 - 23.3 Ensure re-assembled portal hub is filled with correct specification oil (see 2320-D-503-601) when refitted to vehicle in horizontal position.

PORTAL HUB GEARBOX HOUSING**Strip**

- 24 The portal hub gearbox housing is stripped as follows:
 - 24.1 Secure portal hub housing in suitable carrier.
 - 24.2 Remove drive shaft (see Para 20).

24.3 Remove lower bearing from portal hub housing.

24.4 Ensure all traces of Loctite are removed from portal hub housing, especially from inside axle tube.

Re-assemble

25 To re-assemble portal hub gearbox housing, proceed as follows:

25.1 Refit lower bearing to housing.

25.2 Refit drive shaft (see Para 21).

25.3 Further re-assembly is done in reverse order to stripping.

25.4 Ensure re-assembled portal hub is filled with correct specification oil (see 2320-D-503-601) when refitted to vehicle in horizontal position.

REAR AXLE BASE

Measure

26 To measure the rear axle base, proceed as follows:

NOTE

Wheel bearings and steering bolts must be in perfect condition before correct measurement can be made.

26.1 Lift vehicle with jack on front and rearmost differential casings until wheels just clear ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable support between axle stand and floorpan to avoid damage to paint

26.2 Place axle stands under floorpan ridges and lower vehicle.

26.3 Remove all wheels.

26.4 Clean contact surfaces and centring collar of brake discs. Fasten suitable measuring flanges to wheel hubs (see Fig 23).

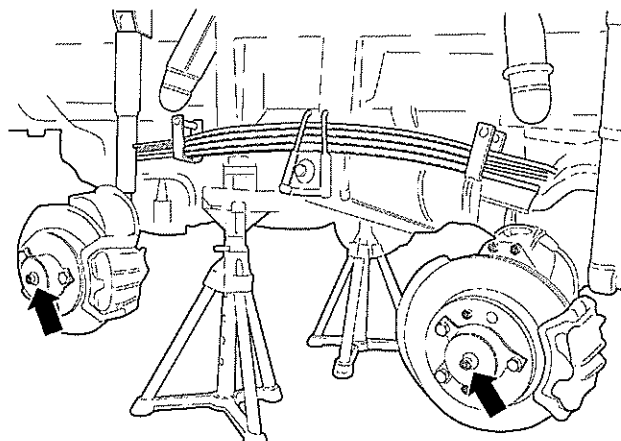


Fig 23 Axle base measurement

NOTE

Take care to fit flanges flush and concentric.

- 26.5 Extract adjustable gauge rods so that measuring pins can be completely inserted into measuring flanges. Tighten all but the left most clamping screw.
- 26.6 Read off axle base. Rotate measuring flanges through 180° with end clamping screw still loose. Read off axle base again. Correct axle base is given by the mean of both readings.
- 26.7 Transfer measuring flange to front axle and check again that flange fits flush and concentric.
- 26.8 Check that front and rear axle brake discs are level using ruler or plank of wood.
- 26.9 Measure axle base in same way as before.
- 26.10 Transfer measuring flange from first rear axle to second rear axle and repeat measuring procedure.
- 26.11 Determine axle base measurements of other side of vehicle.

NOTE

The wheel base difference between left and right hand side of vehicle should not exceed 2 mm. If any of the measured differences exceeds 2 mm, check bores of wheel drive centring bolts and supporting tubes for damage. If undamaged, replace relevant half axle.

- 26.12 Standard axle base measurements are as follows:

Front Axle - First Rear Axle	2 207 ± 1 mm
Front Axle - Second Rear Axle	3187 ± 1 mm
First Rear Axle - Second Rear Axle	980 ± 1 mm

CARRIER TUBE**Removal**

- 27 To remove the carrier tube between the rear axles, proceed as follows:
- 27.1 Remove second rear axle (see Para 8).
- 27.2 Remove hexagon nuts from pneumatic actuator of first rear axle and hang out of way (see Fig 3).

NOTE

Do not remove hexagon screws from actuator as these hold housing together.

- 27.3 Open damping strap sheet clip on carrier tube and remove leads.
- 27.4 Loosen left and right spring bracket retaining screws and remove rear axle springs (see Fig 24).

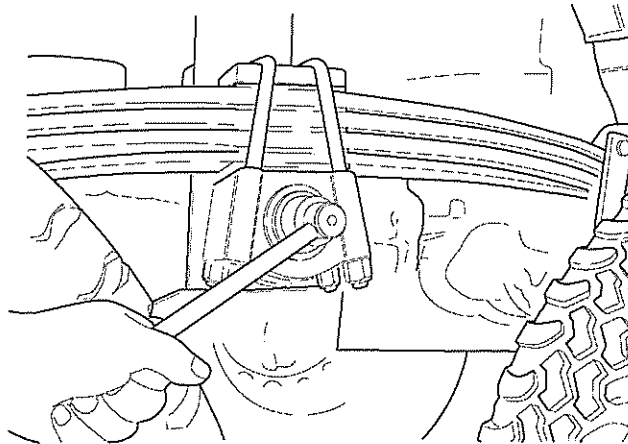


Fig 24 Spring bracket retaining screws

NOTE

Mark mounting position of rear axle springs.

- 27.5 Support carrier tube under centre with moveable jack.
- 27.6 Remove hexagon screws with lock washers.
- 27.7 Loosen cap nuts of anchor screws.
- 27.8 Remove carrier tube taking care not to contact drive shaft.
- 27.9 Remove rubber buffer and adjustment plates.
- 27.10 Loosen distance ring with chisel and remove (see Fig 25).

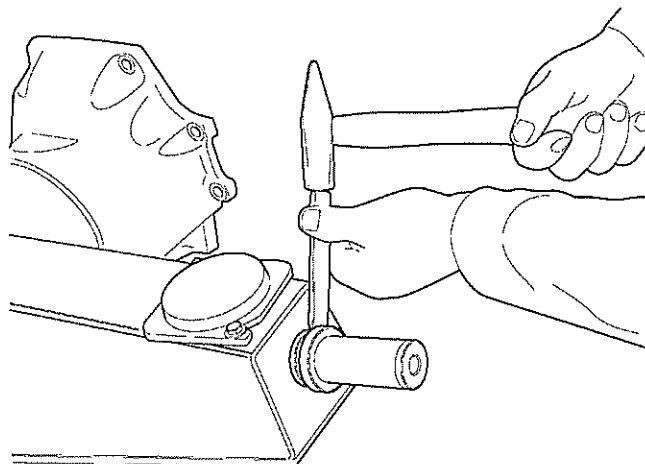


Fig 25 Distance ring removal

Refitting

28 To refit the carrier tube, proceed as follows:

28.1 Apply Loctite 574 to forward sealing surface of carrier tube, lift carrier with jack and refit.

NOTE

Ensure that vent slots and bores on carrier tube are not clogged.

28.2 Apply Loctite Anti Seize compound to hexagon screws and cap nuts, then tighten to correct torque (see Table 2, Ser 5).

NOTE

Ensure hexagon screws are fitted with lock washers and carrier tube is fitted horizontally.

28.3 Refit damping straps with leads into sheet clip, then close clip.

28.4 Check that V-ring in pneumatic unit is seated correctly. Also check condition and position of sealing diaphragm and clamping sleeve. Apply Loctite 574 to new gasket and fit with pneumatic unit (see Fig 9).

28.5 Fit distance ring onto spring bolt. Apply Loctite Anti Seize compound to spring bolt and hexagon screw. Mount leaf spring but only tighten spring bracket when vehicle is on ground and spring support bolts are fitted.

28.6 Tighten spring bracket to correct torque (see Table 2, Ser 16).

28.7 Fit rubber buffer and plate to vehicle support. Select thickness of plate such that 1 mm of play exists when vehicle is unladen (see Fig 26).

NOTE

Insert rubber buffer from inside outwards until stop at hexagon screws, then tighten.

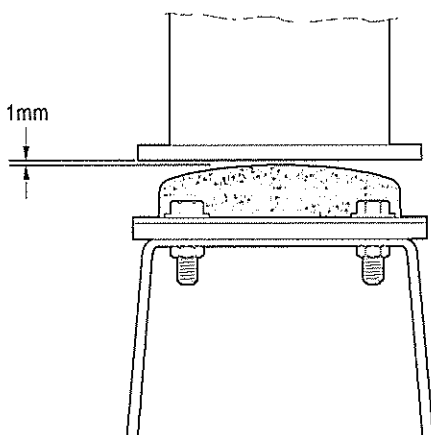


Fig 26 Body support rubber buffer

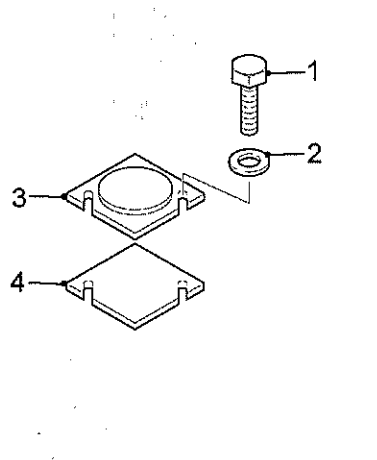
CARRIER TUBE RUBBER BUFFER

Removal

29 To remove the rubber buffer on the short carrier tube, proceed as follows:

29.1 Ensure that vehicle is unloaded.

29.2 Loosen hexagon screws slightly then remove rubber buffer and adjustment plate (see Fig 27).



- | | |
|-----------------|-------------------|
| 1 Hexagon Screw | 3 Rubber Buffer |
| 2 Washer | 4 Adjusting Plate |

Fig 27 Body support assembly

Refitting

30 To refit the rubber buffer, proceed as follows:

30.1 Remove adjustment plate and clean contact area of carrier tube.

30.2 Insert rubber buffer without adjustment plate. Fit from inside outwards until stop at hexagon screws.

30.3 Select adjustment plate such that 1mm of play exists between vehicle and buffer when vehicle is unladen (see Fig 26).

NOTE

Adjustment plates are available in thickness of 2 or 3 mm.

30.4 Fit rubber buffer and plate then tighten screws. Ensure that washers also rest on rubber buffer.

RESTRICTED

RESTRICTED

CHAPTER 7

STEERING REPAIR INSTRUCTIONS

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INTRODUCTION

1 This chapter details the procedure for all work carried out on the steering system.

CAUTION

EQUIPMENT CALIBRATION. Ensure that all measuring equipment is in good condition and within date for calibration.

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools and test equipment are shown in Table 1.

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Item (1)	NSN (2)	Manufacturer No. (3)	Designation (4)
1	2815-99-503-3511	800.1.56.028.1	Maintenance fan guard
2	5120-12-369-5752	905.0.14.502.0	Steering wheel puller

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings for this chapter are shown in Table 2:

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Steering wheel nut	35-40	7.3
2	Track rod nuts	80	9.5
3	Steering spindle housing bolt	25	11.3 13.2 17.4
4	Drag link ball joint castle nut	80	20.2 25.3
5	Drag link arm tension bolt and nut	195	20.7 20.10
6	Ball joint nut	80	20.3
7	Drop arm crown nut	250	25.4
8	Wheel bolts	260	25.6
9	Steering ram piston rod clamping bolt	25	27.3
10	Steering pump	20	31.2
11	Steering pump belt pulley bolt	20	29.1 31.3
12	Steering spindle housing	25	33.1
13	Rotary valve stud coupling	30	33.2
14	Cardan joint bolt	25	17.4 33.5
15	Steering gearbox support bolt	115	34.7
16	Steering support bracket nut	20	35.2
17	Steering output shaft housing to floorpan mounting bolt	45	35.3
18	Body support	250	35.5
19	Drag link arm housing	35	22.6

STEERING CLEARANCE

Check

4 To check the steering clearance proceed as follows:

4.1 Lift vehicle with jack under front differential casing until wheels just clear ground. Place suitable stands under cross beam.

4.2 Check condition of cardan joints of steering shaft and ball joints of drag link by holding joints and moving steering wheel. In case of notable play, replace respective part.

4.3 Check play between steering roller shaft and worm (within steering box) by moving steering wheel to and fro. Steering drop arm must not move and maximum admissible play of steering wheel circumference must not exceed 60 mm.

Adjust

- 5 To adjust steering clearance proceed as follows:
 - 5.1 Loosen lock nut and screw in adjusting bolt until there is negligible play (see Fig 1).

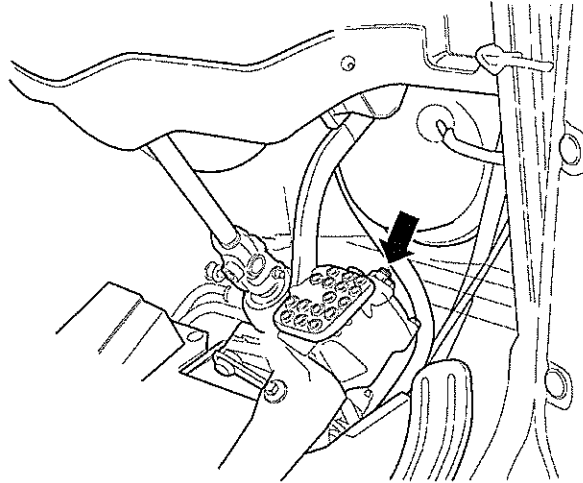


Fig 1 Adjusting steering clearance

- 5.2 Turn ignition lock to position '1'. Then turn steering wheel from lock to lock. Movement should be free with only slight resistance in centre (straight ahead) position.
 - 5.3 Tighten lock nut whilst holding adjusting bolt.
 - 5.4 Lower vehicle to ground.

STEERING WHEEL

Removal

- 6 To remove steering wheel proceed as follows:
 - 6.1 Place front wheels in straight ahead position.
 - 6.2 Remove cover from centre of steering wheel.

WARNING

PERSONAL INJURY. DO NOT FULLY REMOVE THE STEERING WHEEL RETAINING NUT UNTIL THE STEERING WHEEL IS LOOSENED FROM THE SPLINE. IN THE EVENT OF A SUDDEN RELEASE OF THE STEERING WHEEL, THE NUT WILL STOP THE STEERING WHEEL FROM POTENTIALLY INJURING THE OPERATOR.

- 6.3 Slacken fastening nut of steering wheel enough to allow the steering wheel to be loosened. After the steering wheel is loosened, remove the fastening nut and washer.

NOTE

When steering wheel is to be re-used, mark original mounting position before detaching.

- 6.4 Remove cover of steering column mounted switch.
- 6.5 Remove steering column mounted switch clamp.
- 6.6 Pull off steering wheel with puller 905.0.14.502.0 (Table 1, Item 2), in combination with Kukko insert No.6 (supplied with puller) to ensure correct alignment and fit around the steering wheel.

NOTE

Tension steering wheel puller slightly and knock off steering wheel with taps of soft metal hammer on puller spindle.

- 6.7 When changing steering wheel, unbolt flasher return catch and mount in identical position on new part.

Refitting

- 7 To refit the steering wheel proceed as follows:
 - 7.1 Fit steering column mounted switch offset downwards approximately 2 mm from upper collar of steering spindle housing. Insert bracket, positioning lug into longitudinal groove and tighten switch. Attach switch cover.
 - 7.2 Put steering wheel onto steering spindle observing markings made during removal, also take care that flasher return catch is in central position to steering column mounted switch.

CAUTION

STEERING CHECK. When tightened, steering wheel nut must be marked with a white colour dot for checking purposes.

- 7.3 Fit spring washer and nut and tighten to correct torque (see Table 2. Ser 1).
- 7.4 Attach cover to centre of steering wheel.
- 7.5 Check steering wheel centre position during short straight run on even ground. One spoke of steering wheel should be pointing to 12 o'clock. If not, re-set steering wheel.

TOE-IN

Check

- 8 To check the toe-in proceed as follows:

NOTE

Carry out this check when vehicle is loaded with two people in front seats. Before carrying out check, ensure brake discs are serviceable and steering parts and pivots have minimal free play. Also ensure wheel rims are undamaged and there is minimum free play in pivots of portal hubs.

- 8.1 Drive vehicle to flat ground and park with front wheels in straight ahead position.
- 8.2 Check tyre pressure - front and rear should be 2.8 bar.
- 8.3 Sit on front seats or load each with ██████
- 8.4 Move vehicle to and fro in order to balance half-axes corresponding to load.

8.5 Mark front and rear edge of wheel rim at height of wheel centres with chalk line.

8.6 Measure track width behind axles.

8.7 Move vehicle by half wheel turn forward or backward.

CAUTION

MEASUREMENT PROVISIO. Only take measurements from centre height of wheel rims. Slight deviations above or below lead to incorrect measurements.

8.8 Measure track width in front of axle. Toe-in is set correctly if measurement is 2-5 mm less than that measured behind axle.

Adjust

9 To adjust toe-in proceed as follows:

9.1 Check toe-in (see Para 8).

9.2 Loosen outer and inner track rod clamping nuts.

NOTES

(1) Left hand thread ball joints of track rods are mounted inside at right track rod and outside at left. Left hand threads are distinguishable by undercut on nuts (see Fig 2).

(2) Twisting of track rod tubes in driving direction reduces toe-in. Twisting of track rod tubes against driving direction increases toe-in.

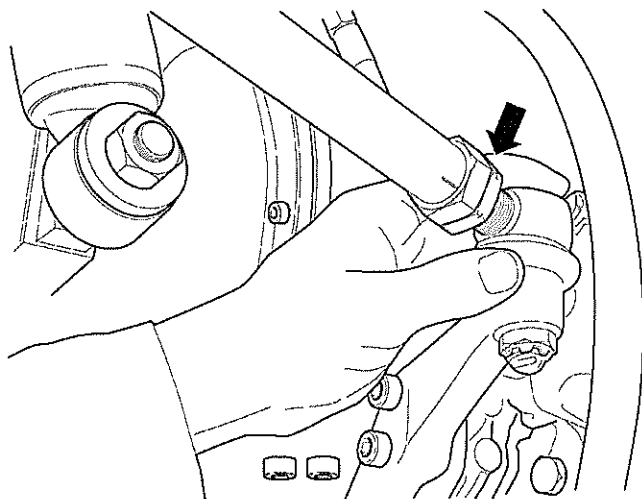


Fig 2 Undercut on nut denoting left hand thread

9.3 Align front wheels by twisting track rod tubes by required amount.

9.4 Carry out Para 8.4 to 8.8 before re-measuring track width. Adjust toe-in by twisting both track rod tubes equally.

9.5 Tighten nuts of track rods to correct torque (see Table 2, Ser 2) observing that both ball joints close in when being tightened. Check action of ball joints by twisting track rods in both directions.

STEERING SPINDLE HOUSING

Removal

- 10 To remove steering spindle housing proceed as follows:
 - 10.1 Remove steering wheel (see Para 6).
 - 10.2 Remove knee guard from below steering column.
 - 10.3 Loosen bolts securing hydraulic steering valve to bracket. Loosen clamping bolt to steering spindle housing (see Fig 3).

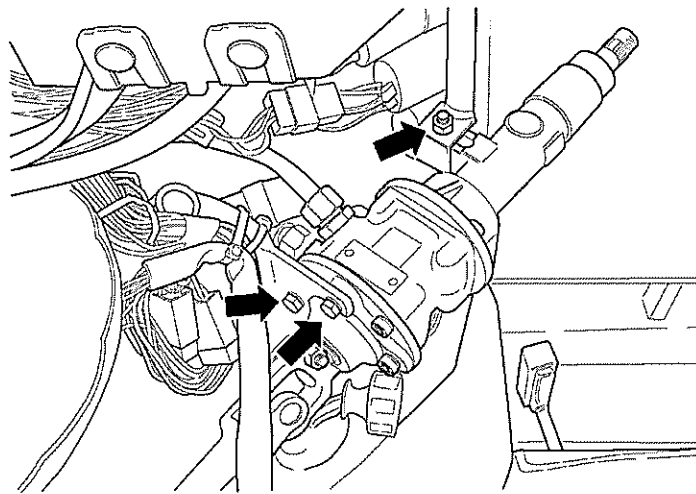


Fig 3 Steering valve and spindle housing fixing bolts

- 10.4 Pull off electrical connector from key switch.
- 10.5 Pull out steering spindle housing slightly from bracket to gain access to bolts.
- 10.6 Turn key in ignition lock to position 1 and remove steering spindle housing (see Fig 4).

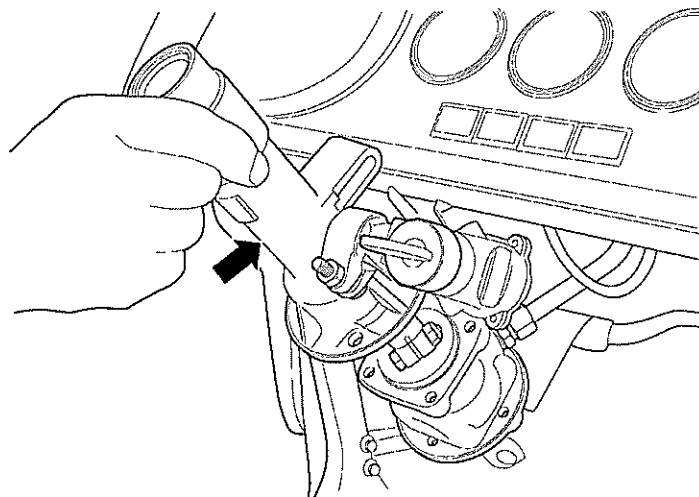


Fig 4 Removing steering spindle housing

Refitting

11 To refit steering spindle housing proceed as follows:

- 11.1 Insert new bearing into steering spindle housing and secure with snap ring.
- 11.2 Transfer ignition lock and retainer to new steering spindle housing. Turn key in ignition lock to position 1. Loosen retainer and twist backwards so that locking pin can be pressed in and steering lock can be pulled out. Before inserting steering lock into new housing, slip on retainer. Keep key in position 1 and ensure that locking pin catches into bore of steering spindle housing. Tighten retainer slightly.
- 11.3 Fit steering spindle housing and tighten retaining bolts to correct torque (see Table 2, Ser 3).
- 11.4 Fit hydraulic steering valve and fix steering spindle housing tension free, tighten clamping bolts.
- 11.5 Fit coupling piece.
- 11.6 Align knee guard to correct position and fit steering lock. Detach knee guard and tighten lock retainer.
- 11.7 Refit steering wheel.
- 11.8 Refit knee guard.

STEERING SPINDLE

Removal

12 To remove steering spindle proceed as follows:

- 12.1 Remove steering spindle housing (see Para 10).
- 12.2 Loosen clamp and pull off steering spindle (see Fig 5).

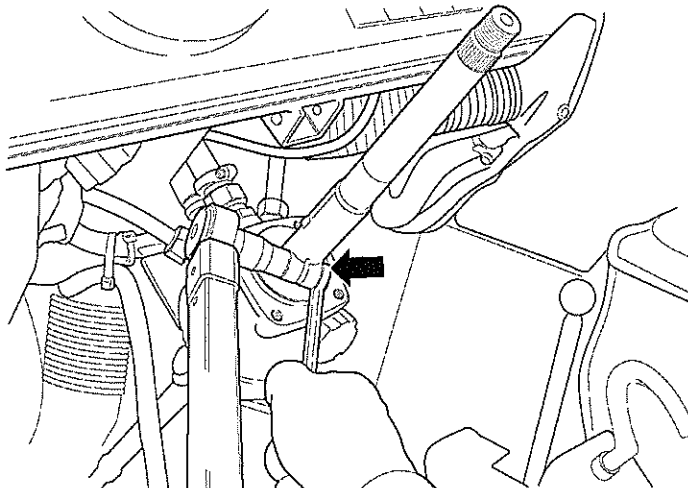


Fig 5 Loosening steering spindle clamp

Refitting

13 To refit steering spindle proceed as follows:

13.1 Slip steering spindle onto splines of hydraulic steering valve with groove for locking wedge pointing upwards.

13.2 Refit clamp bolt and tighten to correct torque (see Table 2, Ser 3).

CAUTION

STEERING CHECK. When tightened, the clamp bolt must be marked with a white colour dot for checking purposes.

13.3 Refit steering spindle housing (see Para 11).

STEERING LOCK

Removal

14 To remove steering lock proceed as follows:

14.1 Remove knee guard.

14.2 Turn key in ignition lock to position 1.

14.3 Loosen clamp nut. Twist clamp upwards and push left, to gain access to locking pin, located at rear of shaft under clamp. Press in locking pin and remove steering lock.

14.4 Pull off electrical connector from ignition lock.

14.5 Lift lock cylinder cover and pull off. Insert key and turn ignition lock into position 1. Press in locking gudgeon located on right hand side of cylinder barrel with drift and remove lock cylinder.

Refitting

15 To refit steering lock proceed as follows:

15.1 Fitting is done in reverse order to removal, observing the following points:

15.1.1 To insert lock cylinder turn key to position 1.

15.1.2 Insert steering lock observing that locking pin catches into steering spindle housing bore. Fix clamp hand tight.

15.1.3 To position steering lock, align knee guard to correct position and fit lock. Remove knee guard and tighten clamp bolt.

STEERING SHAFT**Removal**

- 16 To remove steering shaft proceed as follows:
- 16.1 Remove knee guard.
 - 16.2 Remove clamping bolts of cardan joints (see Fig 6).

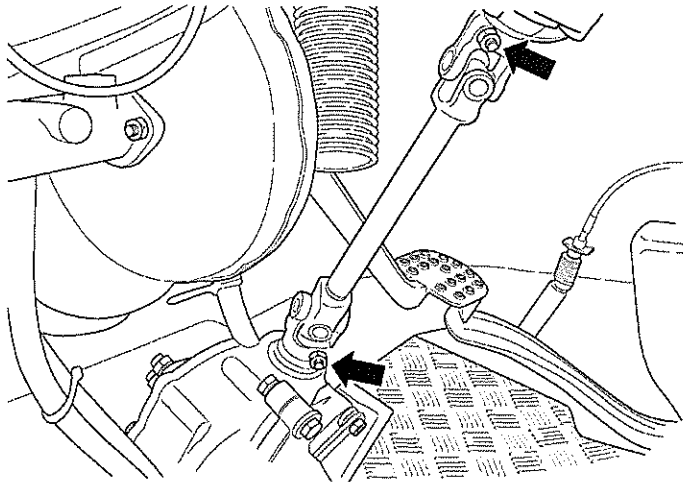


Fig 6 Cardan joint clamping bolts

- 16.3 Remove bolts from hydraulic steering valve bracket. Loosen steering spindle housing clamping bolt.
- 16.4 Pull off upper cardan joint and mark position of cardan on shaft spline.
- 16.5 Pull off lower cardan joint of steering shaft.

Refitting

- 17 To refit steering shaft proceed as follows:
- 17.1 Put lower cardan joint onto splines so that marking is in line with centre of clamping slot.

NOTE

Spray splines with Loctite anti-seize.

- 17.2 Slip upper cardan joint onto splines observing markings made during removal.
- 17.3 Bolt on hydraulic steering valve and fix steering spindle housing tension free with clamping bolt.

CAUTIONS

- (1) **EQUIPMENT DAMAGE.** Observe different bolt length and strength grade:

Upper clamping bolt	M8 x 40 - 8.8
Lower clamping bolt	M8 x 42 - 10.9

Use new, self locking nuts.

- (2) **TORQUE CHECK.** When tightened, the cardan joint clamping bolts must be marked with a white coloured dot for checking purposes.

17.4 Insert both clamping bolts and tighten to correct torque (see Table 2, Ser 13).

17.5 Refit knee guard.

DRAG LINK ARMS

Check for axial play

- 18 To check the drag link arm for axial play proceed as follows:

CAUTION

EQUIPMENT DAMAGE. Use suitable pad (e.g. felt) between trestle and floorpan in order to avoid damage to paintwork or underseal.

18.1 Lift vehicle with jack on front axle casing until wheels just clear ground. Arrange suitable stands under cross beam and lower jack.

18.2 Press drag link arm with suitable lever up and down and check axial play. Maximum admissible play is 1.0 mm. If maximum admissible play is exceeded, adjust drag link arm and balance axial play, as detailed in Para 20.

18.3 Lower vehicle to ground.

Removal

- 19 To remove drag link arm proceed as follows:

19.1 Remove centre beam (see Chapter 5-1).

19.2 Place oil drip pan under drag link arm housing and turn drag link arm to right (see Fig 7).

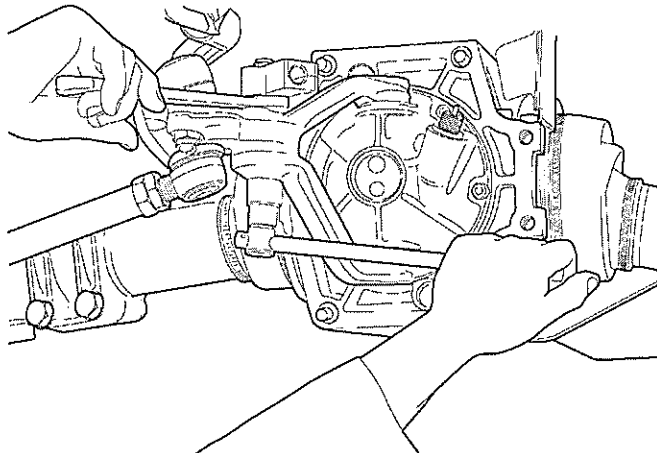


Fig 7 Removing drag link arm tension bolt

- 19.3 Loosen clamp bolt and unscrew power cylinder ram.
- 19.4 Remove nut joining ends of top and bottom drag link arms and remove bottom arm with washer, shims and O-ring. Discard O-ring.
- 19.5 Remove top arm with left and right track rods, drag link, washer, adjusting shims and O-ring. Discard O-ring.
- 19.6 Mark left track rod.
- 19.7 Remove and discard split pins, remove castle nuts and press out left and right ball joints and drag link ball joint.
- 19.8 Remove nut securing steering ram joint and take off ram with washers and O-rings. Discard O-rings.
- 19.9 Remove tension bolt from top arm.
- 19.10 Check ball joints of track rod, drag link and power cylinder for wear.

Refitting

20 To refit the drag link arm proceed as follows:

- 20.1 Clean and degrease tapers of ball joints and female ends of drag link arms.

CAUTION

EQUIPMENT DAMAGE. When inserting ball joints of drag link and track rods, split pin bores must be parallel to drag link arm.

- 20.2 Fit drag link ball joint to top drag link arm and tighten nut to correct torque (see Table 2, Ser 4), secure with split pin.
- 20.3 Fit right track rod ball joint and tighten to correct torque (see Table 2, Ser 6), secure with split pin.
- 20.4 Replace left track rod ball joint as per Para 20.3.
- 20.5 Smear new O-rings with grease and fit to housing. Insert top drag link arm with adjusting shims and washer.
- 20.6 Insert bottom drag link arm with adjusting shims and washer ensuring splines of top and bottom arms are correctly engaged.
- 20.7 To tighten drag link arms tensioning bolt, fit drag link into drag link arm and steering drop arm and tighten both ball joints. Tighten tensioning bolt to correct torque (see Table 2, Ser 5).

20.8 Remove drag link and check axial movement of drag link arm. Adjusting shim thickness is correct if drag link arm has no free play but is just clear to move. If checking by feeler gauge reveals axial play between housing and bearing disk, adjust by adding shims. Shims are available in thickness of 0.1, 0.2 and 0.3 mm (see Fig 8).

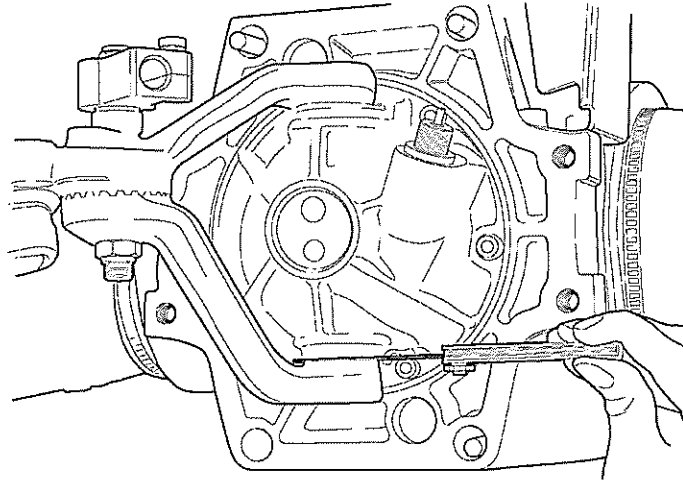


Fig 8 Measuring drag link arm axial clearance

20.9 Refit centre beam (see Chapter 5-1).

CAUTION

PROCEDURAL CHECK. When tightened, the tension bolt nut and ball joint crown nuts must be marked with a white coloured dot for checking purposes (see Fig 9).

20.10 Refit drag link arm with new self-locking nut and tighten to correct torque (see Table 2, Ser 5).

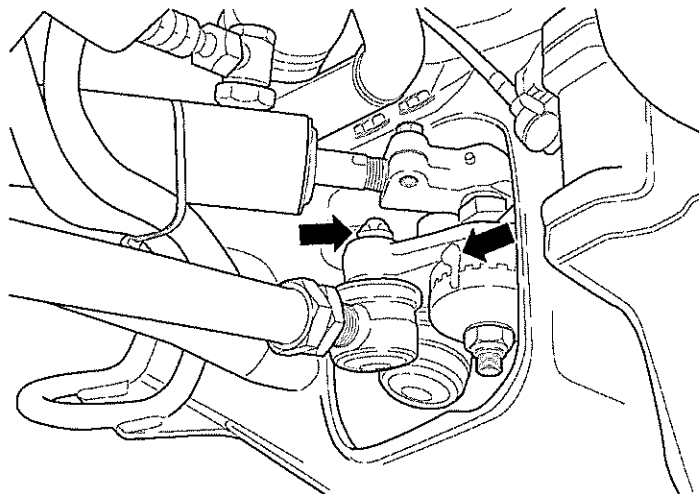


Fig 9 Confirmatory markings

20.11 Top up axle drive oil to overflow level.

DRAG LINK ARM BEARING BUSHES**Removal**

- 21 To replace drag link bearing bushes arm proceed as follows:
- 21.1 Remove centre beam (see Chapter 5-1).
 - 21.2 Drain oil from axle housing. Place oil pan under axle housing and drag link arm housing.
 - 21.3 Remove drag link arm housing.
 - 21.4 Clamp top drag link arm into vice and loosen nut to tension bolt. Hold with open ring spanner on hexagon of tension bolt.
 - 21.5 Remove bottom drag link arm, washer, adjusting shims and O-ring. Discard O-ring (see Fig 10).

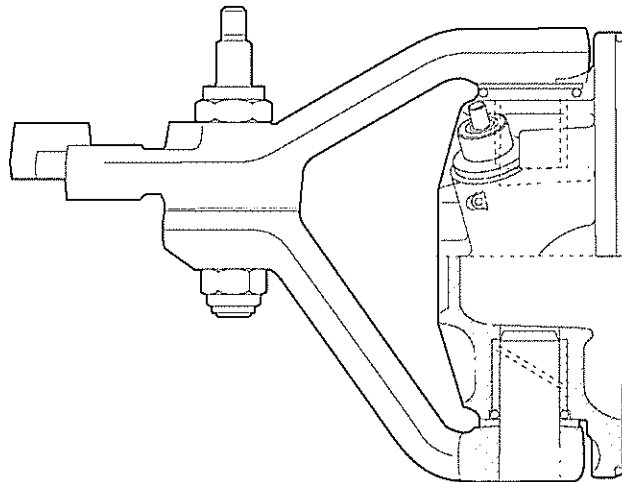


Fig 10 Drag link arm housing assembly

- 21.6 Remove top drag link arm, washer, adjusting shims and O-ring. Discard O-ring.
- 21.7 Heat drag link arm housing to about 100 °C and clamp into vice. Remove upper and lower bushes.
- 21.8 Check splines of driven helical gear to speedometer and tachograph drive for wear. Renew sealing ring and O-ring if there are signs of oil leakage (see Chapter 5-1).

Refitting

- 22 To refit bearing bushes to the drag link arm proceed as follows:
- 22.1 Heat drag link arm housing to about 100 °C and press in upper bearing bush, bevelled side first to stop.
 - 22.2 Replace bottom bush as per Para 22.1.
 - 22.3 Oil bearing bushes and fit new O-ring to top and bottom of housing with standard grease.
 - 22.4 Slip new washer and adjusting shim to top drag link arm pivot and put on drag link arm housing upper side first, so that washer sits close to housing to prevent distortion.

CAUTION

EQUIPMENT DAMAGE. Replace drag link arms showing traces of wear at pivot pin.

- 22.5 Attach bottom drag link arm and insert into splines of top drag link arm.
- 22.6 Refit drag link arm housing. Apply Loctite 243 to new bolts and tighten to correct torque (see Table 1. Ser 19).
- 22.7 Check free play as in Para 18.
- 22.8 Refit centre beam (see Chapter 5-1).
- 22.9 Fill up axle drive oil to overflow level.

CHECK BALL JOINTS

- 23 To check the ball joints proceed as follows:
 - 23.1 Put vehicle on flat ground with wheels straight.
 - 23.2 Grip ball joint and use lever to check for play with thumb and forefinger.
 - 23.3 Turn steering wheel alternately left and right. There must be no noticeable play at ball joints.
 - 23.4 Check sealing bellows for damage and replace if necessary.

STEERING DROP ARM

Removal

- 24 To remove the steering drop arm proceed as follows:

CAUTION

EQUIPMENT DAMAGE. Use suitable padding on top of stands to prevent damage to paintwork.

- 24.1 Lift vehicle with jack under front differential casing until wheels just clear ground. Arrange suitable stands under cross beam and lower jack.
- 24.2 Ascertain whether vehicle is left or right hand drive and remove corresponding wheel.
- 24.3 Prise back tab washer at steering drop arm and remove nut.

CAUTION

EQUIPMENT DAMAGE. When loosening nut, hold steering wheel and ensure that steering gear is not resting against final stop.

- 24.4 Remove split pin and ball joint nut and press off drag link ball joint from steering drop arm (see Fig 11).

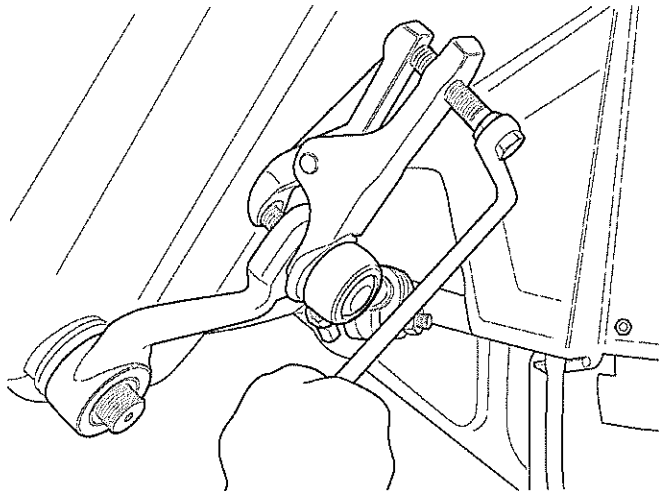


Fig 11 Pressing out drop arm ball joint

24.5 Mark position of steering drop arm on steering roller shaft and remove using suitable puller.

24.6 Check shaft oil seal for leaks and V-ring and dust seal for damage. Check condition of ball joint sealing bellows, replace if necessary.

Refitting

25 To refit steering drop arm proceed as follows:

25.1 Fill space of V-ring with standard grease and slip onto steering roller shaft.

25.2 Fit steering drop arm to steering roller shaft splines, so that mark on steering drop arm is in line with mark on steering roller shaft. Attach new tab washer and tighten nut hand tight.

CAUTIONS

(1) **EQUIPMENT DAMAGE.** When tightening nut hold steering wheel and take care that steering gear is not resting against final stop.

(2) **TORQUE CHECK.** When tightened, the ball joint nut and steering drop arm nut must be marked with a white colour dot for checking purposes.

25.3 Degrease taper in steering drop arm and cone of ball joint. Insert drag link ball joint into steering drop arm, fit castle nut and tighten to correct torque (see Table 2, Ser 4). Replace split pin.

25.4 Tighten nut of steering drop arm to correct torque (see Table 2, Ser 7) swage tab washer to lock nut.

25.5 Refit wheel.

25.6 Lower vehicle to ground and tighten wheel bolts to correct torque (see Table 2, Ser 8).

HYDRAULIC CYLINDER

WARNING

HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.

CAUTIONS

- (1) **WASTE PRODUCTS.** Personnel responsible for the disposal of waste products must comply with local regulations and procedures.
- (2) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.
- (3) **LUBRICANT CHECK.** Before operating vehicle, ensure oils and lubricants are filled to the correct level.
- (4) **EQUIPMENT DAMAGE.** Absolute cleanliness is necessary when working on hydraulic systems and components. All ports and orifices must be capped off immediately a component is removed or a pipe is disconnected.

Removal

- 26 To remove power cylinder proceed as follows:
 - 26.1 Mark pipes for ease of refitting. Remove unions on hydraulic ram, seal hose ends to prevent ingress of dirt.
 - 26.2 Loosen clamp bolt and unscrew power cylinder ram.
 - 26.3 Loosen clamp bolt on cylinder and unscrew from spherical rod.

Refitting

- 27 Refitting is the reverse of removal, noting the following:
 - 27.1 Spray threads on piston and end of ram with Loctite Anti-Seize prior to fitting.
 - 27.2 When fitting piston, screw into joint so that 8 mm of thread remains visible.
 - 27.3 Tighten clamp bolts to correct torque (see Table 2, Ser 9).

SERVO STEERING PUMP

WARNINGS

(1) **HAZARDOUS SUBSTANCES.** THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.

(2) **PERSONAL INJURY.** DO NOT ALLOW ANY LOOSE ITEMS OF CLOTHING TO BECOME CAUGHT IN THE FAN BLADES OR ANY OTHER MOVING ENGINE PARTS. REMAIN ALERT AS TO THE LOCATION OF THE ROTATING FAN, PULLEYS, BELTS ETC, WHEN WORKING ON A RUNNING ENGINE. FIT MAINTENANCE FAN GUARD (800.1.56.028.1) AS NECESSARY.

CAUTIONS

(1) **WASTE PRODUCTS.** Personnel responsible for the disposal of waste products must comply with local regulations and procedures.

(2) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.

(3) **LUBRICANT CHECK.** Before operating vehicle, ensure oils and lubricants are filled to the correct level.

(4) **EQUIPMENT DAMAGE.** Absolute cleanliness is necessary when working on hydraulic systems and components. All ports and orifices must be capped off immediately a component is removed or a pipe is disconnected.

Removal

28 To replace the steering pump, proceed as follows:

28.1 Remove the front seats and engine cover (see Chapter 16-2).

28.2 Loosen fixings of V-belt pulley (see Fig 12 (1)).

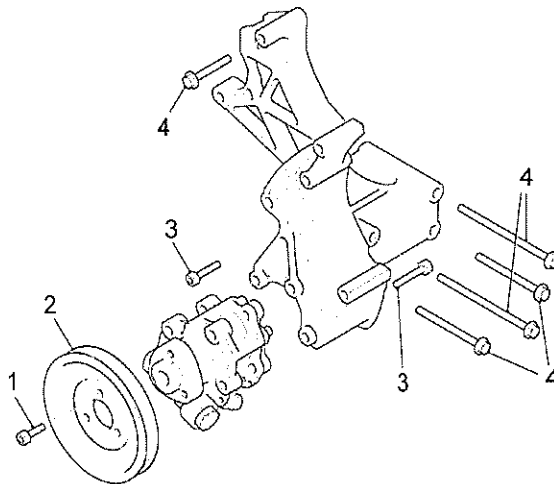


Fig 12 Steering pump (5-cylinder Euro 3 engine variant)

- 28.3 Unscrew (22 mm) expansion/pressure hose on steering pump.
- 28.4 Collect the hydraulic fluid in a suitable container.
- 28.5 Disconnect suction/intake hose from reservoir to steering pump, by releasing worm band (jubilee clip).
- 28.6 Remove the ribbed V-belt (FEAD) (see Chapter 1).
- 28.7 Unscrew the M8 fixings of V-belt pulley (see Fig 12 (1)) from steering pump and remove V-belt pulley (2).
- 28.8 Unscrew captive hexagon head bolts (3 and 4) securing steering pump to bracket.
- 28.9 Remove steering pump from bracket.

Refitting

29 Replacement is as follows:

- 29.1 Insert the steering pump in the bracket.
- 29.2 Screw in bolts (see Fig 12 (3 and 4)) to secure steering pump to bracket. Tighten to 20 Nm torque (see Table 2, Ser 10).
- 29.3 Mount pulley (see Fig 1 (2)) on steering pump. Tighten screws (see Fig 12 (1)) to 20 Nm torque (see Table 2, Ser 11).
- 29.4 Screw expansion/pressure line onto steering pump.
- 29.5 Reconnect suction/intake hose onto steering pump.
- 29.6 Install ribbed V-belt (FEAD) (see Chapter 1).
- 29.7 Fill reservoir (located at the rear of the engine) with hydraulic fluid.
- 29.8 Fit maintenance fan guard 800.1.56.028.1 (Table 1, Item 1) to cover the viscous fan blades at the front of the engine.
- 29.9 Start the engine and observe fluid level in the reservoir.
- 29.10 The fluid level must drop. If this is not the case, switch OFF engine, unscrew the expansion/pressure hose and wait until the hydraulic fluid escapes.
- 29.11 Collect the hydraulic fluid in a suitable container.
- 29.12 Screw expansion/pressure line onto steering pump again.
- 29.13 Start the engine and observe fluid level in the reservoir.
- 29.14 If the fluid level does not drop, repeat Para 29.9 through 29.12, until the fluid level is observed to drop to a satisfactory level.
- 29.15 Top up power steering fluid if required. Check hose connections for leaks.
- 29.16 Switch OFF the engine and check fluid level of power steering.
- 29.17 Once level is acceptable, remove maintenance fan guard 800.1.56.028.1 (Table 1, Item 1) and refit engine cover and front seats.

HYDRAULIC STEERING VALVE**WARNING**

HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.

CAUTIONS

- (1) **WASTE PRODUCTS.** Personnel responsible for the disposal of waste products must comply with local regulations and procedures.
- (2) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.
- (3) **LUBRICANT CHECK.** Before operating vehicle, ensure oils and lubricants are filled to the correct level.
- (4) **EQUIPMENT DAMAGE.** Absolute cleanliness is necessary when working on hydraulic systems and components. All ports and orifices must be capped off immediately a component is removed or a pipe is disconnected.

Removal

- 30 To remove the hydraulic steering valve proceed as follows:
- 30.1 Remove knee guard.
 - 30.2 Remove steering wheel (see Para 6).
 - 30.3 Pull off coupling piece from ignition lock.
 - 30.4 Loosen bolts of hydraulic steering valve bracket, steering spindle housing clamping bolt and clamping bolt of top cardan joint of steering shaft.
 - 30.5 Mark pipes to aid refitting.
 - 30.6 Pull steering spindle housing partially out of bracket below instrument panel, loosen union nuts of left and right pipes and return and pressure pipes while holding respective bolt neck. Catch hydraulic oil in suitable container. Plug pipes to prevent ingress of dirt.
 - 30.7 Tilt steering spindle housing out of bracket at instrument panel and pull off hydraulic steering valve from steering shaft.
 - 30.8 Clamp steering spindle housing with aluminium jaws into vice and remove stud couplings.

NOTE

Mark stud couplings according to numbers on housing in order to refit with correct sealing tapers (cutting rings) of connection pipes.

- 30.9 Screw two longer bolts into hydraulic steering valve and clamp valve into vice, and then remove steering spindle housing. To detach housing, turn key in steering lock to position 1 (see Fig 13).

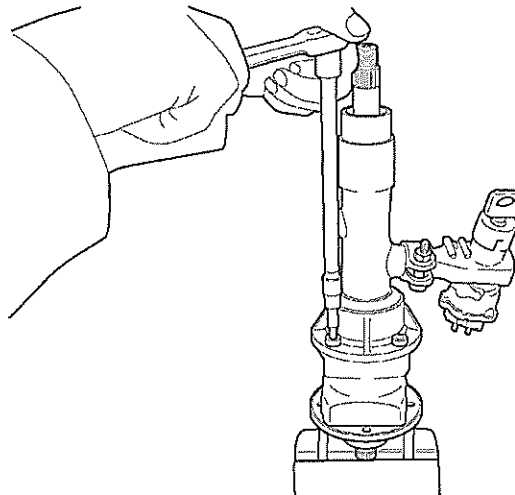


Fig 13 Removing steering spindle housing

30.10 Loosen dowel bolt and pull off steering spindle.

Refitting

31 Refitting the hydraulic steering valve is done in reverse order to removal, observing the following points:

CAUTION

TORQUE CHECK. When tightened, the dowel pin must be marked with a white colour dot for checking purposes.

31.1 Put on steering spindle, tighten dowel pin and steering spindle housing to correct torque (see Table 2, Ser 12).

31.2 Remove Loctite residues from stud couplings, spray with Loctite Hydraulic sealing 542, fit corresponding to markings made during removal and tighten to correct torque (see Table 2, Ser 13) (see Fig 14).



Fig 14 Refitting stud couplings using Loctite 542

31.3 Tighten pressure pipe, then return pipe hand tight. Tighten both pipes fully after fitting hydraulic steering valve and having positioned steering spindle housing.

- 31.4 Fix steering spindle housing tension free with clamping bolt.
- 31.5 Tighten clamping bolt to cardan joint of steering shaft to correct torque (see Table 2, Ser 14).
- 31.6 Refit steering wheel.
- 31.7 Bleed hydraulic steering unit (see Para 38).
- 31.8 Check tightness of pipe connections at hydraulic steering valve.
- 31.9 Attach knee guard.

STEERING GEARBOX

Removal

- 32 To remove steering gearbox proceed as follows:
 - 32.1 Remove steering drop arm (see Para 24).
 - 32.2 Detach V-ring and dust seal.
 - 32.3 Turn quick release bolts of floorpan to right and remove floorpan.
 - 32.4 Remove steering shaft (see Para 16).
 - 32.5 Loosen right body support to central beam at front wall (see Chapter 5-1).
 - 32.6 Loosen nuts and bolts. Remove steering gearbox.
 - 32.7 Remove steering gearbox bracket. Transfer to new steering gearbox and tighten to correct torque (see Table 2, Ser 15).

Refitting

- 33 To refit steering gearbox proceed as follows:

NOTE

Spray steering worm splines with Loctite Anti Seize.

- 33.1 Bolt roller shaft housing to floorpan hand tight, ensure a close fit.

NOTE

If necessary, use new special lock washers (chamfered version).

- 33.2 Attach washer and nut to steering support bracket and tighten to correct torque (see Table 2, Ser 16). Use Loctite 242.
- 33.3 Tighten roller shaft housing to floor pan mounting bolts to correct torque (see Table 1, Ser 17).
- 33.4 Fill space of new dust seal (V-ring) with standard grease and slip onto steering roller shaft.
- 33.5 Refit body support to correct torque (see Table 2, Ser 18).

CAUTIONS

- (1) **EQUIPMENT DAMAGE.** When tightening nut, hold steering wheel and take care that steering gear is not resting against final stop.
 - (2) **TORQUE CHECK.** When tightened steering gear fastening nut and cardan joint clamping bolt must be marked with a white coloured dot for easier checking.
- 33.6 Refit steering shaft (see Para 17).
- 33.7 Refit steering drop arm (see Para 25).
- 33.8 Insert floorpan and fix with quick fasteners.
- 33.9 Lift out oil plug in steering gearbox housing with screwdriver. Loosen filler plug screw in roller shaft housing. Fill gear oil into roller shaft housing first and then into steering housing until lower edge of filler openings. Fit oil plug and tighten.

STEERING GEARBOX ROLLER SHAFT BUSH

Removal

- 34 To remove steering gearbox roller shaft housing bush proceed as follows:
- 34.1 Remove steering gearbox (see Para 34).
 - 34.2 Clamp steering gearbox roller shaft housing into vice using soft jaws.
 - 34.3 Remove bolts securing housing to steering gearbox. Using suitable lever between shaft housing and steering gearbox, press off shaft housing. Catch leaking oil in suitable container.
 - 34.4 Pull out bush with seal using internal puller. Remove and discard O-ring (see Fig 15).

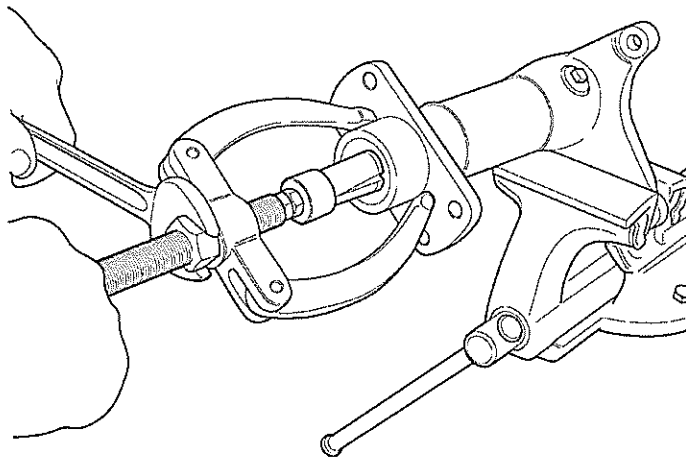


Fig 15 Steering gearbox roller shaft housing bush

Refitting

35 To refit bush in steering gearbox roller shaft housing proceed as follows:

35.1 Press in bush and seal until stop.

35.2 Insert new O-ring and oil well.

35.3 Insert steering gearbox and fit retaining bolt hand tight. Renew dust seal if necessary.

NOTE

Tighten bolt finally after remaining retaining bolts and steering support have been fitted.

35.4 Refit steering gearbox (see Para 35).

BLEED HYDRAULIC STEERING**WARNING**

HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.

CAUTIONS

(1) **WASTE PRODUCTS.** Personnel responsible for the disposal of waste products must comply with local regulations and procedures.

(2) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.

(3) **LUBRICANT CHECK.** Before operating vehicle, ensure oils and lubricants are filled to the correct level.

36 To bleed the hydraulic steering proceed as follows:

36.1 Undo and remove the rear maintenance hatch of the engine cover.

36.2 The power steering oil reservoir is located within the aperture and is identified with its green/black cap.

36.3 Remove the reservoir cap and fill reservoir with hydraulic oil to maximum mark.

36.4 Lift vehicle with jack on front axle casing until wheels just clear ground.

WARNING

TOXIC FUME HAZARD. DO NOT RUN ENGINE IN CLOSED OR POORLY VENTILATED BUILDING.

36.5 Start engine and allow to idle.

CAUTION

EQUIPMENT DAMAGE. Ensure there is always sufficient hydraulic oil in steering reservoir.

36.6 Bleed hydraulic system by turning steering wheel several times from lock to lock.

36.7 Bleeding is complete when no further bubbles can be seen rising within steering reservoir, there is no further frothing and hydraulic oil level remains constant.

36.8 Stop engine, lower vehicle to ground and top up/drain steering oil to maximum mark.

NOTE

It is usual for the oil level to rise by 2-3 mm when engine stops.

36.9 Refit reservoir cap, replace rear maintenance hatch of the engine cover.

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CHAPTER 8

SUSPENSION

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- 8 Suspension
- 8-1 Front suspension
- 8-2 Rear suspension

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CHAPTER 8-1

FRONT SUSPENSION

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- 1 Introduction
- 2 Special tools and equipment
- 3 Torque wrench settings
- Front coil spring
- 4 Removal (CAUTION)
- 5 Refitting (CAUTION)
- Front rubber hollow spring
- 6 Removal
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- Front right shock absorber
- 8 Removal
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- 10 Removal
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INTRODUCTION

1 This chapter details the procedure for all work carried out on the suspension

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools and test equipment are shown in Table 1.

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Ser (1)	NSN (2)	Manufacturer's Part No. (3)	Designation (4)
1	5120-99-331-1588	9053333051	Pressing tool
2	7VECT 5120-99-246-6416	8252569050	Spring compressor *
3	7VECT 5120-99-813-0553	8252569051	Jaws (for above) *

* For use with 8251548557 spring only.

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings in this chapter are shown in Table 2:

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Wheel bolts	260	5.6
2	Shock absorber retaining bolt	200	9.3
			11.3

FRONT COIL SPRING**Removal**

4 To remove the front coil spring proceed as follows:

4.1 Lift vehicle with jack on front differential casing until wheels just clear ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable support between axle stand and floor pan to avoid damage to paint.

4.2 Place axle stands under floorpan ridges and lower vehicle.

4.3 Remove wheel.

WARNING

PERSONAL INJURY. POSITION SPRING COMPRESSOR JAWS AT LEAST ONE FULL COIL IN FROM THE TOP AND BOTTOM OF THE COIL SPRING. ONLY USE SPRING COMPRESSOR SPECIFIED IN TABLE 1.

4.4 Insert spring compressor (see Table 1, Ser 2 and 3) into spring and tension. Place jack under portal hub, lift hub whilst compressing spring. Compress spring until upper end clears stop of spring seat after lowering portal hub.

4.5 Lower portal hub. Restrain spring cup and unbolt retaining nut. Remove compressed spring together with rubber hollow spring and spring cup.

4.6 Take out spring cup and rubber hollow spring and relieve spring tension by releasing spring compressor.

Refitting

NOTE

Always replace coil springs as a pair across an axle.

5 To refit the front coil spring proceed as follows:

CAUTION

EQUIPMENT DAMAGE. Springs are grouped into grades denoted by colour markings on outer diameter. Coil springs of the same grade must always be used on the same axle. Both coil springs and spring support bolts must be changed as pairs.

5.1 Insert spring support into centring ring, fit to spring cup. Hold coil spring end close to stop of centring ring, apply spring compressor. By alternately tightening tensioning bolts, compress coil spring sufficiently to refit.

5.2 Fill ball shaped cavity in bottom spring cap with XG305, or equivalent. Refit compressed coil spring with handle of spring compressor pointing outwards to spring support bolt.

5.3 Insert rubber hollow spring and spring cup in the compressed coil spring and fit onto spring seat.

5.4 Align coil spring, so that spring end and spring seat stop are vertical. Lift portal hub with jack until spring rests in spring seat to stop. By alternately slackening tensioning bolts loosen spring compressor and take off.

5.5 Lower jack and refit wheel.

5.6 Lower vehicle to ground and tighten wheel bolts to correct torque (see Table 2, Ser 1).

FRONT RUBBER HOLLOW SPRING

Removal

6 To remove the front rubber hollow spring proceed as follows:

6.1 Remove spring cup of rubber hollow spring (see Para 4) (see Fig 1).

6.2 Clamp spring cup in vice using soft faced jaws and remove socket bolt.

6.3 Take off rubber hollow spring and spring cup.

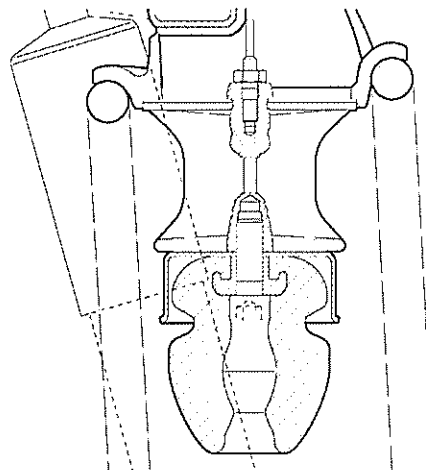


Fig 1 Front rubber hollow spring

Refitting

- 7 To refit the front rubber hollow spring proceed as follows:
 - 7.1 Check fit of fixing stud in spring cup.
 - 7.2 Smear thread of socket bolt with Loctite Anti seize. Smear outside of socket head with silicon paste. Insert bolt into rubber hollow spring.
 - 7.3 Refit rubber hollow spring with cap and secure to spring cup.
 - 7.4 Refit spring cup to vehicle.
 - 7.5 Refit coil spring (see Para 5).

FRONT RIGHT SHOCK ABSORBER**Removal**

- 8 To remove the front right shock absorber proceed as follows:
 - 8.1 Remove front seats and engine cover (see Chapter 16-2).
 - 8.2 Remove top retaining bolt at bracket, inside engine bay.
 - 8.3 Remove bottom retaining bolt at portal hub, remove shock absorber.

NOTE

Always replace shock absorbers as a pair across an axle.

Refitting

- 9 To refit the front right shock absorber proceed as follows:
 - 9.1 Check position of intermediate piece between shock absorber lower mounting and portal hub.
 - 9.2 Smear thread and shaft of retaining bolts with Loctite Anti Seize and mount shock absorber. Insert top bolt with head pointing forward and bottom bolt pointing backward. Distance sleeves pressed into shock absorber must point backward. Refit bush with collar pointing toward shock absorber. Attach top nut and washer, then bottom nut.

- 9.3 Tighten top and bottom retaining bolts to correct torque (see Table 2, Ser 2).

CAUTION

EQUIPMENT DAMAGE. When tightening bottom bolt, axle must be in horizontal position.

- 9.4 Refit engine cover and seats (see Chapter 16-2).

FRONT LEFT SHOCK ABSORBER

Removal

- 10 To remove the front left shock absorber proceed as follows:
- 10.1 Remove front seats and engine cover (see Chapter 16-2).
 - 10.2 Remove top retaining bolt at bracket in engine bay.
 - 10.3 Remove bottom retaining bolt at portal hub and remove shock absorber.

NOTE

Always replace shock absorbers as a pair across an axle.

Refitting

- 11 To refit the front left shock absorber proceed as follows:
- 11.1 Check position of intermediate piece between shock absorber lower mounting and portal hub.
 - 11.2 Smear thread and shaft of retaining bolts with Loctite Anti Seize and refit shock absorber. Insert top bolt with bolt head pointing forward and bottom bolt pointing backward. Distance sleeves pressed into shock absorber must point backward. Refit bush with collar pointing toward shock absorber. Attach top nut and washer, then bottom nut.
 - 11.3 Tighten top and bottom retaining bolts to correct torque (see Table 2, Ser 2).

CAUTION

EQUIPMENT DAMAGE. When tightening bottom bolt, axle must be in horizontal position.

- 11.4 Refit engine cover and seats (see Chapter 16-2).

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CHAPTER 8-2

REAR SUSPENSION

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2	Special tools and equipment
3	Torque wrench settings
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6	Removal (CAUTION)
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10	Removal (CAUTION)
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12	Removal
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14	Removal
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16	Removal (CAUTION)
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18	Removal (CAUTION)
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INTRODUCTION

1 This chapter details the procedure for all work carried out on the suspension

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools and test equipment are shown in Table 1.

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Ser (1)	NSN (2)	Manfr No. (3)	Designation (4)
1	5120-99-331-1588	905.333.305.1	Pressing tool

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings in this chapter are shown in Table 2:

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Spring seat retaining screws	35	5.2 13.1
2	Spring support U bolt	75	5.4 13.3
3	Spring support bolt	200	5.5 13.4 17.4 19.2
4	Shock absorber retaining bolt	200	9.3 11.3
5	Wheel bolts	260	5.6 17.7
6	Spring bracket screw	160	17.6

REAR LEAF SPRING

Removal

4 To remove the rear axle leaf spring, proceed as follows:

4.1 Lift vehicle with jack under rearmost differential casing until wheels are clear of ground (see Fig 1).

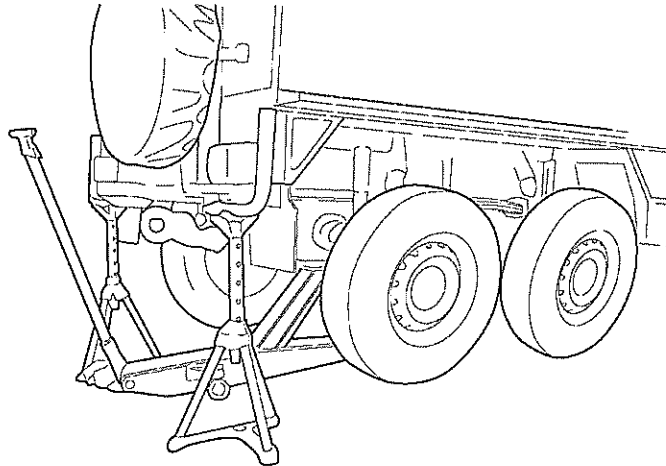


Fig 1 Vehicle supports

CAUTION

EQUIPMENT DAMAGE. Use suitable support between trestle and cross-member to avoid damage to paintwork.

4.2 Place axle stands under rear body cross-member and lower vehicle.

4.3 Unscrew both leaf spring support bolts by 15 - 20 mm (see Fig 2).

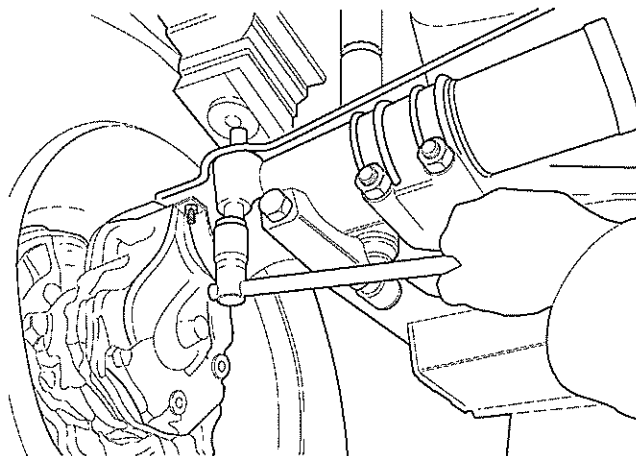


Fig 2 Spring support bolts

4.4 Remove spring U-bolts (see Fig 3).

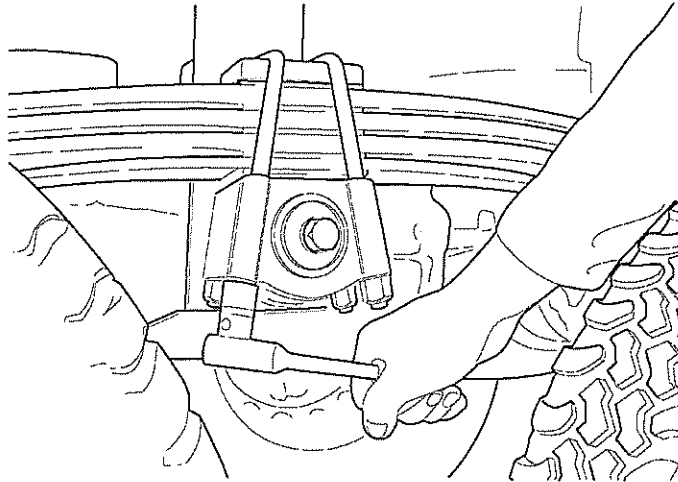


Fig 3 Spring bracket

- 4.5 Remove leaf spring, tension plate and top and bottom distance plate from spring bracket.
- 4.6 Clamp leaf spring in vice, insert suitable wedge between third and fourth leaf springs and open as far as possible (see Fig 4).

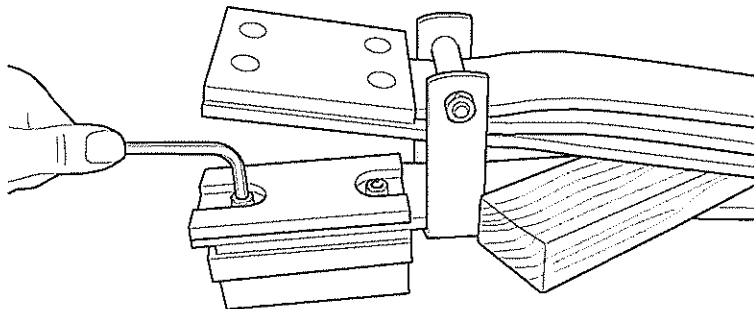


Fig 4 Spring seat

- 4.7 Remove spring seat.
- 4.8 Check that spring seat and spring support bolt in wheel drive housing is serviceable.

NOTE

Always replace rear springs as a pair across an axle.

Refitting

- 5 To refit rear leaf spring, proceed as follows:
 - 5.1 Open leaf spring (see Para 4.6).
 - 5.2 Smear thread of spring seat with Loctite anti-seize compound and mount spring seat. Tighten spring seat retaining screws to correct torque (see Table 2, Ser 1).
 - 5.3 Smear ball shaped cavity of supporting shell in spring seat as well as centring collar of spring centre bolt with XG 305.
 - 5.4 Refit distance plate onto spring bracket. Insert leaf spring into spring bracket. Refit top distance plate and spring tension plate with spring U-bolts. Apply Loctite 242 to hexagon nut thread, mount and tighten U bolts to correct torque (see Table 2, Ser 2).
 - 5.5 Tighten spring support bolts to correct torque (see Table 2, Ser 3).
 - 5.6 Lower vehicle to ground.

REAR RUBBER HOLLOW SPRING

Removal

- 6 To remove the rear rubber hollow spring proceed as follows:
 - 6.1 Lift vehicle with jack under rearmost differential casing until wheels are clear of ground (see Fig 1).

CAUTION

EQUIPMENT DAMAGE Use suitable support between trestle and cross-member to avoid damage to paintwork.

- 6.2 Place axle stands under rear body cross-member and lower vehicle.
- 6.3 Insert Allen key into rubber hollow suspension and remove with spring retainer (see Fig 5).

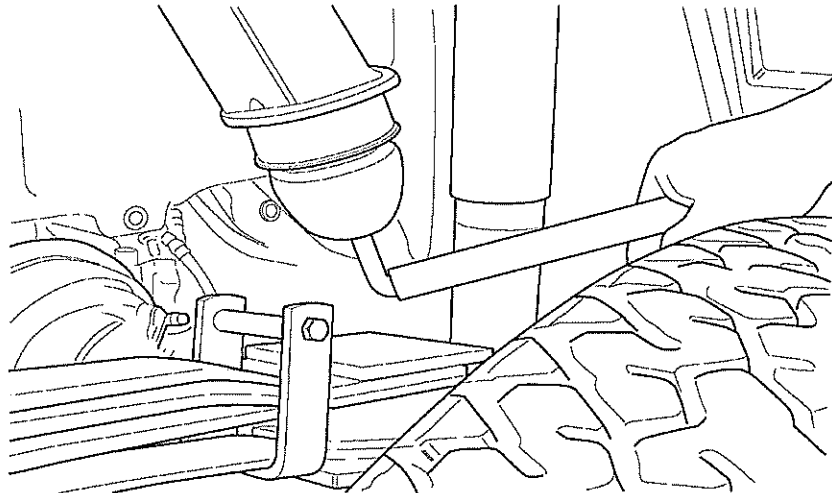


Fig 5 Rubber hollow suspension

Refitting

- 7 To refit the rear rubber hollow spring proceed as follows:
 - 7.1 Smear cheese head screw thread with Loctite anti-seize compound, then smear screw head with silicon paste and insert screw into rubber hollow suspension (see Fig 6).
 - 7.2 Refit rubber hollow spring with spring retainer.
 - 7.3 Lower vehicle to ground.

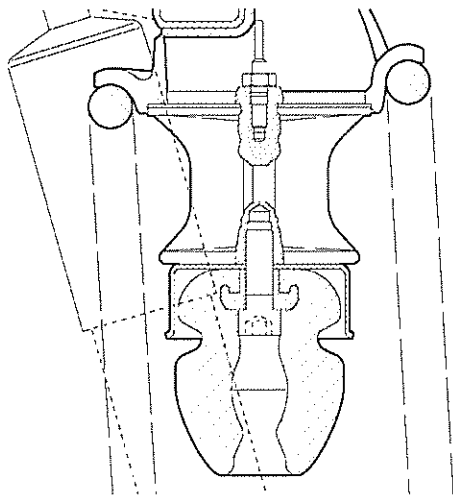


Fig 6 Rubber hollow suspension

REAR SHOCK ABSORBER**Removal**

- 8 To remove the rear shock absorber proceed as follows:

NOTE

When changing shock absorber using a pit, wheels need not be removed.

- 8.1 Lift vehicle with jack under rearmost differential casing until wheels clear ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable support between stand and cross member to avoid damage to paintwork.

- 8.2 Place axle stands under rear cross member and lower vehicle.
- 8.3 Remove wheel.
- 8.4 Lift portal hub slightly with jack.
- 8.5 Remove top and bottom shock absorber retaining bolts and remove shock absorber.

NOTE

Always replace shock absorbers as a pair across an axle.

Refitting

- 9 To refit the rear shock absorber proceed as follows:
 - 9.1 Insert shock absorber into top bracket and bottom bracket.
 - 9.2 Smear retaining bolts along whole length with Loctite Anti Seize, insert with bolt head pointing forward. Attach top nut and washer, then bottom nut.
 - 9.3 Lift half axle into horizontal position and tighten top and bottom retaining bolts to correct torque (see Table 2, Ser 4).
 - 9.4 Lower portal hub and remove jack.
 - 9.5 Refit wheel.
 - 9.6 Lower vehicle to ground and tighten wheel bolts to correct torque (see Table 2, Ser 5).

REAR SHOCK ABSORBER/AIR SPRING

Removal

NOTES

- (1) Some vehicles are fitted with a combined shock absorber and air spring on the third axle.
 - (2) When changing shock absorber/air spring using a pit, wheels need not be removed.
- 10 To remove the rear shock absorber/air spring proceed as follows:

- 10.1 Lift vehicle with jack under rearmost differential casing until wheels clear ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable support between stand and cross member to avoid damage to paintwork.

- 10.2 Place axle stands under rear cross member and lower vehicle.
- 10.3 Remove wheel.
- 10.4 Deflate air spring (if fitted) through valve on left side of vehicle behind shock absorber/air spring.
- 10.5 Lift portal hub slightly with jack.
- 10.6 Remove top and bottom shock absorber retaining bolts and remove shock absorber/air spring.
- 10.7 Remove air pipe connections from top of shock absorber/air pipe.

Refitting

- 11 To refit the rear shock absorber/air spring proceed as follows:
 - 11.1 Insert shock absorber/air spring into top and bottom bracket.
 - 11.2 Smear shock absorber retaining bolts along whole length with Loctite Anti-Seize compound, insert with bolt head pointing forward. Attach top and bottom nuts and washers.
 - 11.3 Lift half axle into horizontal position and tighten top and bottom shock absorber retaining bolts to correct torque (see Table 2, Ser 4).
 - 11.4 Refit air pipe hand tight to top of shock absorber/air spring.
 - 11.5 Lower portal hub and remove jack.
 - 11.6 Refit wheel.
 - 11.7 Lower vehicle to ground and tighten wheel bolts to correct torque (see Table 2, Ser 5).
 - 11.8 Re-inflate air bags to 3 bar using valve on vehicle left side.
 - 11.9 Check all air connections for leaks and tighten if necessary.

LEAF SPRING SEAT**Removal**

- 12 To remove the leaf spring seat, proceed as follows:
 - 12.1 Remove leaf spring (see Para 4).
 - 12.2 Clamp leaf spring in vice. Insert suitable wedge between third and fourth spring leaves and spread as far as possible.
 - 12.3 Unscrew spring seat.
 - 12.4 Check spring support bolt in wheel drive housing is serviceable.

Refitting

- 13 To refit the leaf spring seat, proceed as follows:
 - 13.1 Smear thread of spring seat retaining screws with Loctite anti-seize compound, then mount spring seat. Tighten screws to correct torque (see Table 2, Ser 1).
 - 13.2 Smear support shell in spring seat cavity and centring collar of spring centre bolt with XG 305.
 - 13.3 Refit distance plate and spring bracket. Insert leaf spring into spring bracket. Fit top distance plate and spring tension plate with U-bolt. Apply Loctite 242 to hexagon nut thread, then fit and tighten U bolts to correct torque (see Table 2, Ser 2).
 - 13.4 Tighten spring support bolt to correct torque (see Table 2, Ser 3).
 - 13.5 Lower vehicle to ground.

LEAF SPRING SUPPORT

Removal

- 14 To remove the leaf spring support, proceed as follows:
 - 14.1 Remove leaf spring (see Para 4).
 - 14.2 Remove spring seat (see Para 12).
 - 14.3 Press out supporting shell.
 - 14.4 Check spring seat and support bolt for serviceability.

15 Refitting

- 15.1 To refit the leaf spring support, proceed as follows:
 - 15.2 Remove Loctite residue from spring seat.
 - 15.3 Put spring seat onto suitable drift punch. Apply Loctite 270 outside to support shell, then press in until stop.
 - 15.4 Refit spring seat (see Para 13).
 - 15.5 Refit leaf spring (see Para 5).

LEAF SPRING BRACKET BUSH

Removal

- 16 To remove the spring bracket bush, proceed as follows:
 - 16.1 Lift vehicle with jack at rearmost differential casing until wheels clear ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable support between stand and cross-member to avoid damage to paintwork.

- 16.2 Place axle stands under rear cross-member and lower vehicle.
- 16.3 Remove wheel from second axle.
- 16.4 Unscrew both spring support bolts by 20mm (see Fig 3).
- 16.5 Loosen hexagon screw on spring bracket and remove with disk.
- 16.6 Remove leaf spring from bearing neck at short carrier tube.

NOTE

Compress spring ends to prevent damage to brake pipes.

- 16.7 Press out ultra bush using pressing tool (Table 1, Ser 1) (see Fig 7).

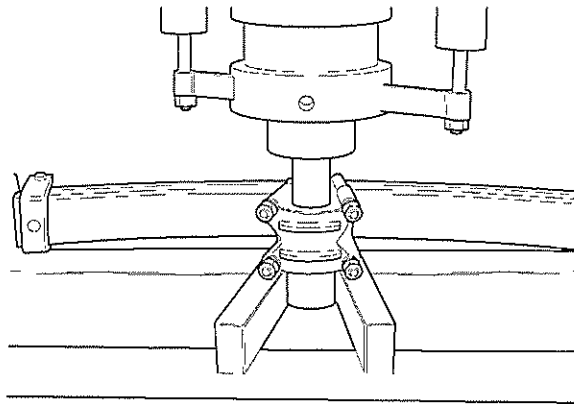


Fig 7 Ultra Bush

- 16.8 Check spring seat and leaf spring for serviceability.

Refitting

- 17 To refit the spring bracket bush, proceed as follows:
- 17.1 Oil spring bracket bore and bush exterior. Push in bush, bevelled side forward, until flush with spring bracket using pressing tool (Table 1, Ser 1).
- 17.2 Smear carrier tube bearing neck and spring seat support shell with XG 305.
- 17.3 Refit spring and spring bracket and mount hexagon screw with disk without tightening.
- 17.4 Tighten spring support bolts to correct torque (see Table 2, Ser 3).
- 17.5 Refit wheel and lower vehicle to ground.
- 17.6 Tighten hexagon screw on spring bracket to correct torque (see Table 2, Ser 6).
- 17.7 Tighten wheel bolts to correct torque (see Table 2, Ser 5).

LEAF SPRING SUPPORT BOLT

Removal

- 18 To remove the leaf spring support bolt, proceed as follows:
- 18.1 Lift vehicle with jack at rearmost differential casing until wheels clear ground.

CAUTION

EQUIPMENT DAMAGE. Use suitable support between stand and cross-member to avoid damage to paintwork.

- 18.2 Place axle stands under rear cross-member and lower vehicle.
- 18.3 Remove spring support bolt, then check spring seat and support shell for wear.

Refitting

- 19 To refit the leaf spring support bolt, proceed as follows:
 - 19.1 Clean support shell cavity and smear with XG 305.
 - 19.2 Smear thread of spring support bolt with Loctite Anti Seize compound, screw in and tighten to correct torque (see Table 2, Ser 3).
 - 19.3 Lower vehicle to ground.

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CHAPTER 9

RUNFLAT WHEEL AND TYRE REPAIR INSTRUCTIONS

CONTENTS

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- 1 Introduction (CAUTION)
- 2 Special tools and test equipment
- 3 Torque wrench settings
- 4 Changing runflat wheel and tyre assemblies (WARNING)
- 5 Fitting a runflat insert
- 8 Runflat inspection and reuse (WARNING)

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2 Runflat installation.....	5

INTRODUCTION

1 This chapter details the procedure for replacing a runflat wheel and tyre and assembly or the runflat insert.

CAUTION

In the event of a puncture, swap punctured tyre(s) onto middle axle if possible and repair/replace tyre as soon as possible.

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools and test equipment are shown in Table 1.

TABLE 1 SPECIAL TOOLS , TEST EQUIPMENT AND CONSUMABLES

Item (1)	NSN (2)	Manfr No. Pinzgauer RFI (3)	Designation (4)
1	TBA	8251569022 RFI 012	High Temperature Grease
2	8030-12-328-2434	8251569023	Loctite 243 Thread Adhesive
3	TBA	8251569025 RFI 020	Assembly Cord
4	TBA	8251569024 RFI 016	Bead Lifting Tool
5	5120-99-147-9510	8251569021	Torque Limiting tool with 8mm A/F Female Socket
6	5120-99-760-9883	8251569020	" T " Bar Fitting Tool 8mm A/F

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings for this chapter are shown in Table 2:

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Wheel bolts	260	4.8

CHANGING RUNFLAT WHEEL AND TYRE ASSEMBLIES**WARNING**

PERSONAL INJURY. A RUNFLAT WHEEL AND TYRE ASSEMBLY WEIGHS APPROXIMATELY 54 kg AND REQUIRES A TWO-MAN LIFT.

NOTE

Before using the hydraulic jack, take time to find solid, flat ground. If necessary, use supporting plates for the vehicle and jack.

4 Wheels should be changed in the following way:

4.1 Set the parking brake.

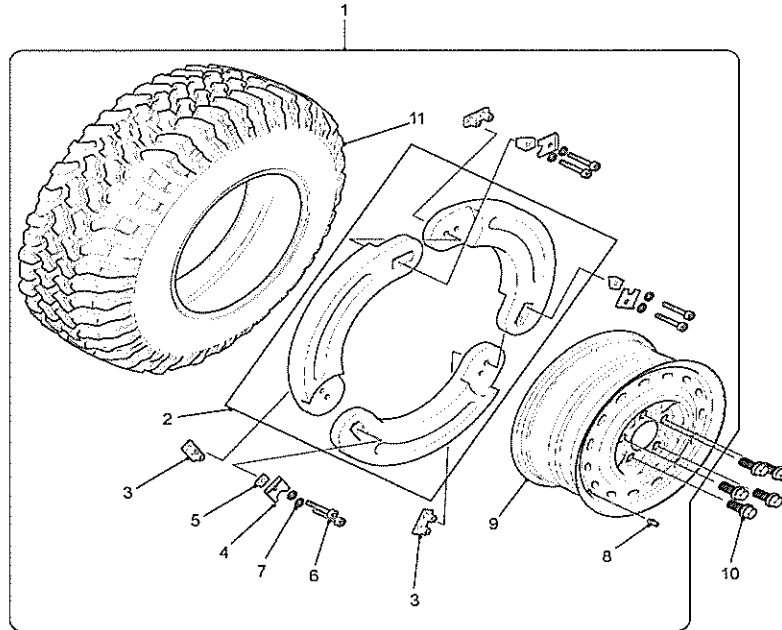
- 4.2 Loosen the wheel bolts (do not unscrew).
- 4.3 Place a suitable jack under the axle near to the wheel. Jack the wheel up until it is clear of the ground.
- 4.4 Unscrew the wheel bolts and remove the wheel.
- 4.5 Clean the contact surface, centring collar and wheel bolts from dirt.
- 4.6 Place the replacement wheel onto the centring collar and screw in the wheel bolts by hand.
- 4.7 Tighten the bolts in the lifted position with the wrench provided.
- 4.8 Lower the jack and further tighten the wheel bolts using the wrench with the jack bar as an extension (use a torque wrench adjusted to 260 Nm).
- 4.9 Check and adjust the tyre to the correct inflation pressure.

NOTE

If no torque wrench is available when changing a wheel, re-tighten the wheel bolts after driving about 30 miles.

FITTING A RUNFLAT INSERT

5 The vehicle is provided with BF Goodrich 285/75 R16 M/T tyres on single piece 7J X 16 steel drop centre wheels fitted with 3 piece Runflat International Limited runflat roller inserts (see Fig 1), negating the need to carry a spare wheel. Following a puncture, the runflat will limit the collapse of the tyre thus preventing premature deterioration of its walls. The vehicle will be able to run on for several tens of kilometres, whilst still retaining the tyre on the wheel.



- 1 Runflat, wheel and tyre assembly
- 2 Runflat roller insert assembly
- 3 Rivet nut plate
- 4 Clamping plate
- 5 Wedge
- 6 Bolt
- 7 Double locking washer
- 8 Clamp in valve
- 9 Wheel
- 10 Wheel bolt
- 11 Tyre

Fig 1 Runflat, wheel and tyre components

6 To fit a runflat insert, proceed as follows:

6.1 Remove valve core and deflate tyre. Break both beads and fit on a tyre fitting machine with valve uppermost.

6.2 If not already fitted replace existing valve with metal clamp-in valve.

6.3 Disassemble new runflat insert assembly (see Fig 1/2). Using high temperature grease (see Table 1, Ser. 1) grease underside of rollers making sure that grease slots are completely full of grease (see Fig 2/1).

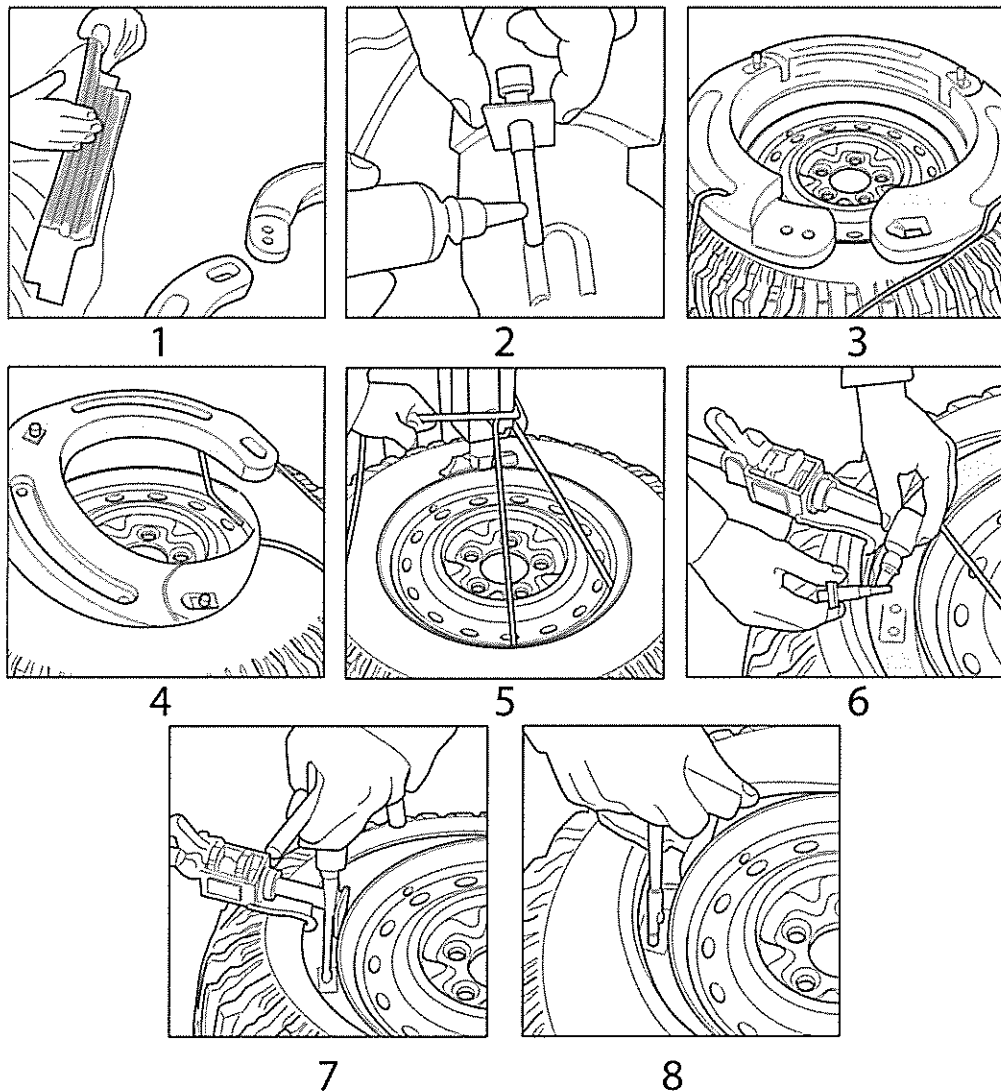


Fig 2 Runflat installation

6.4 Fit a double locking washer and wedge to two bolts and Apply Loctite 243 (see Table 1, Ser. 2) thread adhesive to bolt thread (see Fig 2/2).

6.5 Link the three runflat rollers together and using two wedge bolts and secure loosely into rivnut plates (in opposite side of rollers). Leave third joint unconnected (see Fig 2/3).

6.6 Pass assembly cord (see Table 1, Ser. 3) through adjacent holes in third joint (see Fig 2/3).

6.7 Lift top bead of tyre and insert runflat rollers, with wedge slot uppermost, making sure wedges sit at the top of the wedge bolts (see Fig 2/4). Align the third joint approximately in line with the valve.

6.8 Using the cord, pull ends of roller together (see Fig 2/5). It may be necessary to lift up the tyre to bring the runflat assembly into the well of the wheel. When the ends of the third joint roller are pulled together, rotate the whole assembly so that the joint sits both sides of the valve with the ends of the roller overlapping.

6.9 Secure assembly cord (on tyre fitting machine) to keep rollers in correct position. Clean off any residual grease from side of tyre.

6.10 Pull over top bead of tyre in area of valve with tyre lever or bead spreader (see Table 1, Ser. 4).

6.11 Fit a double locking washer and wedge to third bolt and Apply Loctite 243 (see Table 1, Ser. 2) thread adhesive to bolt thread (see Fig 2/6). Tighten down wedge bolt so that wedge top is level with top of wedge slot and the gaps between the roller ends are the same.

6.12 Remove the assembly cord after the third wedge bolt has been fitted.

6.13 Check that the joint sits both sides of the valve and tighten down each wedge in turn so that the top of each wedge sits just below the top of the wedge slot.

6.14 Use the torque limiting tool (see Table 1, Ser. 5) to tighten each wedge to the torque marked on top of the roller.

6.15 Fit a double locking washer and clamping plate to clamping plate bolts and Apply Loctite 243 (see Table 1, Ser. 2) thread adhesive to bolt thread.

6.16 Fit clamping plate bolts (see Fig 2/8) and tighten down using "T" bar fitting tool (see Table 1, Ser. 6).

6.17 Mount top bead of tyre, ensuring that all traces of grease removed.

6.18 Inflate tyre and balance wheel and tyre assembly in the normal way.

7 Strip down of a runflat wheel and tyre assembly is essentially a reverse of the fitting procedure.

RUNFLAT INSPECTION AND REUSE

WARNING

INJURY TO PERSONNEL. IF IN DOUBT ALWAYS RENEW THE RUNFLAT SYSTEM AFTER RUNFLAT USE.

8 The runflat inserts are designed to be returned to service after runflat use providing:

- 1) There is no ballistic or explosive damage
- 2) There are no signs of other mechanical damage

9 **If in doubt, renew the runflat system as a whole.**

10 If the runflat use led to any noticeable damage to the tyre a detailed inspection of the runflat must be performed prior to returning the unit to service.

11 The inserts should be carefully cleaned and inspected at each system strip down, regardless of runflat use. In the event that cracks, fissures or mechanical damage is observed, the runflat should be replaced (or a Runflat International Limited distributor inspection arranged).

12 If upon inspection there is no sign of surface damage to the insert but runflat use is known to have occurred, the insert should be fitted to a bare wheel (wheel with no tyre) from the vehicle to which the runflat system was fitted. The wedge bolts should be installed and tighten to correct torque as detail in Para 6.

13 If the system can be rotated on the wheel the runflat should be replaced (or a Runflat International Limited distributor inspection arranged).

14 If there is no movement of the runflat system on the wheel, remove it, re-grease and assemble as a complete runflat, wheel and tyre assembly in accordance with the procedure detailed at Para 6 – ensuring that new fixing bolts and double locking washers are used.

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CHAPTER 10

ANTI-LOCK BRAKING SYSTEM

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INTRODUCTION

1 This Chapter details the procedures for work carried out on the braking system.

WARNINGS

(1) **HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.**

(2) **DANGER TO LIFE AND LIMB. FAILURE TO BLEED THE BRAKING SYSTEM WHENEVER ANY HYDRAULIC SYSTEM FITTING IS LOOSENEED OR DISCONNECTED WILL ALLOW AIR TO REMAIN IN THE SYSTEM. THIS WILL PREVENT THE HYDRAULIC PRESSURE IN THE BRAKE SYSTEM FROM RAISING ENOUGH TO APPLY THE BRAKES PROPERLY. THIS WILL CAUSE THE STOPPING DISTANCE TO INCREASE AND CAN RESULT IN SERIOUS PERSONAL INJURY.**

CAUTIONS

(1) **WASTE PRODUCTS. Personnel responsible for the disposal of waste products must comply with local regulations and procedures.**

(2) **FLUID SPILLS. Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.**

(3) **LUBRICANT CHECK. Before operating vehicle, ensure oils and lubricants are filled to the correct level.**

(4) **EQUIPMENT DAMAGE. Absolute cleanliness is necessary when working on hydraulic systems and components. All ports and orifices must be capped off immediately a component is removed or a pipe is disconnected.**

(5) **EQUIPMENT DAMAGE. Brake fluid is corrosive to varnish and paint work. If brake fluid is spilled, rinse immediately with water.**

(6) **EQUIPMENT DAMAGE. Ensure all tools and equipment used on the braking system hydraulic circuits are able to withstand the effects of brake fluid.**

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools or test equipment for this Chapter are shown in Table 1:

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

No (1)	NSN (2)	Man No. (3)	Designation (4)
1.	4910-12-337-5562	446 300 331 0	Diagnostic controller
2.	6625-99-251-8654	8001370170	Diagnostic cable - ABS
3.	7025-99-862-1580	446 300 783 0	Diagnostic program card
4.	4910-99-441-1023	446 300 350 0	Diagnostic sensor probe
5.	5998-99-131-1170	446 300 604 0	Diagnostic sensor probe Program card
6.	6625-99-684-4137	8001370180	Diagnostic sensor probe cable - ABS

TORQUE WRENCH SETTINGS

3 Torque wrench settings for this Chapter are shown in Table 2:

TABLE 2 TORQUE WRENCH SETTINGS

No (1)	Item (2)	Torque Nm (3)	Para (4)
1.	Handbrake flange bolts/dome nuts	80	62 76
2.	Modulator pipe connections	16	9
3.	Sensor bracket mounting bolts	40	81.9
4.	Pole wheel screws	3	84.3
5.	Brake pipes	15	35 37
6.	Calliper retaining bolts	35	22
7.	Calliper bracket retaining bolts	125	36
8.	Body supports	250	67
9.	Wheel bolts	260	26 40
10.	Disc retaining screws	28	34.1

BRAKING SYSTEM – HYDRAULIC SIDE

MANUAL BLEED PROCEDURE

WARNINGS

(1) **DANGER TO LIFE AND LIMB. FAILURE TO BLEED THE BRAKING SYSTEM WHENEVER ANY HYDRAULIC SYSTEM FITTING IS LOOSENED OR DISCONNECTED WILL ALLOW AIR TO REMAIN IN THE SYSTEM. THIS WILL PREVENT THE HYDRAULIC PRESSURE IN THE BRAKE SYSTEM FROM RISING ENOUGH TO APPLY THE BRAKES PROPERLY. THIS WILL CAUSE THE STOPPING DISTANCE TO INCREASE AND CAN RESULT IN SERIOUS PERSONAL INJURY.**

(2) **DANGER TO LIFE AND LIMB – HIGH PRESSURE BRAKE FLUID. THE VEHICLE ELECTRICAL SYSTEM MUST REMAIN OFF FOR THE ENTIRE BLEED PROCEDURE. ENERGIZING THE UNIT DURING BLEEDING MUST BE IMPOSSIBLE.**

4 During repair to the braking system that involves opening any of the hydraulic connections, air may get into the systems hydraulic circuits. In addition, overtime, brake fluid absorbs moisture and therefore should be changed in accordance with the maintenance schedule. In either event, bleeding of the braking system must conclude the maintenance activity.

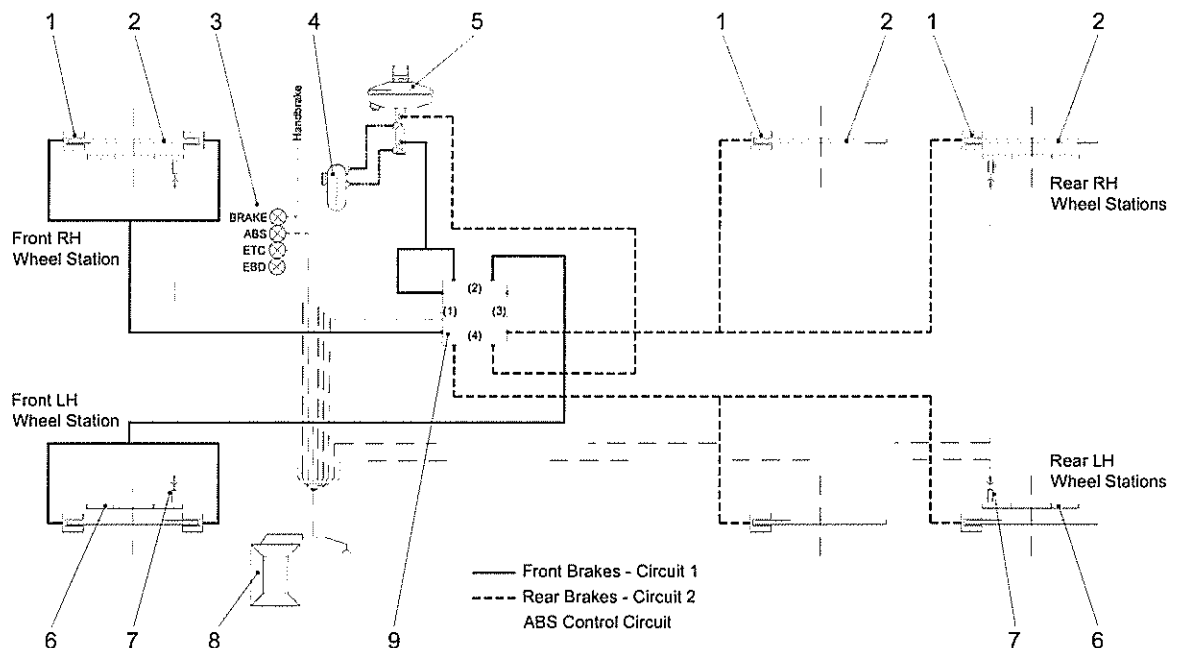
5 Without the use of a brake bleeding device two personnel are required to bleed the system. To bleed the braking system proceed as follows:

- 5.1. Ensure the vehicle's park brake is applied.
- 5.2. Isolate the electrical system. Turn the battery isolation switch in the vehicle cab, behind the passenger's seat to the OFF position. Disconnect the vehicle's negative (-ve) battery terminal and ensure that this is safely placed, ie cannot reconnect with the terminal unintentionally.
- 5.3. Remove the cap from the brake fluid reservoir.
- 5.4. Check the brake fluid level in the reservoir and top up as necessary with new brake fluid.

CAUTION

FLUID LEVEL. When bleeding the braking system observe the brake fluid level in the reservoir and ensure that the level does not drop below the minimum mark. Failure to keep the brake reservoir level above minimum could result in more air entering system, making it impossible to effectively bleed the system. Only top up the brake fluid reservoir with new brake fluid.

- 5.5. Depress the brake pedal 5 times in approximately 5 seconds using a stroke between 1/3 travel and maximum travel.
- 5.6. Release the pedal for 5 to 10 seconds. Air bubbles will rise into the reservoir while depressing and releasing pedal.
- 5.7. Ensuring that the fluid level does not drop below the minimum mark in the reservoir, repeat Para 5.5 and 5.6 another three times, or until pedal resistance is felt and commence bleeding the hydraulic brake circuits
- 5.8. Bleed system in following sequence (see Fig 1):
 - 5.8.1. Second rear axle, calliper on left side
 - 5.8.2. Second rear axle, calliper on right side
 - 5.8.3. First rear axle, calliper on left side
 - 5.8.4. First rear axle, calliper on right side
 - 5.8.5. Front axle, both callipers on left side
 - 5.8.6. Front axle, both callipers on right side



- | | | | |
|---|---|---|-------------------------|
| 1 | Brake calliper | 6 | Pole wheel |
| 2 | Brake disc | 7 | Sensor |
| 3 | Brake system warning lamps | 8 | Electronic Control Unit |
| 4 | Fluid reservoir with loss indicator | 9 | Modulator |
| 5 | Servo unit and tandem master brake cylinder | | |

Fig 1 Braking system

5.8.7. Bleed the brakes at each wheel station separately, in the above order, through transparent tube of an appropriate diameter to suit the bleed nipple. Bleed fluid into a suitable transparent container until clear, bubble free fluid drains off.

CAUTION

EQUIPMENT DAMAGE. Both the tubing and container must be able to withstand to the effects of brake fluid.

- 5.9. Locate the dust cap on the respective calliper, remove dust cap from the bleed nipple, clean the nipple and connect bleeder tube. Make sure the tube fits snugly. Insert end of tube into transparent container holding sufficient fluid to immerse end of tube.
- 5.10. Whilst an assistant depresses the brake pedal 10 to 15 times, using the maximum available stroke, loosen the bleed nipple through 2 turns and continue pumping the pedal until it is possible to feel resistance at the brake pedal and clear light coloured fluid is bled (old brake fluid is darker in colour).
- 5.11. Depress pedal once more and hold down until the bleed nipple is tightened.
- 5.12. Ensuring that the fluid level does not drop below the minimum mark in the reservoir.
- 5.13. Repeat Para 5.10 through 5.12 several times, until the discharged fluid is free or air bubbles.

- 5.14. Check dust caps for damage and wipe away any surplus fluid before refitting to bleed nipples.
- 5.15. Repeat Para 5.9 through 5.13 in the sequence described in Para 5.8.

NOTE

Callipers on front wheels can be bled simultaneously. See Fig 2

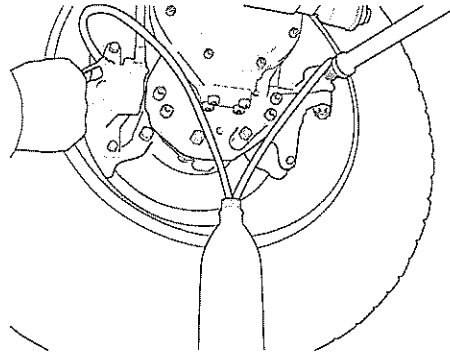


Fig 2 Bleeding front callipers

- 5.16. Check the travel of the brake pedal. If a firm resistance is felt the manual bleeding procedure is complete.
- 5.17. Check the fluid level in reservoir and top up as necessary. Replace reservoir cap and dispose of used brake fluid in accordance with local regulations and procedures.
- 5.18. Reconnect batteries, switch on vehicle isolator and with the engine running depress the brake pedal and hold it for 10 seconds. Release the pedal, switch off the engine and check the braking system for leaks.

CHANGING BRAKE FLUID

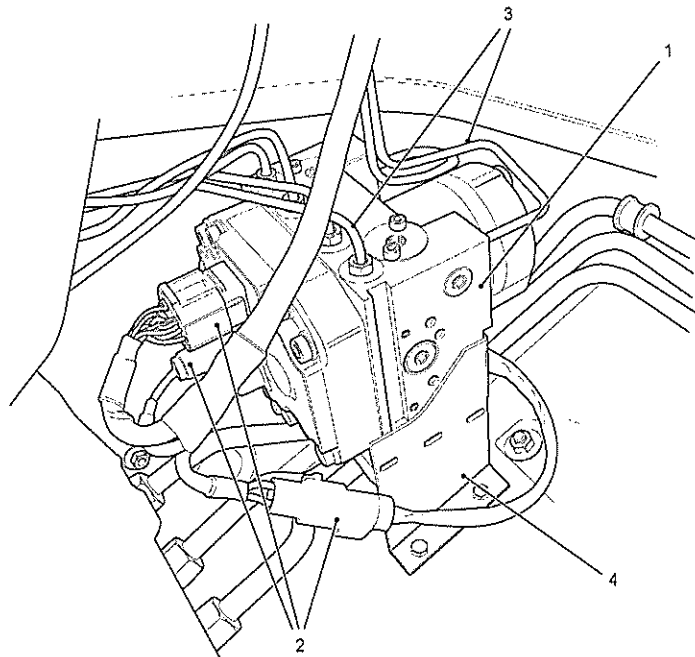
6 When a complete change of brake fluid is required, follow the procedure for bleeding the braking system but continue process until clean light coloured brake fluid (old fluid is darker in colour) is bled from each brake.

REPLACE ABS MODULATOR

7 The ABS modulator is a non-serviceable item. In the event of malfunction the entire modulator unit must be replaced.

Removal

- 8 To replace the ABS modulator proceed as follows:
 - 8.1. Isolate the electrical system. Turn the battery isolation switch in the vehicle cab, behind the passenger's seat to the OFF position. Disconnect the vehicle's negative (-ve) battery terminal and ensure that this is safely placed, i.e. cannot reconnect with the terminal unintentionally.
 - 8.2. Locate the modulator cover in the drivers foot well, remove securing bolts and withdraw cover from foot well.
 - 8.3. Unplug the electrical connections at the modulator (see Fig 3) and route the wiring away from the foot well. Note position of any cable ties removed to enable re-routing of wiring.



1	Modulator	3	Hydraulic pipes
2	Electrical connections	4	Modulator bracket

Fig 3 Modulator

- 8.4. With absorbent materials at hand, note location and unscrew the 6 hydraulic pipes (see Fig 3 (3)). Wipe away surplus brake fluid from the area.
- 8.5. Working carefully to avoid damaging the hydraulic pipes, create sufficient clearance around the modulator to permit its removal from the foot well. Cover the ends of the pipes to prevent ingress of dirt.
- 8.6. Remove the 3 bolts securing the modulator bracket and withdraw the bracket complete with modulator from the foot well. Wipe away surplus brake fluid from the area.
- 8.7. Remove the two bolts securing the bracket to the modulator. Remove bracket and retain. Dispose of modulator in accordance with local regulations and procedures.

Refitting

CAUTIONS

- (1) **EQUIPMENT DAMAGE.** Do not use a replacement modulator if the vacuum packaging is damaged on the Use By date has been exceeded.
- (2) **EQUIPMENT DAMAGE.** Do not expose the modulator to shock loads or excessive vibration prior to its installation.
- (3) **EQUIPMENT DAMAGE.** Do not allow compressed air to enter the hydraulic connections of the modulator.

9 Replacement modulators are provided pre-charged with brake fluid. Carefully remove the modulator from the vacuum packaging ensuring that all hydraulic ports are plugged. Refit the modulator in the reverse order to the removal procedure, paying particular attention to the following notes:

NOTES

- (1) Do not plug in the electrical connections or reconnect the batteries until the modulator has been secured in the foot well and the hydraulic pipes connected.
- (2) Tighten hydraulic pipe connections to correct torque, see Table 2, Ser 2.
- (3) Secure all wiring with cable ties in accordance with original installation.
- (4) Wipe away surplus brake fluid from the area.

10 Prior to replacing the modulator cover fill and bleed the braking system in accordance with Para 4 and perform a leak inspection of the whole brake system. Replace the modulator cover.

WARNING

HIGH PRESSURE BRAKE FLUID. ENSURE THAT THE FLOOR PLATE AND MODULATOR COVER IN THE DRIVERS FOOT WELL ARE IN PLACE AND SECURE PRIOR TO PERFORMING A SYSTEM CHECK.

11 Connect the diagnostic controller (see AESP 2320-D-503-512, Chapter 10) and perform a system check of the ABS.

BRAKING SYSTEM – MECHANICAL SIDE

BRAKE PADS

WARNING

INJURY TO PERSONNEL. THE VECTOR PPV VARIANT IS FITTED WITH SPECIFIC BRAKE PADS. IT IS ESSENTIAL THAT THE CORRECT BRAKE PADS ARE FITTED TO THE VEHICLE AS LISTED IN THE ILLUSTRATED PARTS CATALOGUE AESP 2320-D-503-711.

Change brake pads

NOTES

- (1) The Pinzgauer is equipped with disc brakes at front and rear axles featuring two 2-piece callipers (piston housing/brake anchor plate) per wheel at front axle and one per wheel at rear axles.
- (2) Change brake pads as soon as linings possess no more than 2 mm remaining thickness (without lining rear plate) or are worn unequally. Replacing of brake pads must always be simultaneously done at one axle. Brake pad repair sets have been fixed accordingly.

12 Lift vehicle in accordance with the following procedures:

To Access Front Brakes

- 12.1. Lift vehicle with jack on front axle casing until wheels just clear ground. Support vehicle using suitable stands placed under floorpan support rails (see Fig 4).

CAUTION

EQUIPMENT DAMAGE. Use suitable pad (e.g. felt) between trestle and vehicle in order to avoid damage to paintwork or under-seal.

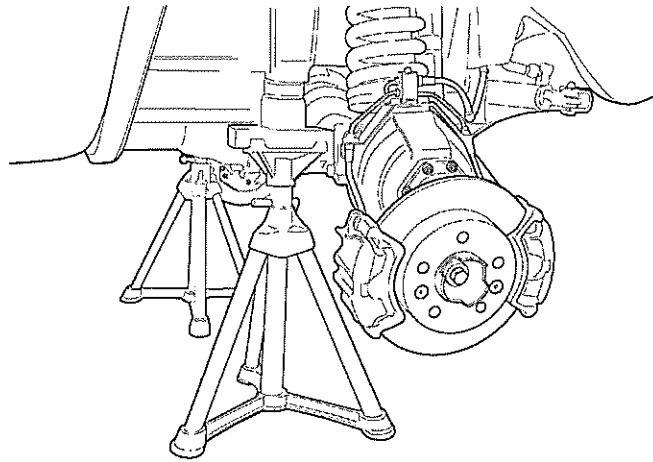


Fig 4 Supporting front body

To Access Rear Brakes

- 12.2. Lift vehicle with jack under rearmost differential casing until wheels are clear of ground (see Fig 5). Place axle stands under rear body cross-member and lower vehicle.

CAUTION

EQUIPMENT DAMAGE. Use suitable pad (eg felt) between trestle and vehicle in order to avoid damage to paintwork or under-seal.

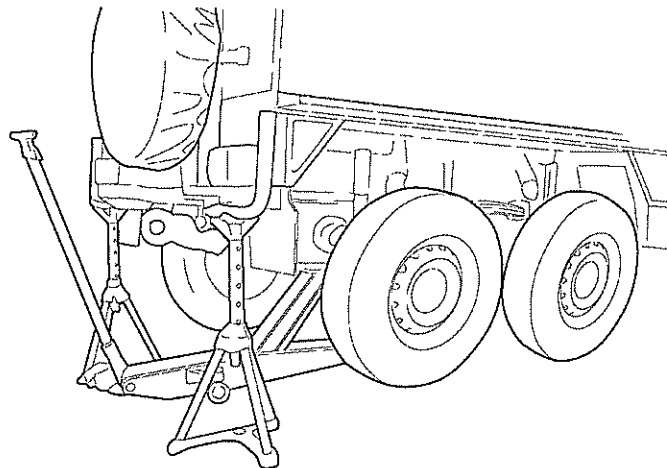


Fig 5 Support rear body (typical 6x6 variant)

- 13 Unscrew and remove applicable road wheels.
- 14 Access brake fluid reservoir and siphon brake fluid down to min. mark.
- 15 Using both hands, pull brake calliper firmly outwards to release pressure on brake pads.
- 16 Loosen both top and bottom calliper retaining bolts (see Fig 6 (1)) to cylinder housing while backing up guide pin with open ended spanner (2).

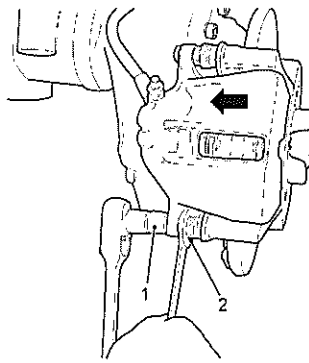


Fig 6 Loosen calliper retaining bolts

CAUTION

EQUIPMENT DAMAGE. Avoid twisting, bending or straining brake hoses when removing calliper.

- 17 Hang calliper locally from the vehicle using rope/wire (see Fig 7 (1)).

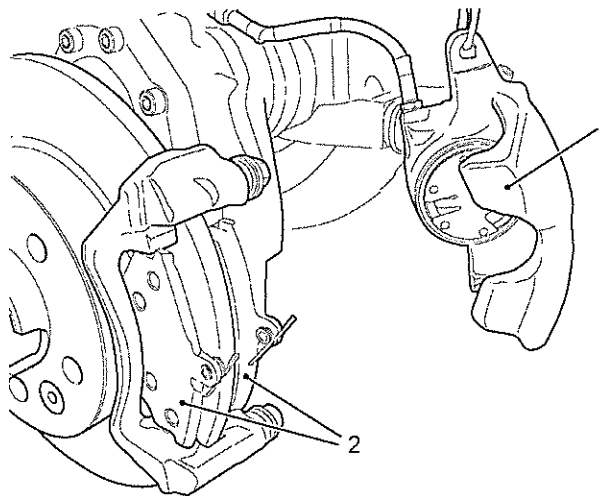


Fig 7 Removing brake pads

- 18 Remove brake pads (2)

Checking

19 Remove damping plate (see Fig 8/1). Check piston dust sleeve (see Fig 8 (2)) as well as bellows (3) for condition and elasticity. Check guide pins (4) are freely movable in brake anchor plate. If necessary, grease with Alfalub (SKF) – or equivalent bearing grease. Check brake disc (5) for wear. Min. thickness 11 mm. Traces of wear predominately on one side of brake disc indicate jamming of piston in cylinder bore. In this case change calliper and brake disc together. If brake disc is in perfect condition, remove rust crust at outer edges with scraper and smoothen with emery cloth. Clean calliper dry only, do not use fluids containing mineral oil.

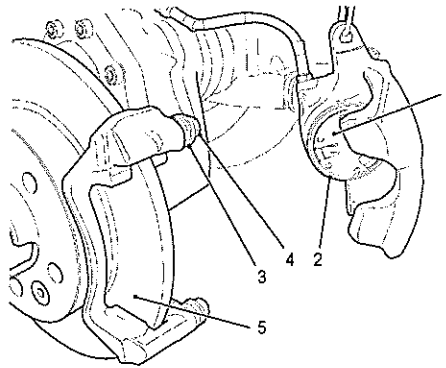


Fig 8 Checking brake components

Fitting

20 Clean pad guiding surfaces and mount new brake pads. Guiding catches (see Fig 9 (1)) of lining support plates must rest on slideway of brake anchor plate and be freely movable. Push back piston completely and insert damping plate (2).

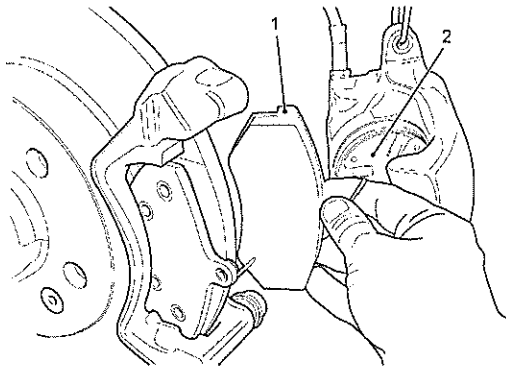


Fig 9 Inserting brake pads

CAUTION

EQUIPMENT DAMAGE. Avoid twisting, bending or straining brake hoses when installing calliper.

21 Release calliper from hanging position and install. Align lining springs to rest close at housing inner side (Fig 10).

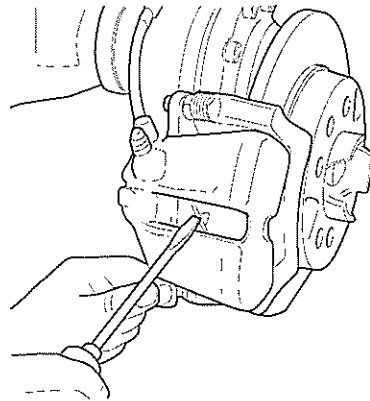


Fig 10 Align lining springs

22 Insert new calliper retaining bolts and tighten to correct torque, see Table 2, Ser 6, while backing up guide pin (see Fig 11).

NOTE

Retaining bolts are self-locking (micro-encapsulated). To safeguard their securing effect, retaining bolts must be replaced after every loosening. Brake pad repair sets therefore contain new retaining bolts.

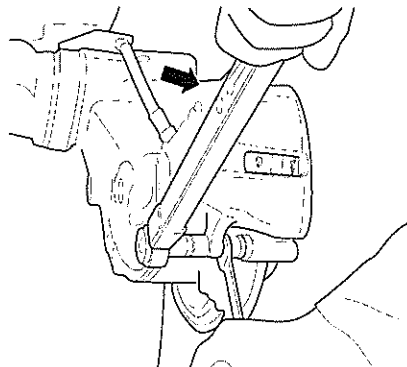


Fig 11 Refitting calliper housing

23 Top up brake fluid to max mark. Put brake pads into operational position by actuating brake pedal a few times. Top up brake fluid again if necessary.

24 Check condition and serviceability of brake hoses. Replace any damaged hoses if necessary and bleed brake system (Para 4).

25 Fit road wheels.

26 Lower vehicle to ground and tighten wheel bolts to correct torque, see Table 2, Ser 9.

27 Conduct a short road test with brake test then re-torque road wheel bolts and check brake fluid level.

NOTE

In order to bed brake pads to brake disc and attain optimum performance and life the vehicle user should be instructed to avoid heavy braking for the first 200 km after a pad change.

BRAKE CALLIPER/DISC

Replace brake calliper/disc

Removing

- 28 Lift vehicle in accordance with the procedures detailed at Para 12 to access applicable wheel station.
- 29 Unscrew and remove applicable road wheels.
- 30 Access brake fluid reservoir and siphon brake fluid down to min. mark.
- 31 Using both hands, pull brake calliper firmly outwards to release pressure on brake pads.

NOTE

Extract brake fluid only when several callipers are dismantled.

- 32 Loosen brake hose to calliper at retainer at wheel drive housing (see Fig 12 (1 and 2)) and plug brake line to avoid excessive fluid loss.

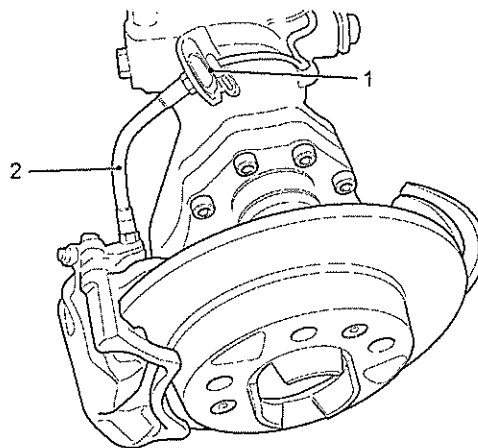


Fig 12 Brake pipe connections (typical)
Rear axle wheel station illustrated

- 33 Loosen retaining screws (see Fig 13) and remove calliper complete with brake pads.

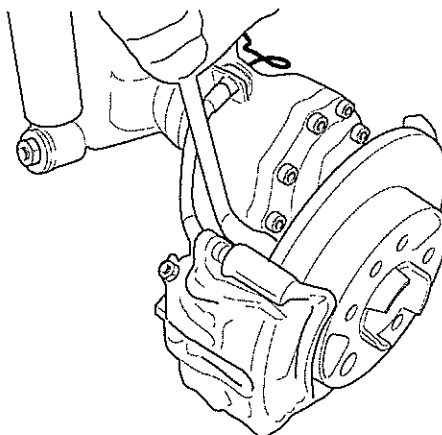


Fig 13 Remove calliper with brake pads

Check/Refit

34 Check brake disc for wear; min thickness 11 mm (see Fig 14). Brake discs showing deep furrows, one-sided wear or axial run-out of more than 0.15 must be replaced. Refer to Chapter 5 for procedure to check axial run-out.

- 34.1. In the event a new brake disc is required, apply ant-seize grease to 4-off countersunk fixing screws and tighten to correct torque, see Table 2, Ser 10.

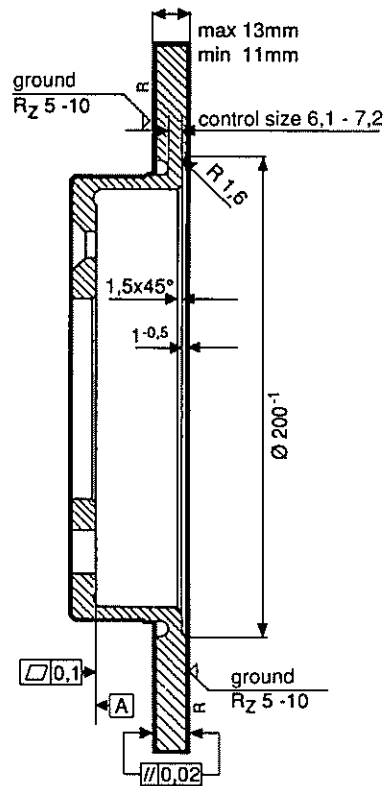


Fig 14 Brake disc dimensions

35 Check brake hose for serviceability, transfer to new calliper or replace as appropriate and tighten to correct torque, see Table 2, Ser 5.

36 Apply Loctite 242 to threads of retaining screws and mount calliper. Tighten screws (see Fig 15) to correct torque, see Table 2, Ser 7.

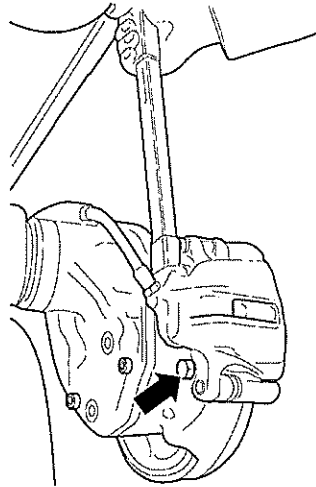


Fig 15 Calliper retaining screws (typical)
Rear axle wheel station illustrated

37 Remove temporary brake line plug and reconnect brake hose(s) (see Fig 16). Tighten coupling to correct torque, see Table 2, Ser 5.

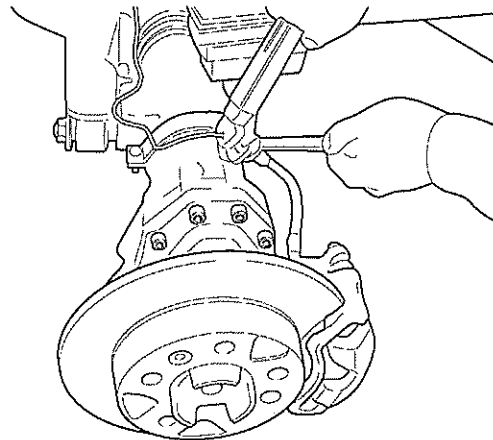


Fig 16 Tighten brake lines (typical)
Rear axle wheel station illustrated

38 Bleed brake system (see Para 4).

39 Fit road wheels.

40 Lower vehicle to ground and tighten wheel bolts to correct torque, see Table 2, Ser 9.

41 Conduct a short road test with brake test then re-torque road wheel bolts and check brake fluid level.

Overhaul Calliper

42 To overhaul brake calliper proceed as follows:

42.1. Remove brake calliper, see Para 28.

- 42.2. Insert small piece of wood within calliper to prevent damage and use compressed air to force out piston.
- 42.3. Remove dust cover and oil seal from calliper bore (see Fig 17).
- 42.4. Check all components for signs of damage or wear and replace if necessary.
- 42.5. Refit piston with new seals using brake cylinder paste to lubricate.
- 42.6. Refit calliper (see Para 34) and bleed brake system, see Para 4.

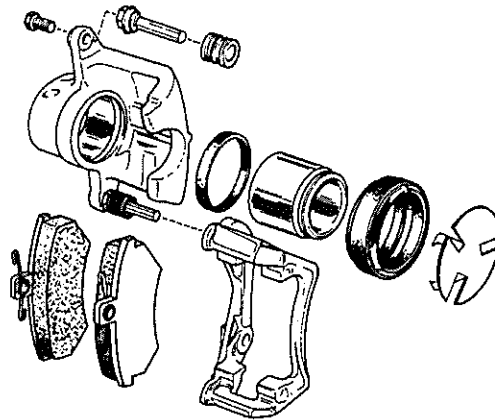


Fig 17 Brake calliper

HANDBRAKE

Check and Adjust

- 43 To check and adjust the handbrake proceed as follows:
 - 43.1. Remove clip (Fig 18 (1)) and remove pin (2) from angle lever.
 - 43.2. Full travel of brake angle lever from rest stop to maximum application stop must be 80mm.
 - 43.3. Adjustment is made by moving lock nut on linkage at right hand side of rear axle (as linkage enters axle casing).
 - 43.4. Refit handbrake cable to angle lever and adjust cable using lock nut on cable fork.
 - 43.5. If measurement at brake angle lever cannot be achieved by adjustment of the linkage, the length of the handbrake cable must be adjusted.
 - 43.6. To adjust handbrake cable length:
 - 43.6.1. Loosen lock nut (5), remove clip (1) and remove pin (2) from angle lever.
 - 43.6.2. Rotate fork (4) until required distance has been reached and tighten lock nut (5).

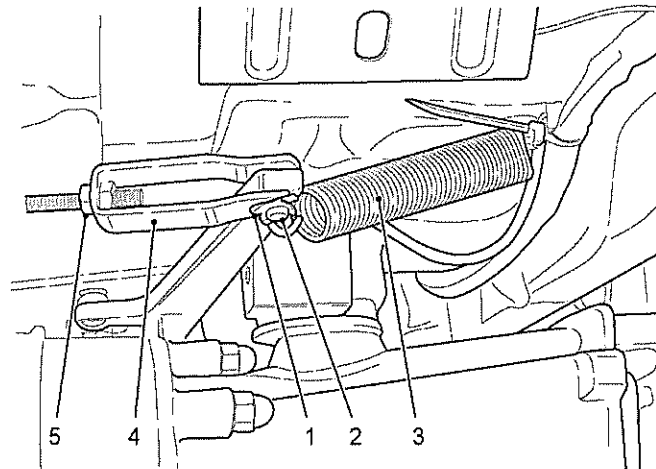


Fig 18 Handbrake angle lever arrangement

43.7. Repeat Para 43.1 through 43.4 until correct handbrake adjustment is achieved.

43.8. Road test vehicle then re-check handbrake.

CAUTION

EQUIPMENT DAMAGE. If handbrake is over adjusted it will heat up during road test and damage disc lining and/or handbrake flange

Change, remove and fit lining discs of handbrake

Removing

44 Lift vehicle in accordance with the procedures detailed at Para 12.

45 Release handbrake.

46 Remove clip (Fig 18 (1)) and remove pin (2) from angle lever.

47 Unhook return spring (3) from angle lever.

48 Loosen and remove body support bolt at towing flange (see Fig 19), washer and nut, leaving upper support shim and top rubber support in position. A sectional view of the body support at the towing flange is provided at Fig 22.

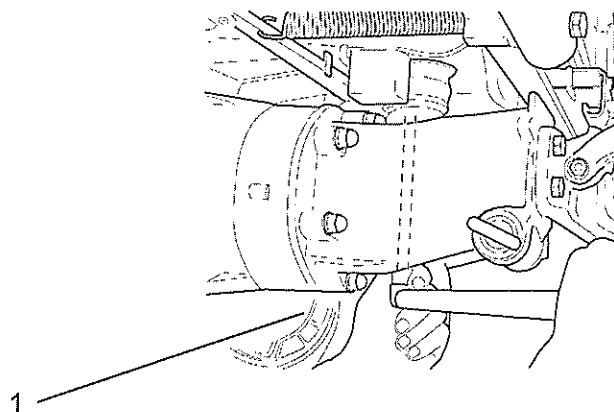


Fig 19 Rear body support bolt removal

- 49 Loosen and remove body support screws at rear cross beams, noting their positions.
- 50 Pull off locking spring (see Fig 20 (1)) and remove angle lever (3) with washer (2) from cutting bolt.

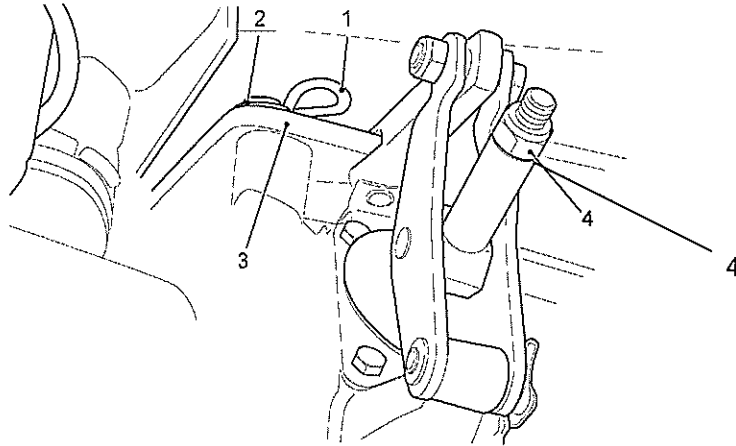


Fig 20 Remove locking spring and angle lever

- 51 Unscrew 5 off cap nuts (see Fig 19 (1)) from towing flange and remove special lock washers.
- 52 Pull towing flange off stud bolts, leaving lower rubber body support and shim in position.
- 53 If towing flange cannot be removed, press rear axle downwards/body upwards with a crow bar to aid removal. Use a suitable pad between body and axle housing to prevent body damage.
- 54 Remove rear lining disc (see Fig 21 (1)).

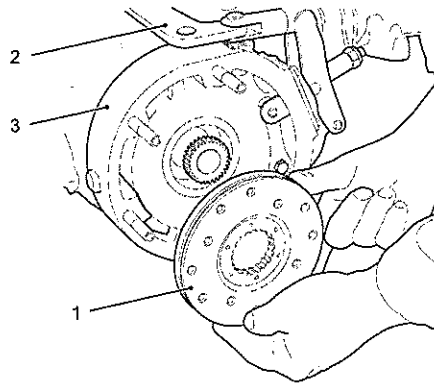


Fig 21 Remove lining discs and brake housing

- 55 Swivel angle lever backwards (2) and remove complete brake housing.
- 56 Remove front lining disc.

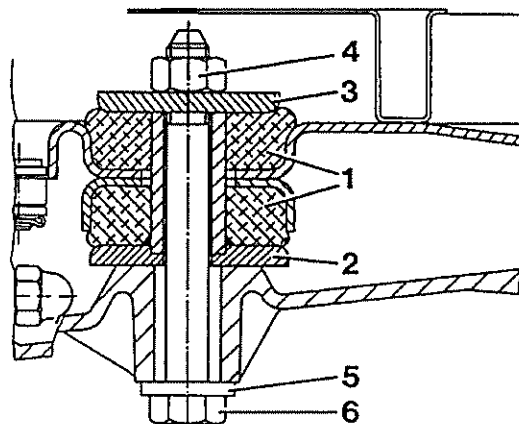
Checking

- 57 Check as follows:
- 57.1. Change lining discs if any are contaminated with oil.

- 57.2. Check spline shaft profile of lining discs, change lining discs if necessary.
- 57.3. Check lining thickness, min. lining thickness – 0.5 mm above rivet heads.
- 57.4. Check springs of brake disc for sufficient pre-tension, change if necessary.
- 57.5. Check brake flange for traces of wear and furrows, change if necessary.
- 57.6. Check towing flange for traces of wear and furrows, change if necessary.
- 57.7. Check rotary shaft seal ring in axle journal for serviceability, change if necessary.

Fitting

- 58 Slide front lining disc onto brake shaft.
- 59 Apply surface sealant Loctite 574 to both sides of sealing surfaces of brake housing and slide on until stop.
- 60 Fit rear lining disc.
- 61 If previously removed, insert bottom rubber support (see Fig 22) and lower support shim (see Fig 23/2) and fit towing flange. If necessary, press rear axle downwards/body upwards to aid installation.



- | | | |
|-----------------------|-----------------------|-----------|
| 1. Rubber supports | 3. Upper support shim | 5. Washer |
| 2. Lower support shim | 4. Nut | 6. Bolt |

Fig 22 Body support mounting

- 62 Attach special lock washers and tighten cap nuts to correct torque, see Table 2, Ser 1.
- 63 If previously removed, insert top rubber support (see Fig 22) and upper support shim (see Fig 22 (3)) with rounded side pointing to rubber support. Fit nut (4) and refit towing flange, securing with washer (5) and rear body support bolt (6) but do not tighten.
- 64 Fit body support at rear cross beams but do not tighten.
- 65 Fit angle lever with washer and locking spring (see Fig 20).
- 66 Fit return spring at angle lever (see Fig 18 (3)).
- 67 Lower vehicle to ground and tighten 5 off body supports to correct torque, see Table 2, Ser 8.
- 68 Check adjustment of handbrake, adjust if necessary, see Para 43.

CAUTION

EQUIPMENT DAMAGE. If handbrake is over adjusted it will heat up during road test and damage disc lining and/or handbrake flange.

HANDBRAKE FLANGE**Removal and refitting**Removing

69 Remove lining discs of handbrake, see Para 44.

70 Unscrew 2 off nuts only (see Fig 23/1) securing pneumatic diff lock actuator. The 2 off hexagon screws (see Fig 23/2) secure the pneumatic diff lock actuator housing halves and must not be removed.

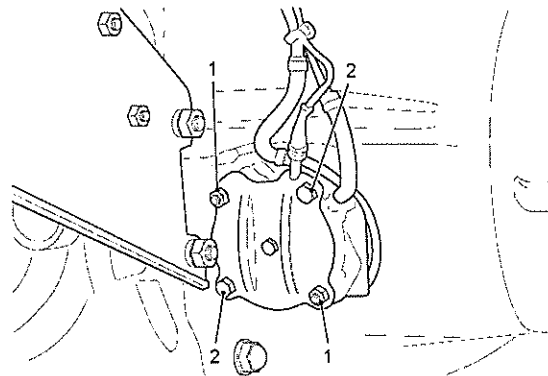


Fig 23 Pneumatic diff lock actuator securing screws

71 Remove pneumatic diff lock actuator unit (see Fig 24 (1)) and hang from the vehicle with a suitable strap.

72 Remove hexagon screws (2) and special lock washers from load apportioning valve bracket (4) and set aside. Remove similar hexagon screws from right hand side of handbrake flange.

73 Loosen cap nuts (3) of anchor bolts while backing up at other end.

74 Loosen handbrake flange (with plastic hammer if necessary) and remove.

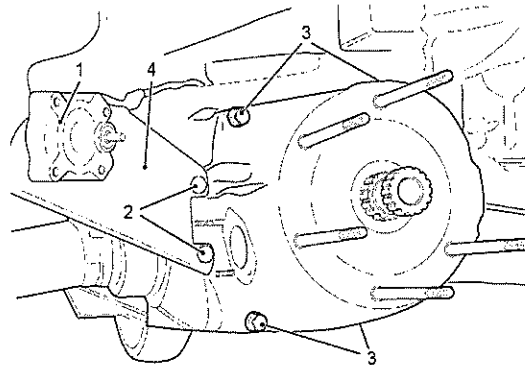


Fig 24 Handbrake flange fixings

Fitting

75 Apply surface sealant Loctite 574 to sealing surface of handbrake flange (see Fig 25 (1)) and refit handbrake flange.

NOTE

Ensure vent slots and bores (2) are not clogged.

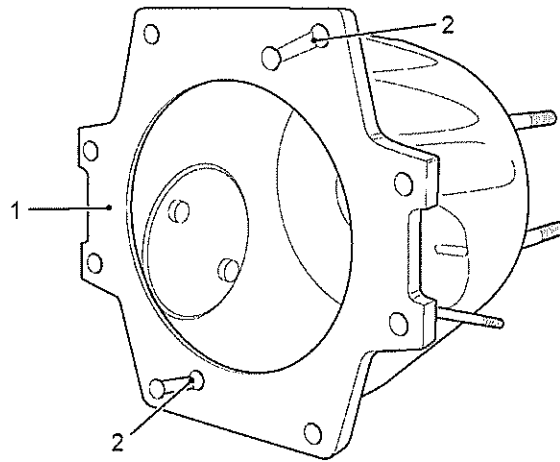


Fig 25 Handbrake flange

76 Smear threads of hexagon screws and cap nuts (see Fig 26 (1)) with Loctite anti-seize and fit and tighten to correct torque (Table 2, Ser 1).

NOTE

To aid installation of load apportioning valve bracket fix spacers (2) with grease before installing bracket and securing with hexagon screws.

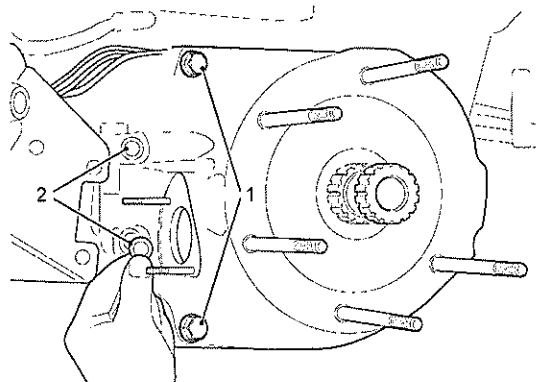


Fig 26 Hexagon screws, cap nuts and spacers

77 Prior to installing pneumatic diff lock actuator, check front-sided seat of V-ring (see Fig 27 (1)) at bush (2) in axle journal. Check sealing diaphragm (3) and clamping sleeve (see Fig 28 (4)) for good condition and correct position respectively.

78 Install pneumatic diff lock actuator with new gasket treated with surface sealant Loctite 574 on both sides, in central position, i.e. use existing play for stud bolts (Fig 27 (5)) so that diaphragm fits evenly inside bush (2) in axle journal.

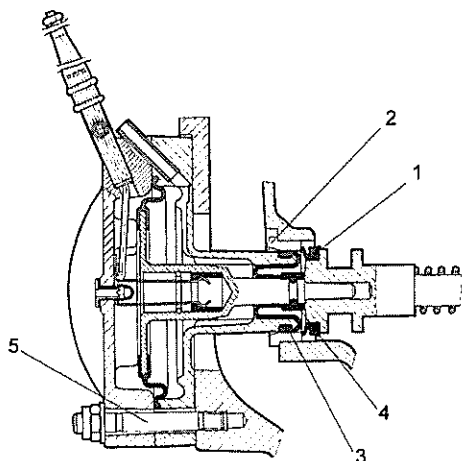


Fig 27 Pneumatic diff lock actuator

79 Check/fit lining discs of handbrake, see Para 57.

80 Check operation of handbrake and adjust if necessary, see Para 43.

ABS SENSOR

Replace

81 To replace an ABS sensor proceed as follows:

- 81.1. Isolate the electrical system. Turn the battery isolation switch in the vehicle cab, behind the passenger's seat to the OFF position. Disconnect the vehicle's negative (-ve) battery terminal and ensure that this is safely placed, ie cannot reconnect with the terminal unintentionally.
- 81.2. Remove brake calliper and disc, see Para 48, from the appropriate wheel station. Carefully tie calliper out of the way. Do not disconnect hydraulic hoses.
- 81.3. First noting location, remove cable ties securing sensor cable to axle and unplug connection with main ABS loom.
- 81.4. Remove two bolts (Fig 28 (2)) securing the sensor bracket (1) to the axle casing, note location of bolts for reassembly, remove bracket complete with sensor and bush.
- 81.5. First noting orientation, remove old sensor (3) and bush (4) from bracket. Thoroughly clean the bracket.
- 81.6. Inspect the pole wheel (5) for signs of wear or damage. Replace as necessary.

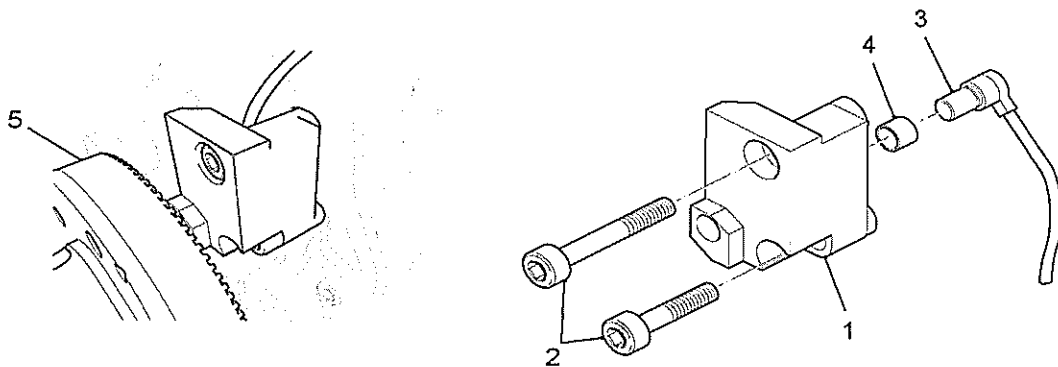


Fig 28 ABS sensor mounting

- 81.7. Prior to fitting new sensor, remove the rubber grommet closest to the sensor by carefully cutting it from the sensor cable (Fig 29).

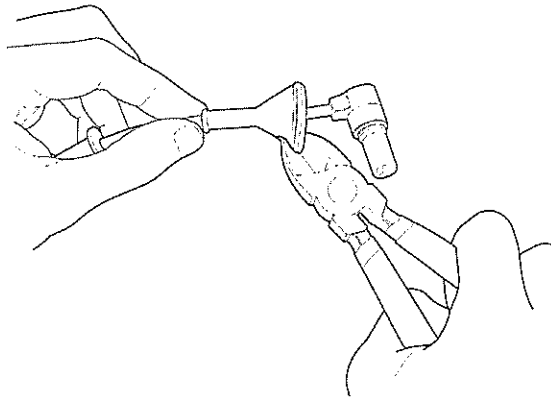


Fig 29 Removing surplus sensor cable grommet

- 81.8. Fit the new sensor bush into the bracket and insert the new sensor into the bush.
- 81.9. Re-fit sensor bracket and torque mounting bolts, see Table 2, Ser 3.
- 81.10. Using a feeler gauge adjust the sensor to provide an air gap with the pole wheel of 0.2 – 1mm, through a complete rotation of the pole wheel.
- 81.11. Plug the sensor cable back into the main ABS loom and cable tie to axle.
- 81.12. Replace brake disc and calliper, see Chapter 5-1 (front axle) or Chapter 5-2 (rear axle).
- 81.13. Connect the diagnostic controller (see AESP 2320-D-503-512 Chapter 10) and perform a system check of the ABS.

Check Sensor Air Gap

- 82 To check the sensor pole/wheel air gap proceed as follows:
- 82.1. Isolate the electrical system. Turn the battery isolation switch in the vehicle cab, behind the passenger's seat to the OFF position. Disconnect the vehicle's negative (-ve) battery terminal and ensure that this is safely placed, ie cannot reconnect with the terminal unintentionally.
 - 82.2. Remove brake calliper and disc, see Para 34, from the appropriate wheel station. Carefully tie calliper out of the way. Do not disconnect hydraulic hoses.
 - 82.3. Using a feeler gauge adjust the sensor to provide an air gap with the pole wheel of 0.2 – 1mm, through a complete rotation of the pole wheel.
 - 82.4. Replace brake disc and calliper, see AESP 2320-D-503-522 Chapter 5-1 (front axle) or Chapter 5-2 (rear axle).
 - 82.5. Connect the diagnostic controller (see AESP 2320-D-503-512 Chapter 10) and perform a system check of the ABS.

POLE WHEEL**Removal**

- 83 To remove an ABS pole wheel proceed as follows:
- 83.1. Isolate the electrical system. Turn the battery isolation switch in the vehicle cab, behind the passenger's seat to the OFF position. Disconnect the vehicle's negative (-ve) battery terminal and ensure that this is safely placed, ie cannot reconnect with the terminal unintentionally.
 - 83.2. First noting location, remove cable ties securing sensor cable to axle and unplug connection with main ABS loom.
 - 83.3. Remove and strip brake anchor plate, Para 28.
 - 83.4. Remove 6 Allen screws securing pole wheel to brake anchor plate and remove pole wheel.

Refitting**WARNING****BURN HAZARD. ALWAYS USE HEATPROOF GLOVES WHEN HANDLING PRE-HEATED POLE WHEEL.**

- 84 To fit a new pole wheel proceed as follows:
- 84.1. Heat new pole wheel in an oven at approximately 230° C for 45 minutes.
 - 84.2. Using heatproof gloves remove pole wheel from oven, locate on brake anchor plate and align with the tapped fixing holes.
 - 84.3. Smear Loctite 242 on the 6 Allen screws and secure pole wheel to brake anchor plate. Tighten screws to correct torque, see Table 2, Ser 4.
 - 84.4. Rebuild and refit brake anchor plate, see Para 34.
 - 84.5. Before refitting brake disc and calliper, check the sensor pole/wheel air gap in accordance with Para 71.

CHAPTER 11

FUEL AND EXHAUST SYSTEM

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INTRODUCTION

1 This chapter details the procedures for work carried out on the fuel and exhaust system. Some procedures are also covered in Chapter 1, but are repeated for clarity.

WARNINGS

(1) **DANGER TO LIFE AND LIMB. THE FUEL INJECTION PUMP MUST BE HANDLED WITH EXTREME CAUTION. ATOMISED FUEL CAN BE INJECTED THROUGH THE SKIN.**

(2) **DANGER TO LIFE AND LIMB. THERE IS A RISK OF EXPLOSION OR FIRE PARTICULARLY WHEN WORKING ON THE PRESSURISED INJECTION SYSTEM.**

(3) **DANGER TO LIFE AND LIMB. ENSURE THAT MAINTENACE FAN GUARD 800.1.56.028.1 IS FITTED IF WORKING ON THE ENGINE WHEN RUNNING AND WITH THE ENGINE COVER REMOVED.**

(4) **PERSONAL INJURY. DO NOT ALLOW ANY LOOSE ITEMS OF CLOTHING TO BECOME CAUGHT IN THE FAN BLADES OR ANY OTHER MOVING ENGINE PARTS. REMAIN ALERT AS TO THE LOCATION OF THE ROTATING FAN, PULLEYS, BELTS ETC, WHEN WORKING ON A RUNNING ENGINE. FIT MAINTENANCE FAN GUARD (800.1.56.028.1) AS NECESSARY.**

(5) **HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.**

CAUTIONS

- (1) **WASTE PRODUCTS.** Personnel responsible for the disposal of waste products must comply with local regulations and procedures.
- (2) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools and test equipment are shown in Table 1.

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Item (1)	NSN (2)	Manfr No. (3)	Designation (4)
1	5120-12-196-5869	905.3.14.103.0	Extractor
2	5120-12-194-8771	905.3.15.101.1	Ring spanner
3	5120-99-301-1615	905.3.36.103.2	Brace / counter hold tool
4	5120-99-212-6710	800.1.56.034.1	Vacuum pump
5	6625-99-601-8637	800.1.56.015.1	Diagnostic CD-ROM complete w/cable
6	4910-99-190-7143	800.1.56.016.1	Test box
7	5120-99-724-2800	800.1.56.002.1	Flexible head wrench
8	6685-12-307-9256	800.1.56.014.1	Turbocharger testing device
9	5120-12-194-8771	905 3.15 101.1	Open ring spanner
10	2815-99-503-3511	800.1.56.028.1	Maintenance fan guard

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings in this chapter are shown in Table 2. The exploded views throughout this chapter also give torque figures where appropriate.

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Seat mountings	26	6.2 7.5
2	Turbo / exhaust manifold clinch nuts	25	12.2
3	Turbo oil return line	30	12.4
4	Turbo oil supply line cap nut	25	12.6
5	Turbo front exhaust pipe flange gasket	25	12.7
6	Injection pump sprocket securing nut	90	39
7	Injection pump deflection roller securing nut	20	56
8	Glow plugs	15	79.2
9	Fuel injection lines / screw for clamping collar	25	63.5

DIAGNOSTIC SOFTWARE

4 See 2320-D-503-512 for details of using the VAG-COM diagnosis software kit 800.1.56.015.1. This package allows the user to run a software diagnostic tool for the TDI 2.5 Euro 3 engine on a Windows-based PC connected to the vehicle diagnostic connector with the HEX-COM interface lead. The other end of the HEX-COM interface lead is connected to the vehicle diagnostic connector for the EDC control unit (J248). The diagnostic connector is located within the Vehicle Power Distribution Box (VPDB) situated behind the passenger seat on the rear (nearside) bulkhead of the cab. The connector is accessed by removing the uppermost panel of the VPDB that is secured with six captive screws.

5 A hand-held test box 800.1.56.016.1 may also be used for fault diagnosis. It is connected directly to the 121-pin connector of the EDC control unit (J248). The EDC control unit (J248) is located within the VPDB located behind the passenger seat on the rear (nearside) bulkhead of the cab.

ENGINE COVER

WARNINGS

(1) **INJURY TO PERSONNEL. INSTALLATION/REMOVAL OF THE SEATS IS ONLY TO BE CARRIED OUT BY A QUALIFIED VEHICLE MECHANIC AND THE GENERAL CONDITION OF THE SEAT FIXINGS AND MOUNTINGS SHOULD BE INSPECTED PRIOR TO INSTALLATION/REMOVAL.**

(2) **PERSONAL INJURY. TO MAINTAIN THREAT INTEGRITY ENSURE THAT THE ENGINE COVER IS ALWAYS RE-FITTED IN ACCORDANCE WITH THE STATED PROCEDURE, USING ALL BOLTS.**

(3) **IMPACT HAZARD. HANDLE ENGINE COVER WITH CARE WHEN PERFORMING ROUTINE MAINTENANCE TASKS (TOP PLATE 16 KG. LH SIDE 34 KG. RH SIDE 32 KG).**

CAUTION

DAMAGE TO ENGINE COVER BLANKET. Do not place sharp objects on the blanket.

Removal

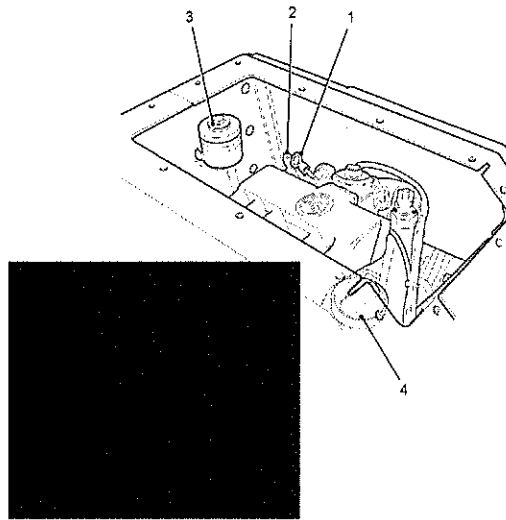
6 [REDACTED]
[REDACTED]
[REDACTED] The majority of maintenance tasks covered in Chapter 11 require removal of the top and left and right sides of the engine maintenance cover or at the very minimum the engine cover top plate (to access the: engine oil dip stick (see Fig1 (1)); automatic gearbox fluid dip stick (2); power steering fluid reservoir (3); engine oil fill point (4), for routine maintenance tasks). To remove the engine cover proceed as follows:-

6.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

6.2 Remove the driver and passenger seats in the vehicle cab. Each seat is held in place with four M8 fixings (torque to 26 Nm).

6.3 [REDACTED]

6.4 Using the 17mm socket and ratchet provided in the vehicle CES remove and retain the 14 off bolts securing the top plate of the engine cover and carefully remove top plate from the vehicle.



6.5 Disconnect the profile hose from the air filter. The hose passes through a circular cut-out in the right hand side of the engine cover. Slacken the jubilee clip and slide the hose through the engine cover.

6.6 Remove the box-cover over the air filter, with a fire extinguisher and jack attachment.

6.7 Remove the retaining bolts securing the LH and RH sides of the engine cover and carefully remove from the vehicle commencing with the RH side.

Replacement

7 Upon completion of maintenance task replacement of the engine cover is the reverse of the removal procedure, noting the following:

7.1 Check serviceability of securing bolts and threads in engine cover. **Do not return the vehicle to service without the engine cover in place or with missing or damaged bolts.**

7.2 Re-fit the engine cover and re-fit all securing bolts using the 17mm socket and ratchet provided in the vehicle CES.

7.3 Using the 17mm socket and pre-set 66 Nm torque wrench provided in the vehicle CES, tighten all bolts. The bolts are tight when the torque wrench clicks.

7.4 [REDACTED]

NOTE

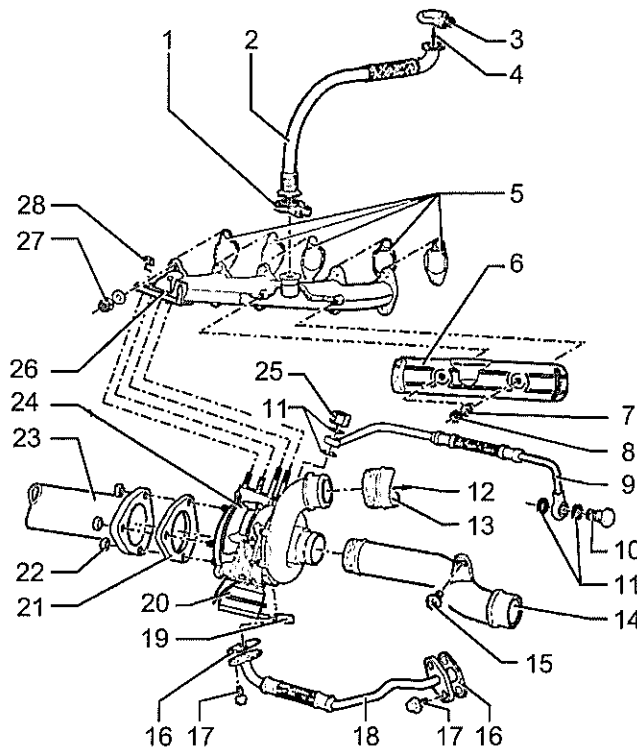
7.5 Re-fit the driver and passenger seats in the vehicle cab. Each seat is held in place with four M8 fixings (torque to 26 Nm).

7.6 Stow tools back on board vehicle.

TURBOCHARGER

System components

8 The parts for the turbocharger system are shown in Fig 2.



- | | | | |
|----|---|----|---|
| 1 | Clamp on exhaust manifold | 15 | M6 Captive screw
– tighten to 10 Nm torque |
| 2 | Connecting pipe | 16 | Seal |
| 3 | Clamp on EGR valve | 17 | M6 Captive screw
– tighten to 30 Nm torque |
| 4 | To EGR valve | 18 | Oil return line to cylinder block |
| 5 | Seal | 19 | Control line (vacuum) |
| 6 | Heat shield | 20 | Wastegate |
| 7 | Washer | 21 | Seal |
| 8 | Clinch nuts (12 mm)
– tighten to 25 Nm torque | 22 | M8 Nut for seal – tighten to 25 Nm torque |
| 9 | Oil supply line | 23 | Front exhaust pipe |
| 10 | M10 Banjo bolt – tighten to 30 Nm torque | 24 | Turbocharger |
| 11 | Sealing ring | 25 | Captive nut – tighten to 25 Nm torque |
| 12 | To charge air pipe | 26 | Exhaust manifold |
| 13 | Charge air hose | 27 | Captive screw – tighten to 25 Nm torque |
| 14 | Connecting pipe, between turbocharger and
connecting pipe of air mass flow meter
(G70). | 28 | Clinch nut (12 mm)
– tighten to 25 Nm torque |

Fig 2 Turbocharger system – exploded view

Test conditions

- 9 Before testing the turbocharger, the following conditions should be met:
- 9.1 There are no faults in fault memory.
 - 9.2 There are no leaks on the intake and exhaust side.
 - 9.3 There is no fault in the engine / injection system, e.g. commencement of injection, injectors or compression pressure.
 - 9.4 The engine oil temperature is at least 80 °C.

Test procedure**WARNING**

ACCIDENT AVOIDANCE. IF USING THE VAG-COM SOFTWARE WITH THE VEHICLE IN MOTION, TWO PERSONS WILL BE REQUIRED; ONE TO DRIVE THE VEHICLE AND THE OTHER TO CARRY OUT THE DATA ANALYSIS.

NOTE

Refer to 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

- 10 The test procedure is as follows:
- 10.1 The engine must be running at idle. Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.
 - 10.2 On the select control module screen click the [01 – Engine] button to access the engine control module.
 - 10.3 On the open controller screen click the [Meas. Blocks – 08] button, to access the measuring blocks screen.
 - 10.4 On the measuring blocks screen enter **011** in the Group field to activate '*Display group number 011*' and confirm entry with [Go] button.
 - 10.5 Accelerate the vehicle in 3rd gear from approx 1500 rpm at full throttle.
 - 10.6 The set-point value (in display field 3) should be between 1780 and 1970 mbar. If the set-point value is not reached, carry out the final control element diagnosis and actuate the solenoid valve for boost pressure control (N75).
 - 10.7 The solenoid valve must operate and as part of the process the linkage of the pressure unit for boost pressure control on the turbocharger must move back and forth. Movement should occur at least three or four times as long as vacuum is present in the vacuum reservoir.
 - 10.8 If the linkage moves and boost pressure set-point values are not reached, renew the turbocharger.
 - 10.9 If the linkage does not move because the solenoid valve does not operate, check the solenoid valve for boost pressure control (N75). Check the vacuum pressure hoses.

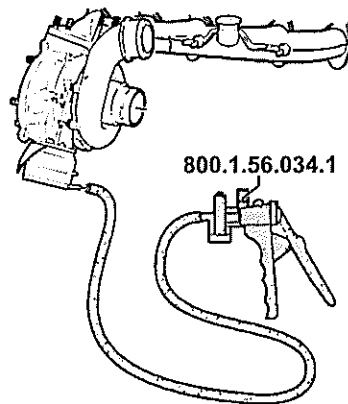


Fig 3 Vacuum pump test

10.10 If the linkage does not move but the solenoid valve operates, connect vacuum pump 800.1.56.034.1 to boost pressure control valve and check freedom of movement of linkage.

10.11 If linkage does not move freely renew turbocharger.

10.12 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.

10.13 To close the VAG-COM software click on the [Exit] button.

Removing turbocharger

WARNING

ELECTRICAL SAFETY. DISCONNECT THE EARTH STRAP FROM THE BATTERY WITH IGNITION SWITCHED OFF.

11 Remove as follows:

11.1 Remove both front seats and the engine cover (see Para 6). Some access from beneath the vehicle is also required.

11.2 Disconnect the main intake pipe located over top/front of the engine that connects to the EGR plenum chamber of the inlet manifold. Cut all cable ties securing the wiring loom to the pipe and unplug the connector for the intake manifold temperature sender (G72) located on the top of the pipe. The pipe is held in clamped place with hose (jubilee) clips at each end and is fixed to the cylinder head on the right-hand side with a bracket and M6 bolt and an M8 bolt that passes through the engine lifting eye on the top.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN DRAINING HOT FLUIDS.

11.3 Carefully undo the hose (jubilee) clip on the coolant pipe/engine breather hose, feed disconnected hose through the eyelet on the main intake pipe and re-connect as quickly as possible, re-tighten hose (jubilee) clip. Coolant fluid will escape and should be collected in a suitable container for correct disposal in accordance with local procedures.

11.4 Remove the main intake pipe complete.

11.5 Remove charge air hose (see Fig 4 (1)) and connecting pipe (3) from turbocharger.

11.6 Unscrew oil supply line (2) and oil return line (4) from turbocharger.

- 11.7 Disconnect vacuum hose (5).

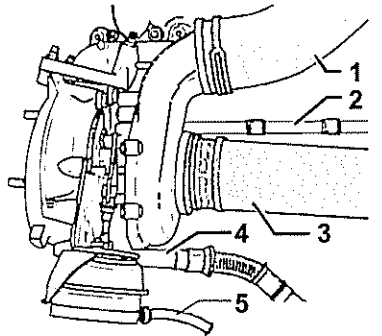


Fig 4 Turbocharger connections

- 11.8 Working from beneath the vehicle, remove exhaust pipe (see Fig 5 (1)).

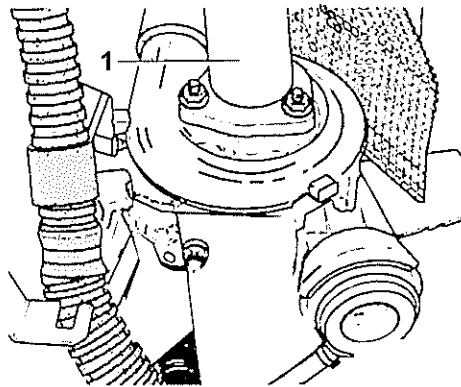


Fig 5 Turbocharger removal

- 11.9 So that the mounting clinch nuts between exhaust manifold and turbocharger can be accessed (see Fig 2 (28)), remove the intake manifold (see Fig 8 (1)) and remove the connecting pipe to EGR valve (see Fig 2 (2)).

- 11.10 Unscrew mounting clinch nuts between exhaust manifold and turbocharger.

- 11.11 Working from beneath the vehicle, remove turbocharger downwards.

- 11.12 Remove heat shield from turbocharger and retain. Inspect for corrosion and damage and renew if required.

Installing turbocharger

12 Replace as follows:

12.1 Fit heat shield on turbocharger.

12.2 Grease thread and head contact surface of mounting nuts between exhaust manifold and turbocharger with lubricating grease (G 000 500) and tighten nuts (see Table 2, Ser 2).

12.3 Re-fit inlet manifold and connecting pipe to EGR.

12.4 Fit oil return line with new seal and tighten (see Table 2, Ser 3).

12.5 Fill turbocharger with engine oil when fitting oil supply line.

12.6 Fit oil supply line with new sealing rings and tighten cap nut (see Table 2, Ser 4).

12.7 Fit flange on front exhaust pipe with new gasket and tighten (see Table 2, Ser 5).

NOTE

Pull slightly against all screw fittings when installing (parts must just be freely movable to one another). Then tighten tension-free.

12.8 Push on vacuum hoses and control lines and secure with clamps.

12.9 Mount connecting pipe on turbocharger and oil filter holder.

12.10 Mount charge air hose on turbocharger.

12.11 Re-route and reconnect the main intake pipe located over top/front of the engine that connects to the EGR plenum chamber of the inlet manifold. The pipe is held in clamped place with hose (jubilee) clips at each end and is fixed to the cylinder head on the right-hand side with a bracket and M6 bolt and an M8 bolt that passes through the engine lifting eye on the top.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN DRAINING HOT FLUIDS.

12.12 Carefully undo the hose (jubilee) clip on the coolant pipe/engine breather hose, feed disconnected hose through the eyelet on the main intake pipe and re-connect as quickly as possible, re-tighten hose (jubilee) clip. Coolant may escape and should be collected in a suitable container for correct disposal in accordance with local procedures. Use cable ties as necessary, paying particular attention to retaining the anti-chafing sleeve in place, where the hose passes through the eyelet provided on the main intake pipe.

12.13 Plug in the connector for the intake manifold temperature sender (G72) located on the top of the pipe. Re-route all vacuum hoses and wiring using cable ties secured using the eyelets provided on the main intake pipe.

CAUTION

DAMAGE TO TURBOCHARGER. Do not rev up the engine immediately, run the engine at idle to ensure sufficient oil supply reaches the turbocharger, otherwise damage may result.

12.14 Fit maintenance fan guard (see Table 1, Item 10) to cover the viscous fan blades at the front of the engine.

12.15 Run engine for approx one minute at idle after installing the turbocharger.

SOLENOID VALVE FOR BOOST PRESSURE CONTROL (N75)**NOTE**

Solenoid valve for boost pressure control (N75) is located on the rear bulkhead of the vehicle cab, behind the air filter. It is identified by its grey top cap.

Check solenoid valve for boost pressure control (N75)

13 To check the solenoid valve (N75), proceed as follows:

NOTE

There may be a box-cover over the air filter, with a fire extinguisher attachment. If this is the case, the fire extinguisher and cover will also require removal.

13.1 Disconnect the profile hose from the air filter. The hose passes through a circular cut-out in the right (off) side of the engine cover, remove the rear maintenance hatch of the engine cover (see Fig 1/1) slacken the jubilee clip and slide the hose off the air filter connection.

13.2 Undo the clips retaining the air filter and remove the air filter.

13.3 Pull off the plug (see Fig 6/1) on the solenoid valve for boost pressure control (N75) (see Fig 6 (2)).

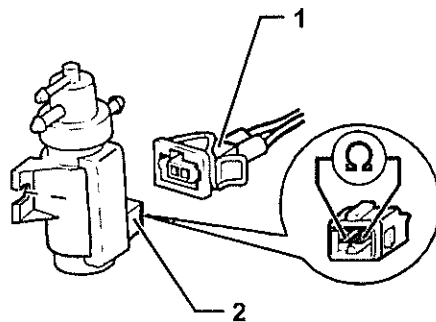


Fig 6 Solenoid valve for boost pressure control (N75)

13.4 Using a multi-meter, measure the resistance between the valve contacts. The set-point value is between 15 and 20 Ω .

13.5 If the set-point value is not attained, renew the solenoid valve for boost pressure control (N75).

13.6 If the set-point value is attained, switch on the ignition, measure the supply voltage on plug contact one (see Fig 7). The set-point value should approximately match the battery voltage supply.

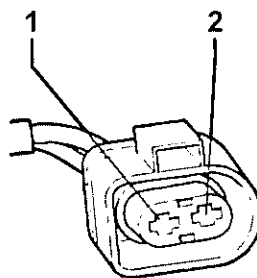


Fig 7 Connector plug for solenoid valve for boost pressure control (N75)

13.7 If the set-point value is still not attained, switch off the ignition, connect the test box (see Table 1, Item 6) to the EDC control unit (J248) wiring loom. The EDC control unit (J248) is located within the VPDB located behind the passenger seat on the rear (nearside) bulkhead of the cab. The EDC engine control unit (J248) is not connected in the process.

13.8 Check the lines between the test box and the plug for open circuits using the vehicle wiring diagrams.

- (1) Contact 1 + socket 1 + 2
- (2) Contact 2 + socket 62
- (3) Wire resistance – max 1.5 Ω

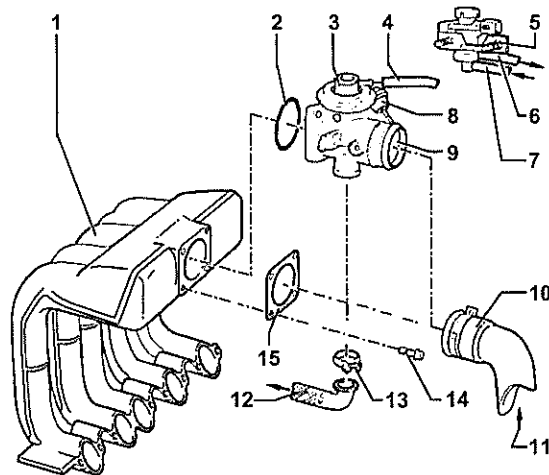
13.9 In addition, check the wires for short circuits to each other, to the vehicle earth and to the battery positive. The set-point value is $\infty \Omega$.

13.10 If no wiring faults are evident, disconnect the test box and replace the EDC control unit (J248).

EGR SYSTEM

Components

14 The parts for the Exhaust Gas Recirculation (EGR) system are shown in Fig 8.

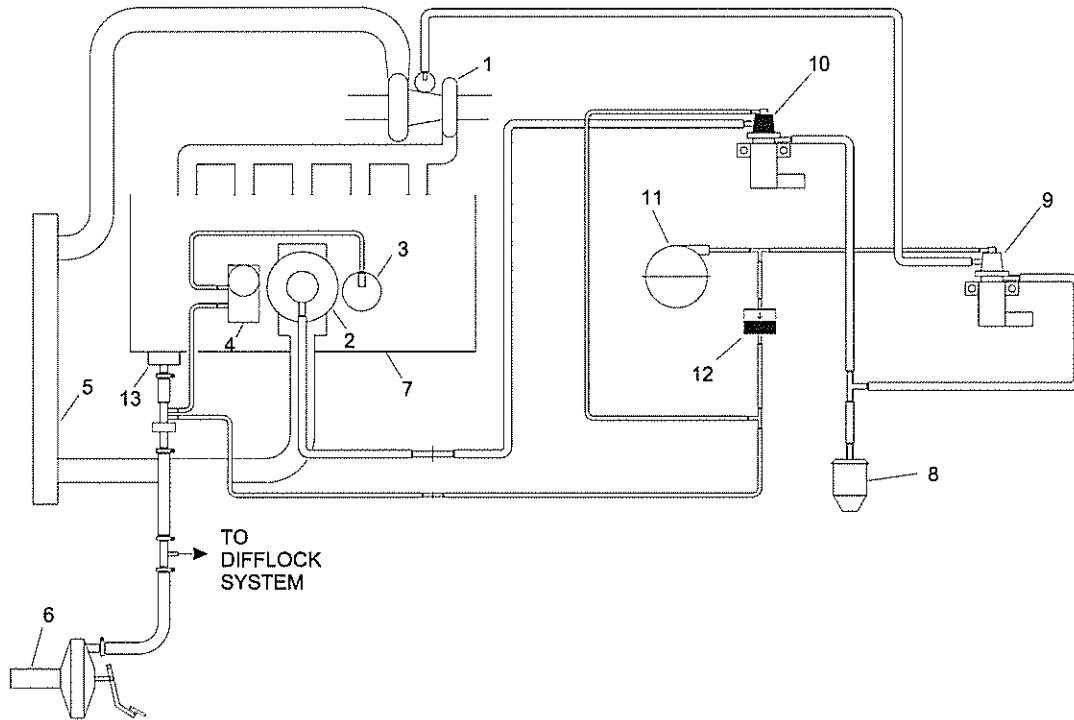


- 1 Intake manifold
- 2 Sealing ring
- 3 EGR valve
- 4 Vacuum hose
- 5 Switchover valve for intake manifold flap (N239)
- 6 Pipe to vacuum control element for intake manifold flap
- 7 Pipe to vacuum reservoir
- 8 Vacuum control element
- 9 EGR actuator / intake flap mechanism
- 10 Charge air hose
- 11 From charge air pipe
- 12 Connecting pipe to exhaust manifold
- 13 Clamp on EGR valve (item 3)
- 14 M8 Captive screw (hex head) for EGR valve (item 3) – tighten to 15 Nm torque
- 15 Seal for EGR valve (item 3).

Fig 8 EGR system – exploded view

Connections

15 The connections for the vacuum hoses are shown in Fig 9.



- | | |
|----|--|
| 1 | Turbocharger |
| 2 | Exhaust gas recirculating valve |
| 3 | Intake manifold shut off valve (not used on the Pinzgauer) |
| 4 | Electro-pneumatic converter for shut off valve (not used on the Pinzgauer) |
| 5 | Intercooler |
| 6 | Brake servo |
| 7 | Engine |
| 8 | Vacuum filter |
| 9 | Charge pressure control solenoid valve |
| 10 | Exhaust gas recirculating solenoid valve |
| 11 | Vacuum reservoir |
| 12 | Non-return valve |
| 13 | Vacuum pump |

Fig 9 EGR system – connection diagram for vacuum hoses

EGR VALVE

Check EGR valve

- 16 To check the EGR valve proceed as follows:
 - 16.1 Disconnect vacuum hose from EGR valve.
 - 16.2 Remove air pressure hose between EGR valve and charge air pipe from EGR valve.
 - 16.3 Connect hand vacuum pump (see Table 1, Item 4) to EGR valve (see Fig 10).

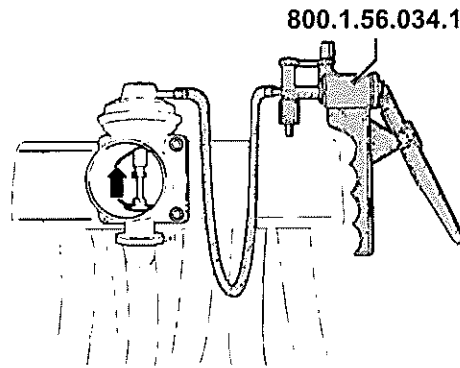


Fig 10 EGR valve connecting hand vacuum pump

- 16.4 Operate pump. The diaphragm rod should move toward the vacuum connection.
- 16.5 Disconnect hose of hand vacuum pump from EGR valve. The closing of the valve must be heard clearly and the diaphragm rod moves towards the connecting pipe.
- 16.6 If operation of valve is unsatisfactory, replace EGR valve.

CHECK EGR

Test procedure

NOTE

Refer to 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

- 17 The EGR function is checked in Function 04 (basic settings). With this test procedure the EGR valve is cycled every 10 seconds so that in measuring value block 003 the extreme values for EGR (air volume sensor) can be read in display field three. The test procedure is as follows:
 - 17.1 The engine must be running at idle. Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.
 - 17.2 On the select control module screen click the [01 – Engine] button to access the engine control module.
 - 17.3 On the open controller screen click the [Basic Settings – 04] button, to access the measuring blocks/basic settings screen.
 - 17.4 On the measuring blocks screen enter **003** in the Group field to activate 'Display group number 003' and confirm entry with [Go] button.

17.5 The value in display field 2 should fluctuate every 10 seconds between EGR active and EGR inactive.

17.6 The displays in display field 3 and 4 must fluctuate within the following control range:

17.6.1 EGR inactive set-point values:

- (1) Display field 3: 400 -500 mg/stroke
- (2) Display field 4: 0 %

17.6.2 EGR active set-point values:

- (1) Display field 3: 100 -250 mg/stroke
- (2) Display field 4: 99 %

NOTES

(1) If in display field 3 a constant value of 539 mg/stroke is displayed, check the air mass flow meter (G70).

(2) The displays in display field 3 are pressure, and therefore also altitude-dependent. The specified values refer to 0 m above sea level. Should the values measured differ greatly due to the geographical altitude, then check for a set-point value difference of at least 100 mg/stroke between the EGR active and EGR inactive values in display field 3.

17.7 If the set-point values are not reached, check the mechanical EGR valve (see Fig 9). Check the EGR solenoid valve (N18).

17.8 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.

17.9 To close the VAG-COM software click on the [Exit] button.

EGR BOOST SOLENOID FILTER

NOTE

EGR boost solenoid filter is located on the rear bulkhead of the vehicle cab, behind the air filter. It is identified as an in-line grey cylindrical plug in filter.

Replace EGR boost solenoid filter

18 To replace the EGR solenoid filter, proceed as follows:

NOTE

There may be a box-cover over the air filter, with a fire extinguisher attachment. If this is the case, the fire extinguisher and cover will also require removal.

18.1 Disconnect the profile hose from the air filter. The hose passes through a circular cut-out in the right (off) side of the engine cover. Remove the rear hatch in the engine cover (see Fig 1 (1)), slacken the jubilee clip and slide the hose off the air filter connection.

18.2 Undo the clips retaining the air filter and remove the air filter.

18.3 Unplug the EGR solenoid filter and remove.

18.4 Replacement and refitting is the reverse of the above procedure.

EGR SOLENOID VALVE (N18)

NOTE

EGR solenoid valve (N18) is located on the rear bulkhead of the vehicle cab, behind the air filter. It is identified by its black top cap.

Check EGR solenoid valve (N18)

19 To check the EGR solenoid valve (N18), proceed as follows:

NOTE

There may be a box-cover over the air filter, with a fire extinguisher attachment. If this is the case, the fire extinguisher and cover will also require removal.

19.1 Disconnect the profile hose from the air filter. The hose passes through a circular cut-out in the right (off) side of the engine cover. Remove the rear hatch in the engine cover (see Fig 1/1), slacken the jubilee clip and slide the hose off the air filter connection.

19.2 Undo the clips retaining the air filter and remove the air filter.

19.3 Pull off the plug (see Fig 11 (1)) on the EGR solenoid valve (N18) (see Fig 11 (2)).

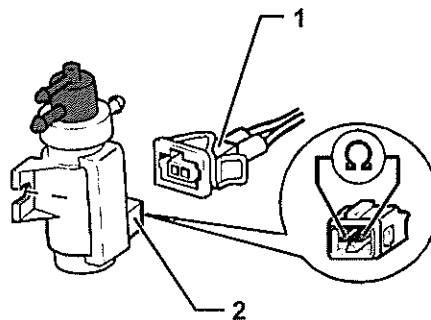


Fig 11 EGR solenoid valve (N18)

NOTE

At room temperature the resistance is in the lower tolerance range, at operating temperature resistance is in the upper tolerance range.

19.4 Using a multi-meter, measure the resistance between the valve contacts. The set-point value is between 14 and 18 Ω .

19.5 If the set-point value is not attained, renew the EGR solenoid valve (N18).

19.6 If the set-point value is attained, switch ON the ignition, measure the supply voltage on plug contact one (see Fig 12 (1)) and on the engine earth. The set-point value should approximately match the battery voltage supply.

19.7 If the set-point value is still not attained, switch off the ignition, connect the test box (see Table 1, Item 6) to the EDC control unit (J248) wiring loom. The EDC control unit (J248) is located within the VPDB located behind the passenger seat on the rear (nearside) bulkhead of the cab. The EDC engine control unit (J248) is not connected in the process.

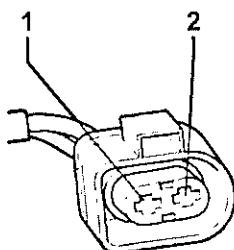


Fig 12 Connector plug for EGR solenoid valve (N18)

19.8 Check the lines between the test box and the plug for open circuits using the current flow diagrams (see Chapter 13):

- (1) Contact 1 + socket 1 + 2
- (2) Contact 2 + socket 61
- (3) Wire resistance – max 1.5 Ω

19.9 In addition, check the wires for short circuits to each other, to the vehicle earth and to the battery positive. The set-point value is $\infty \Omega$.

19.10 If no wiring faults are evident, disconnect the test box and replace the EDC control unit (J248).

INTAKE MANIFOLD TEMPERATURE SENDER (G72)

Testing procedure

NOTE

Refer to AESP 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

20 The test procedure is as follows:

20.1 The engine must be running at idle. Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.

20.2 On the select control module screen click the [01 – Engine] button to access the engine control module.

20.3 On the open controller screen click the [Meas. Blocks – 08] button, to access the measuring blocks screen.

20.4 On the measuring blocks screen enter **007** in the Group field to activate 'Display group number 007' and confirm entry with [Go] button.

20.5 If there is no realistic display in display field 3 or if a replacement temperature of 136.8 $^{\circ}\text{C}$ is displayed, check the intake manifold temperature sender and the cable connections to the sender as follows:

20.5.1 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.

20.5.2 To close the VAG-COM software click on the [Exit] button.

20.6 Switch the ignition OFF.

20.7 Remove both front seats and the engine cover (see Para 6).

20.8 Fit maintenance fan guard (see Table 1, Item 10) to cover the viscous fan blades at the front of the engine.

20.9 Remove the connector from the intake manifold temperature sender (G72), located on the main intercooler to EGR valve inlet pipe. Measure resistance between contacts 1 and 2 on the sender (see Fig 13).

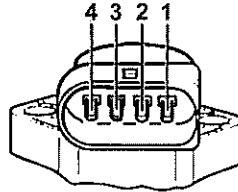


Fig 13 Connector plug for intake manifold temperature sender (G72)

20.10 Referring to the set-point diagram (see Fig 14), area A shows the resistance values for the temperature range 0 through 50 °C; area B shows the resistance values for the temperature range 50 through 100 °C. For example, a read-out of 30 °C corresponds to a resistance of 1500 to 2000 Ω , whereas a readout of 80 °C corresponds to a resistance of 275 to 375 Ω .

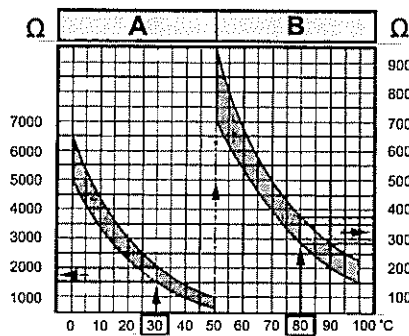


Fig 14 Set-point values

20.11 If the set-point value is not reached, replace the intake manifold temperature sender (G72) (see Fig 15).

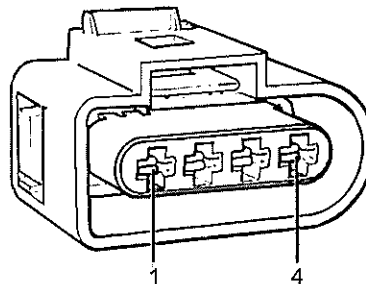


Fig 15 Connector plug for intake manifold temperature sender (G72)

20.12 If the set-point value is reached, connect the test box (see Table 1, Item 6) to the control unit wiring loom.

20.13 Check wires between test box and connector for breaks using current flow diagram (see Chapter 13):

- (1) Contact 1 + socket 52
- (2) Contact 2 + socket 73
- (3) Cable resistance – max 1.5 Ω

20.14 Also check the cables for short-circuiting among themselves, to the vehicle earth or the battery positive (+ve) terminal. Set-point value - ∞ Ω .

20.15 If after completion of all the above tests no fault in the cables is discovered, the EDC control unit (J248) should be replaced.

20.16 Remove the maintenance fan guard (see Table 1, Item 10) and refit the engine cover and front seats.

FUEL TEMPERATURE SENDER (G81)

Testing procedure

NOTE

Refer to AESP 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

21 The test procedure is as follows:

21.1 The engine must be running at idle. Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.

21.2 On the select control module screen click the [01 – Engine] button to access the engine control module.

21.3 On the open controller screen click the [Meas. Blocks – 08] button, to access the measuring blocks screen.

21.4 On the measuring blocks screen enter **007** in the Group field to activate '*Display group number 007*' and confirm entry with [Go] button.

21.5 If there is no realistic display in display field 1 or if a replacement temperature of -5.4 °C is displayed, check the fuel temperature sender (G81) and the cable connections to the sender as follows:

21.5.1 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.

21.5.2 To close the VAG-COM software click on the [Exit] button.

21.6 Switch the ignition OFF.

21.7 Remove both front seats and the engine cover (see Para 6).

21.8 Fit maintenance fan guard (see Table 1, Item 10) to cover the viscous fan blades at the front of the engine

21.9 Remove the connector from the fuel temperature sender (G81) adjacent to the injection pump. Measure resistance between contacts 4 and 7 on the connector (see Fig 16).

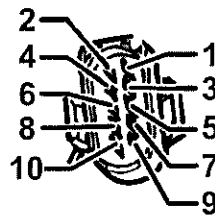


Fig 16 Connector plug for fuel temperature sender (G81)

21.10 Referring to the set-point diagram (see Fig 17), area A shows the resistance values for the temperature range 0 through 50 °C; area B shows the resistance values for the temperature range 50 through 100 °C. For example, a readout of 30 °C, corresponds to a resistance of 1500 to 2000 Ω, whereas, a readout of 80 °C, corresponds to a resistance of 275 to 375 Ω.

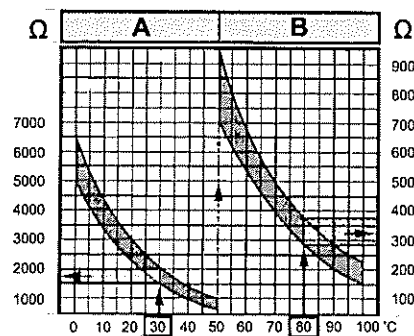


Fig 17 Set-point values

21.11 If the set-point value is not reached, replace the injection pump (see Para 22).

21.12 If the set-point value is reached, connect the test box (see Table 1, Item 6) to the control unit wiring loom.

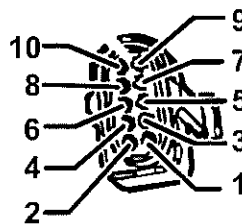


Fig 18 Connecting test box to fuel temperature sender (G81).

21.13 Check wires between test box and connector for breaks using current flow diagram (see Chapter 13):

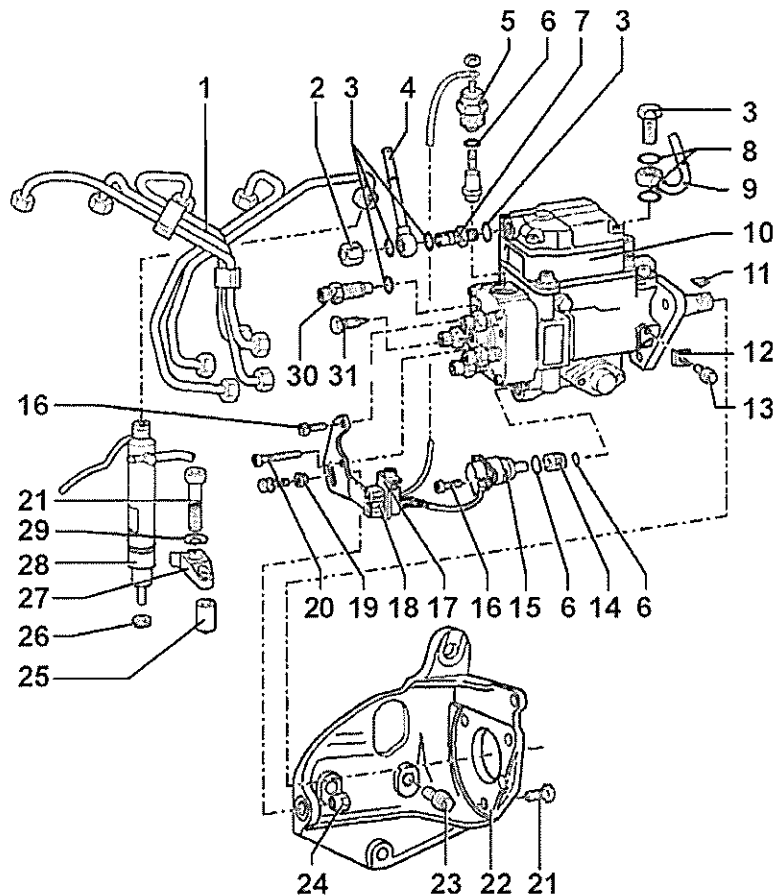
- (1) Contact 7 + socket 111
- (2) Contact 4 + socket 103
- (3) Cable resistance – max 1.5 Ω

21.14 Also check the cables for short-circuiting among themselves, to the vehicle earth or the battery positive (+ve) terminal. Set-point value - ∞ Ω.

21.15 If after completion of all the above tests no fault in the cables is discovered, the EDC control unit (J248) should be replaced.

21.16 Remove the maintenance fan guard (see Table 1, Item 10) refit the engine cover and front seats.

INJECTION PUMP AND ANCILIARIES



- | | | | |
|----|---|----|---|
| 1 | Injection lines | 17 | Bracket |
| 2 | Nut – tighten to 25 Nm torque | 18 | Pin connector – not fitted (only for use with 7-pin injection pump) |
| 3 | Sealing ring | 19 | Bush |
| 4 | Return line – to control valve / fuel filter | 20 | Screw – tighten to 12 Nm torque |
| 5 | Fuel cut-off valve (N109) – tighten to 40 Nm torque | 21 | Screw – tighten to 25 Nm torque |
| 6 | O-ring | 22 | Console |
| 7 | Connecting tube | 23 | Screw – tighten to 45 Nm torque |
| 8 | Hollow screw – tighten to 25 Nm | 24 | Tapered nut – tighten to 25 Nm torque |
| 9 | Supply line | 25 | Support |
| 10 | Injection pump (see note) | 26 | Heat protection seal |
| 11 | Woodruff key | 27 | Clamping collar |
| 12 | Intermediate plate | 28 | Injection nozzle – for cylinder 5 with needle lift sender |
| 13 | Blocking bolt – tighten to 12 Nm with intermediate plate (item 12) or 30 Nm without | 29 | Ball washer |
| 14 | Sieve | 30 | Connecting tube with pressure valve – tighten to 45 Nm torque |
| 15 | Commencement of injection valve (N108) | 31 | Screw – tighten to 20 Nm torque |
| 16 | Screw – tighten to 10 Nm torque | | |

Fig 19 Injection pump and ancillaries – exploded view

NOTE

Quantity adjuster (N146), modulating piston movement sender (G149) and fuel temperature sender (G81) are integrated within the injection pump and are non-serviceable items.

REMOVAL AND RE-FITTING OF THE INJECTION PUMP

CAUTIONS

- (1) **EQUIPMENT DAMAGE.** Thoroughly clean all joints and connections before loosening.
- (2) **EQUIPMENT DAMAGE.** Place all removed components on clean surface and ensure these are covered with either plastic or lint-free material. Cotton waste or fluffy materials should never be used.
- (3) **EQUIPMENT DAMAGE.** Ensure all open connections are sealed to prevent ingress of dirt.
- (4) **EQUIPMENT DAMAGE.** Only refit completely clean parts. Ensure new parts are unpacked immediately before refitting. Never use parts supplied with damaged or missing packaging.
- (5) **EQUIPMENT DAMAGE.** After breaking into fuel injection system, vehicle should not be moved and use of compressed air or pneumatic tools should be avoided.
- (6) **EQUIPMENT DAMAGE.** Do not allow diesel fuel to come into contact with coolant hoses or other rubber/synthetic materials.
- (7) **EQUIPMENT DAMAGE.** Any defect with injection pump necessitates replacement of the pump.

Removal

- 22 Remove both front seats and engine cover (see Para 6).
- 23 Remove the toothed belt for the injection pump in accordance with procedure in Chapter 1.
- 24 Using counter hold tool (see Table 1, Item 3), slacken the securing nut for the injection pump sprocket by approximately one revolution.

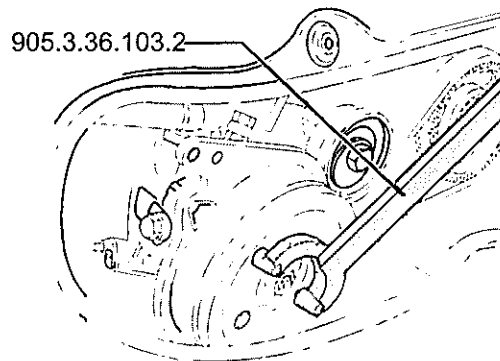


Fig 20 Securing nut for injection pump

- 25 Remove the idler pulley.
- 26 Clamp/disconnect all associated coolant, vacuum and fuel hoses/lines as required.

- 27 Remove the injection lines using open ring spanner (see Table 1, Item 2).

NOTE

Always remove complete set of lines. Do not change the original shape.

- 28 Cover the openings with a clean cloth.
29 Use extractor (see Table 1, Item 1) to pre-tension the injection pump sprocket.

NOTE

In place of the extractor, screw two cylinder screws (provided with Table 1, Item 1) (See Fig 21 (1)) into the tapped hole of the injection pump sprocket.

- 30 Separate the injection pump sprocket from the taper of the injection pump by lightly tapping the spindle of the extractor (see Fig 21 arrow).

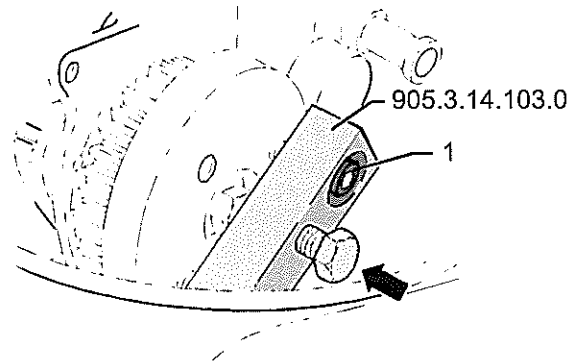


Fig 21 Pre-tension injection pump sprocket

- 31 Remove the injection pump sprocket.
32 Separate 10-pin connector for injection pump and unhook plug from bracket.
33 Unscrew the securing screws (see Fig 22 (1)) and the tapered nut (2) from the bracket.

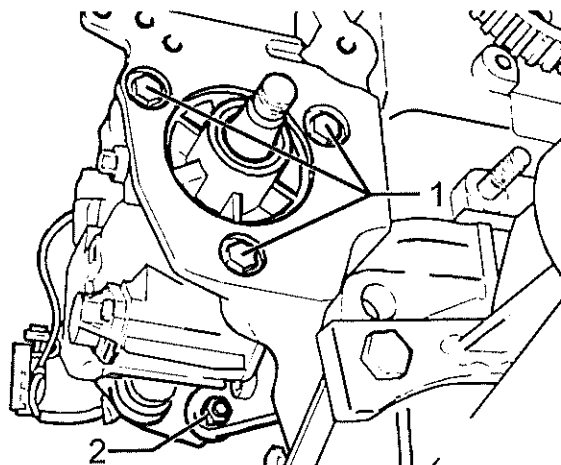


Fig 22 Injection pump securing

- 34 Remove the complete injection pump.

Refitting

NOTE

New injection pumps are already blocked for delivery commencement. They have to be 'primed' before use.

- 35 Block the injection pump from delivery using the procedure in Chapter 1.
- 36 Place injection pump in the bracket.
- 37 Tighten the securing screws (see Fig 22 (1)) and tapered nut (2) to 25 Nm torque.
- 38 Fit the injection pump sprocket. When aligning, ensure that the Woodruff keys are correctly aligned.

CAUTION

DAMAGE TO INJECTION PUMP. When tightening the securing nuts, make sure that none of the torque is transferred to the injection pump shaft which is blocked for delivery commencement.

- 39 Tighten the securing nut (see Table 2, Ser 6) using counter hold tool (see Table 1, Item 3) to hold in place.
- 40 At the connection for the return line, fill the injection pump with clean diesel fuel. The filling capacity for a new pump is at least 180 ml.
- 41 Connect the injection lines, fuel lines and electrical cables.
- 42 Install the idler pulley and the toothed belt for the injection pump using procedure in Chapter 1.

NOTE

The commencement of injection is set dynamically using the diagnostic tester.

- 43 Test the injection commencement dynamically and adjust if necessary using procedure in Para 44.

TESTING AND ADJUSTING THE INJECTION COMMENCEMENT DYNAMICALLY

44 The following tests are carried out using the VAG-COM diagnostic software tool.

NOTES

(1) The dynamic test and correction of the injection commencement is only possible in function 04 'Basic Setting of the Engine'

(2) The injection commencement must always be checked and if necessary, adjusted after replacement of the toothed belt or after removing the screwed connections on the injection pump or the toothed belt sprockets.

Test and adjustment conditions

45 The following conditions must be satisfied prior to testing and setting of commencement of injection:

45.1 The basic engine static timing must be set correctly.

45.2 The tension of the toothed belt for the camshaft drive must be OK.

45.3 The coolant temperature must be at least 80 °C.

Testing injection commencement**NOTE**

Refer to AESP 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

46 Remove the engine cover and front seats (see Para 6). Fit maintenance fan guard (see Table 1, Item 10).

47 Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.

48 On the select control module screen click the [01 – Engine] button to access the engine control module.

49 On the open controller screen click the [Basic Settings – 04] button, to access the measuring blocks/basic settings screen.

50 On the measuring blocks screen enter 000 in the Group field to activate 'Display group number 000' and confirm entry with [Go] button. Values on the display from 1 through 10 are the display sectors. Clicking on the [VAG-Scope] and/or [TDI-Timing] buttons will display graphical representations of the figures in separate dialogue boxes on the screen.

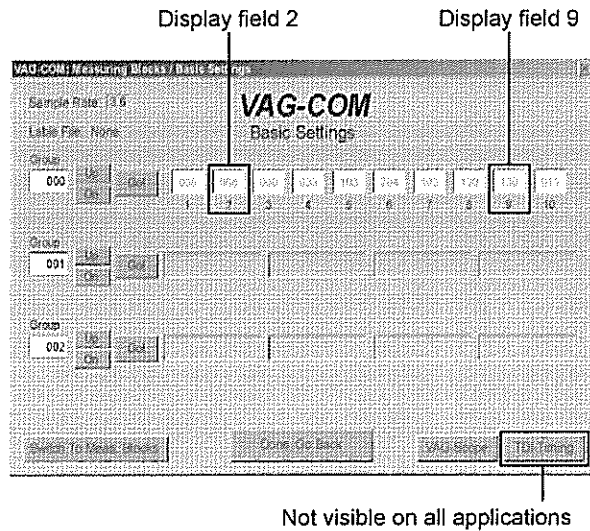


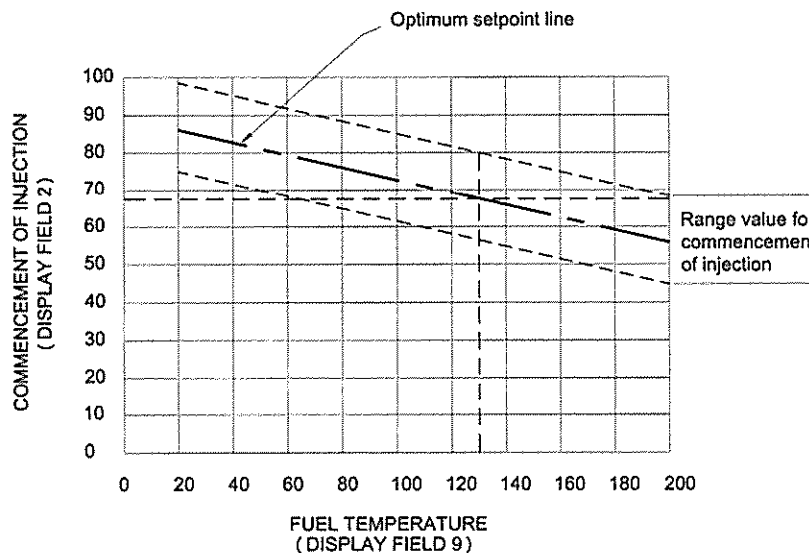
Fig 23 Example display

51 To read off the commencement of injection in display field 2, the fuel temperature in display field 9 must be within the numerical range 88 through 198.

52 The **example** readout (see Fig 23) shows value 130 in display field 9 this is equivalent to a numerical value of 68 in the Commencement of Injection field, display field 2. With these readings the injection timing is correct.

NOTES

- (1) The "TDI-Timing" button may not be visible on all applications as this is dependant on the particular ECU date of manufacture.
- (2) After repairs such as removing and fitting the injection pump, etc, set the commencement of injection as near to the optimum value line on the following graph, for maximum efficiency.



Graph 1 Optimum commencement of injection range

Setting the commencement of injection

53 If adjustment is required, loosen the securing nut (see Fig 24/2) of the deflection roller (see Fig 24 (1)).

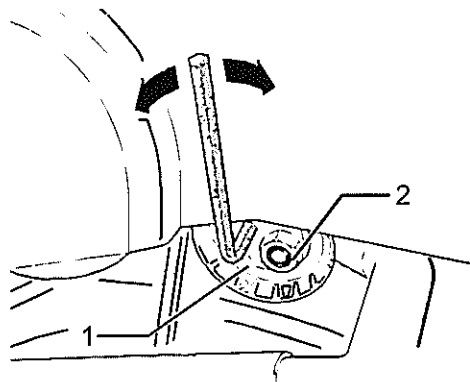


Fig 24 Injection pump – deflection roller

54 Turn the deflection roller with an Allen wrench.

55 Observe the value in display field 2 and if necessary, repeat the setting until the displayed value remains at the mean value of the set-point value range (C).

56 Tighten the securing nut (see Table 2, Ser 7) (see Fig 24 (2)).

57 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] the [Go Back] to return to the main screen.

58 To close the VAG-COM software click on the [Exit] button.

NEEDLE LIFT SENDER (G80)**Testing procedure**

59 The needle lift sender is required to determine the injection commencement. In the event of failure, the injection commencement is controlled (dependent upon engine speed and load); in normal operation, the injection commencement is regulated (dependent upon engine speed, load and temperature).

60 The test procedure is as follows:

60.1 Switch the ignition OFF.

60.2 Remove both front seats and engine cover (see Para 6).

60.3 Pull out the connector for the needle lift sender (G80), located with the injection pump connector, identified with a brown housing (see Fig 25). The needle lift sender is fitted to the injector rearmost cylinder (#5).

60.4 Using a multi-meter, measure the resistance between the valve contacts. The set-point value is between 80 and 120 Ω .

60.5 If the set-point value is not attained, renew the injection nozzle complete with needle lift sender (G80).

60.6 If the set-point value is attained, connect test box (see Table 1, Item 6) to the EDC control unit (J248) wiring loom.

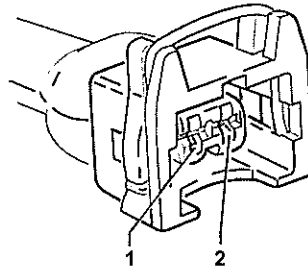


Fig 25 Connector plug for needle lift sender (G80)

60.7 Check for breaks in the cables between the test box and the connector using the current flow diagrams (see Chapter 13):

- (1) Contact 1 + socket 109
- (2) Contact 2 + socket 101
- (3) Cable resistance – max 1.5 Ω .

60.8 Check the earth cable between the needle lift sender and earth connection in the diesel direct injection wiring loom in accordance with the current flow diagrams (see Chapter 13). The cable resistance is a maximum of 1.5 Ω .

60.9 Also check the cables for short-circuiting amongst themselves, to the vehicle earth or battery positive (+ve) terminal. The set-point value is $\infty \Omega$.

60.10 If no wiring faults are evident, disconnect the test box and replace the EDC control unit (J248).

60.11 Refit the engine cover and front seats.

Replace injection nozzle

61 Defective injection nozzles can cause the following:

- (1) Ignition failure
- (2) Knocking in one or more cylinders
- (3) Engine overheating
- (4) Drop in power / performance
- (5) Excessive black exhaust smoke
- (6) High fuel consumption
- (7) Increased blue smoke at cold start

62 Defective nozzles can be detected by slackening the injection line union nuts one after the other while the engine is idling at a relatively high speed. If the engine speed remains constant after the union nut has been slackened, this indicates a defective nozzle.

63 Replace as follows:

63.1 Remove both front seats and engine cover (see Para 6).

63.2 Remove the injection lines using the ring spanner (see Table 1, Item 2).

NOTE

Always remove complete set of injection lines. Do not change the original shape.

63.3 Slacken the securing screw, take off the clamping collar and remove the injection nozzle.

NOTE

Always replace heat protection seal between the cylinder head and the injection nozzles.

63.4 Insert the injection nozzles, ensuring that the supports in the cylinder head are correctly seated.

63.5 Insert the clamping collar. Tighten the injection lines and screw for clamping collar (see Table 2, Ser 9).

63.6 Refit the engine cover and front seats.

CHECK INJECTION TIMING DEVICE ADJUSTMENT RANGE**Testing procedure**

64 The injection timing device control range is adjusted in function 04 (basic setting). This procedure clocks the commencement of injection valve so that in measured value block 004 the extreme values for the advance and retard position of the injection timing device can be read off in display field 3.

NOTE

Refer to 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

65 The test procedure is as follows:

65.1 The engine must be running at idle. Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.

65.2 On the select control module screen click the [01 – Engine] button to access the engine control module.

65.3 On the open controller screen click the [Basic Settings – 04] button, to access the measuring blocks screen.

65.4 On the measuring blocks screen enter **004** in the Group field to activate '*Display group number 004*' and confirm entry with [Go] button.

65.5 The specified value in display field 3 is between 7 and 9 ° before TDC. After approximately 10 seconds the injection distributor is moved into its retarded position.

65.6 The specified value in display field 3 is between 3 and 5 ° before TDC. If the set-point values are not reached, check the commencement of injection valve (N108).

Checking the commencement of injection valve (N108) electrically

66 The test procedure is as follows:

66.1 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.

66.2 To close the VAG-COM software click on the [Exit] button.

66.3 Switch the ignition OFF.

66.4 Undo the connector for commencement of injection valve (N108) – connector to quantity adjuster of injection pump.

66.5 Using a multi-meter, measure resistance between contacts 9 and 10 on connector. The set-point value is between 12 and 20 Ω . If the set-point value is not reached, replace the commencement of injection valve (N108).

66.6 If the set-point value is reached, connect the test box (see Table 1, Item 6) to the EDC control unit (J248) wiring loom.

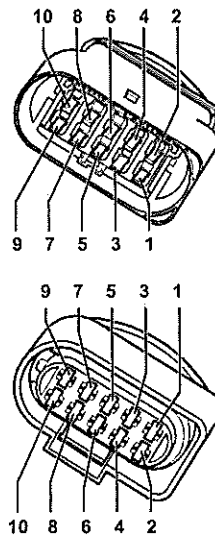


Fig 26 10-pin injection pump connector – plug and socket

66.7 Check wires between test box and connector for breaks using current flow diagram (see Chapter 13):

- (1) Contact 9 + socket 114
- (2) Contact 10 + socket 1 and 2
- (3) Cable resistance – max 1.5 Ω

66.8 Also check the cables for short-circuiting among themselves, to the vehicle earth or the battery positive (+ve) terminal. Set-point value - ∞ Ω .

66.9 If after completion of all the above tests no fault in the cables is discovered, the EDC Control unit (J248) may be faulty and should be replaced.

AIR MASS METER (G70)**Testing procedure****WARNING**

ACCIDENT AVOIDANCE. IF USING THE VAG-COM SOFTWARE WITH THE VEHICLE IN MOTION, TWO PERSONS WILL BE REQUIRED; ONE TO DRIVE THE VEHICLE AND THE OTHER TO CARRY OUT THE DATA ANALYSIS.

67 The air mass meter signal is required from the control unit for calculating the permissible injection quantity and for controlling the exhaust gas recirculation. The smaller the signal from the air mass meter is the less fuel may be injected.

NOTE

Refer to 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

68 The test procedure is as follows:

68.1 The engine must be running at idle. Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.

68.2 On the select control module screen click the [01 – Engine] button to access the engine control module.

68.3 On the open controller screen click the [Meas. Blocks – 08] button, to access the measuring blocks screen.

68.4 On the measuring blocks screen enter **010** in the Group field to activate '*Display group number 010*' and confirm entry with [Go] button.

68.5 Accelerate the vehicle in 2nd gear from approx 1500 rpm at full throttle.

68.6 Take reading with accelerator pedal completely depressed at approx 3000 rpm.

68.7 The set-point value in display field 4 refers to the accelerator pedal position. If the set-point value is not reached, repeat the test and accelerate the vehicle at full throttle.

68.8 The set-point value in display field 1 should be over 700 mg/stroke – aspirated air mass. If the set-point value is still not reached, renew the air mass meter (G70).

68.9 If approximately 550 mg/H is constantly shown in the display field, this indicates a fixed substitute value is being used.

68.10 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.

68.11 To close the VAG-COM software click on the [Exit] button.

68.12 Switch the ignition OFF.

68.13 Remove both front seats and engine cover (see Para 6).

68.14 Undo the connector for air mass flow meter (G70) (see Fig 29). The air mass flow meter (G70) is located on the off-side of the engine in the fresh air line to the turbocharger. Switch ON the ignition.

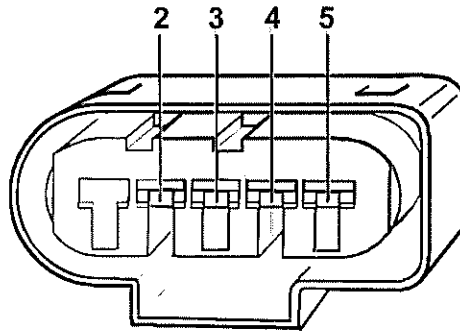


Fig 27 Connector for air mass meter (G70)

68.15 Using a multi-meter measure resistance between the following contacts (see Fig 27) of the connector:

- (1) 2 + earth - approx battery voltage
- (2) 2 + 3 - approx battery voltage
- (3) 4 + earth - approx 5 V dc
- (4) 4 + 3 - approx 5 V dc

68.16 If the set-point values are not reached, switch the ignition OFF.

68.17 Connect the test box (see Table 1, Item 6) to the EDC control unit (J248) wiring loom.

68.18 Check wires between test box and connector for breaks using current flow diagram (see Chapter 13):

- (1) Contact 2 + socket 1 and 2
- (2) Contact 3 + socket 49
- (3) Contact 4 + socket 30
- (4) Contact 5 + socket 68
- (5) Cable resistance – max 1.5 Ω

68.19 Also check the cables for short-circuiting among themselves, to the vehicle earth or the battery positive (+ve) terminal. Set-point value - $\infty \Omega$.

68.20 If after completion of all the above tests no fault in the cables is discovered, the EDC control unit (J248) should be replaced.

CHECK MODULATING PISTON MOVEMENT SENDER (G149) AND QUANTITY ADJUSTER (N146)

Testing procedure

69 The quantity adjuster (N146) is an electromagnetic rotary switch which is activated from the control unit by a targeted pulse duty factor. The eccentric shaft of the quantity adjuster (N146) moves the control sleeve on the high-pressure piston, thus determining the injection quantity.

70 The modulating piston movement sender (G149) supplies the control unit with the position of the quantity adjuster (N146) thus determining the injection quantity.

NOTE

Refer to AESP 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

71 The test procedure is as follows:

71.1 The engine must be running at idle. Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.

71.2 On the select control module screen click the [01 – Engine] button to access the engine control module.

71.3 On the open controller screen click the [Meas. Blocks – 08] button, to access the measuring blocks screen.

71.4 On the measuring blocks screen enter **001** in the Group field to activate 'Display group number 001' and confirm entry with [Go] button.

71.5 Check the coolant temperature in display field 4. The set-point value should be at least 85 C. Only continue the test when the coolant temperature has been reached.

71.6 Check voltage from modulating piston movement sender (G149) in display field 3.

71.7 The set-point value in display field 3 should be between 1.250 and 2.0 V dc. If the set-point value is not reached, check the modulating piston movement sender (G149) and quantity adjuster (N146) as follows:

Checking the modulating piston movement sender (G149)

72 Test as follows:

72.1 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.

72.2 To close the VAG-COM software click on the [Exit] button.

72.3 Switch the ignition OFF.

72.4 Undo the connector for fuel temperature sender (G81) – connector to quantity adjuster mechanism of fuel injection pump.

72.5 Using a multi-meter measure resistance between contacts 1 + 2 and 2 +3 of the connector (see Fig 28).

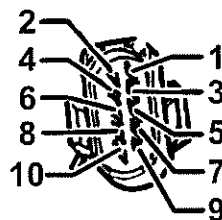


Fig 28 10-pin injection pump connector - plug

72.6 If the set-point values are not reached, replace the injection pump.

72.7 If the set-point values are reached, connect the test box (see Table 1, Item 6) to the EDC control unit (J248) wiring loom.

72.8 Check wires between test box and connector for breaks (see Fig 29) using vehicle wiring diagram:

- (1) Contact 1 + socket 108
- (2) Contact 2 + socket 106
- (3) Contact 3 + socket 99
- (4) Cable resistance – max 1.5 Ω

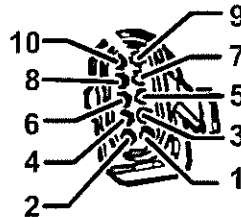


Fig 29 10-pin injection pump connector – socket

72.9 Also check the cables for short-circuiting among themselves, to the vehicle earth or the battery positive (+ve) terminal. Set-point value - $\infty \Omega$.

72.10 If after completion of all the above tests no fault in the cables is discovered, the EDC control unit (J248) should be replaced.

Checking the quantity adjuster (N146)

73 Test as follows:

73.1 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.

73.2 To close the VAG-COM software click on the [Exit] button.

73.3 Switch the ignition OFF.

73.4 Undo the connector for quantity adjuster (N146) – connector to quantity adjuster mechanism of fuel injection pump.

73.5 Using a multi-meter measure resistance between contacts 5 and 6 of the connector (see Fig 30).

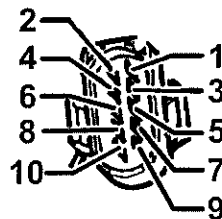


Fig 30 10-pin injection pump connector - plug

73.6 If the set-point value is not reached, replace the injection pump.

73.7 If the set-point value is reached, connect the test box (see Table 1, Item 6) to the EDC control unit (J248) wiring loom.

73.8 Check wires between test box and connector for breaks (see Fig 31) using vehicle wiring diagram:

- (1) Contact 5 + socket 1 and 2
- (2) Contact 6 + socket 116 and 121
- (3) Cable resistance – max 1.5 Ω

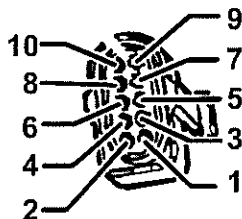


Fig 31 10-pin injection pump connector - socket

73.9 Also check the cables for short-circuiting among themselves, to the vehicle earth or the battery positive (+ve) terminal. Set-point value - ∞ Ω .

73.10 If after completion of all the above tests no fault in the cables is discovered, the EDC control unit (J248) should be replaced.

ENGINE CONTROL POTENTIOMETER

Check engine control potentiometer/cable calibration

NOTE

Refer to 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

74 To check the throttle potentiometer proceed as follows:

74.1 Switch the ignition ON. Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.

74.2 On the select control module screen click the [01 – Engine] button to access the engine control module.

74.3 On the open controller screen click the [Meas Blocks – 08] button, to access the measuring blocks screen.

74.4 On the measuring blocks screen enter **010** in the Group field to activate 'Display group number 010' and confirm entry with [Go] button.

74.5 Take two readings of display field 4, firstly without the accelerator pedal pressed and secondly with the accelerator pedal completely depressed.

74.6 The set-point values in display field 4 refer to the accelerator pedal position. If the set-point values displayed are not 0 % and 100 % respectively, remove the air filter so that the throttle potentiometer is accessible and adjust the nut on the cable until the correct values are displayed.

74.7 If after adjusting the calibration of the throttle potentiometer a 0% and/or 100% set-point value cannot be reached the potentiometer and/or connecting cable should be replaced.

74.8 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.

74.9 To close the VAG-COM software click on the [Exit] button.

74.10 Switch the ignition OFF.

Replace potentiometer

75 Replace as follows:

75.1 Remove the air filter so that the throttle potentiometer is accessible on the rear bulkhead of the engine bay.

75.2 Undo the M6 fixing in the centre of the throttle cam and carefully move to one side.

75.3 Undo and remove the two M6 fixings for the throttle potentiometer and slide out the potentiometer.

75.4 Refit in reverse order of the above procedure and perform calibration check (see Para 74).

Replace cable

76 Replace as follows:

76.1 Remove the air filter so that the throttle potentiometer is accessible on the rear bulkhead of the engine bay.

76.2 Undo and remove the four fixings securing the handbrake cover on the left-side of the driver's footwell and move cover so that the throttle cable can be accessed.

76.3 Undo and release the cable from the throttle cam at the rear of the engine bay and the linkage to the throttle pedal in the driver's footwell. Remove cable taking note of its routing on the particular vehicle.

76.4 Fit new cable taking care to route in the same position as the previously removed cable.

76.5 Secure cable at each end, cam at rear and pedal linkage at front.

76.6 Refit the handbrake cover.

76.7 Perform throttle calibration check (see Para 74).

76.8 Refit the engine cover and front seats.

GLOW PLUGS**WARNING**

SEVERE BURNS. EXTREME CARE MUST BE TAKEN WHEN WORKING WITH GLOW PLUGS, THEY BECOME EXTREMELY HOT DURING OPERATION AND CAN CAUSE SEVERE BURNS.

Check glow plug system

77 To check the glow plug system proceed as follows:

77.1 Remove the connector from the coolant temperature sender (G62).

NOTE

Removing the connector from the sender simulates a "cold" engine state and when the ignition is switched ON the corresponding pre-heating process takes place.

77.2 Remove the glow plug connector from the glow plug on cylinder 1.

77.3 Connect a multi-meter for voltage measurement between the glow plug connector and the vehicle earth.

77.4 Switch ON the ignition. For approx 20 seconds the approx battery voltage is displayed.

77.5 If there is no voltage check the wiring for faults, breaks etc, using vehicle wiring diagram.

Check glow plugs**NOTE**

Battery voltage must be at least 11.5 V dc. Ignition must be switched OFF.

78 To check the glow plug system proceed as follows:

78.1 Remove the connector from the glow plugs.

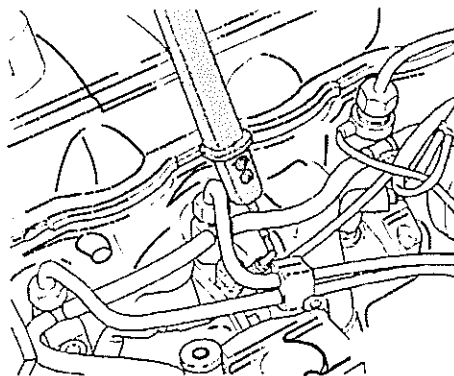


Fig 32 Glow plugs - testing

78.2 Connect one end of a cable of a continuity tester to the battery positive (+ve) terminal.

78.3 Connect the other end of the continuity tester cable on each glow plug, in sequence.

78.4 If the continuity tester indicates that any of the glow plugs are faulty, the faulty glow plug(s) should be replaced.

Replace glow plugs

79 Replace as follows:

79.1 Use flexible head wrench (see Table 1, Item 7) to remove and refit the glow plugs.

79.2 Tighten glow plugs (see Table 2, Ser 8).

ENGINE SPEED SENSOR (G28)

Test procedure

80 The engine speed sender (G28) is the speed and reference mark sender. In the event of a failure, the engine continues to run in the emergency cylinder program; the substitute sender is the needle lift sender (G80) located on the injector of No. #5 cylinder.

81 To check the engine speed sensor (G28) proceed as follows:

81.1 Switch the ignition OFF.

81.2 Remove both front seats and engine cover (see Para 6).

81.3 Undo the connector for engine speed sender (G28) located on the near-side of the engine block (see Fig 33) identified with a grey housing.

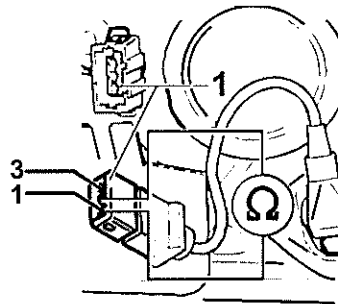


Fig 33 Engine speed sender (G28) – connector location

81.4 Using a multimeter measure resistance between contacts 1 and 2 of the connector. The setpoint value is between 1.1 and 1.6 Ω.

81.5 If the setpoint value is not reached, replace the engine speed sender (G28).

81.6 If the setpoint value is reached, connect the test box (see Table 1, Item 6) to the EDC control unit (J248) wiring loom.

81.7 Check wires between test box and connector for breaks (see Fig 34) using vehicle wiring diagram:

- (1) Contact 1 + socket 102
- (2) Contact 2 + socket 110
- (3) Contact 3 + socket 86
- (4) Cable resistance – max 1.5 Ω

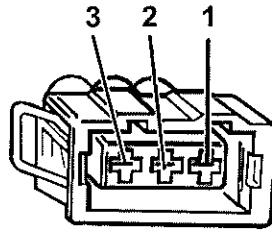


Fig 34 Engine speed sender (G28) - 3-pin connector

81.8 Also check the cables at the 3-pin connector for short-circuiting with each other. Set-point value - $\infty \Omega$.

81.9 If after completion of all the above tests no fault in the cables is discovered, the EDC control unit (J248) should be replaced.

81.10 Refit the engine cover and both front seats.

CHECK SENDER FOR INTAKE MANIFOLD PRESSURE (G71) AND ALTITUDE SENDER (F96)

82 The altitude sender (F96) is located in the EDC control unit (J248). The intake manifold pressure sender (G71) is a separate component and is located together with the intake manifold temperature sender (G72) in a shared housing located on the charge air hose for the EGR valve.

NOTE

Refer to 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

83 The test procedure is as follows:

83.1 The engine must be running at idle. Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.

83.2 On the select control module screen click the [01 – Engine] button to access the engine control module.

83.3 On the open controller screen click the [Meas. Blocks – 08] button, to access the measuring blocks screen.

83.4 On the measuring blocks screen enter **010** in the Group field to activate 'Display group number 010' and confirm entry with [Go] button.

83.5 Compare the values in display field 2 (altitude sender – F96) and display field 3 (sender for intake manifold pressure – G71) and the display on the turbocharger tester (see Table 1, Item 8) with each other. The pressures should match up (± 30 mbar tolerance).

NOTE

The turbocharger tester is required to obtain an independent comparison value. The turbocharger tester must be set to measuring range 1 (absolute pressure). A barometer may also be used in place of the specialist tester.

83.6 Take reading with accelerator pedal completely depressed at approx 3000 rpm.

83.7 If the value in display field 2 deviates, click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.

- 83.8 To close the VAG-COM software click on the [Exit] button.
- 83.9 Switch the ignition OFF.
- 83.10 The EDC control unit (J248) may be faulty and should be replaced.
- 83.11 If the value in display field 3 deviates, click on [Done, Go Back].
- 83.12 Switch the ignition OFF.
- 83.13 Restart the engine to idle. On the open controller screen click the [Meas. Blocks – 08] button, to access the measuring blocks screen.
- 83.14 On the measuring blocks screen enter **010** in the Group field to activate 'Display group number 010' and confirm entry with [Go] button.
- 83.15 Pull out the connector for the intake manifold pressure sender.
- 83.16 Observe the value in display field 3 (sender for intake manifold pressure – G71).
- 83.17 The value should drop to approx 400 mbar briefly and then assume the value of display field 2 (altitude sender – F96).
- 83.18 If the set-point value is reached, replace the sender for intake manifold pressure (G71) with the sender for intake manifold temperature.
- 83.19 If the set-point value is not attained, click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.
- 83.20 To close the VAG-COM software click on the [Exit] button.
- 83.21 Switch the ignition OFF.
- 83.22 Connect the test box (see Table 1, Item 6) to the EDC control unit (J248) wiring loom.
- 83.23 Remove both front seats and engine cover (see Para 6).
- 83.24 Check wires between test box and connector for breaks (see Fig 35) using vehicle wiring diagrams:

- (1) Contact 3 + socket 31
- (2) Contact 4 + socket 71
- (3) Cable resistance – max 1.5 Ω

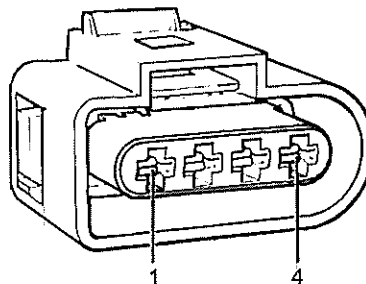


Fig 35 4-pin connector -socket

- 83.25 Also check the cables for short-circuiting among themselves, to the vehicle earth or the battery positive (+ve) terminal. Set-point value - ∞ Ω .

83.26 If after completion of all the above tests no fault in the cables is discovered, the EDC control unit (J248) should be replaced.

83.27 Refit engine cover and both front seats.

CHECK POWER SUPPLY FOR DIRECT DIESEL INJECTION SYSTEM

84 Check as follows:

NOTE

The battery voltage should be tested before carrying out this test.

84.1 Switch the ignition OFF.

84.2 Connect the test box (see Table 1, Item 6) to the control unit wiring loom and EDC control unit (J248).

84.3 Using a multi-meter, measure the voltage between the following sockets:

- (1) 1/2 and 4/5/38
- (2) 37 and 4/5/38

84.4 The set-point value is approximately 0 V dc.

84.5 Switch ON the ignition.

84.6 Using a multi-meter, measure the voltage between the following sockets again:

- (1) 1/2 and 4/5/38
- (2) 37 and 4/5/38

84.7 The set-point value is approximately the battery voltage.

84.8 If the set-point value is not attained, check the relay for power supply terminal 30 (J317). Also check the cable connections for breaks, short-circuiting and transition resistance at the contact points.

84.9 If after completion of all the above tests no fault in the cables or the relay is discovered, the EDC control unit (J248) should be replaced.

CHECK ADDITIONAL SIGNALS

Check speed signal

WARNING

ACCIDENT AVOIDANCE. IF USING THE VAG-COM SOFTWARE WITH THE VEHICLE IN MOTION, TWO PERSONS WILL BE REQUIRED; ONE TO DRIVE THE VEHICLE AND THE OTHER TO CARRY OUT THE DATA ANALYSIS.

NOTES

- (1) The speedometer must be in working order for this test sequence to be performed.
 - (2) Refer to AESP 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.
- 85 The test procedure is as follows:
- 85.1 The engine must be running at idle. Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.
 - 85.2 On the select control module screen click the [01 – Engine] button to access the engine control module.
 - 85.3 On the open controller screen click the [Meas. Blocks – 08] button, to access the measuring blocks screen.
 - 85.4 On the measuring blocks screen enter **006** in the Group field to activate '*Display group number 006*' and confirm entry with [Go] button.
 - 85.5 Carry out a test drive with a second person and compare the display on the diagnostic reader to the display on the speedometer.
 - 85.6 Check the speed in display field 1. The set-point value should be the approximate driving speed.
 - 85.7 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.
 - 85.8 To close the VAG-COM software click on the [Exit] button.
 - 85.9 Switch the ignition OFF.
 - 85.10 If no speed is indicated, connect the test box (see Table 1, Item 6) to the control unit wiring loom.
 - 85.11 Check cable connection to/from contact 20 on the plug of the EDC control unit (J248) for breaks or short circuiting.
- 86 The signal from the engine speed sender (G28) cannot be used further in its direct form and is therefore generated by the engine control unit. The signal is required for the control unit of the automatic gearbox for calculating the shift points and for the tachometer (rev counter).
- 86.1 Connect the test box (see Table 1, Item 6) to the wiring harness.
 - 86.2 Check cable connection to/from contact 27 on the test box for breaks or short circuiting using vehicle wiring diagram.

FINAL CONTROL DIAGNOSIS (DIAGNOSIS OF ACTUATORS)**General**

NOTE

Refer to 2320-D-503-512 for use of the VAG-COM vehicle diagnostic software, and evaluation of measuring blocks.

87 With the diagnosis of actuators, the following components are activated in the order stated:

- (1) Commencement of injection valve (N108)
- (2) EGR valve (N18)
- (3) Fuel cut-off valve (N109)
- (4) Solenoid valve for boost pressure control (N75)
- (5) Glow plug relay (J52)
- (6) Glow plug warning lamp (K29)

NOTES

- (1) The activation of the individual actuators is limited to 30 seconds, but it can be terminated at any time by clicking on the [Close Controller, Go Back – 06] button on the open controller screen.
- (2) Before the diagnosis of actuators is repeated, the ignition must be switched OFF.
- (3) Other actuators may be displayed (eg A/C compressor engagement information) which should be ignored.

Test procedure**CAUTION**

ENGINE OPERATION. It is possible to render the vehicle inoperable or damage components using advanced functions if the user makes changes without the correct information and training.

88 The procedure is as follows:

- 88.1 Remove both front seats and the engine cover (see Para 6).
- 88.2 Fit maintenance fan guard (see Table 1, Item 10) to cover the viscous fan blades at the front of the engine.
- 88.3 Connect the diagnostic tester to the vehicle diagnostic connector for the EDC control unit (J248). The diagnostic connector is located within the VPDB located behind the passenger seat on the rear (nearside) bulkhead of the cab. The connector is accessed by removing the uppermost panel of the VPDB that is secured with captive screws to the vehicle diagnostic socket located in the nearside rear of the cab behind the passenger seat.
- 88.4 Start the engine and run at idle speed.
- 88.5 From the main screen of the VAG-COM software, click on the [Select] button to access the select control module screen, then select the engine control module by clicking on the [01 – Engine] button.
- 88.6 Observe the on-screen information whilst the tests are completed.

88.7 Click on the Diagnosis of Actuators [Output Tests – 03] button. Tests are performed in the order shown in Para 87.

88.8 When the commencement of injection valve (N108) is activated there may be a clearly audible change in the sound of combustion (knocking). If this is the case the injection timing may require adjustment.

88.9 When the EGR valve (N18) is activated the valve must click. If it does not, check the EGR system.

NOTE

If the clicking of the valve is cannot be heard it should be felt by directly touching the solenoid valve.

88.10 When the fuel cut-off valve (N109) is activated the engine must stop. If the engine does not stop, switch the ignition OFF, unscrew the fuel cut-off valve and clean it to remove any ingress of dirt or swarf. Repeat the diagnosis of actuators. If the engine still does not stop, replace the fuel cut-off valve (N109).

88.11 The remaining diagnosis of actuators is carried out with the engine stopped and the ignition switched ON.

88.12 When the solenoid valve of boost pressure control (N75) is activated the valve must click. If it does not, check the solenoid valve for boost pressure control (N75).

NOTE

If the clicking of the valve is cannot be heard it should be felt by directly touching the solenoid valve.

88.13 When the glow plug relay (J52) is activated the relay must click. Due to the high rated voltage of the glow plugs, the switching of the relay may also be seen from an increase and decrease in brightness of the cab interior light. If it does not, check the glow plug relay (J52).

88.14 When the glow period warning lamp (K29) is activated, the warning lamp on the dash must flash. If it does not check the lamp for electrical faults.

88.15 Once all the tests are complete, quit data interchange by clicking on the [Close Controller, Go Back – 06] button and switch the ignition OFF.

REPLACE FUEL CUT OFF VALVE (N109)

89 The fuel cut off valve (N109) is located on top-front of injection pump. Replace as follows:

89.1 Unscrew the fuel cut off valve (N109), disconnect the wiring and remove it from the injection pump housing.

89.2 Reconnect wiring to new fuel cut off valve (N109) and replace by screwing back into injector pump housing.

89.3 Test fuel cut off valve (N109) by performing final control diagnosis (diagnosis of actuators) (see Para 87).

REPLACE GLOW PLUG RELAY (J52)

90 The glow plug relay (J52) is located on the front panel of the VPDB behind the passenger seat in the front cab. Replace as follows:

- 90.1 Switch the vehicle ignition OFF.
- 90.2 Undo and remove the captive studs securing the glow plug relay to the VPDB.
- 90.3 Disconnect all wiring and connectors.
- 90.4 Replace glow plug relay (J52).
- 90.5 Refitting is the reverse of the above procedure.
- 90.6 Test glow plug relay (J52) by performing final control diagnosis (diagnosis of actuators) (see Para 87).

REPLACE GLOW PLUG WARNING LAMP (K29)

91 Replace as follows:

- 91.1 To replace the glow plug warning lamp (K29), located on the dash of the vehicle, (see Chapter 13).
- 91.2 Prise the trim holder out of the dash panel.
- 91.3 Disconnect the electrical wires to the lamp and remove the lamp.
- 91.4 Reconnect new lamp to the wiring and refit into trim holder.
- 91.5 Refit trim holder in dash panel.
- 91.6 Test glow plug warning lamp (K29) by performing final control diagnosis (diagnosis of actuators) (see Para 87).

REPLACE EDC CONTROL UNIT (J248)

92 The EDC control unit is housed within the VPDB. The entire VPDB is to be replaced in accordance with the procedure in Chapter 13.

FUEL SYSTEM PRIMING AND BLEEDING**WARNING**

HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.

CAUTIONS

- (1) **WASTE PRODUCTS.** Personnel responsible for the disposal of waste products must comply with local regulations and procedures.
- (2) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.

INTRODUCTION

93 The fuel system is self bleeding which eliminates air through the routine action of running the engine. In the event there is a fuel leak a situation may occur where air is introduced via a defective fuel line or component on a continuous basis. Self bleeding of the fuel system will continue but engine running problems will be experienced (notified as various fault codes) if a significant volume of air is being introduced.

94 If the fuel supply has been completely or partially exhausted (as a result of fuel system maintenance or allowing the fuel tank to run dry) a large volume of air may have been introduced to the system and manual priming of the fuel system may be necessary.

Priming a depleted fuel system by cranking the engine

CAUTIONS

(1) **DAMAGE TO STARTER MOTOR.** Do not operate the starter motor continuously to prime the fuel system. Continuous use will generate excessive heat that may damage the starter motor.

(2) **DAMAGE TO STARTER MOTOR.** If the engine fails to start, ensure that the starter motor has stopped revolving before retrying.

(3) **BATTERY LIFE.** If the engine fails to start, continued use of the starter motor will drain batteries.

95 To prime a depleted fuel system by cranking the engine proceed as follows:

95.1 Fill fuel tank.

95.2 Crank over the engine for a maximum of 10 seconds.

95.3 Pause for 15 seconds.

95.4 Repeat process for a maximum of 10 attempts until fuel has reached the injection pump and the engine has fired.

95.5 If the engine fails to start after 10 attempts manually prime the fuel system (see Para 98).

Priming a depleted fuel system manually

96 To prime a depleted fuel system manually proceed as follows:

96.1 Fill fuel tank.

96.2 Remove both front seats and the engine cover, see Para 6.

96.3 Fit maintenance fan guard 800.1.56.028.1 to cover the viscous fan blades at the front of the engine.

96.4 Remove the return pipe from the fuel injection pump and connect vacuum pump 800.1.56.034.1 using clear hose in place of the return pipe (see Fig 36).

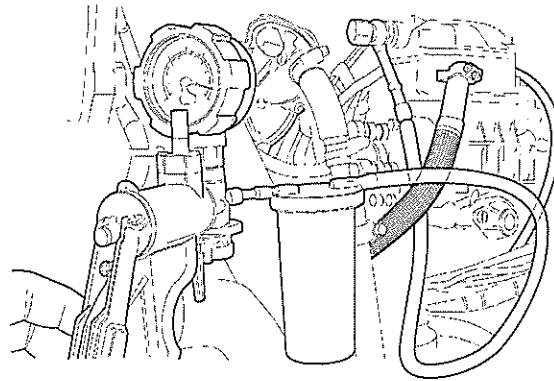


Fig 36 Priming fuel system manually

- 96.5 Draw a vacuum until fuel is observed in the feed hose to the injection pump.
- 96.6 Disconnect vacuum pump and hose and reconnect return pipe to fuel injection pump.
- 96.7 Perform priming procedure by cranking engine (see Para 95).

FUEL TANK

WARNING

HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.

CAUTIONS

- (1) **WASTE PRODUCTS.** Personnel responsible for the disposal of waste products must comply with local regulations and procedures.
- (2) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.

Removal

- 97 To remove the fuel tank proceed as follows:
 - 97.1 Remove side tank guard retaining bolts and take off guard.
 - 97.2 Remove front and rear tank guard retaining bolts and take off guard.
 - 97.3 Open fuel filler cap.
 - 97.4 Remove fuel tank drain plug and drain fuel in a suitable container.
 - 97.5 Pull off electrical connectors from fuel sender unit.
 - 97.6 Support fuel tank with jack.

- 97.7 Loosen nuts securing fuel retaining straps and gradually lower tank.
- 97.8 Loosen hose clips and pull off hoses from fuel supply unit.
- 97.9 Remove fuel tank from vehicle with aid of jack.
- 97.10 Rotate fuel supply unit anti-clockwise and remove.
- 97.11 Rotate fuel sender unit anti-clockwise and remove.
- 97.12 Loosen hose clips and remove fuel tank breather hose.
- 97.13 Remove pads and pull off tank edge guard from around waist of fuel tank.
- 97.14 Loosen bolts and remove brackets from forward and rear edges of fuel tank.

Refitting

98 The fuel tank is refitted as follows:

- 98.1 Refitting is done in reverse order of removal, ensuring that new O-ring seals are used to refit fuel supply unit and fuel gauge sender units.

NOTE

Fuel system is self bleeding once engine is started. Operate starter motor for a maximum of 10 seconds and then pause for 30 seconds and repeat if necessary.

- 98.2 On completion of refitting, start engine and check for leaks.

FUEL SENDER UNIT (TANK MOUNTED)

WARNING

HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.

CAUTIONS

- (1) **WASTE PRODUCTS.** Personnel responsible for the disposal of waste products must comply with local regulations and procedures.
- (2) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.

Removal

99 To remove fuel sender unit proceed as follows:

- 99.1 Remove drivers seats (see Para 6).
- 99.2 Loosen air filter cover by rotating turn buckles and remove cover.
- 99.3 Loosen hose clip and pull off air filter discharge hose (to engine).
- 99.4 Loosen hose clip, pull off air filter inlet hose and remove filter.

- 99.5 Loosen retaining nuts and remove connecting blocks and fuel pipe cover (situated below air filter).
- 99.6 Pull off electrical connectors from fuel sender unit, located below cover.
- 99.7 Rotate fuel sender unit anti-clockwise and remove.

Refitting

100 Refitting is done in reverse order of removal, ensuring that new O-ring seal is used to secure fuel sender unit.

ROUTINE MAINTENANCE

Draining the fuel filter and water separator

101 Draining should always be performed on both fuel filter and water separator and should be more frequent when refilling is done by means of a jerry can. Proceed as follows:

- 101.1 Loosen the bleeder screw (see Fig 37 (1)) on the filler support a few turns.
- 101.2 Connect a hose onto the hose nipple of the drain plug and put the other end of the hose into a transparent container (2).
- 101.3 Loosen the drain plug and allow 100 cc to flow out (or until clean fuel flows out).
- 101.4 Tighten the drain plug and bleeder screw.

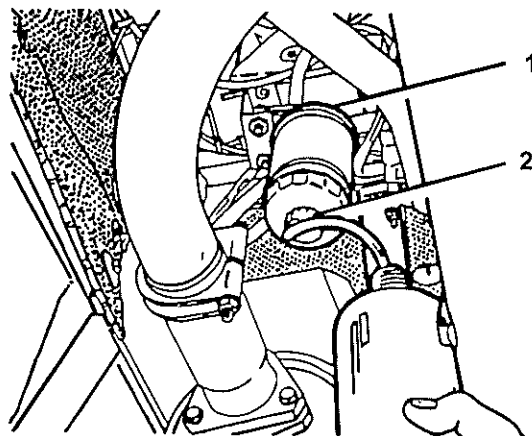


Fig 37 Water separator

Fuel filter change

- 102 To change the fuel filter, take the following steps:
 - 102.1 Remove the engine cover in accordance with the procedure detailed in Para 6.
 - 102.2 Open the hose band clips (see Fig 38 (1)) and pull off the fuel lines from the fuel filter.
 - 102.3 Replace the hose band clips.
 - 102.4 Attach the fuel lines paying attention to the marking arrows.

102.5 Check the tightness of the fuel system.

102.6 Replace engine cover in accordance with the procedure detailed in Para 7.

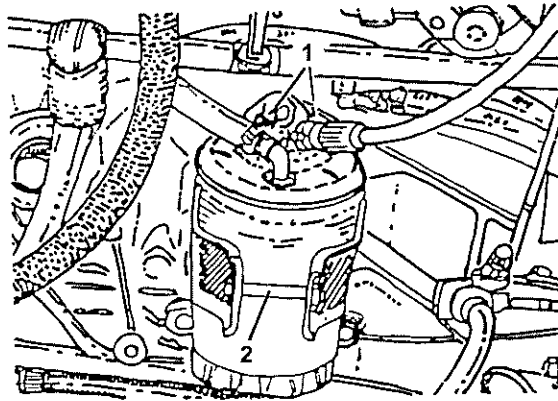


Fig 38 Fuel filter

Draining the fuel tank

103 If necessary the fuel tank should be drained of any sediment. The drain plug is located on the underside of the fuel tank. Place a container below the drain plug and allow about one litre of fuel to drain off.

OPTIMUM ENGINE MAPPING (OEM) MODULE CONNECTION

104 To improve performance when operating the vehicle on AVTUR, an Optimum Engine Mapping (OEM) module is provided. The OEM module **should only be connected** when it is necessary to operate the vehicle on AVTUR and is designed to achieve enhanced performance by modifying the fuel injection parameters. The OEM operates independently of the EDC engine management system and is installed in-line between the fuel injection pump and the engine harness.

CAUTION

ENGINE DAMAGE. Operating the vehicle on regular diesel will damage the engine if the OEM module is fitted. Always remove the OEM module prior to operating on diesel.

105 A cable connects the OEM module to the in-line position between the fuel injection pump and the engine harness. If the module needs to be disconnected either for EDC engine management fault diagnosis or to replace a faulty unit, the in-line connection between the fuel injection pump and the engine harness should be removed to disconnect the OEM module.

RESTRICTED

RESTRICTED

CHAPTER 12

COOLING SYSTEM

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INTRODUCTION

1 This Chapter details the procedures for work carried out on the cooling system. Some minor maintenance tasks (e.g. refilling coolant levels) are also covered in AESP 2320-D-503-201, Chapter 4.

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools and test equipment are shown in Table 1.

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Item (1)	NSN (2)	Manufacturer's Part No. (3)	Designation (4)
1	2815-99-503-3511	800.1.56.028.1	Maintenance fan guard
2	4910-99-190-7143	800.1.56.016.1	Testing box
3	5120-99-328-6679	800.1.56.006.1	Brace / counter hold tool

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings in this Chapter are shown in Table 2. The exploded views throughout this Chapter also give torque figures where appropriate.

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Water pump securing bolts	20	9.1
2	Thermostat securing bolt	10	10.7
3	Cooling fan securing bolts	10	20.3
4	Electro-magnetic clutch M6 bolts	10	24.1
5	Electro-magnetic clutch M4 bolts	4	24.2
6	Electro-magnetic clutch M12 bolts	80	24.3
7	Electro-magnetic clutch M8 bolts	20	26

REPLACE COOLANT**WARNINGS**

(1) **BURN HAZARD. ALWAYS LET THE ENGINE COOL DOWN BEFORE REMOVING THE FILLER CAP. WHEN THE ENGINE IS RUNNING, THE INTERNAL PRESSURE OF THE COOLING SYSTEM BUILDS UP. UNSCREWING THE FILLER CAP WHEN THE ENGINE IS HOT WILL RESULT IN BLOW OUT OF COOLANT.**

(2) **BURN HAZARD. WHEN DRAINING COOLANT USING THE PROCEDURE IN PARA 5, ONLY APPROXIMATELY FIVE LITRES OF COOLANT WILL DRAIN VIA THE COOLANT DRAIN PLUG. A LARGE VOLUME OF FLUID WILL STILL BE PRESENT IN THE ENGINE, SO EXTRA CARE MUST BE TAKEN WHEN REMOVING COOLANT HOSES.**

(3) **BURN HAZARD. CONTACT WITH HOT COOLANT WILL CAUSE PERSONAL INJURY. REMOVING THE FILLER CAP WHILST THE ENGINE IS HOT CAN BE DANGEROUS. REMOVE THE FILLER CAP SLOWLY AND WITH CARE, ALLOWING EXCESS PRESSURE TO ESCAPE.**

Coolant level check

4 To check the coolant level, proceed as follows:

4.1 Put the vehicle in a horizontal position. Open the bonnet hatch in front of the windscreen to provide access to the coolant reservoir (see Fig 1 (1)).

- 4.2 As the expansion bottle is transparent, a visual check can be carried out.
- 4.3 Check the level of the coolant. The system is filled correctly when the coolant level reaches the maximum mark.

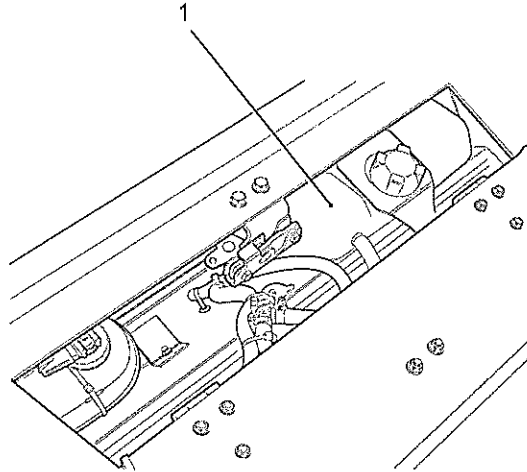


Fig 1 Coolant compensation reservoir

- 4.4 Unscrew and remove the cap.
- 4.5 Top up with coolant (AL39) and water mixture as required. The mixture ratio should be 50:50.
- 4.6 Replace the cap properly.

Draining coolant

- 5 Drain the cooling system as follows:
 - 5.1 Put the vehicle in a horizontal position and allow the engine to cool down.
 - 5.2 Carefully unscrew the filler cap by hand (see Fig 1 (2)).
 - 5.3 Allow over pressure to be released before completely unscrewing the cap.
 - 5.4 Place a suitable container under vehicle, to catch coolant draining from system. Open the heater valve and unscrew the drain plug (see Fig 2) at the feed line.

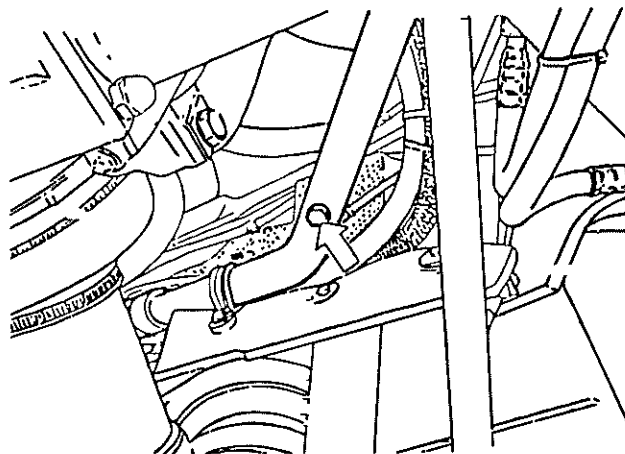


Fig 2 Coolant draining plug

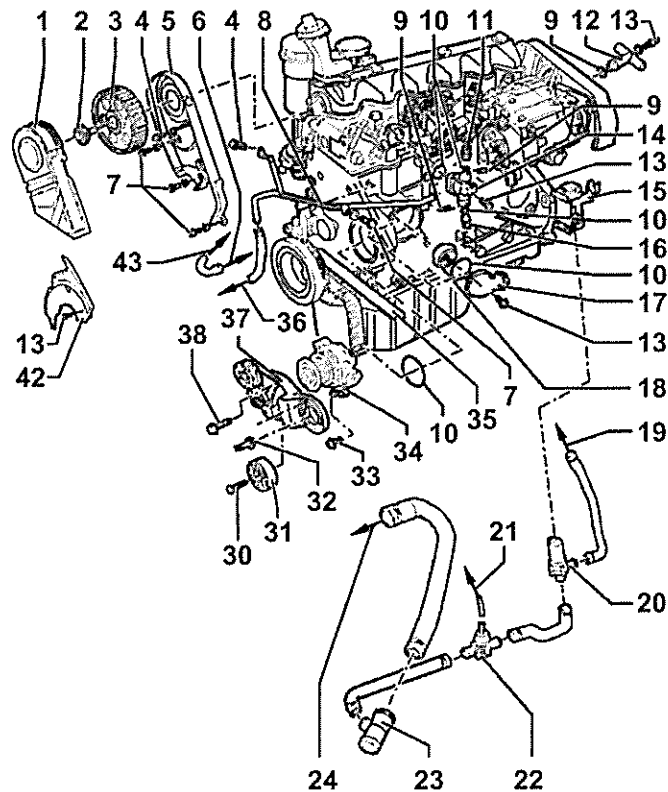
- 5.5 Drain the coolant from the compensation reservoir.

Refilling the coolant

- 6 To refill the cooling system, proceed as follows:
 - 6.1 Replace the drain plug (see Fig 2).
 - 6.2 Fill the compensation reservoir (see Fig 1 (1)) with coolant and water mixture (50:50) up to the maximum level.
 - 6.3 Tighten the filler cap securely by hand.
 - 6.4 Start the engine and let it run for several minutes.
 - 6.5 Check the coolant level repeatedly until any subsidence stops.

COOLANT SYSTEM

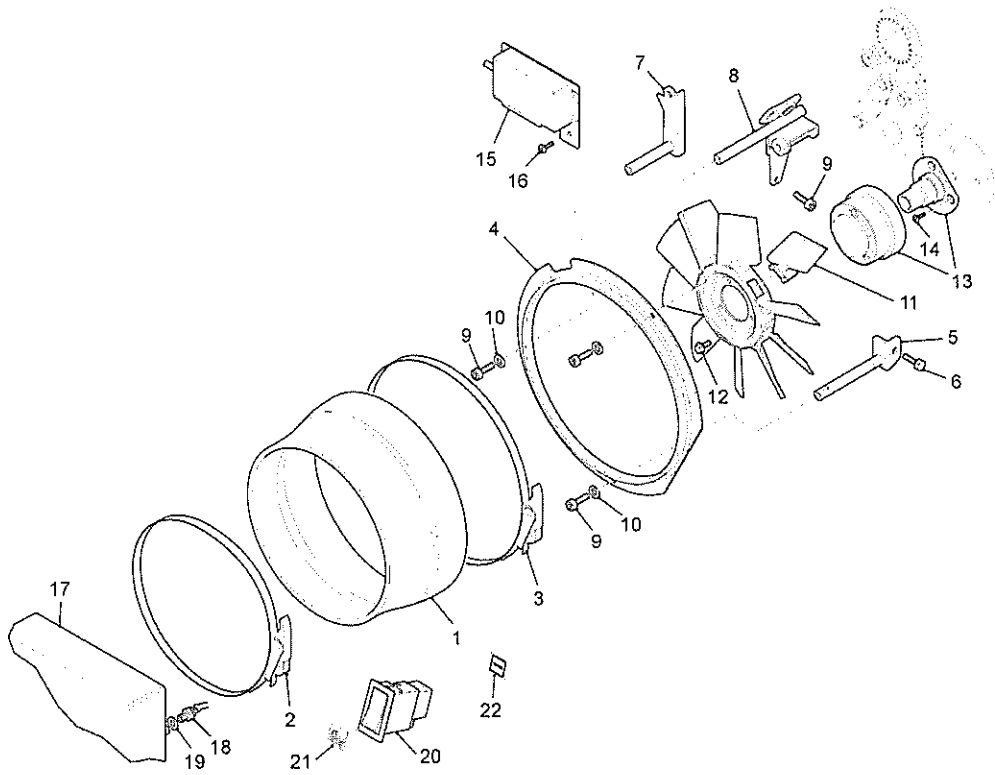
7 The major parts of the coolant system are shown in Figs 3 and 4



Key

- | | | | |
|----|--|----|---|
| 1 | Upper section of toothed belt | 21 | To timing valve |
| 2 | Mounting bolt for camshaft sprocket - 85/100 Nm torque | 22 | Vacuum valve |
| 3 | Camshaft sprocket | 23 | T-piece |
| 4 | Bolt for rear toothed belt guard (item 5) - 10 Nm torque | 24 | Pipe to fitting (item 17) |
| 5 | Rear toothed belt guard | 25 | Not used |
| 6 | Pipe to oil cooler | 26 | Not used |
| 7 | Bolt for rear toothed belt guard (item 5) - 20 Nm torque | 27 | Not used |
| 8 | Coolant pipe | 28 | Not used |
| 9 | Retaining clip | 29 | Not used |
| 10 | O-ring | 30 | Bolt for idler pulley (item 31) - torque 20 Nm |
| 11 | Thermo-switch for coolant circulation prolong (F95) | 31 | Idler pulley |
| 12 | Fitting | 32 | Bolt for flange shaft - torque to 20 Nm |
| 13 | Bolt for fitting (item 12) - 10 Nm torque | 33 | Bolt for coolant pump (item 34) - torque to 20 Nm |
| 14 | Fitting | 34 | Coolant pump |
| 15 | Bracket for pump for coolant circulation run-on (V51) | 35 | Toothed belt for camshaft |
| 16 | Coolant temperature sender (G62) | 36 | Pipe to oil cooler |
| 17 | Thermostat housing | 37 | Bracket for viscous fan |
| 18 | Thermostat | 38 | Bolt for bracket (item 37) - torque to 40 Nm |
| 19 | Pipe to fitting (item 12) | 39 | Not used |
| 20 | Pump for coolant circulation run-on (not applicable to Vector PPV) | 40 | Not used |
| | | 41 | Not used |
| | | 42 | Toothed belt guard |
| | | 43 | To cylinder block |

Fig 3 Component parts of cooling system (on engine) - exploded view



Key

1	Duct, flexible	14	Screw M6 x 16 csk
2	Clamp, duct, front	15	Control unit, fan clutch
3	Clamp, duct, rear	16	Screw M6 x 16
4	Cowl, cooling fan	17	Radiator
5	Bracket, duct mounting, nearside	18	Sender, temperature
6	Screw M10 x 25	19	Washer, sender, temperature
7	Bracket, duct mounting, offside	20	Switch, wading
8	Bracket, duct mounting, centre	21	Lens, switch, wading
9	Cap screw M8 x 22	22	Label, switch, wading
10	Washer, M8, flat	NI	Loom, temperature sender
11	Blade, cooling fan	NI	Loom, fan clutch
12	Bolt, M6 x 16	NI	Loom, fan clutch, instrument panel
13	Clutch assembly		

Fig 4 Component parts of cooling system (electro-magnetic fan/clutch) – exploded view

REPLACE WATER PUMP

NOTE

Check for smooth running. Only replace the complete unit if damaged or leaking.

8 To replace the water pump, proceed as follows:

- 8.1 Drain coolant, see Para 5.
- 8.2 Remove the front seats and engine cover, see Chapter 16-2.
- 8.3 Remove the ribbed V-belt (FEAD) and tensioning element, see Chapter 1.
- 8.4 Remove toothed belt and tensioning element for camshaft, see Chapter 1.
- 8.5 Remove electromagnetic fan/clutch assembly, see Para 19.
- 8.6 Disconnect pipes and remove water pump and O-ring.

9 Replacement is the reverse of the above noting the following care points:

- 9.1 Renew the O-ring for the water pump. Tighten the bolts securing the water pump to 20 Nm torque. Reconnect pipes.
- 9.2 Replace the V-belt (FEAD) and/or toothed belt for camshaft if there is evidence of wear or within 1000 km prior to scheduled replacement; see AESP 2320-D-503-601 for maintenance interval.
- 9.3 Replace engine cover and front seats, see Chapter 16-2.
- 9.4 Refill coolant, see Para 6.

REPLACE THERMOSTAT

10 To replace the thermostat, proceed as follows:

- 10.1 Drain coolant, see Para 5.
- 10.2 Remove the front seats and engine cover, see Chapter 16-2.
- 10.3 Remove alternator EMC filter, held in place with M8 fixings.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN DRAINING HOTS FLUIDS.

- 10.4 Loosen hose (jubilee) clips from connecting hoses and disconnect hoses from thermostat housing. Coolant fluid will escape, drain into a suitable container for disposal in accordance with local health and safety procedures.
- 10.5 Undo the M6 securing bolts and remove the thermostat housing (see Fig 3 (17)), O-ring (10) and thermostat (18).
- 10.6 Check the replacement thermostat by heating in a water bath. Start of opening should be approx 87 °C and end should be approx 102 °C. The opening stroke should be at least 7 mm.
- 10.7 Install the replacement thermostat and O-ring. Reinstall fitting and tighten securing bolt to 10 Nm torque.
- 10.8 Reconnect hoses to thermostat.

- 10.9 Refit the alternator EMC filter.
- 10.10 Replace engine cover and front seats, see Chapter 16-2.
- 10.11 Refill coolant, see Para 6.

CHECK COOLANT TEMPERATURE SENDER (G62)

NOTE

Refer to AESP 2320-D-503-512 Chapter 1 for use of the VAG-COM vehicle diagnostic software, evaluation of measuring blocks and for procedure to connect the test box to the EDC.

- 11 To check the coolant temperature sender (G62), proceed as follows:
 - 11.1 The coolant temperature sender (G62) is located on the nearside of the engine (see Fig 3 (16)). It is identified as a 4-pin black connector with a purple ring and is with temperature gauge sender (G2).
 - 11.2 Switch the ignition ON.
 - 11.3 Connect the diagnostic tester to the vehicle. From the main screen click the [Select] button to access the control module.
 - 11.4 On the select control module screen click the [01 – Engine] button to access the engine control module.
 - 11.5 On the open controller screen click the [Meas. Blocks – 08] button, to access the measuring blocks screen.
 - 11.6 On the measuring blocks screen enter **007** in the Group field to activate '*Display group number 007*' and confirm entry with [Go] button.
 - 11.7 Check the coolant temperature value in display field 4. The temperature value must rise evenly without interruption. If a fault has developed, the fuel temperature is displayed instead.
 - 11.8 If there is no realistic display in display field 4 or if the fuel temperature is displayed as replacement, check the sender for coolant temperature and the cable connections to the sender.
 - 11.9 Click on [Done, Go Back] followed by [Close Controller, Go Back – 06] then [Go Back] to return to the main screen.
 - 11.10 To close the VAG-COM software click on the [Exit] button.
 - 11.11 Switch the vehicle ignition OFF.
 - 11.12 Remove the front seats and engine cover, see Chapter 16-2.
 - 11.13 Remove the connector from the coolant temperature sender (G62) located on the nearside of the engine behind the alternator (see Fig 3 (16)). It is identified as a 4-pin black connector with a purple ring. It may be necessary to move the main intercooler to EGR pipe out of the way for ease of access to the coolant temperature sender (G62). If this is the case:
 - 11.13.1 Disconnect the main intake pipe located over top/front of the engine that connects to the EGR plenum chamber of the inlet manifold. Cut all cable ties securing the wiring loom to the pipe and unplug the connector for the intake manifold temperature sender (G72) located on the top of the pipe. The pipe is held in clamped place with hose (jubilee) clips at each end and is fixed to the cylinder head on the right-hand side with a bracket and M6 bolt and an M8 bolt that passes through the engine lifting eye on the top.

WARNING

SCALDING HAZARD. DANGER OF SCALDING WHEN DRAINING HOT FLUIDS.

11.13.2 Carefully undo the hose (jubilee) clip on the coolant pipe/engine breather hose, feed disconnected hose through the eyelet on the main intake pipe and re-connect as quickly as possible, re-tighten hose (jubilee) clip. Coolant fluid will escape and should be collected in a suitable container for correct disposal in accordance with local procedures.

11.13.3 Remove the main intake pipe complete.

11.14 Using a multi-meter, measure the resistance between contacts 1 and 3 on the sender (see Fig 5).

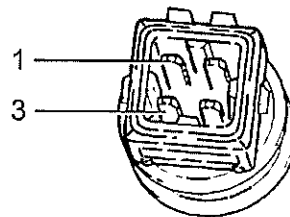


Fig 5 Coolant temperature sender (G62)

11.15 Referring to the setpoint diagram (see Fig 6), area A shows the resistance values for the temperature range 0 through 50 °C; area B shows the resistance values for the temperature range 50 through 100 °C. For example, a read-out of 30 °C corresponds to a resistance of 1500 to 2000 Ω. Whilst a readout of 80 °C corresponds to a resistance of 275 to 375 Ω.

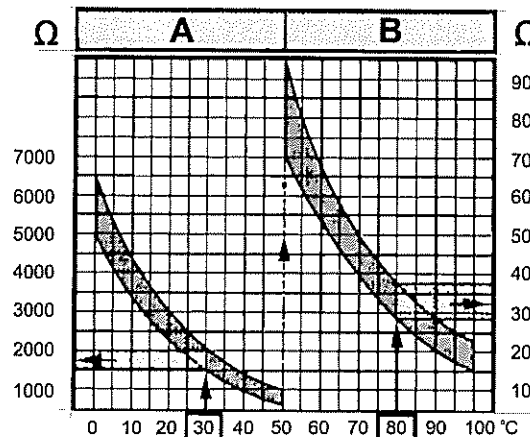


Fig 6 Setpoint values

11.16 If the setpoint value is not reached, replace the coolant temperature sender (G62).

If the setpoint value is reached, connect the test box 800.1.56.016.1 to the EDC control unit (J248) wiring loom.

11.17 Check wires between test box and 4-pin connector (see Fig 7) for breaks using vehicle wiring diagram :

- (1) Contact 3 + socket 104
- (2) Contact 4 + socket 112
- (3) Cable resistance – max. 1.5 Ω

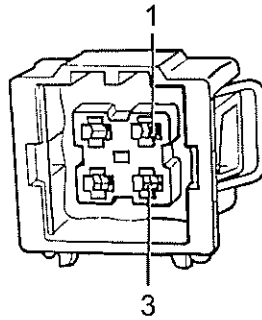


Fig 7 4-pin connector

11.18 Also check the cables for short-circuiting among themselves, to the vehicle earth or the battery positive (+ve) terminal. Setpoint value - $\infty \Omega$.

11.19 If after completion of all the above tests no fault in the cables is discovered, the EDC control unit (J248) should be replaced.

PRESSURE TEST COOLING SYSTEM

12 To test the cooling system pressure proceed as follows:

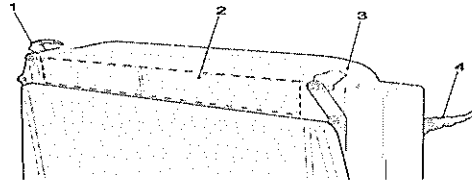
- 12.1 Check coolant level.
- 12.2 Push heater control valve lever fully to left.
- 12.3 Place standard cooling system testing device on radiator.
- 12.4 Using a proprietary pump, produce pressure of 1 bar in radiator.
- 12.5 Check radiator, coolant pump, thermostat housing, engine block and heating system for leaks.
- 12.6 Check tubes and hoses for leaks. Replace hardened and swollen hoses.
- 12.7 Remove testing device, replace filler cap.

RADIATOR

Removal

13 The radiator is removed as follows:

- 13.1 Access radiator by removing the bonnet (see Chapter 16-1).
- 13.2 Drain coolant (see Para 5).
- 13.3 Remove intercooler (see Para 17).
- 13.4 Remove boost bracket.
- 13.5 Disconnect the coolant temperature sensor (Fig 8 (4)) mounted in the radiator (3) and gearbox oil temperature sensor (1) mounted in the oil cooler (2).



- | | |
|---|--------------------------------|
| 1 | Gearbox oil temperature sensor |
| 2 | Oil cooler |
| 3 | Radiator |
| 4 | Coolant temperature sensor |

Fig 8 Electro-magnetic fan clutch system temperature sensors

- 13.6 Tilt radiator to front, loosen hose clips, pull off hoses and remove radiator.

Refitting

- 14 The radiator is refitted as follows:

- 14.1 Refitting is done in reverse order to removal, observing the following point:
14.2 Fill coolant (see Para 6).

COMPENSATION RESERVOIR

Removal

- 15 The compensation reservoir is located beneath the inspection cover in the bonnet and is removed as follows:

- 15.1 Remove radiator (see Para 13).
15.2 Loosen hose clips and remove hose.
15.3 Loosen bolt and remove bracket.
15.4 Loosen hose clip, pull off hose and remove reservoir.

Refitting

- 16 To refit the compensation reservoir, proceed as follows:

- 16.1 Refitting reservoir is done in reverse order to removal.

INTERCOOLER**Removal**

- 17 To remove intercooler, proceed as follows:
 - 17.1 Remove bolts from body nose cone, tip radiator cover forwards. Remove hose of windscreen washer nozzle.
 - 17.2 Remove radiator cover.
 - 17.3 Unscrew nuts and bolts and remove brackets.
 - 17.4 Unscrew nuts and loosen clips.
 - 17.5 Remove intercooler.
 - 17.6 Unscrew rubber suspension from intercooler.

Refitting

- 18 The intercooler is refitted as follows:
 - 18.1 Fitting is done in reverse order to removal.

ELECTRO-MAGNETIC FAN/CLUTCH SYSTEM**Remove fan assembly**

- 19 To remove the fan assembly from the electromagnetic fan/clutch assembly, proceed as follows:
 - 19.1 Isolate the electrical system. Turn the battery isolation switch in the vehicle cab, behind the passenger's seat to the OFF position.
 - 19.2 Remove the front seats and engine cover, see Chapter 16-2.
 - 19.3 Undo two duct retaining clamps (Fig 9 (1 and 3)) that secure the flexible fan duct (2) to the vehicle air tunnel and the cooling fan cowl (4) located on the engine. Remove the clamps from vehicle and retain after first noting their positions for re-assembly.

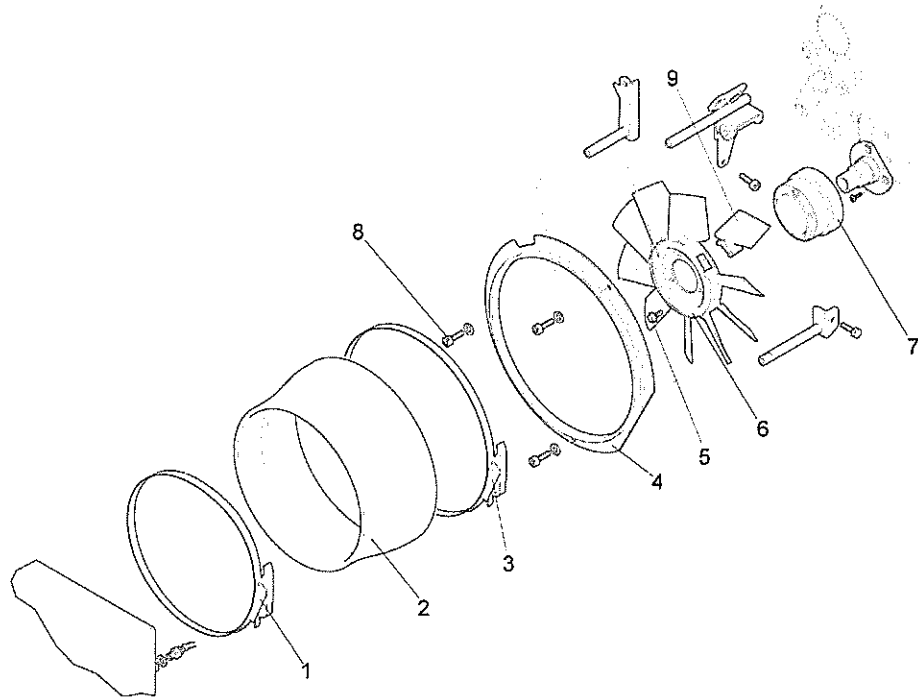


Fig 9 Electromagnetic fan clutch system

19.4 Peel the flexible duct from the vehicle air tunnel mounting lip and the cooling fan cowl (4) lip, remove from vehicle and retain.

19.5 After first noting orientation of fan, undo three M6 bolts (5) that secure the fan assembly (Fig 9/6) to the electromagnetic clutch (7) and remove from vehicle.

NOTE

The M6 bolts secure the fan assembly to clutch and the two halves of the fan hub together. Upon removal of the bolts the fan hub must be held together to ensure the fan blades do not move from their locations. Use an M6 bolt and nut to temporarily hold the fan assembly together whilst other activities are performed.

Refit fan assembly

20 To refit the fan assembly proceed as follows:

20.1 If fitted to temporarily hold the fan assembly together, remove M6 bolt and nut.

20.2 Install fan assembly (Fig 9 (6)) on to the electromagnetic clutch (7) ensuring fan is orientated correctly.

20.3 Fit three M6 bolts (5) to the fan assembly using Loctite 243 thread lock or equivalent and tighten bolts to 10Nm.

20.4 Install flexible duct (2) between air tunnel and duct mounting ring (4), ensure marking "TOP" on flexible duct is uppermost.

20.5 Refit the two duct retaining clamps (1 and 3) in their original positions.

20.6 Replace engine cover and front seats, see Chap 16-2.

Replace fan blade

21 In the event of damage to a fan blade(s) (Fig 9 (9)) remove fan assembly, see Para 19, and after first noting orientation, carefully split fan hub and replace fan blades as necessary.

22 Refit fan assembly and flexible duct, see Para 20.

Remove electro-magnetic clutch

23 The electro-magnetic clutch assembly is removed as follows:

23.1 Remove flexible duct and fan assembly, see Para 19.

23.2 After first noting orientation, undo the fan M8 retaining bolts (Fig 9 (8)) from the duct mounting ring (4) and remove ring from mounting brackets.

23.3 Remove the ribbed V-belt (FEAD), see Chap 1.

23.4 Fit the brace tool (see Table 1, Item 3) onto the electromagnetic clutch end cap (Fig 10 (2)) using the M6 screws supplied. The screws should be finger tight and used without washers.

23.5 Remove the M6 bolts (1) that secure the end cap (2) to the electro-magnetic clutch and remove end cap and brace tool.

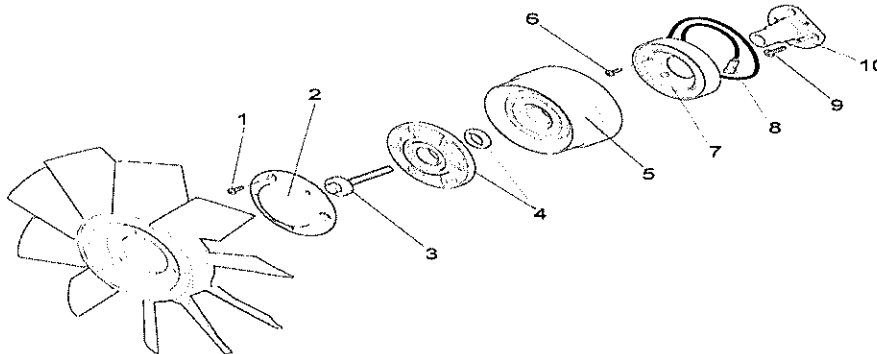


Fig 10 Electromagnetic fan clutch system – clutch components

23.6 Disconnect electro-magnet fly lead (8) from main loom connector (secured to the intercooler pipe).

23.7 Undo the M12 securing bolt (3) from the centre of the electromagnetic clutch assembly.

23.8 Remove clutch plate and spacer (4) from assembly.

23.9 Remove drive drum (5) from assembly

23.10 After first noting position, cut cable tie securing electro magnet fly lead to engine bracket.

23.11 Undo the M4 hex screws (6) that secure the electro magnet (7) to the mounting spindle (10).

23.12 Undo the countersunk screws (9) that secure the mounting spindle to the engine and remove mounting spindle.

Refit electro-magnetic clutch

24 Refitting of the electromagnetic clutch assembly is a reverse of the removal procedure, noting the following care points:

24.1 Fit all M6 bolts using Loctite 243 thread lock or equivalent and tighten to 10 Nm.

24.2 Fit all M4 bolts using Loctite 243 thread lock or equivalent and tighten to 4 Nm.

24.3 Fit M12 securing bolt using Loctite 243 thread lock or equivalent and tighten to 80 Nm.

24.4 Ensure that the electro magnet fly lead is cable tied to the engine bracket and positioned away from the drive drum.

25 Refit the ribbed V-belt (FEAD), see Chap 1.

26 Refit the duct mounting ring ensuring the cut out for the coolant bleed hose is on the right hand side. Secure to mounting brackets with M8 bolts. Fit all M8 bolts using Loctite 243 thread lock or equivalent and tighten to 20 Nm.

27 Refit fan assembly and flexible duct, see Para 20.

Temperature sensors

28 To replace either the gearbox oil temperature sensor (Fig 8 (1)) or coolant temperature sensor (4), proceed as follows:

28.1 Isolate the electrical system. Turn the battery isolation switch in the vehicle cab, behind the passenger's seat to the OFF position.

28.2 Access radiator by removing brush guard and bonnet (soft skin variants) / raising bonnet (armoured variants).

28.3 Disconnect the wiring loom from the appropriate sensor.

28.4 Using a 19 mm spanner undo the defective sensor.

NOTE

If the engine coolant temperature sensor is being changed an amount of coolant will escape when the sensor is removed.

29 Refitting a sensor is the reverse of the remove procedure, noting the following care point:

29.1 If any coolant has been lost replenishment is required.

RESTRICTED

RESTRICTED

CHAPTER 13

ELECTRICAL SYSTEM REPAIR INSTRUCTIONS

CONTENTS

Para

- 1 Introduction (WARNING)(CAUTION)
- 2 Special tools and test equipment
- 2 Torque wrench settings
- 4 Earth bonding points and ferrites
- 5 Earth bonding points
- 6 Ferrites
- Starter motor
- 7 Removal (WARNINGS) (CAUTION)
- 8 Refitting (WARNINGS)
- Alternator
- 9 Replacement (CAUTION)
- Alternator drive belts
- 11 Replacement (CAUTION)
- 13 Vehicle batteries (WARNINGS)(CAUTIONS)
- 15 Removal (CAUTION)
- 16 Refitting
- Vehicle Power Distribution Box (VPDB)
- 17 Removal (CAUTION)
- 18 Refitting (CAUTION)
- Steering lock
- 19 Removal
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- 21 Removal
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- 25 Refitting
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- ABS power supply
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4 Battery box	9
5 ABS control board	13

INTRODUCTION

1 This Chapter details the procedures for work carried out on the electrical system. For associated wiring diagrams, refer to AESP 2320-D-503-512 Chapter 13.

WARNING

ELECTRIC SHOCK. ALWAYS ISOLATE VEHICLE ELECTRICS AT THE BATTERY MAIN SWITCH AND DISCONNECT BATTERIES PRIOR TO MAINTENANCE OF THE ELECTRICAL SYSTEM.

CAUTION

DAMAGE TO ELECTRICAL SYSTEM. Prior to carrying out any welding on the vehicle, isolate vehicle electrics at the battery main switch, disconnect batteries and alternator and remove Vehicle Power Distribution Box.

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools or test equipment for this chapter are shown below:

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

No (1)	NSN (2)	Manufacturers Part No (3)	Designation (4)
1	4910-12-337-5562	446 300 331 0	Diagnostic Controller
2	6625-99-251-8654	8001370170	Diagnostic Cable - ABS
3	TBA	446 300 783 0	Diagnostic Program Card
4	TBA	446 300 350 0	Diagnostic Sensor Probe
5	TBA	446 300 604 0	Diagnostic Sensor Probe Program Card
6	TBA	8001370180	Diagnostic Sensor Probe Cable - ABS

TORQUE WRENCH SETTINGS

3 All torque wrench settings specified in this Chapter are shown in Table 2.

TABLE 2 TORQUE WRENCH SETTINGS

Ser. (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Earth bonding points	15	5 (Note)
2	M10 bolts for RH engine mount	49	8 (Note 4)
3	M12 bolts for securing starter motor to gearbox bell housing	50	8 (Note 3)
4	M12 vertical securing bolt for RH engine mount to chassis	75	8 (Note 4)

EARTH BONDING POINTS AND FERRITES

4 Regular maintenance of the earth bonds and ferrites maintains EMC standards.

Earth Bonding Points

5 There are many earth bonding leads on the vehicle in addition to standard component earth bonds. Earth bonds should be inspected for damage, corrosion and security as part of the 6-month service. During a 12-month service earth bond integrity should be spot checked. Bonds should have a maximum impedance of 2 milliohms. If necessary earth bonding point and lead should be disassembled and cleaned with a mild abrasive material (emery cloth). Upon re-installation the bonding point should be covered in silicone electrical grease. Earth bonding points are:

- (1) Front LH Door / Frame
- (2) Front RH Door / Frame
- (3) Rear LH Door / Frame
- (4) Rear RH Door / Frame
- (5) Front Hatch / Frame
- (6) Rear Hatch / Frame
- (7) Front LH Door Surround / Frame
- (8) Front RH Door Surround / Frame
- (9) Bonnet Hatch / Bonnet
- (10) Bonnet / LH Front panel
- (11) Windscreen Surround / Frame
- (12) LH Front Panel / Frame
- (13) RH Front Panel / Frame
- (14) Body Panel 1 LH / Frame
- (15) Body Panel 2 LH / Frame
- (16) Body Panel 3 LH / Frame
- (17) Body Panel 1 RH / Frame
- (18) Body Panel 2 RH / Frame
- (19) Body Panel 3 RH / Frame
- (20) Body Rear Panel / Frame
- (21) Fuel Tank / Floor
- (22) Wiper Motor / Frame
- (23) Ground Plane Housing / Roof
- (24) Roof Front / Frame
- (25) Roof Rear / Frame
- (26) L* Remotes / Frame
- (27) GPS / Battery Charger Backplate
- (28) M* Transmitter / Frame
- (29) Q1 Plate / Frame
- (30) Q2 Plate / Frame
- (31) 2EY Unit LHS / Frame
- (32) AJK Unit / Frame
- (33) FFR Distribution Box / Frame
- (34) 2EY Unit RHS / Frame
- (35) Battery Charger Backplate / Frame
- (36) Hydraulic system hinged panel / module frame

NOTE

In the majority of places, the bonds are mounted to a boss via an M6 bolt. Tighten bolt to correct torque when the bond is re-attached post maintenance (see Table 2, Ser 1).

Ferrites

6 Ferrites (clip on suppressors) should be inspected for damage and security as part of the 6-month service. Ferrites should be secured in place on the relevant cable using cable ties to ensure that they do not slide on the cable. Cables should be secured so that the ferrite cannot impact against a hard surface as they are brittle. Ferrites are located as follows:

- (1) ABS control board cable to into voltage converter (2-off)
- (2) ABS control board cable entering fuse box
- (3) ABS control board main 12V cable
- (4) ABS control board main 24V cable
- (5) Flasher unit wiring
- (6) Wiper motor loom (within motor enclosure)
- (7) Vehicle Power Distribution Box (VPDB) 12V cable from the battery
- (8) VPDB 24V switched cable
- (9) VPDB 24V un-switched cable
- (10) Each leg of engine loom at VPDB
- (11) Environmental Control System compressor green clutch wire
- (12) Injection pump cable

STARTER MOTOR

Removal

7 Removal of the starter motor is as follows:

- 7.1 Position the vehicle on level ground or a maintenance ramp, ensuring that the maximum Safe Working Load (SWL) of the ramp is not exceeded. Apply the vehicle handbrake and chock the wheels.
- 7.2 Isolate the electrical system and disconnect the batteries in accordance with the procedure in Paras 15.1 through 15.4.

CAUTION

DAMAGE TO ENGINE MANAGEMENT SYSTEM – AUTOMOTIVE BATTERIES. If the 12V dc positive (+ve) wire is not disconnected first and the 24V dc negative (-ve) cable is removed first, the 12V dc wire could act as a negative (-ve) wire for the 24V dc system and could cause system damage.

- 7.3 Disconnect the yellow (or white and orange) wire from the 12V dc positive (+ve) terminal and ensure that this is safely placed, i.e. cannot reconnect with the any terminal unintentionally.
- 7.4 Disconnect the 24V dc negative (-ve) battery terminal and ensure that this is isolated and safely placed, i.e. cannot reconnect with the terminal unintentionally.
- 7.5 Disconnect the 24V dc positive (+ve) battery terminal and ensure that this is isolated and safely placed, i.e. cannot reconnect with the terminal unintentionally.

WARNING

INJURY TO PERSONNEL. INSTALLATION/REMOVAL OF THE SEATS IS ONLY TO BE CARRIED OUT BY A QUALIFIED VEHICLE MECHANIC AND THE GENERAL CONDITION OF THE SEAT FIXINGS AND MOUNTINGS SHOULD BE INSPECTED PRIOR TO INSTALLATION/REMOVAL.

- 7.6 Remove the front seats and engine cover (see Chap 16-2).
- 7.7 Support the engine using the lifting eye provided on the front top and a suitable workshop lifting device.
- 7.8 Working from below the vehicle, remove the M12 vertical securing bolt from the RH engine mount.
- 7.9 Using the lifting device, to raise the right hand side of engine, check that there is a gap between the RH engine mount and its mounting bracket.

7.10 Working from below the vehicle, undo the M8 securing nut on the front of the starter motor and disconnect the fly lead (spade connector) of the starter motor solenoid, cut off the cable tie and route the wiring loom away from the engine and gearbox.

7.11 Working from below the vehicle, undo the two M12 securing bolts that pass through the gearbox bell housing to secure the starter motor to the engine block.

7.12 Working from below the vehicle, undo the three M10 bolts of the right-hand engine mount bracket. Remove the RH engine mount bracket. Slide out the starter motor and remove.

Refitting

8 Starter motor installation is the reverse of the above procedure, paying particular attention to the following notes:

NOTES

- (1) Apply silicone RTV to the mating face of the starter motor and fit it in place in the torque converter housing.
- (2) Re-fit the right hand engine mount, use Loctite 243 on the threads of the M10 bolts.
- (3) Refit the two M12 securing bolts that pass through the gearbox bell housing to secure the starter motor to the engine block, torque to 50 Nm. Refit the M8 securing nut on the front of the starter motor.
- (4) Lower the engine back into position, refit the M12 vertical securing bolt for the RH engine mount to chassis and torque to 75 Nm. Tighten the three M10 bolts of the RH engine mount and torque to 49 Nm.
- (5) Reconnect the fly lead (spade connector) of the starter motor solenoid, fit cable ties and route the wiring loom.

WARNING

INJURY TO PERSONNEL. INSTALLATION/REMOVAL OF THE SEATS IS ONLY TO BE CARRIED OUT BY A QUALIFIED VEHICLE MECHANIC AND THE GENERAL CONDITION OF THE SEAT FIXINGS AND MOUNTINGS SHOULD BE INSPECTED PRIOR TO INSTALLATION/REMOVAL.

- (6) Re-fit engine cover and seats (see Chap 16-2).
- (7) Reconnect batteries in the reverse of the disconnect procedure.

ALTERNATOR

Replacement

9 The automotive and FFR 28V 100A alternators are found in the hydraulic module located on the left external side of the vehicle. The upper unit is the automotive alternator. To replace either alternator proceed as follows:

- 9.1 Isolate the electrical system and disconnect the batteries in accordance with the procedure in Para 15.1 through 15.4.

CAUTION

DAMAGE TO ENGINE MANAGEMENT SYSTEM – AUTOMOTIVE BATTERIES. If the 12V dc positive (+ve) wire is not disconnected first and the 24V dc negative (-ve) cable is removed first, the 12V dc wire could act as a negative (-ve) wire for the 24V dc system and could cause system damage.

9.2 Remove and retain the bolts securing the hinged side of the hydraulic module and lower the side (see Fig 1).

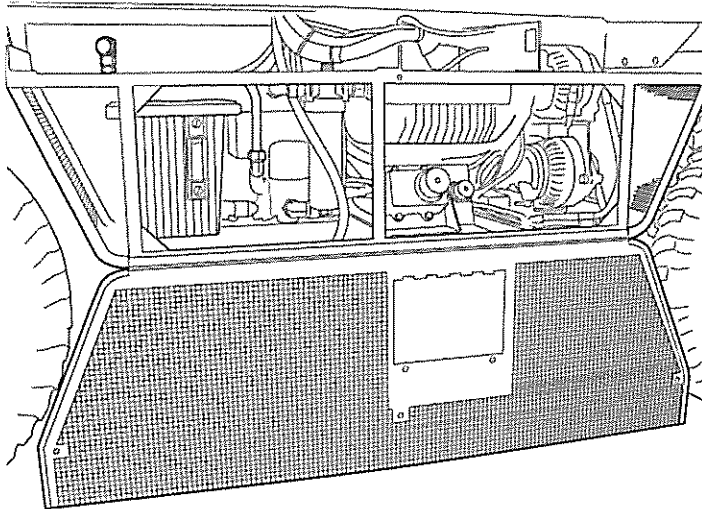


Fig 1 Hydraulic module access - side

9.3 Remove and retain the bolts securing rear end cover of the hydraulic module and remove the cover (see Fig 2).

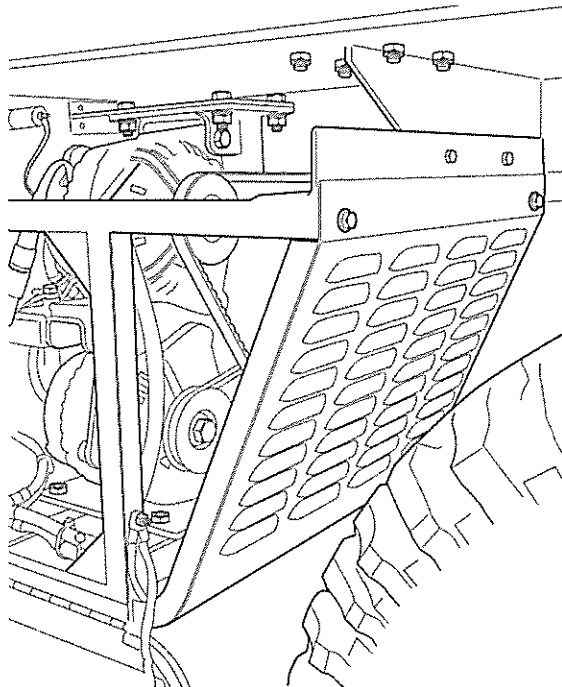


Fig 2 Hydraulic module access - rear

- 9.4 Loosen the pivot and adjuster bolts (see Fig 3 (1 and 2)) from the required alternator, release tension from drive belt and remove belt.

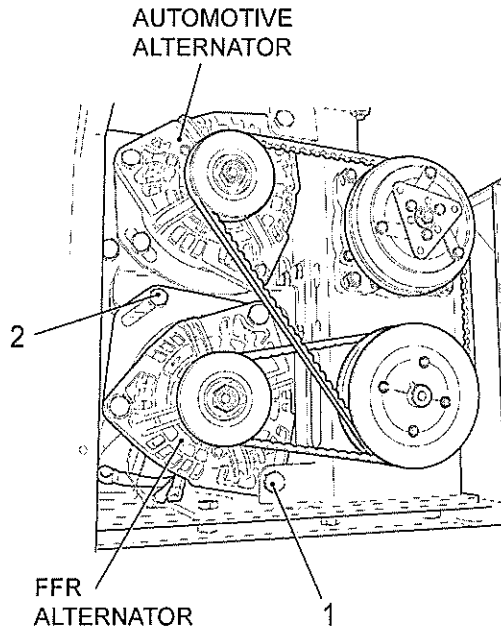


Fig 3 Hydraulic module drive belts

- 9.5 After first noting positions, disconnect leads of alternator EMC filter, wiring loom connection and battery cable.
- 9.6 Disconnect earth bonding lead from hydraulic module frame.
- 9.7 Remove the pivot and adjuster bolts and withdraw alternator from the hydraulics module.
- 9.8 Remove alternator carrier bracket and earth bonding lead from alternator and retain.
- 10 Alternator installation is the reverse of the above procedure, paying particular attention to the following notes:

NOTES

- (1) Clean earth bonding point and lead should with a mild abrasive material (emery cloth) prior to installation. Upon installation the bonding point should be covered in silicone electrical grease.
- (2) The belt is correctly tensioned when longest length between pulleys can be twisted by hand no more than 90° .
- (3) Run vehicle upon completion and ensure charge control lamps extinguish.

ALTERNATOR DRIVE BELTS

Replacement

- 11 The automotive and FFR 28V 100A alternators are found in the hydraulic module located on the left external side of the vehicle. To replace either alternator belt proceed as follows:

11.1 Isolate the electrical system and disconnect the batteries in accordance with the procedure in Para 15.1 through 15.4.

CAUTION

DAMAGE TO ENGINE MANAGEMENT SYSTEM – AUTOMOTIVE BATTERIES. If the 12V dc positive (+ve) wire is not disconnected first and the 24V dc negative (-ve) cable is removed first, the 12V dc wire could act as a negative (-ve) wire for the 24V dc system and could cause system damage.

11.2 Remove and retain the bolts securing rear end cover of the hydraulic module and remove the cover (see Fig 2).

11.3 Loosen the pivot and adjuster bolts (see Fig 3 (1 and 2)) from the required alternator, release tension from drive belt and remove belt.

12 Belt installation is the reverse of the above procedure, paying particular attention to the following notes:

NOTES

- (1) The belt is correctly tensioned when longest length between pulleys can be twisted by hand no more than 90°.
- (2) Run vehicle upon completion and ensure charge control lamps extinguish.

VEHICLE BATTERIES

WARNINGS

- (1) **INJURY TO PERSONNEL. NEVER EXPOSE A BATTERY TO A NAKED FLAME.**
- (2) **ELECTRIC SHOCK. REMOVE ALL JEWELLERY BEFORE WORKING WITH BATTERIES.**
- (3) **ELECTRIC SHOCK. BE CAREFUL WHEN USING METAL TOOLS ON OR NEAR A BATTERY.**
- (4) **ELECTRIC SHOCK. ALWAYS ISOLATE VEHICLE ELECTRICS AT THE BATTERY MAIN SWITCH AND DISCONNECT BATTERIES PRIOR TO MAINTENANCE OF THE ELECTRICAL UNITS OR SYSTEM.**

CAUTIONS

- (1) **DAMAGE TO ELECTRICAL SYSTEM.** Never disconnect the vehicle batteries whilst the engine is running.
- (2) **DAMAGE TO ELECTRICAL SYSTEM.** Prior to carrying out any welding on the vehicle, isolate vehicle electrics at the battery main switch, disconnect batteries and alternator and remove Vehicle Power Distribution Box.
- (3) **DAMAGE TO ELECTRICAL SYSTEM.** Disconnect the batteries prior to boost charging.

13 The battery box is located at the forward end of the rear compartment (see Fig 4 (1)). Two pairs of 12V 85 Ah Absorbed Glass Mat (AGM), maintenance free, sealed for life, lead acid batteries supply the 12/24V dc automotive electrical system and 24V dc FFR circuit. Automotive batteries (5) are located on the RH side of the battery box. FFR batteries (6) are located on the LH side.

14 Push each of the latches down (see Fig 4 (2)) to unlock, raise the lid (3) and gain access to the batteries. Lock the lid by pressing closed the latches (4) upon closing the battery box lid.

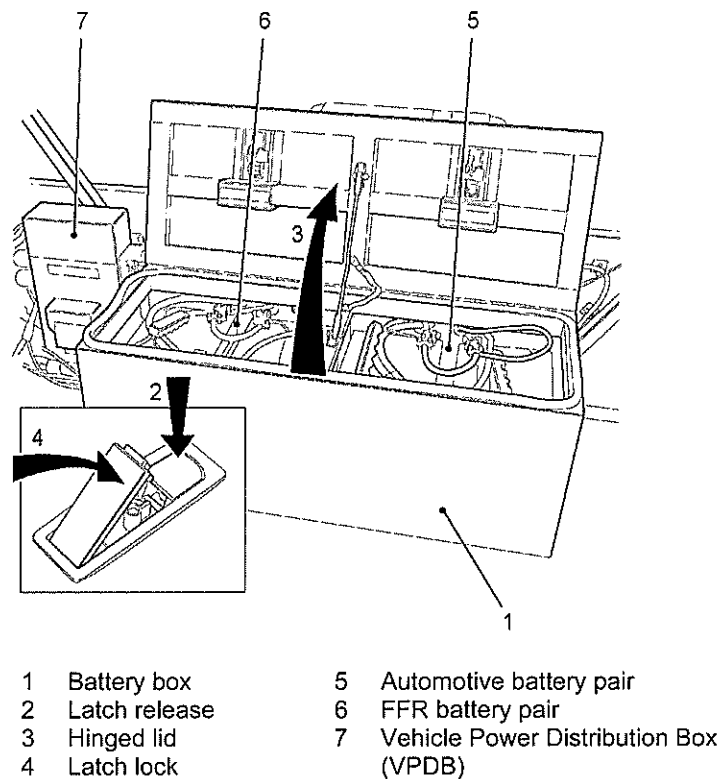


Fig 4 Battery box

Removal

15 Both pairs of batteries are linked in series to provide 24V dc. Due to the EURO III engine management system operating on 12V dc there is a single wire that takes a 12V dc feed from the automotive batteries. Removal of the vehicle batteries is as follows:

15.1 Isolate the electrical system. Turn the battery main switch in the vehicle cab, behind the passenger seat to the OFF position. Turn the FFR battery switch mounted on the FFR box to the OFF position. Access the required battery pair.

CAUTION

DAMAGE TO ENGINE MANAGEMENT SYSTEM – AUTOMOTIVE BATTERIES. If the 12V dc positive (+ve) wire is not disconnected first and the 24V dc negative (-ve) cable is removed first, the 12V dc wire could act as a negative (-ve) wire for the 24V dc system and could cause system damage.

15.2 Automotive batteries only. Disconnect the yellow (or white and orange) wire from the 12V dc positive (+ve) terminal and ensure that this is safely placed, i.e. cannot reconnect with the any terminal unintentionally.

15.3 Disconnect the 24V dc negative (-ve) battery terminal and ensure that this is isolated and safely placed, i.e. cannot reconnect with the terminal unintentionally.

15.4 Disconnect the 24V dc positive (+ve) battery terminal and ensure that this is isolated and safely placed, i.e. cannot reconnect with the terminal unintentionally.

15.5 Remove the batteries from the battery box.

Refitting

16 Refitting of the vehicle batteries is the reverse of the above procedure.

VEHICLE POWER DISTRIBUTION BOX (VPDB)

Removal

17 Removal of the Vehicle Power Distribution Box (VPDB) is as follows:

17.1 Isolate the electrical system and disconnect the batteries in accordance with the procedure in Para 15.1 through 15.4.

CAUTION

DAMAGE TO ENGINE MANAGEMENT SYSTEM – AUTOMOTIVE BATTERIES. If the 12V dc positive (+ve) wire is not disconnected first and the 24V dc negative (-ve) cable is removed first, the 12V dc wire could act as a negative (-ve) wire for the 24V dc system and could cause system damage.

17.2 Undo all circular plastic connectors to the VPDB.

17.3 Undo the 'P' clip retaining the engine harness, located on the LH side when viewed from the front of the box.

17.4 Undo jack-screws and disconnect 'D'-type connectors on engine loom.

17.5 Unplug the two plugs (removing cap first) from the top of the glow plug relay (J52).

17.6 Disconnect the two earth leads from the M8 screws at the top-left of the VPDB.

17.7 Disconnect all leads from the four studs (3-off M6, 1-off M5) on the RH side of the box.

17.8 Undo and remove the 4 off M6 nuts securing the VPDB to the backboard. Lift off the VPDB and remove from the vehicle.

Refitting

18 Refitting of the VPDB is the reverse of the above procedure, paying particular attention to the following notes:

NOTES

(1) 12V dc power feed to glow plug relay (yellow or white/orange cable) terminates to top stud (M5).

(2) Switched supply from the switched side of the isolator switch (usually the upper switched terminal) is connected to the third stud (M6) down from the top of the VPDB.

(3) The fourth stud (M6) is connected to the permanent live side of the isolator switch and to the alternator feed. This is identified as the red cable that passes up through the feed through in the floor of the vehicle cab.

(4) When reconnecting the 'D'-type connectors, ensure that they are fully mated home before tightening screws and fitting 'P' clips.

CAUTION

DAMAGE TO ELECTRICAL SYSTEM. Ensure all cables and looms are connected to the VPDB before re-powering.

- (5) Upon installation and connection of a VPDB the ignition should be initially turned on for a minimum of 15 seconds in order to permit a "hand shake" between the ECU and the rest of the engine management system.

STEERING LOCK

Removal

- 19 To remove the steering lock, proceed as follows:
- 19.1 Isolate the electrical system. Turn the battery main switch in the vehicle cab, behind the passenger seat to the OFF position. Turn the FFR battery switch mounted on the FFR box to the OFF position.
 - 19.2 Remove plastic guard cover from back of steering lock on steering column.
 - 19.3 Remove screws from steering lock retaining clamp and take off clamp.
 - 19.4 Remove plastic knee guard from beneath steering column.
 - 19.5 Separate steering lock cable connectors.
 - 19.6 Take off steering lock with harness.

Refitting

- 20 Refitting is done in reverse order to removal. Ensure clearance of approximately 2 mm between switch clamp and top collar of steering spindle.

BRAKE LIGHT SWITCH

Removal

- 21 To replace the brake light switch, proceed as follows:
- 21.1 Isolate the electrical system. Turn the battery main switch in the vehicle cab, behind the passenger seat to the OFF position. Turn the FFR battery switch mounted on the FFR box to the OFF position.
 - 21.2 Remove plastic knee guard from beneath steering column.
 - 21.3 Loosen lock nuts securing brake light switch, pull off electrical plug and take off switch.

Refitting

- 22 Refitting is done in reverse order to removal. Ensure that approximately 5 mm of thread protrudes through switch bracket (switch end just touches brake lever).

REPLACE DASHBOARD WARNING LAMPS

- 23 To replace the dashboard warning lamps, proceed as follows:
- 23.1 Isolate the electrical system. Turn the battery main switch in the vehicle cab, behind the passenger seat to the OFF position. Turn the FFR battery switch mounted on the FFR box to the OFF position.
 - 23.2 Gently remove warning lamp covers from dashboard using a screwdriver. Take care not to damage dashboard or lamp cover.
 - 23.3 Pull off socket and replace lamp.

WINDSCREEN WIPER MOTOR**Removal**

- 24 To remove the windscreen wiper motor, proceed as follows:
- 24.1 Isolate the electrical system. Turn the battery main switch in the vehicle cab, behind the passenger seat to the OFF position. Turn the FFR battery switch mounted on the FFR box to the OFF position.
 - 24.2 Remove nut retaining crank arm to wiper motor spindle and take off crank.
 - 24.3 Remove cover from motor enclosure located above dashboard.
 - 24.4 Pull off electrical connector; remove retaining screws and wiper motor.

Refitting

- 25 Refitting is done in reverse order to removal.

WINDSCREEN WIPER LINKAGE**Removal**

- 26 To remove the windscreen wiper linkage, proceed as follows:
- 26.1 Isolate the electrical system. Turn the battery main switch in the vehicle cab, behind the passenger seat to the OFF position. Turn the FFR battery switch mounted on the FFR box to the OFF position.
 - 26.2 After first noting orientation, remove wiper arms.
 - 26.3 Loosen nuts and remove from windscreen wiper bearings.
 - 26.4 Remove nut retaining crank arm to wiper motor spindle and take off crank.
 - 26.5 Remove linkage cover from above dashboard.
 - 26.6 If it is necessary to remove wiper motor enclosure:
 - 26.6.1 Disconnect wiper motor harness bayonet from EMC suppressor (located beneath wiper motor enclosure).
 - 26.6.2 Remove cover from wiper motor enclosure located above dashboard.
 - 26.6.3 Remove three bolts and remove enclosure complete with wiper motor.
 - 26.7 Remove linkage from vehicle cab.

Refitting**CAUTION**

EQUIPMENT DAMAGE. Motor crank arm and linkage must align at motor before tightening nut. Observe adjustment of wiper arms.

- 27 Refitting is done in reverse order to removal

ABS ELECTRONIC CONTROL UNIT

Removal

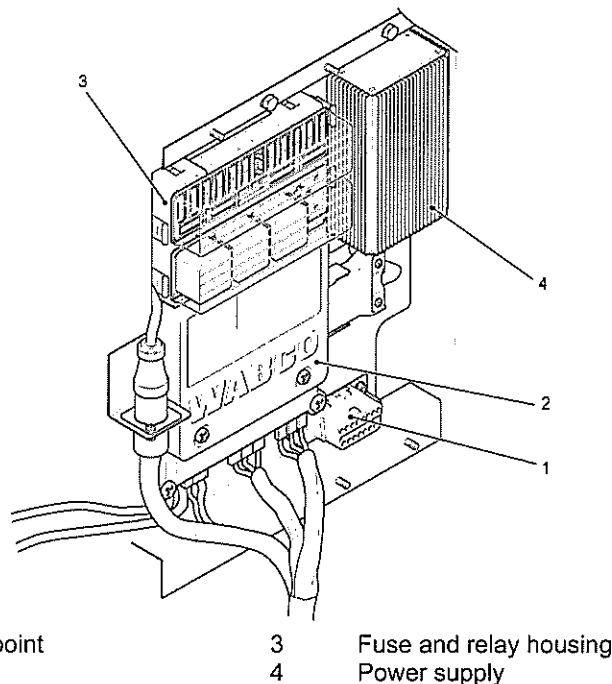
28 To remove the ABS Electronic Control Unit (ECU), proceed as follows:

28.1 Isolate the electrical system and disconnect the batteries in accordance with the procedure in Para 15.1 through 15.4.

CAUTION

DAMAGE TO ENGINE MANAGEMENT SYSTEM – AUTOMOTIVE BATTERIES. If the 12V dc positive (+ve) wire is not disconnected first and the 24V dc negative (-ve) cable is removed first, the 12V dc wire could act as a negative (-ve) wire for the 24V dc system and could cause system damage.

28.2 The electrical element of the ABS system is located on the ABS control board (Fig 5) located on the rear bulkhead of the vehicle cab, behind the passenger seat. To access the control board, remove the cover.



- | | | | |
|---|------------------|---|------------------------|
| 1 | Diagnostic point | 3 | Fuse and relay housing |
| 2 | ABS ECU | 4 | Power supply |

Fig 5 ABS Control Board

28.3 Identify the ECU (Fig 5 (2)) and unplug the electrical cables from it.

28.4 Unscrew the three retaining screws and remove the ECU from the control board.

Refitting

29 Refitting is done in reverse order to removal.

30 Connect the diagnostic controller (see AESP 2320-D-503-512 Chapter 10) and perform a system check of the ABS.

ABS POWER SUPPLY**Removal**

31 To remove the ABS power supply, proceed as follows:

31.1 Isolate the electrical system and disconnect the batteries in accordance with the procedure in Para 15.1 through 15.4.

CAUTION

DAMAGE TO ENGINE MANAGEMENT SYSTEM – AUTOMOTIVE BATTERIES. If the 12V dc positive (+ve) wire is not disconnected first and the 24V dc negative (-ve) cable is removed first, the 12V dc wire could act as a negative (-ve) wire for the 24V dc system and could cause system damage.

31.2 The electrical element of the ABS system is located on the ABS control board (Fig 5) located on the LH side wall of the cab, adjacent to the VPDB. To access the control board, remove the cover. To replace the power supply, the control board must be removed from the vehicle.

NOTE

The power supply may be warm if the vehicle has been in use.

31.3 Unplug the power supply connector from the main control board harness.

31.4 Unscrew the fixings securing the control board to the left hand side wall of the cab, and lay the control board forward to permit access to the rear side.

NOTE

Unplug all necessary electrical cables from the control board to permit access to the rear.

31.5 Unscrew the fixings securing the power supply to control board, and remove power supply.

Refitting

32 Refitting is done in reverse order to removal.

CHAPTER 16

BODY, CAB AND FITTINGS

CONTENTS

Chap

- 16 Body, cab and fittings
- 16-1 Armour body system
- 16-2 Miscellaneous fittings

RESTRICTED

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CHAPTER 16-1

ARMOUR BODY

CONTENTS

Chapter

- 16-1-1 VECTOR armour body system
- 16-1-2 VECTOR 2 armour body system
- 16-1-3 Ambulance variant body system

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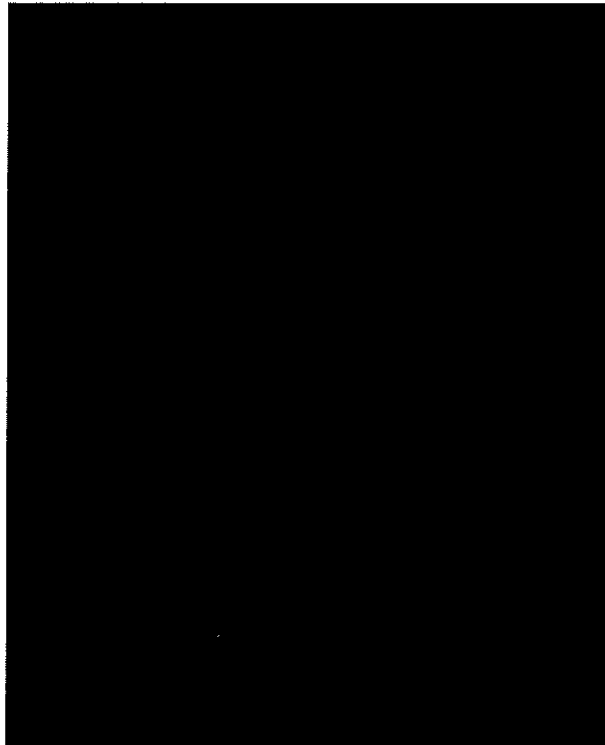
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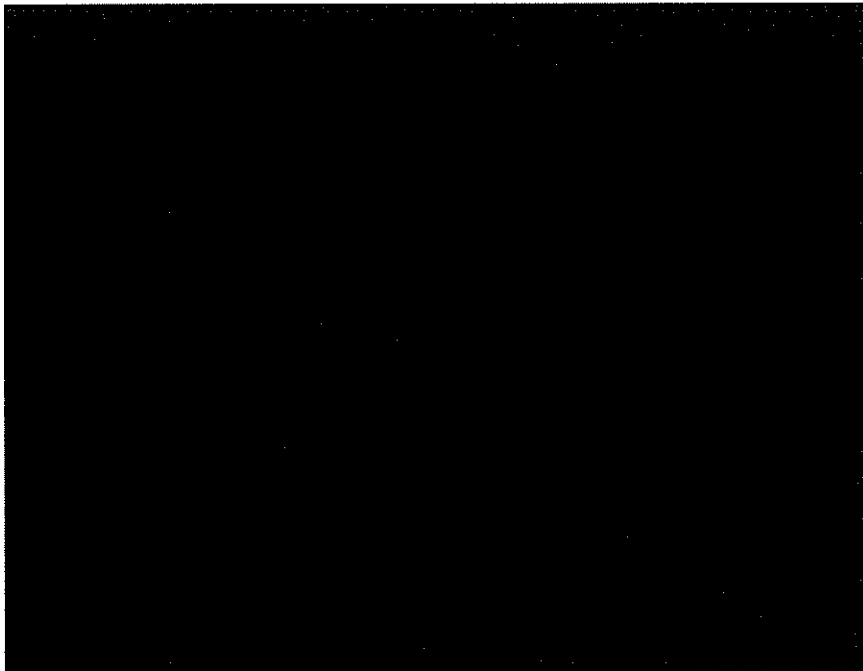
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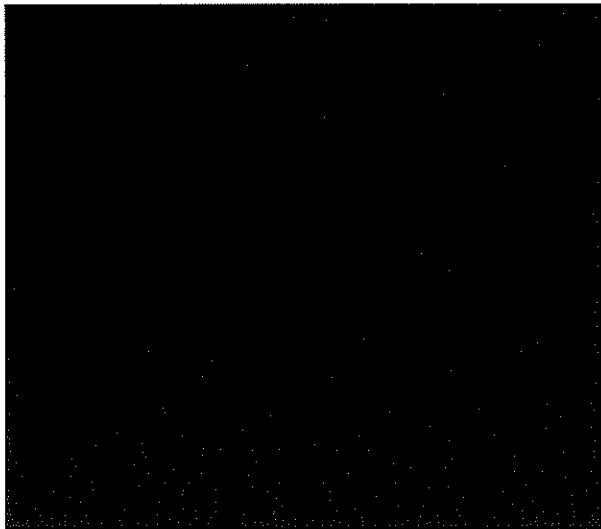
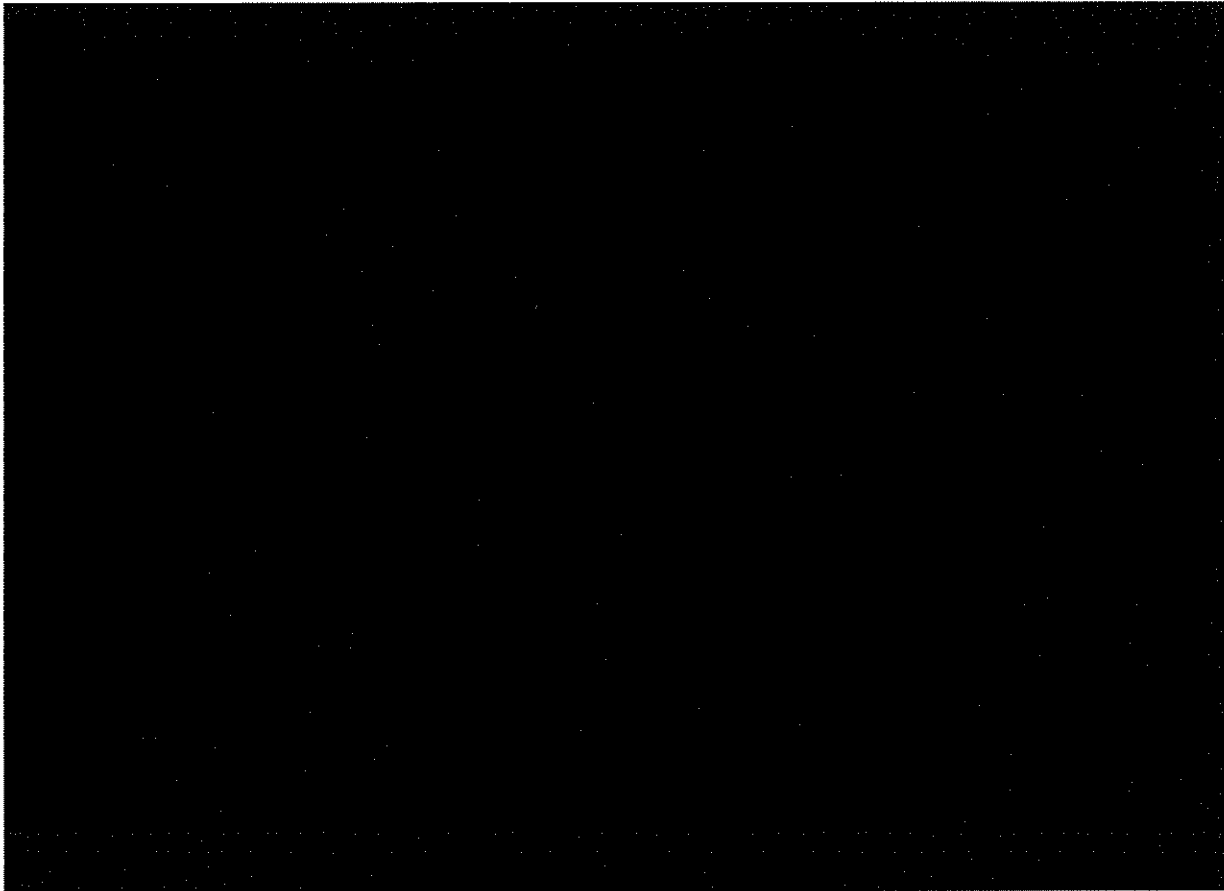
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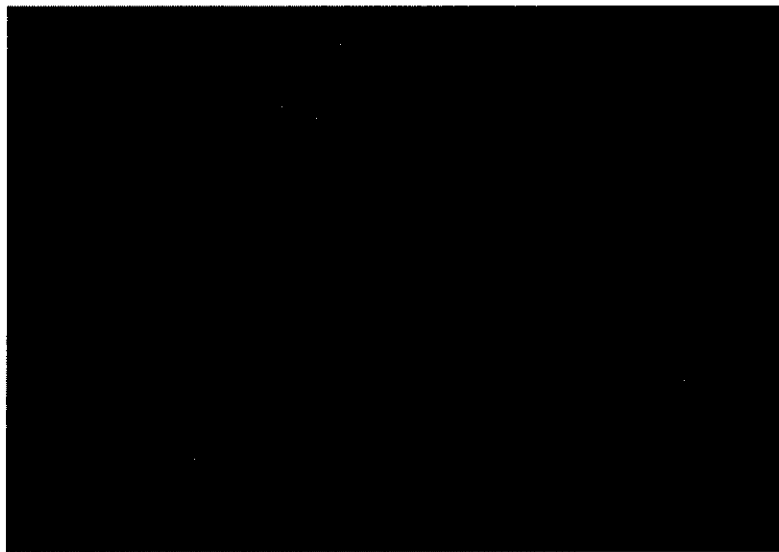
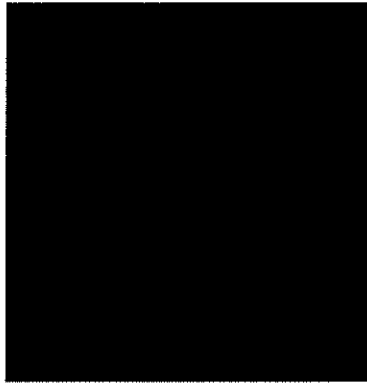
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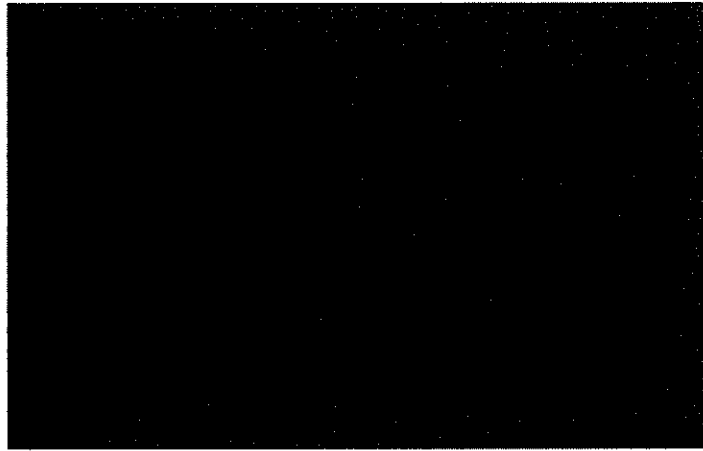
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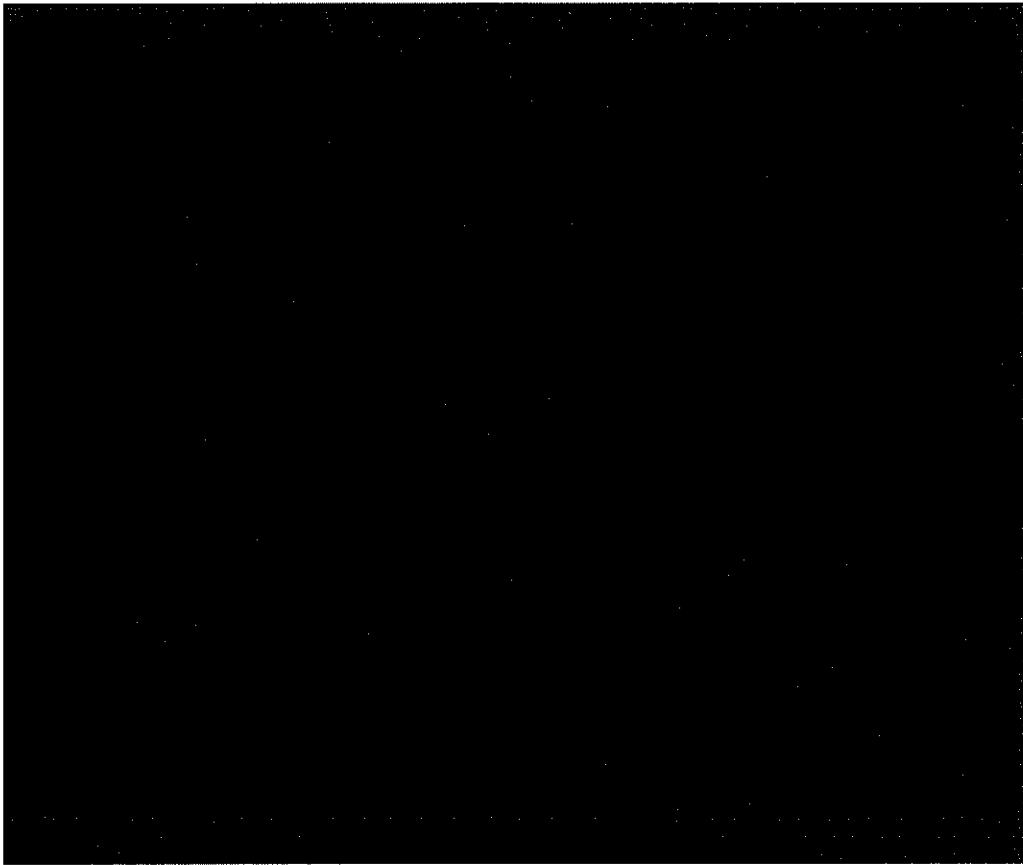
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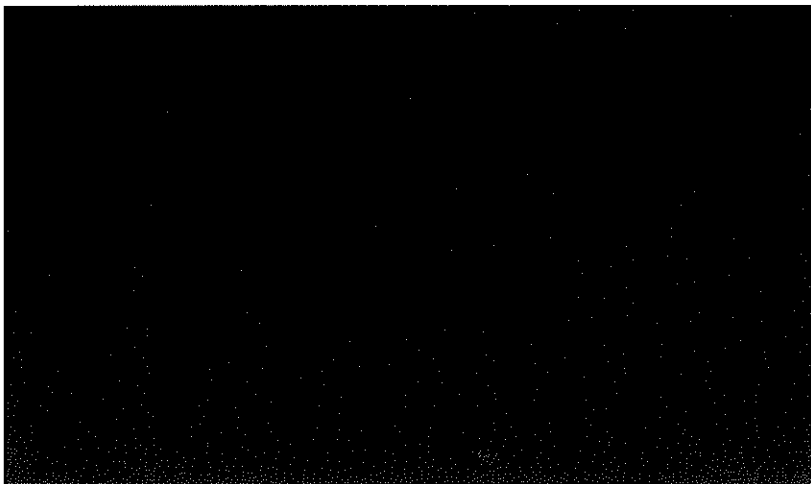
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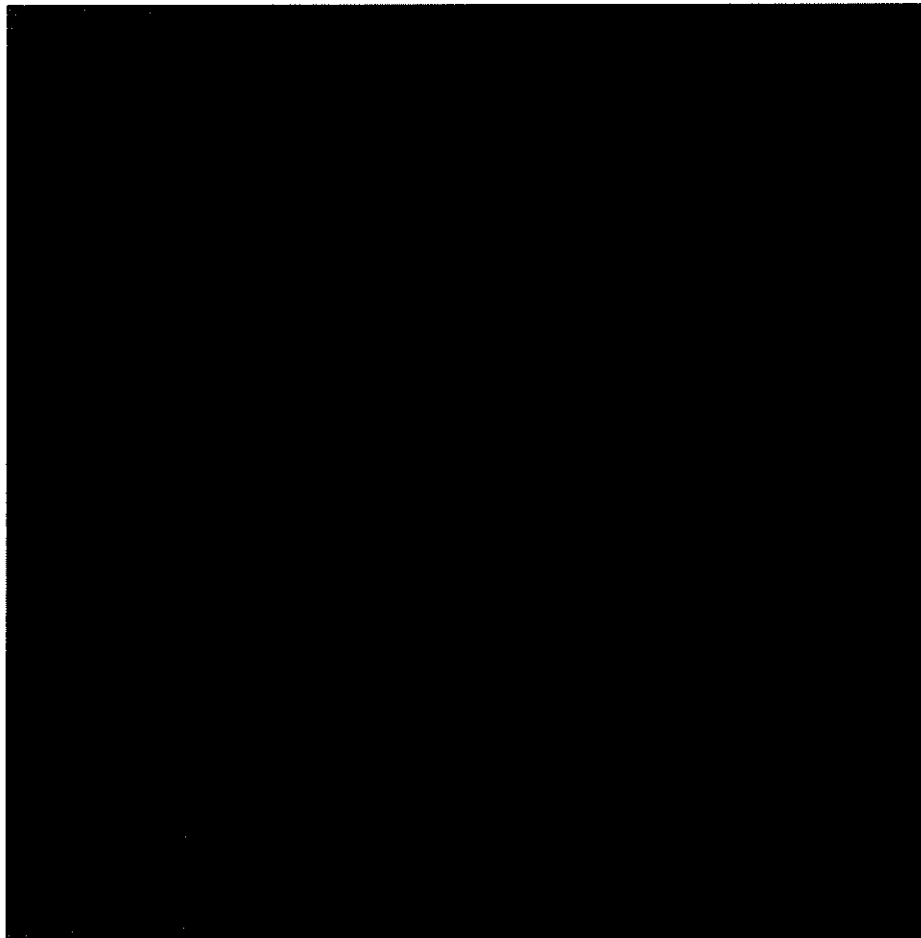
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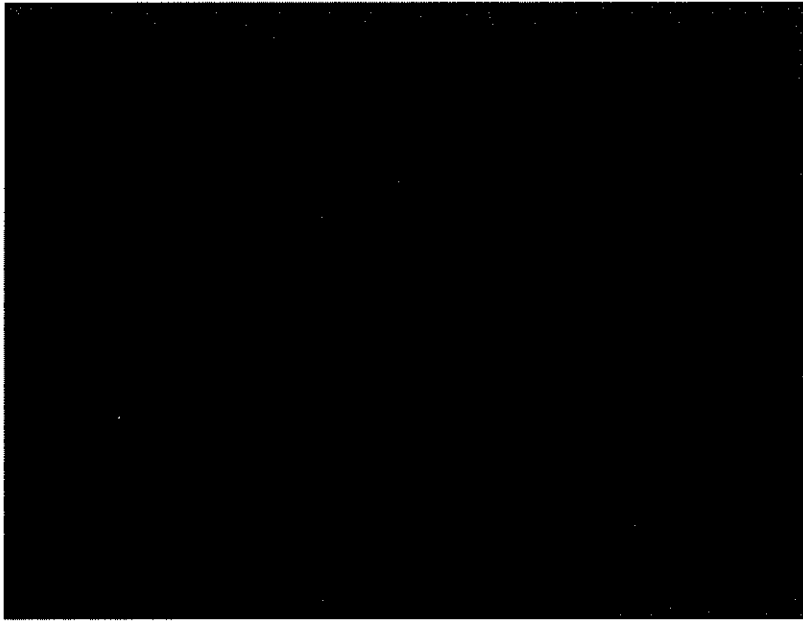
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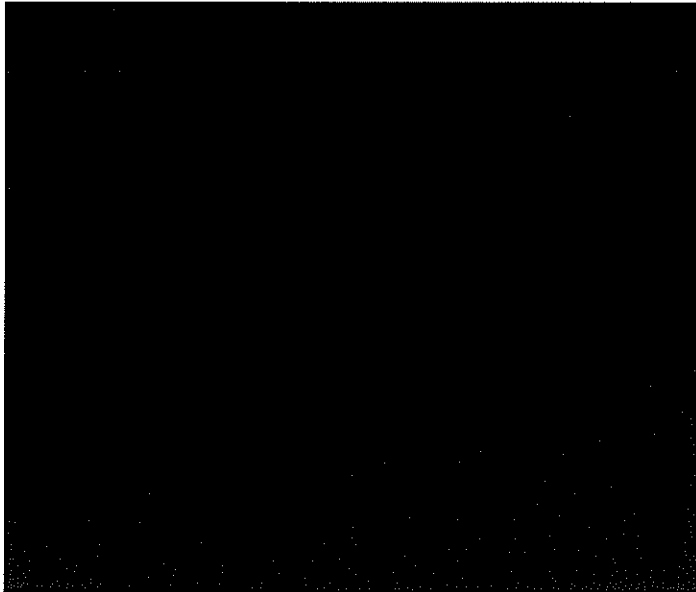
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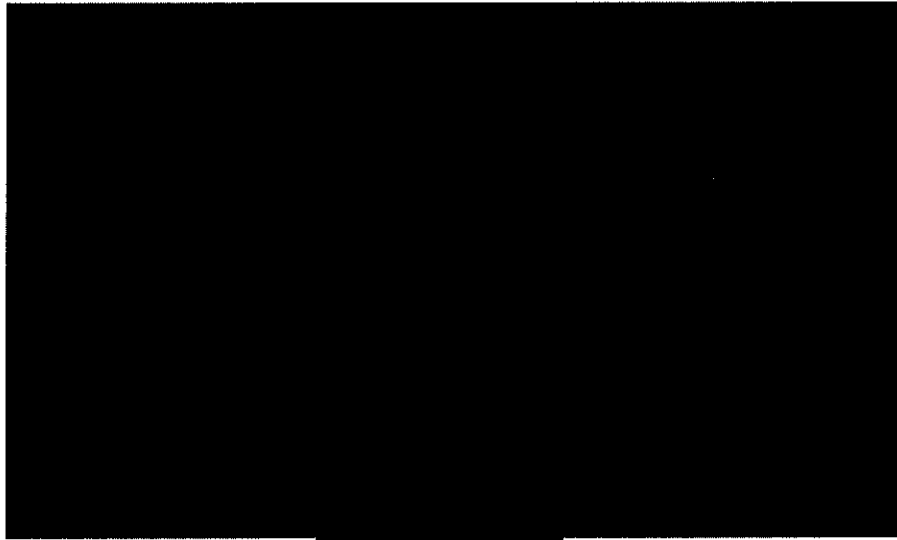
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CHAPTER 17

HYDRAULIC SYSTEM

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INTRODUCTION

1 This Chapter details the procedures for work carried out on the hydraulic system. The majority of tasks described in this chapter can be performed with access via the hinged maintenance side panel and/or front and rear bolted access covers. In some instances access may be aided by unbolting the cover panel from the under side of the hydraulic module.

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools or test equipment for this Chapter are shown below:

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Item (1)	NSN (2)	Manufacturer's Part No. (3)	Designation (4)
1	TBA	8251569268	Pressure test gauge

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings in this chapter are shown below:

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Hydraulic module mounting bolts.	40	18, Note 3
2	Hydraulic motor pulley grub screws	30	48.5
3	Pump securing bolts	44	41, Note 1
4	Pump pulley to key way spacer	22	41, Note 4
5	Pump mounting bracket to engine	44	45
6	FEAD belt tensioner pulley	22	45

GENERAL INFORMATION**WARNINGS**

- (1) **HAZARDOUS SUBSTANCE. HANDLE HYDRAULIC OIL CAREFULLY AND NEVER FILL CONTAINERS WHERE INADVERTENT CONSUMPTION IS POSSIBLE.**
- (2) **HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.**
- (3) **BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.**
- (4) **DANGER TO LIFE AND LIMB – PRESSURISED HYDRAULIC OIL. PRIOR TO PERFORMING ANY SCHEDULED OR UNSCHEDULED MAINTENANCE ENSURE THAT THE VEHICLE ELECTRICAL SYSTEM IS SWITCHED OFF.**

CAUTIONS

- (1) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.
- (2) **EQUIPMENT DAMAGE.** Absolute cleanliness is necessary when working on hydraulic systems and components. All ports and orifices must be capped off immediately when a component is removed or a pipe is disconnected.

(3) WASTE PRODUCTS. Personnel responsible for the disposal of waste products must comply with local regulations and procedures

4 The hydraulic system operates whenever the vehicle engine is running as the engine directly drives the hydraulic pump.

5 System pressure depends on the following factors:

5.1 **Electrical load.** As the electrical load on the alternators increases then the pressure in the system increases.

5.2 **Environmental Control System (ECS) load.** As the ECS increases the pressure in the system increases. This is usually when the ECS is switched on as the loading is at it's highest as the system reduces crew compartment temperature.

5.3 **Engine Speed.** As the engine speed increase then the pressure in the system decreases as the flow increases.

5.4 **Ambient temperature.** As a rule in a hydraulic system the pressure decreases as the ambient temperature increases. This will not be the case in this application as with increasing ambient temperature the ECS load increases.

5.5 In general with the ECS operating the hydraulic system pressure will be between 120 and 240 bar once the system has stabilised after start up.

6 Indicative operating speeds (engine v pump/motor v ECS compressor) are provided in Table 3. The speed of the motor is proportional to the speed of the hydraulic pump and therefore the speed of the engine.

TABLE 3 INDICATIVE SYSTEM RPM

Engine RPM	Hydraulic pump / motor RPM	ECS compressor RPM
777	1165	1192
1750	2625	2686
3400	5100	5219
4300	6450	6600

7 The component layout in the hydraulic module is provided in Fig 1.

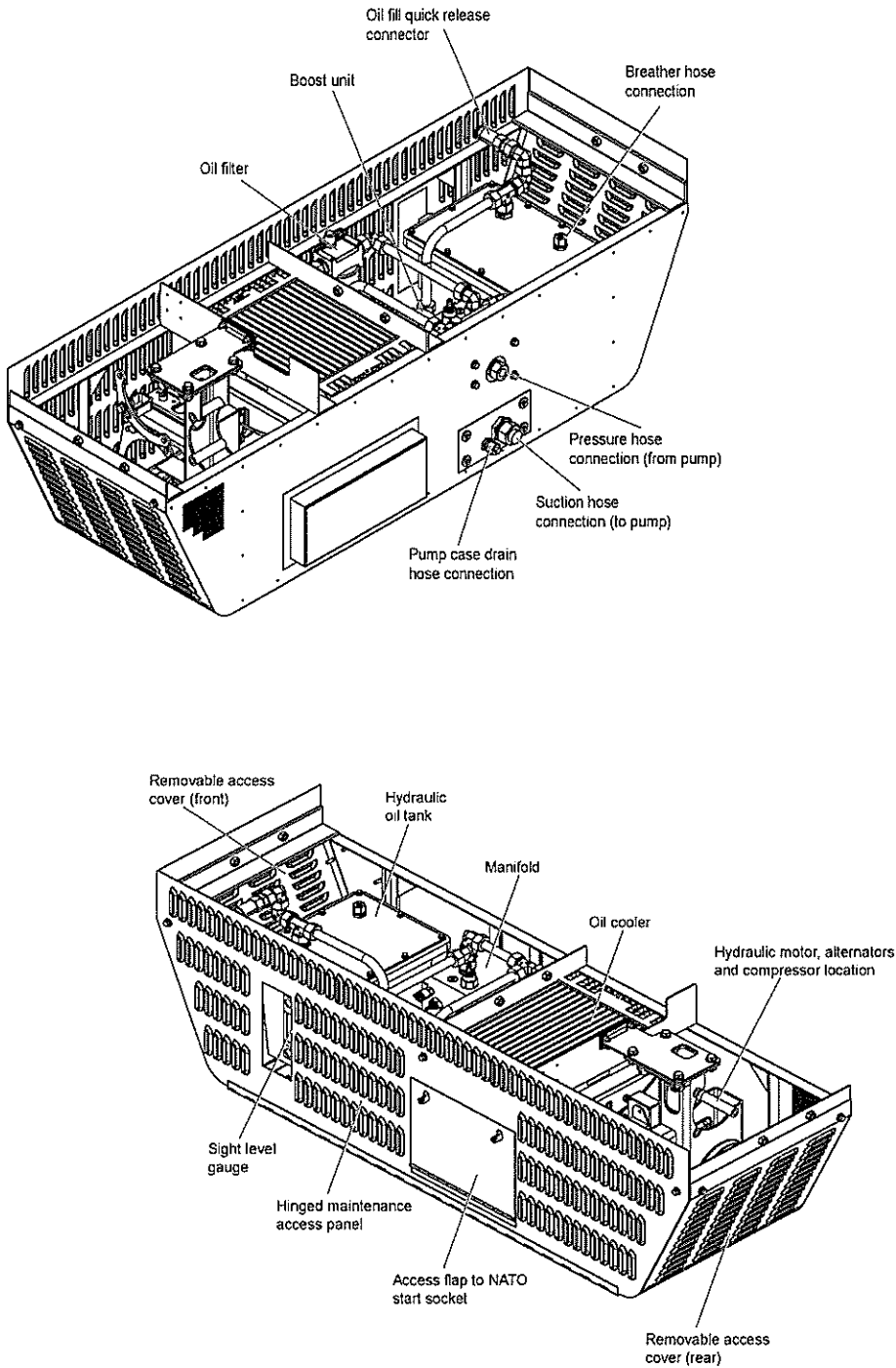


Fig 1 Hydraulic module component layout

FILLING AND PRIMING PROCEDURE

8 The level of the oil in the hydraulic module is indicated on the sight level gauge located in the side of the hydraulic system module on the left external side of the vehicle (see Fig 2).

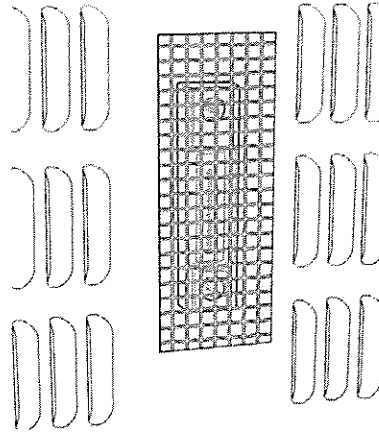


Fig 2 Sight level gauge – hydraulic system

9 The hydraulic oil is at the correct level when the level is between the top and two thirds down the sight level gauge. Whenever any hydraulic component is exchanged in the system an amount of oil will be lost and air will enter the circuit. The addition of air adds instability to the system.

10 When necessary, fill or top up oil level as follows:

10.1 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 2).

10.2 Connect the fill adaptor provided in the vehicle CES onto the quick release connector (see Fig 1 and Fig 3 (1)).

10.3 With the aid of a suitable hose or funnel fill oil until the level is between the top and two thirds down the sight level gauge.

10.4 Disconnect the fill adaptor.

CAUTION

EQUIPMENT DAMAGE. Do not run the vehicle with the fill adaptor connected.

11 Air is expelled from the system via the air breather that is connected to the top of the tank (see Fig 1 and Fig 3 (1)). Once any hydraulic component is exchanged and/or the system oil is changed or topped up, run the engine at tick over for 2 minutes with the air conditioning switched off.

12 Re-check oil level and top up as necessary.

13 Check the filter blocked indicator (see Para 21).

14 Secure the hinged side panel.

15 Stow fill adaptor.

16 Run vehicle upon completion to ensure charge control lamps and hydraulic pressure lamp extinguish and ECS operates.

HYDRAULIC MODULE**WARNING**

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

Removal

17 To remove the hydraulic module proceed as follows:

17.1 Position the vehicle on level ground.

17.2 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

17.3 Locate the vehicles automotive batteries. The battery box is located at the forward end of the rear compartment. Two pairs of 12V 85 Ah Absorbed Glass Mat (AGM) maintenance free sealed for life lead acid batteries supply the 12/24V dc automotive electrical system and 24V dc FFR circuit. Automotive batteries are located on the right hand side of the battery box. FFR batteries are located on the left hand side.

17.4 Disconnect the yellow 12V ECU feed wire, from the automotive batteries then the vehicles negative (-ve) battery terminals and ensure that it is safely stowed, ie so that it cannot unintentionally reconnect with the terminal.

17.5 Place a suitable drain tray on the ground under the hydraulic module beneath the hydraulic hose connections at the in board side of the module (see Fig 1).

17.6 Disconnect the three hoses and allow the oil to drain into the tray. Dispose of used oil in accordance with local regulations and procedures.

17.7 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

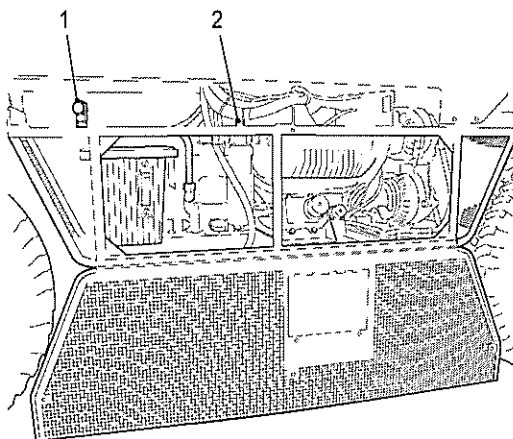


Fig 3 Hydraulic module access – side

17.8 Remove and retain the bolts securing front and rear end covers of the hydraulic module and remove the cover (see Fig 4).

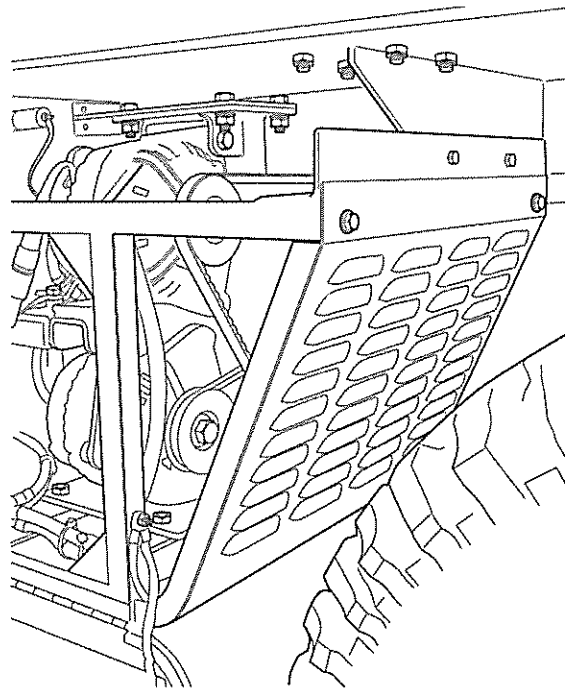


Fig 4 Hydraulic module end cover (typical)

17.9 Decommission the ECS compressor (see Chapter 18).

17.10 When the compressor has been decommissioned disconnect refrigerant hoses, seal ends and electrical connector.

NOTE

When the hydraulic module has been removed from the vehicle remember to measure the quantity of the oil in the compressor in accordance with Chapter 18.

17.11 Disconnect the breather hose from the connection on the top of the hydraulic oil tank (see Fig 1).

17.12 Trace route of the two electrical harnesses and two large red battery leads from entry into the module from the vehicle (through hole in floor of vehicle located approximately above main manifold).

17.13 **After first noting route of harnesses and leads, connection points and location of any cable ties securing the harness**, carefully cut cable ties securing harnesses to module and disconnect harness from alternators, EMC filter boxes, pressure switch (in base of module) etc. Retain all fixing bolts, connection boots etc.

17.14 Check that all necessary electrical points have been disconnected and un-clipped.

17.15 Remove the bolts securing the middle of the hydraulic module frame to the vehicle frame.

17.16 Close the hinged maintenance access panel and secure with loosely with a bolt.

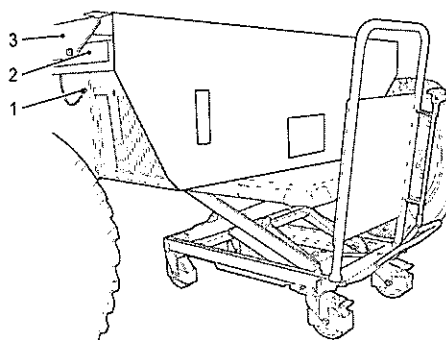


Fig 5 Hydraulic module removal (typical)

- 17.17 Disconnect the earth bonding lead between hydraulic module and vehicle (see Fig 5 (1)).
- 17.18 Support the module with an appropriate scissor lift table (see Fig 5) or jack. Protect the base of the hydraulic module with a piece of wood to prevent damage and/or spread the load of the mechanical handling aid.
- 17.19 Remove the bolts securing the front and back of the hydraulic module frame to the vehicle frame and carefully lower the module down and away from the vehicle.
- 17.20 Contain any oil spill with spill absorbent materials.
- 17.21 Measure the quantity of the oil in the compressor in accordance with Chapter 18.

Refitting

18 Fitting the hydraulic module is generally the reverse of the removal procedure (subject to the following notes):

NOTES

- (1) Commission compressor in accordance with Chapter 18.
- (2) When attaching hydraulic module to vehicle locate module frame to rearward side of mounting plates on vehicle frame.
- (3) Fit all mounting bolts loosely to allow alignment of hydraulic module to vehicle and then tighten to correct torque (see Table 2, Ser 1).
- (4) Upon re-installation of the earth lead, cover the bonding point in silicone electrical grease.
- (5) Route all hoses and electrical harnesses and leads as original installation and connect. Re-clip and cable tie.
- (6) Recharge ECS in accordance with Chapter 18.
- (7) Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.
- (8) Replace all covers and run vehicle upon completion to ensure charge control lamps and hydraulic pressure lamp extinguish and ECS operates.

HYDRAULIC PUMP BELT REPLACEMENT

19 The hydraulic pump is driven via the ribbed V (FEAD) belt on the engine. Refer to Chapter 1 for belt replacement instructions.

HYDRAULIC MOTOR BELT REPLACEMENT

20 The hydraulic motor drives two alternators and the ECS compressor via two drive belts. Refer to Chapter 13 for belt replacement instructions (replacing alternator drive belts).

CHECKING THE OIL FILTER BLOCKED INDICATOR

21 A filter blocked indicator is provided on the oil filter (see Fig 1) head. To check the filter blocked indicator proceed as follows:

21.1 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3) and check indicator (see Fig 3 (2)).

22 If the indicator is red the filter is blocked and must be replaced.

OIL FILTER REPLACEMENT

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

23 To replace the oil filter element proceed as follows:

23.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

23.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

23.3 Position a suitable drip tray under the filter and unscrew the filter bowl and remove the element from the underside of the filter head. Dispose of used oil and filter in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials

24 Install new filter element as a reverse of the remove procedure.

25 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

26 Check the filter blocked indicator (see Para 21).

BOOST FILTER REPLACEMENT**WARNING**

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

27 To replace the boost filter element proceed as follows:

27.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

27.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

27.3 Position a suitable drip tray under the filter and unscrew the boost filter element (adjacent to the manifold (see Fig 1)) using a suitable filter wrench. Dispose of used oil and filter in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

28 Install new filter element as a reverse of the remove procedure.

29 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

BREATHER REPLACEMENT**CAUTION**

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

30 To replace the breather element proceed as follows:

30.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

30.2 Locate the breather on the vehicle roof just behind the ECS condenser assembly. Access the breather via the forward hatch in the rear compartment.

30.3 Remove and retain the three bolts securing the breather and remove breather.

30.4 Dispose of used breather in accordance with local regulations and procedures.

31 Install new breather as a reverse of the remove procedure.

DRAINING THE HYDRAULIC OIL FROM THE TANK

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

32 To drain the oil from the tank proceed as follows:

32.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

32.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

32.3 Remove and retain the bolts securing front end cover of the hydraulic module and remove the cover.

32.4 Place a suitable drain tray on the ground under the hydraulic module beneath the hydraulic oil tank.

32.5 Disconnect wiring from temperature switch located in the port in the forward face of tank.

32.6 Remove the switch from the tank.

32.7 Re-fit drain switch when the flow of oil has stopped and reconnect wiring. Dispose of used oil and filter in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

CHECKING AND RESETTING THE RELIEF VALVE

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

33 To check and reset the relief valve proceed as follows:

33.1 Place a suitable drain tray on the ground under the hydraulic module beneath the hydraulic hose connections at the in board side of the module (see Fig 1).

33.2 Disconnect the pressure and suction hoses and cap the manifold ports using standard 16-S and 18-L pipe tube blanking plugs. Cap the end of the hoses. Dispose of any used oil in accordance with local regulations and procedures.

33.3 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

33.4 Fit a pressure test gauge (see Table 1, Ser 1) to manifold test point TP2.

33.5 Run the engine at fast idle speed (1750 rpm). The reading on the relief valve should be 350 bar.

- 33.6 The pressure of the relief valve (located on the near side face of the manifold assembly) is adjusted by screwing the adjuster thread in (to increase the valve setting) or out, after first releasing the lock nut.
- 33.7 Once the relief valve is set correctly tighten lock nut, switch off the engine and refit the hoses.
- 33.8 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

HIGH OR LOW PRESSURE SWITCH REPLACEMENT

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

- 34 To replace either the high or low pressure switch proceed as follows:
- 34.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.
- 34.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).
- 34.3 Locate required switch. The low pressure switch is located on the rearward side of the manifold adjacent to the two hoses that run to the hydraulic motor (it may be necessary to remove one of the hoses to provide access to the switch – refer to Para 46). The high pressure switch is located on the under side of the manifold.
- 34.4 Disconnect wiring from required switch.
- 34.5 Locate a suitable drain tray under manifold. Remove low pressure switch by directly unscrewing from manifold. Remove high pressure switch by disconnecting pipe nut on elbow fitted to manifold. Dispose of switch and used oil in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.
- 35 Install new switch as a reverse of the remove procedure.
- 36 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

TEMPERATURE SWITCH REPLACEMENT

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

37 To replace either temperature switch fitted in the front or rear of the hydraulic oil tank proceed as follows:

37.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

37.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

37.3 Drain oil from the tank prior to removing temperature switch (see Para 32). If this action removes required switch proceed to Para 38.

37.4 If temperature switch in rearward side of tank requires replacement, disconnect wiring, locate a suitable drain tray under the switch and unscrew from the tank. Dispose of switch and used oil in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

38 Install new switch as a reverse of the remove procedure.

39 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

HYDRAULIC PUMP REPLACEMENT/REMOVAL

WARNINGS

(1) **BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.**

(2) **PERSONAL INJURY. DO NOT ALLOW ANY LOOSE ITEMS OF CLOTHING TO BECOME CAUGHT IN THE FAN BLADES OR ANY OTHER MOVING ENGINE PARTS. REMAIN ALERT AS TO THE LOCATION OF THE ROTATING FAN, PULLEYS, BELTS ETC, WHEN WORKING ON A RUNNING ENGINE.**

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

Removal

40 The hydraulic pump is mounted on the engine. To remove the pump proceed as follows:

40.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

- 40.2 Remove the front seats and engine cover, see Chapter 16-2.
- 40.3 Remove the ribbed V (FEAD) belt, see Chapter 1.
- 40.4 Place a suitable drain tray on the ground under the hydraulic module beneath the hydraulic hose connections at the in board side of the module (see Fig 1).
- 40.5 Disconnect the three hoses and allow the oil to drain into the tray. Dispose of used oil in accordance with local regulations and procedures.
- 40.6 Remove and retain the pump pulley as follows:
- 40.6.1 Remove and retain the three cap head screws securing the pulley to the pump (see Fig 6) and remove pulley (see Fig 6 (1)).
- 40.6.2 After first noting the distance from face of the pump mounting bracket to the key way spacer, remove and retain the securing bolt, key way spacer and key from the pump shaft.

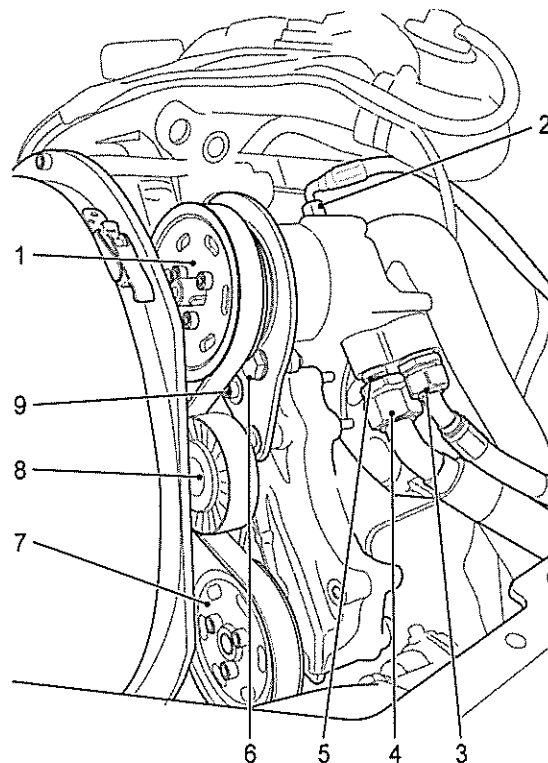


Fig 6 Hydraulic pump

- 40.7 After first noting positions remove and retain (if serviceable) the hoses and adaptors from the pump – (2) (pump case drain hose), (3) (pressure hose) and (4) (suction hose).
- 40.8 Retain hoses if serviceable, otherwise (after first noting positions) un-clip hoses and remove from vehicle.
- 40.9 Remove and retain the two bolts (6) securing the pump to the mounting bracket and remove pump.
- 40.10 Using an Allen key, remove and retain the plug from the fourth port on pump (adjacent to the pressure and suction hose ports (5)).

40.11 Dispose of redundant items and used oil in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

Refitting

41 Fitting a pump is generally the reverse of the remove procedure (subject to the following notes):

NOTES

- (1) Tighten the pump to bracket securing bolts to the correct torque (see Table 2, Ser 3).
- (2) Locate the key way spacer in accordance with the position measured on disassembly and secure the key and key way spacer with the securing bolt.
- (3) Loosely fit the pump pulley and check alignment with the similar power steering pump pulley (see Fig 6 (7)) using a steel rule. Adjust position of key way spacer if necessary to achieve alignment.
- (4) Tighten the three cap head screws securing the pulley to the pump to the correct torque (see Table 2, Ser 4).
- (5) After refitting the plug to the fourth port on pump (5) and connecting the pressure hose (3), suction hose (4), fill the pump case with a small amount of oil via the pump case drain hose port (2) and connect pump case drain hose.

CAUTION

EQUIPMENT DAMAGE. Ensure pump case is primed with oil prior to first operation.

- (6) Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.
- (7) Replace engine cover and front seats (see Chapter 16-2) and run vehicle upon completion to ensure charge control lamps and hydraulic pressure lamp extinguish and ECS operates.

Removal for the purpose of engine replacement

42 In the event the hydraulic pump is being removed in order to remove the engine, there should be no need to disconnect the hoses from the pump or hydraulic module. To remove the pump, in this instance, remove the ribbed V (FEAD) belt (see Chapter 1) together with the FEAD tensioner pulley adjacent to the pump pulley (see Fig 6 (8)).

43 This will allow access to the three cap head screws (9) securing the pump mounting bracket to the engine. Unbolt the bracket from the engine and lay back the complete assembly away from the working area ready to reassembly. Temporarily secure the pump/hose assembly away from the engine to prevent damage/movement.

44 The tensioner pulley on the replacement engine will need to be removed to allow the installation of the pump mounting bracket.

45 Upon reassembly, tighten the three cap head screws securing the pump mounting bracket to the engine to the correct torque (see Table 2, Ser 5) fit the tensioner pulley and tighten to the correct torque (see Table 2, Ser 6).

HYDRAULIC MOTOR REPLACEMENT

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

46 The hydraulic motor is located under the ECS compressor at the rear in board corner of the hydraulic module. To replace the hydraulic motor proceed as follows:

46.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

46.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

46.3 Remove and retain the bolts securing the rear end cover of the hydraulic module and remove the cover (see Fig 4).

46.4 Unbolt and remove the cover panel from the under side of the hydraulic module

46.5 Remove alternators (see Chapter 13). Remove oil cooler (see Para 50)

46.6 To provide access to the motor, remove the bracket on which the NATO start socket is mounted and lay to one side.

46.7 After first noting the distance from face of motor mounting bracket to the pulley, remove and retain the motor pulley as follows:

46.7.1 Remove the 2 off grub screws using an Allen key (see Fig 7 (1)).

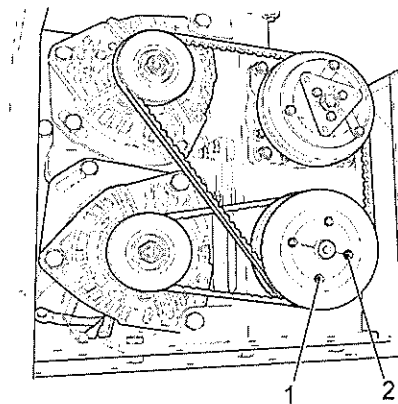


Fig 7 Hydraulic motor pulley

46.7.2 After first oiling the thread and point of the grub screws, insert the removed screws into the jacking holes in the pulley (2). Tighten screws alternatively until the bush is loosened in the hub and assembly is free on the motor shaft.

46.7.3 Remove the assembly from the shaft

46.8 Place a suitable drain tray on the ground under the hydraulic module beneath the manifold and, after first noting connection positions disconnect 1) from the manifold the two larger hoses that run to the motor, 2) from the check valve (adjacent to the boost unit) the third smaller hose that runs to the motor.

46.9 Remove and retain the two bolts that secure the motor to the hydraulic motor bracket, and with draw the motor from the bracket and out of the hydraulic module.

46.10 After first noting positions remove and retain (if serviceable) the hoses and adaptors from the motor.

46.11 Dispose of redundant items and used oil in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

47 Install new motor as a reverse of the remove procedure.

NOTE

Fit motor pulley after installing alternators and ensure that pulley is aligned with alternator and ECS compressor pulleys.

48 To install the motor pulley proceed as follows:

48.1 Sparingly oil the thread and point of the grub screws and place screws loosely in holes threaded in the hub.

48.2 Position the key onto the shaft.

48.3 Clean the motor shaft and fit hub and bush to shaft as one unit and locate in accordance with the position measured on disassembly, remembering that bush will nip the shaft first and then the hub will be slightly drawn on to the bush.

48.4 Using an Allen key tighten screws gradually and alternatively until both are pulled up very tightly.

48.5 Protect the end of the bush to prevent damage and hammer against the large end of the bush. Tighten the grub screws to the correct torque (see Table 2, Ser 2).

NOTE

Once the pulley has been running under load for two minutes, stop and check the tightness of the screws.

49 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

MISCELLANEOUS COMPONENT REPLACEMENT

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

50 In the event the boost unit, oil filter complete, hydraulic oil tank, hydraulic manifold complete, hydraulic hose within the hydraulic module, oil cooler need to be replaced, the following generic procedure applies:

50.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

50.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

50.3 As necessary subject to component location, remove and retain the bolts securing front and rear end covers of the hydraulic module and remove the cover (see Fig 4). In some instances access may be aided by unbolting the cover panel from the under side of the hydraulic module.

50.4 Locate a suitable drain tray under item to be replaced.

50.5 **After first noting route of pipes and hoses, connection points and location of any cable ties or clip**, disconnect pipes/hoses from item to be replaced.

NOTES

- (1) Oil Tank. Drain oil from tank prior to disconnecting pipes/hoses (see Para 32).
- (2) Oil Tank. Disconnect temperature switch wiring at rear of tank prior to tank removal.
- (3) Manifold. Disconnect wiring from pressure switches in manifold prior to manifold removal.
- (4) Manifold. Disconnect pressure hose (see Fig 1).
- (5) Oil cooler. Disconnect wiring from oil cooler prior to cooler removal.
- (6) Oil cooler. Support cooler from the underside using a suitable size support prior to disconnecting.
- (7) Oil cooler. Remove fixing bolts prior to disconnecting hydraulic connections. Avoid spilling oil on NATO start socket and alternators. Protect electrical items with plastic sheeting if necessary.

50.6 Remove and retain fixings that secure item to the hydraulic module and remove item from module.

NOTE

Boost unit may need to be removed to provide access to the manifold.

50.7 Dispose of used oil and component in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

51 Install new item as a reverse of the remove procedure.

52 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

CHAPTER 17

HYDRAULIC SYSTEM

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INTRODUCTION

1 This Chapter details the procedures for work carried out on the hydraulic system. The majority of tasks described in this chapter can be performed with access via the hinged maintenance side panel and/or front and rear bolted access covers. In some instances access may be aided by unbolting the cover panel from the under side of the hydraulic module.

SPECIAL TOOLS AND TEST EQUIPMENT

2 Special tools or test equipment for this Chapter are shown below:

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Item (1)	NSN (2)	Manufacturer's Part No. (3)	Designation (4)
1	TBA	8251569268	Pressure test gauge

TORQUE WRENCH SETTINGS

3 All specified torque wrench settings in this chapter are shown below:

TABLE 2 TORQUE WRENCH SETTINGS

Ser (1)	Item (2)	Torque (Nm) (3)	Para (4)
1	Hydraulic module mounting bolts.	40	18, Note 3
2	Hydraulic motor pulley grub screws	30	48.5
3	Pump securing bolts	44	41, Note 1
4	Pump pulley to key way spacer	22	41, Note 4
5	Pump mounting bracket to engine	44	45
6	FEAD belt tensioner pulley	22	45

GENERAL INFORMATION**WARNINGS**

- (1) **HAZARDOUS SUBSTANCE. HANDLE HYDRAULIC OIL CAREFULLY AND NEVER FILL CONTAINERS WHERE INADVERTENT CONSUMPTION IS POSSIBLE.**
- (2) **HAZARDOUS SUBSTANCES. THE HANDLING OF FUELS, LUBRICANTS AND ASSOCIATED PRODUCTS IS HAZARDOUS. REFER TO LOCAL SAFETY PROCEDURES, INSTRUCTIONS AND WARNINGS ON PACKAGING AND OTHER RELEVANT REGULATIONS FOR HANDLING. MINIMUM ACTION AFTER SKIN CONTACT IS TO WASH THE AFFECTED AREAS WITH SOAP AND WATER. THE USE OF BARRIER CREAM IS RECOMMENDED. PROTECTIVE CLOTHING SHOULD BE WORN.**
- (3) **BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.**
- (4) **DANGER TO LIFE AND LIMB – PRESSURISED HYDRAULIC OIL. PRIOR TO PERFORMING ANY SCHEDULED OR UNSCHEDULED MAINTENANCE ENSURE THAT THE VEHICLE ELECTRICAL SYSTEM IS SWITCHED OFF.**

CAUTIONS

- (1) **FLUID SPILLS.** Spilt oils, lubricants, fluids etc should be contained immediately with spill absorbent materials.
- (2) **EQUIPMENT DAMAGE.** Absolute cleanliness is necessary when working on hydraulic systems and components. All ports and orifices must be capped off immediately when a component is removed or a pipe is disconnected.

(3) WASTE PRODUCTS. Personnel responsible for the disposal of waste products must comply with local regulations and procedures

4 The hydraulic system operates whenever the vehicle engine is running as the engine directly drives the hydraulic pump.

5 System pressure depends on the following factors:

5.1 **Electrical load.** As the electrical load on the alternators increases then the pressure in the system increases.

5.2 **Environmental Control System (ECS) load.** As the ECS increases the pressure in the system increases. This is usually when the ECS is switched on as the loading is at it's highest as the system reduces crew compartment temperature.

5.3 **Engine Speed.** As the engine speed increase then the pressure in the system decreases as the flow increases.

5.4 **Ambient temperature.** As a rule in a hydraulic system the pressure decreases as the ambient temperature increases. This will not be the case in this application as with increasing ambient temperature the ECS load increases.

5.5 In general with the ECS operating the hydraulic system pressure will be between 120 and 240 bar once the system has stabilised after start up.

6 Indicative operating speeds (engine v pump/motor v ECS compressor) are provided in Table 3. The speed of the motor is proportional to the speed of the hydraulic pump and therefore the speed of the engine.

TABLE 3 INDICATIVE SYSTEM RPM

Engine RPM	Hydraulic pump / motor RPM	ECS compressor RPM
777	1165	1192
1750	2625	2686
3400	5100	5219
4300	6450	6600

7 The component layout in the hydraulic module is provided in Fig 1.

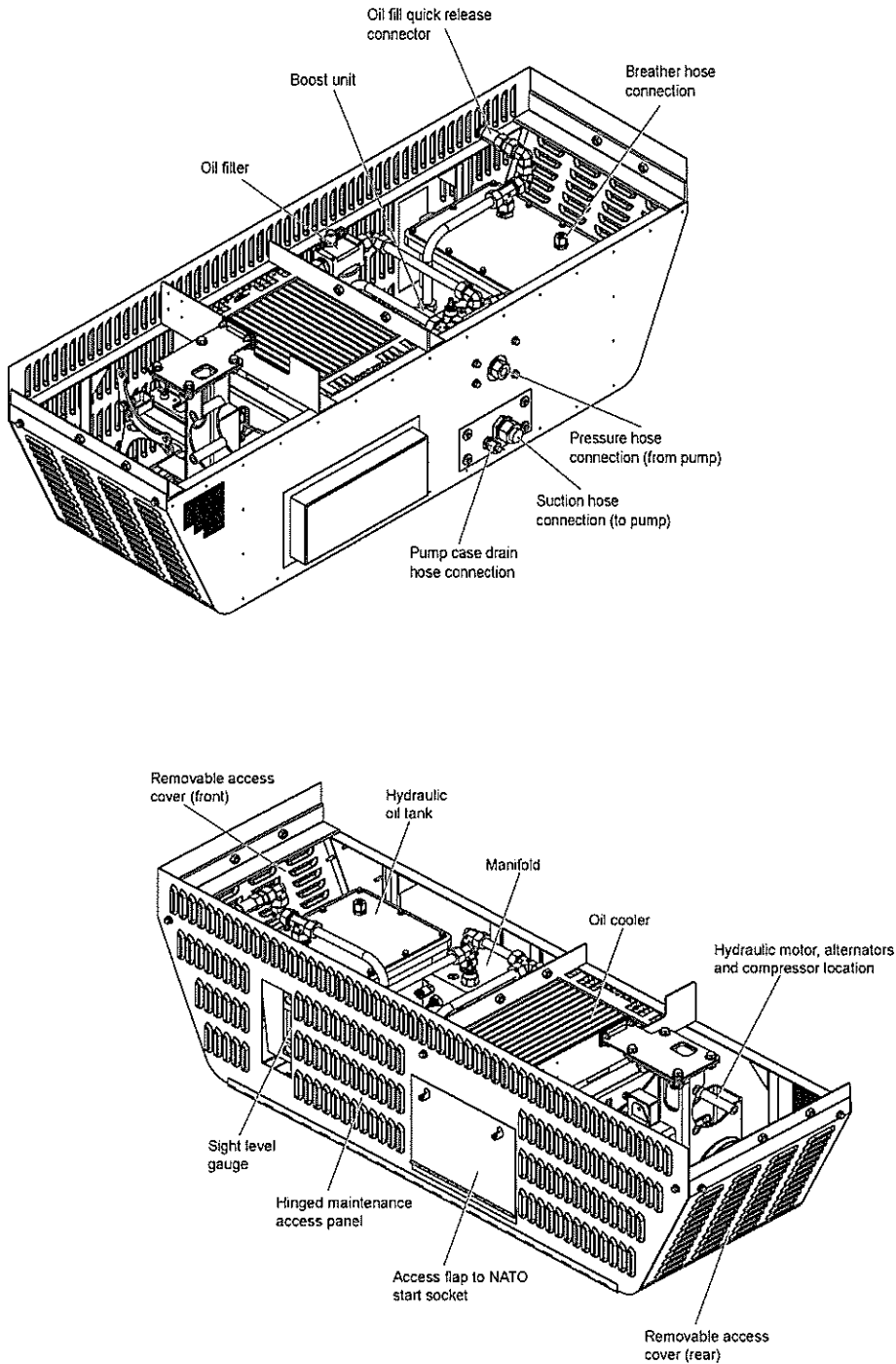


Fig 1 Hydraulic module component layout

FILLING AND PRIMING PROCEDURE

8 The level of the oil in the hydraulic module is indicated on the sight level gauge located in the side of the hydraulic system module on the left external side of the vehicle (see Fig 2).

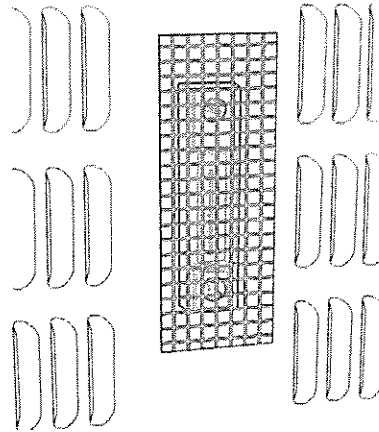


Fig 2 Sight level gauge – hydraulic system

9 The hydraulic oil is at the correct level when the level is between the top and two thirds down the the sight level gauge. Whenever any hydraulic component is exchanged in the system an amount of oil will be lost and air will enter the circuit. The addition of air adds instability to the system.

10 When necessary, fill or top up oil level as follows:

10.1 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 2).

10.2 Connect the fill adaptor provided in the vehicle CES onto the quick release connector (see Fig 1 and Fig 3 (1)).

10.3 With the aid of a suitable hose or funnel fill oil until the level is between the top and two thirds down the sight level gauge.

10.4 Disconnect the fill adaptor.

CAUTION

EQUIPMENT DAMAGE. Do not run the vehicle with the fill adaptor connected.

11 Air is expelled from the system via the air breather that is connected to the top of the tank (see Fig 1 and Fig 3 (1)). Once any hydraulic component is exchanged and/or the system oil is changed or topped up, run the engine at tick over for 2 minutes with the air conditioning switched off.

12 Re-check oil level and top up as necessary.

13 Check the filter blocked indicator (see Para 21).

14 Secure the hinged side panel.

15 Stow fill adaptor.

16 Run vehicle upon completion to ensure charge control lamps and hydraulic pressure lamp extinguish and ECS operates.

HYDRAULIC MODULE**WARNING**

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

Removal

17 To remove the hydraulic module proceed as follows:

17.1 Position the vehicle on level ground.

17.2 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

17.3 Locate the vehicles automotive batteries. The battery box is located at the forward end of the rear compartment. Two pairs of 12V 85 Ah Absorbed Glass Mat (AGM) maintenance free sealed for life lead acid batteries supply the 12/24V dc automotive electrical system and 24V dc FFR circuit. Automotive batteries are located on the right hand side of the battery box. FFR batteries are located on the left hand side.

17.4 Disconnect the yellow 12V ECU feed wire, from the automotive batteries then the vehicles negative (-ve) battery terminals and ensure that it is safely stowed, ie so that it cannot unintentionally reconnect with the terminal.

17.5 Place a suitable drain tray on the ground under the hydraulic module beneath the hydraulic hose connections at the in board side of the module (see Fig 1).

17.6 Disconnect the three hoses and allow the oil to drain into the tray. Dispose of used oil in accordance with local regulations and procedures.

17.7 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

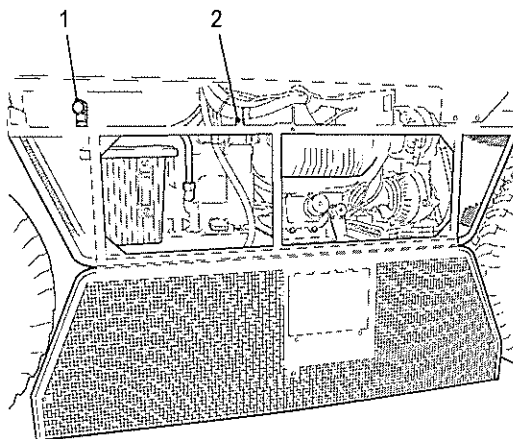


Fig 3 Hydraulic module access – side

17.8 Remove and retain the bolts securing front and rear end covers of the hydraulic module and remove the cover (see Fig 4).

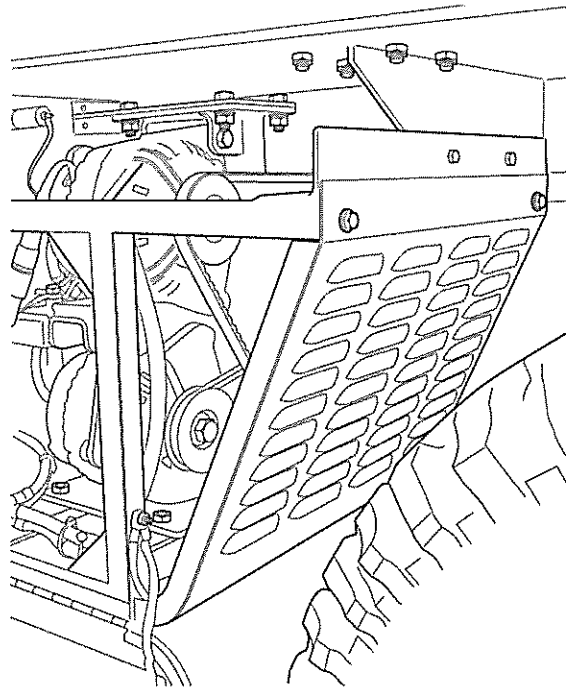


Fig 4 Hydraulic module end cover (typical)

17.9 Decommission the ECS compressor (see Chapter 18).

17.10 When the compressor has been decommissioned disconnect refrigerant hoses, seal ends and electrical connector.

NOTE

When the hydraulic module has been removed from the vehicle remember to measure the quantity of the oil in the compressor in accordance with Chapter 18.

17.11 Disconnect the breather hose from the connection on the top of the hydraulic oil tank (see Fig 1).

17.12 Trace route of the two electrical harnesses and two large red battery leads from entry into the module from the vehicle (through hole in floor of vehicle located approximately above main manifold).

17.13 **After first noting route of harnesses and leads, connection points and location of any cable ties securing the harness**, carefully cut cable ties securing harnesses to module and disconnect harness from alternators, EMC filter boxes, pressure switch (in base of module) etc. Retain all fixing bolts, connection boots etc.

17.14 Check that all necessary electrical points have been disconnected and un-clipped.

17.15 Remove the bolts securing the middle of the hydraulic module frame to the vehicle frame.

17.16 Close the hinged maintenance access panel and secure with loosely with a bolt.

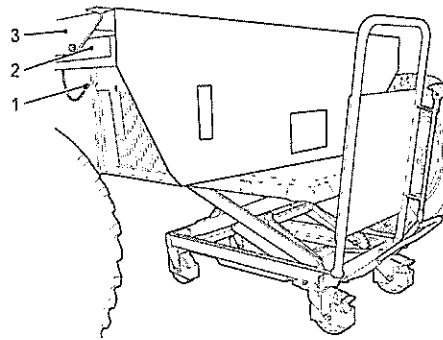


Fig 5 Hydraulic module removal (typical)

- 17.17 Disconnect the earth bonding lead between hydraulic module and vehicle (see Fig 5 (1)).
- 17.18 Support the module with an appropriate scissor lift table (see Fig 5) or jack. Protect the base of the hydraulic module with a piece of wood to prevent damage and/or spread the load of the mechanical handling aid.
- 17.19 Remove the bolts securing the front and back of the hydraulic module frame to the vehicle frame and carefully lower the module down and away from the vehicle.
- 17.20 Contain any oil spill with spill absorbent materials.
- 17.21 Measure the quantity of the oil in the compressor in accordance with Chapter 18.

Refitting

18 Fitting the hydraulic module is generally the reverse of the removal procedure (subject to the following notes):

NOTES

- (1) Commission compressor in accordance with Chapter 18.
- (2) When attaching hydraulic module to vehicle locate module frame to rearward side of mounting plates on vehicle frame.
- (3) Fit all mounting bolts loosely to allow alignment of hydraulic module to vehicle and then tighten to correct torque (see Table 2, Ser 1).
- (4) Upon re-installation of the earth lead, cover the bonding point in silicone electrical grease.
- (5) Route all hoses and electrical harnesses and leads as original installation and connect. Re-clip and cable tie.
- (6) Recharge ECS in accordance with Chapter 18.
- (7) Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.
- (8) Replace all covers and run vehicle upon completion to ensure charge control lamps and hydraulic pressure lamp extinguish and ECS operates.

HYDRAULIC PUMP BELT REPLACEMENT

19 The hydraulic pump is driven via the ribbed V (FEAD) belt on the engine. Refer to Chapter 1 for belt replacement instructions.

HYDRAULIC MOTOR BELT REPLACEMENT

20 The hydraulic motor drives two alternators and the ECS compressor via two drive belts. Refer to Chapter 13 for belt replacement instructions (replacing alternator drive belts).

CHECKING THE OIL FILTER BLOCKED INDICATOR

21 A filter blocked indicator is provided on the oil filter (see Fig 1) head. To check the filter blocked indicator proceed as follows:

21.1 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3) and check indicator (see Fig 3 (2)).

22 If the indicator is red the filter is blocked and must be replaced.

OIL FILTER REPLACEMENT

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

23 To replace the oil filter element proceed as follows:

23.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

23.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

23.3 Position a suitable drip tray under the filter and unscrew the filter bowl and remove the element from the underside of the filter head. Dispose of used oil and filter in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials

24 Install new filter element as a reverse of the remove procedure.

25 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

26 Check the filter blocked indicator (see Para 21).

BOOST FILTER REPLACEMENT**WARNING**

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

27 To replace the boost filter element proceed as follows:

27.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

27.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

27.3 Position a suitable drip tray under the filter and unscrew the boost filter element (adjacent to the manifold (see Fig 1)) using a suitable filter wrench. Dispose of used oil and filter in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

28 Install new filter element as a reverse of the remove procedure.

29 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

BREATHER REPLACEMENT**CAUTION**

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

30 To replace the breather element proceed as follows:

30.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

30.2 Locate the breather on the vehicle roof just behind the ECS condenser assembly. Access the breather via the forward hatch in the rear compartment.

30.3 Remove and retain the three bolts securing the breather and remove breather.

30.4 Dispose of used breather in accordance with local regulations and procedures.

31 Install new breather as a reverse of the remove procedure.

DRAINING THE HYDRAULIC OIL FROM THE TANK

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

32 To drain the oil from the tank proceed as follows:

32.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

32.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

32.3 Remove and retain the bolts securing front end cover of the hydraulic module and remove the cover.

32.4 Place a suitable drain tray on the ground under the hydraulic module beneath the hydraulic oil tank.

32.5 Disconnect wiring from temperature switch located in the port in the forward face of tank.

32.6 Remove the switch from the tank.

32.7 Re-fit drain switch when the flow of oil has stopped and reconnect wiring. Dispose of used oil and filter in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

CHECKING AND RESETTING THE RELIEF VALVE

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

33 To check and reset the relief valve proceed as follows:

33.1 Place a suitable drain tray on the ground under the hydraulic module beneath the hydraulic hose connections at the in board side of the module (see Fig 1).

33.2 Disconnect the pressure and suction hoses and cap the manifold ports using standard 16-S and 18-L pipe tube blanking plugs. Cap the end of the hoses. Dispose of any used oil in accordance with local regulations and procedures.

33.3 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

33.4 Fit a pressure test gauge (see Table 1, Ser 1) to manifold test point TP2.

33.5 Run the engine at fast idle speed (1750 rpm). The reading on the relief valve should be 350 bar.

- 33.6 The pressure of the relief valve (located on the near side face of the manifold assembly) is adjusted by screwing the adjuster thread in (to increase the valve setting) or out, after first releasing the lock nut.
- 33.7 Once the relief valve is set correctly tighten lock nut, switch off the engine and refit the hoses.
- 33.8 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

HIGH OR LOW PRESSURE SWITCH REPLACEMENT

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

- 34 To replace either the high or low pressure switch proceed as follows:
- 34.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.
- 34.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).
- 34.3 Locate required switch. The low pressure switch is located on the rearward side of the manifold adjacent to the two hoses that run to the hydraulic motor (it may be necessary to remove one of the hoses to provide access to the switch – refer to Para 46). The high pressure switch is located on the under side of the manifold.
- 34.4 Disconnect wiring from required switch.
- 34.5 Locate a suitable drain tray under manifold. Remove low pressure switch by directly unscrewing from manifold. Remove high pressure switch by disconnecting pipe nut on elbow fitted to manifold. Dispose of switch and used oil in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.
- 35 Install new switch as a reverse of the remove procedure.
- 36 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

TEMPERATURE SWITCH REPLACEMENT

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

37 To replace either temperature switch fitted in the front or rear of the hydraulic oil tank proceed as follows:

37.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

37.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

37.3 Drain oil from the tank prior to removing temperature switch (see Para 32). If this action removes required switch proceed to Para 38.

37.4 If temperature switch in rearward side of tank requires replacement, disconnect wiring, locate a suitable drain tray under the switch and unscrew from the tank. Dispose of switch and used oil in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

38 Install new switch as a reverse of the remove procedure.

39 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

HYDRAULIC PUMP REPLACEMENT/REMOVAL

WARNINGS

(1) **BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.**

(2) **PERSONAL INJURY. DO NOT ALLOW ANY LOOSE ITEMS OF CLOTHING TO BECOME CAUGHT IN THE FAN BLADES OR ANY OTHER MOVING ENGINE PARTS. REMAIN ALERT AS TO THE LOCATION OF THE ROTATING FAN, PULLEYS, BELTS ETC, WHEN WORKING ON A RUNNING ENGINE.**

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

Removal

40 The hydraulic pump is mounted on the engine. To remove the pump proceed as follows:

40.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

- 40.2 Remove the front seats and engine cover, see Chapter 16-2.
- 40.3 Remove the ribbed V (FEAD) belt, see Chapter 1.
- 40.4 Place a suitable drain tray on the ground under the hydraulic module beneath the hydraulic hose connections at the in board side of the module (see Fig 1).
- 40.5 Disconnect the three hoses and allow the oil to drain into the tray. Dispose of used oil in accordance with local regulations and procedures.
- 40.6 Remove and retain the pump pulley as follows:
- 40.6.1 Remove and retain the three cap head screws securing the pulley to the pump (see Fig 6) and remove pulley (see Fig 6 (1)).
- 40.6.2 After first noting the distance from face of the pump mounting bracket to the key way spacer, remove and retain the securing bolt, key way spacer and key from the pump shaft.

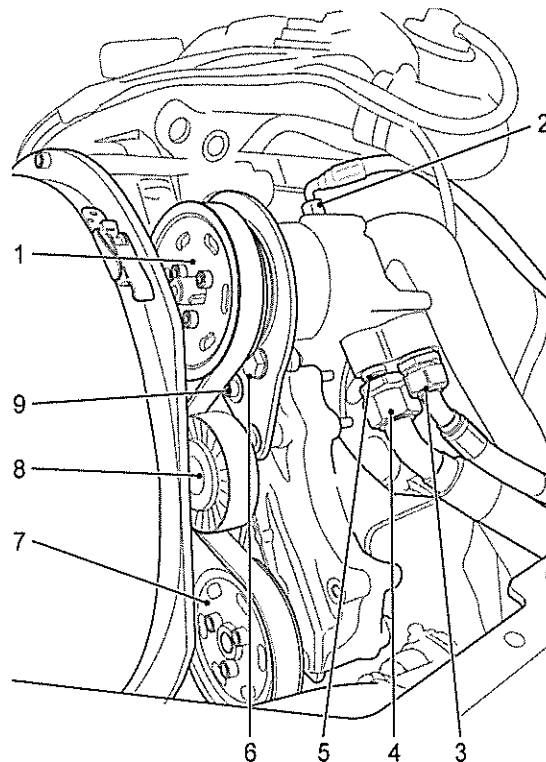


Fig 6 Hydraulic pump

- 40.7 After first noting positions remove and retain (if serviceable) the hoses and adaptors from the pump – (2) (pump case drain hose), (3) (pressure hose) and (4) (suction hose).
- 40.8 Retain hoses if serviceable, otherwise (after first noting positions) un-clip hoses and remove from vehicle.
- 40.9 Remove and retain the two bolts (6) securing the pump to the mounting bracket and remove pump.
- 40.10 Using an Allen key, remove and retain the plug from the fourth port on pump (adjacent to the pressure and suction hose ports (5)).

40.11 Dispose of redundant items and used oil in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

Refitting

41 Fitting a pump is generally the reverse of the remove procedure (subject to the following notes):

NOTES

- (1) Tighten the pump to bracket securing bolts to the correct torque (see Table 2, Ser 3).
- (2) Locate the key way spacer in accordance with the position measured on disassembly and secure the key and key way spacer with the securing bolt.
- (3) Loosely fit the pump pulley and check alignment with the similar power steering pump pulley (see Fig 6 (7)) using a steel rule. Adjust position of key way spacer if necessary to achieve alignment.
- (4) Tighten the three cap head screws securing the pulley to the pump to the correct torque (see Table 2, Ser 4).
- (5) After refitting the plug to the fourth port on pump (5) and connecting the pressure hose (3), suction hose (4), fill the pump case with a small amount of oil via the pump case drain hose port (2) and connect pump case drain hose.

CAUTION

EQUIPMENT DAMAGE. Ensure pump case is primed with oil prior to first operation.

- (6) Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.
- (7) Replace engine cover and front seats (see Chapter 16-2) and run vehicle upon completion to ensure charge control lamps and hydraulic pressure lamp extinguish and ECS operates.

Removal for the purpose of engine replacement

42 In the event the hydraulic pump is being removed in order to remove the engine, there should be no need to disconnect the hoses from the pump or hydraulic module. To remove the pump, in this instance, remove the ribbed V (FEAD) belt (see Chapter 1) together with the FEAD tensioner pulley adjacent to the pump pulley (see Fig 6 (8)).

43 This will allow access to the three cap head screws (9) securing the pump mounting bracket to the engine. Unbolt the bracket from the engine and lay back the complete assembly away from the working area ready to reassembly. Temporarily secure the pump/hose assembly away from the engine to prevent damage/movement.

44 The tensioner pulley on the replacement engine will need to be removed to allow the installation of the pump mounting bracket.

45 Upon reassembly, tighten the three cap head screws securing the pump mounting bracket to the engine to the correct torque (see Table 2, Ser 5) fit the tensioner pulley and tighten to the correct torque (see Table 2, Ser 6).

HYDRAULIC MOTOR REPLACEMENT**WARNING**

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

46 The hydraulic motor is located under the ECS compressor at the rear in board corner of the hydraulic module. To replace the hydraulic motor proceed as follows:

46.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

46.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

46.3 Remove and retain the bolts securing the rear end cover of the hydraulic module and remove the cover (see Fig 4).

46.4 Unbolt and remove the cover panel from the under side of the hydraulic module

46.5 Remove alternators (see Chapter 13). Remove oil cooler (see Para 50)

46.6 To provide access to the motor, remove the bracket on which the NATO start socket is mounted and lay to one side.

46.7 After first noting the distance from face of motor mounting bracket to the pulley, remove and retain the motor pulley as follows:

46.7.1 Remove the 2 off grub screws using an Allen key (see Fig 7 (1)).

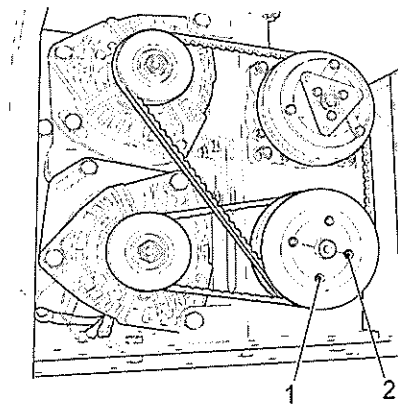


Fig 7 Hydraulic motor pulley

46.7.2 After first oiling the thread and point of the grub screws, insert the removed screws into the jacking holes in the pulley (2). Tighten screws alternatively until the bush is loosened in the hub and assembly is free on the motor shaft.

46.7.3 Remove the assembly from the shaft

46.8 Place a suitable drain tray on the ground under the hydraulic module beneath the manifold and, after first noting connection positions disconnect 1) from the manifold the two larger hoses that run to the motor, 2) from the check valve (adjacent to the boost unit) the third smaller hose that runs to the motor.

46.9 Remove and retain the two bolts that secure the motor to the hydraulic motor bracket, and with draw the motor from the bracket and out of the hydraulic module.

46.10 After first noting positions remove and retain (if serviceable) the hoses and adaptors from the motor.

46.11 Dispose of redundant items and used oil in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

47 Install new motor as a reverse of the remove procedure.

NOTE

Fit motor pulley after installing alternators and ensure that pulley is aligned with alternator and ECS compressor pulleys.

48 To install the motor pulley proceed as follows:

48.1 Sparingly oil the thread and point of the grub screws and place screws loosely in holes threaded in the hub.

48.2 Position the key onto the shaft.

48.3 Clean the motor shaft and fit hub and bush to shaft as one unit and locate in accordance with the position measured on disassembly, remembering that bush will nip the shaft first and then the hub will be slightly drawn on to the bush.

48.4 Using an Allen key tighten screws gradually and alternatively until both are pulled up very tightly.

48.5 Protect the end of the bush to prevent damage and hammer against the large end of the bush. Tighten the grub screws to the correct torque (see Table 2, Ser 2).

NOTE

Once the pulley has been running under load for two minutes, stop and check the tightness of the screws.

49 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

MISCELLANEOUS COMPONENT REPLACEMENT

WARNING

BURN HAZARD. PRIOR TO PERFORMING ANY MAINTENANCE ENSURE THAT THE HYDRAULIC SYSTEM HAS COOLED SUFFICIENTLY TO PREVENT PERSONAL INJURY.

CAUTION

EQUIPMENT DAMAGE. Ensure the equipment cannot be started when carrying out this procedure.

50 In the event the boost unit, oil filter complete, hydraulic oil tank, hydraulic manifold complete, hydraulic hose within the hydraulic module, oil cooler need to be replaced, the following generic procedure applies:

50.1 Turn the battery isolation switches, located a) on the bulkhead behind the co-driver's seat (the automotive battery main switch), b) mounted on the FFR box located adjacent to the right hand side of the battery box fixed to the side of the rear compartment (FFR battery switch) to the OFF position.

50.2 Remove and retain the bolts securing the hinged maintenance access panel (see Fig 1) of the hydraulic module and open the panel (see Fig 3).

50.3 As necessary subject to component location, remove and retain the bolts securing front and rear end covers of the hydraulic module and remove the cover (see Fig 4). In some instances access may be aided by unbolting the cover panel from the under side of the hydraulic module.

50.4 Locate a suitable drain tray under item to be replaced.

50.5 **After first noting route of pipes and hoses, connection points and location of any cable ties or clip**, disconnect pipes/hoses from item to be replaced.

NOTES

- (1) Oil Tank. Drain oil from tank prior to disconnecting pipes/hoses (see Para 32).
- (2) Oil Tank. Disconnect temperature switch wiring at rear of tank prior to tank removal.
- (3) Manifold. Disconnect wiring from pressure switches in manifold prior to manifold removal.
- (4) Manifold. Disconnect pressure hose (see Fig 1).
- (5) Oil cooler. Disconnect wiring from oil cooler prior to cooler removal.
- (6) Oil cooler. Support cooler from the underside using a suitable size support prior to disconnecting.
- (7) Oil cooler. Remove fixing bolts prior to disconnecting hydraulic connections. Avoid spilling oil on NATO start socket and alternators. Protect electrical items with plastic sheeting if necessary.

50.6 Remove and retain fixings that secure item to the hydraulic module and remove item from module.

NOTE

Boost unit may need to be removed to provide access to the manifold.

50.7 Dispose of used oil and component in accordance with local regulations and procedures. Contain any oil spill with spill absorbent materials.

51 Install new item as a reverse of the remove procedure.

52 Fill and prime hydraulic system (see Para 8), check for leaks and rectify as necessary.

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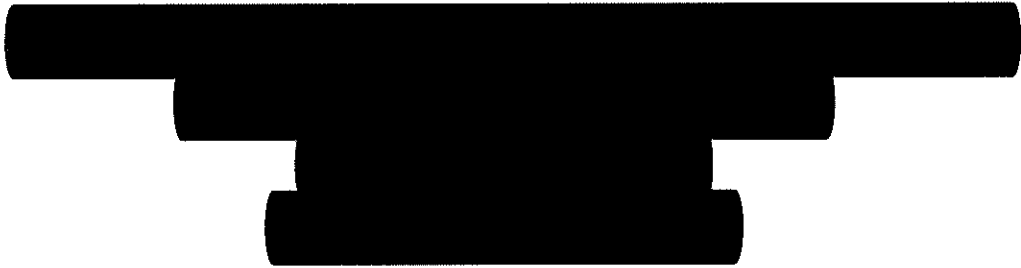
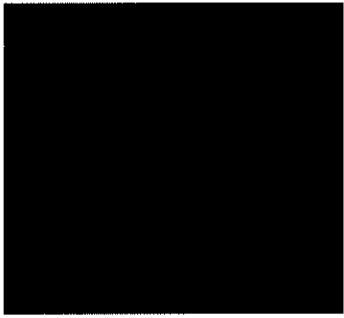
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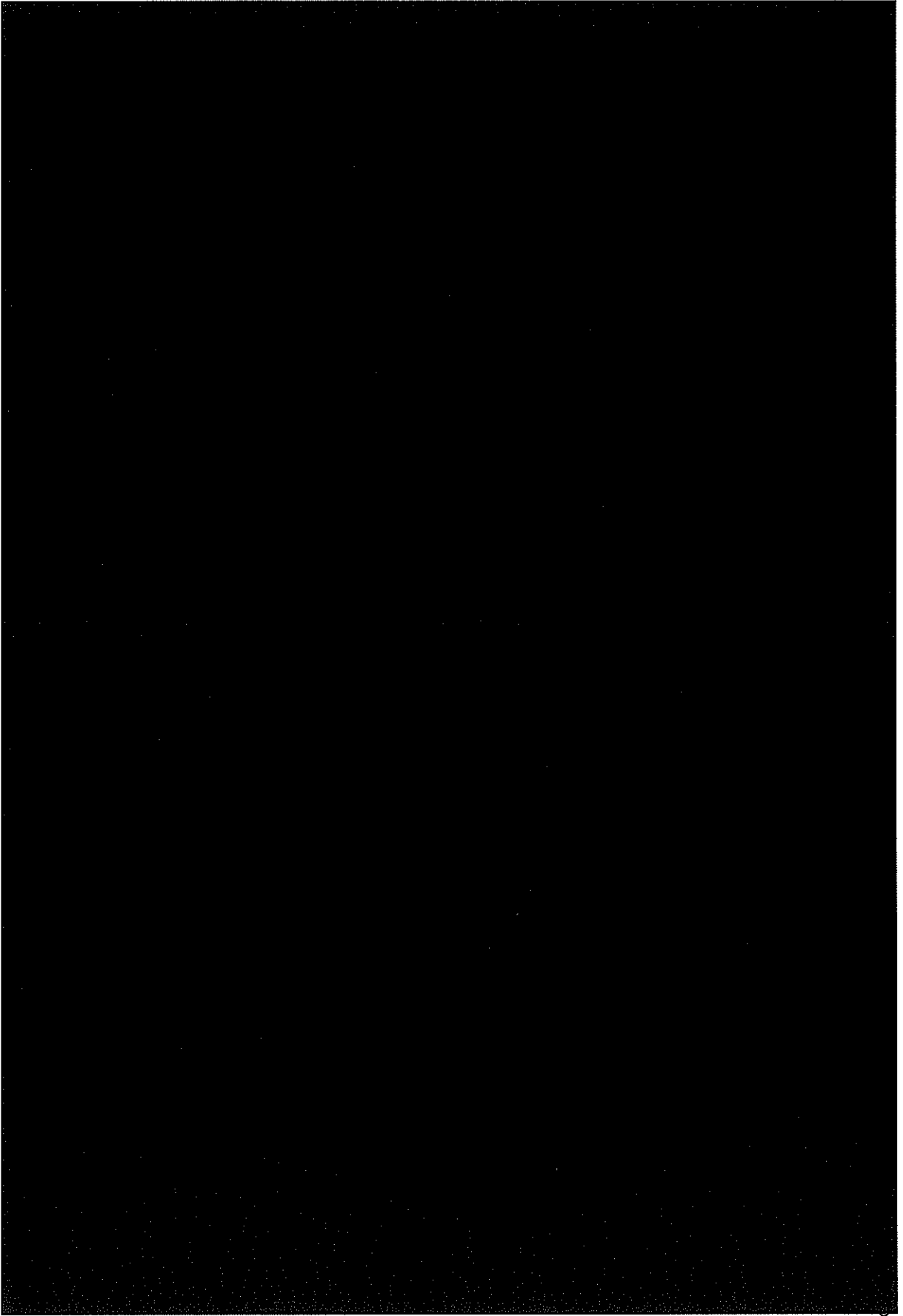
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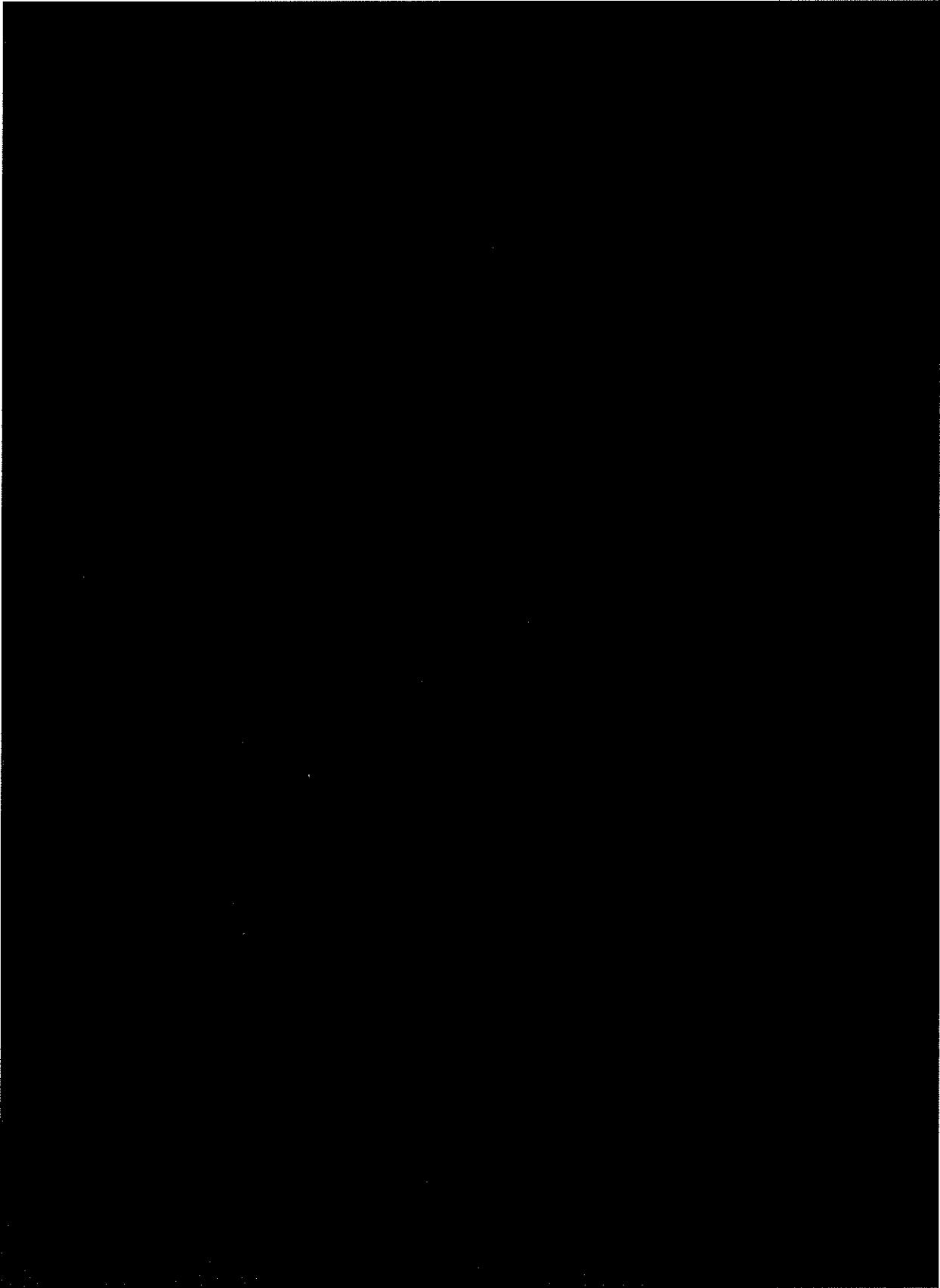
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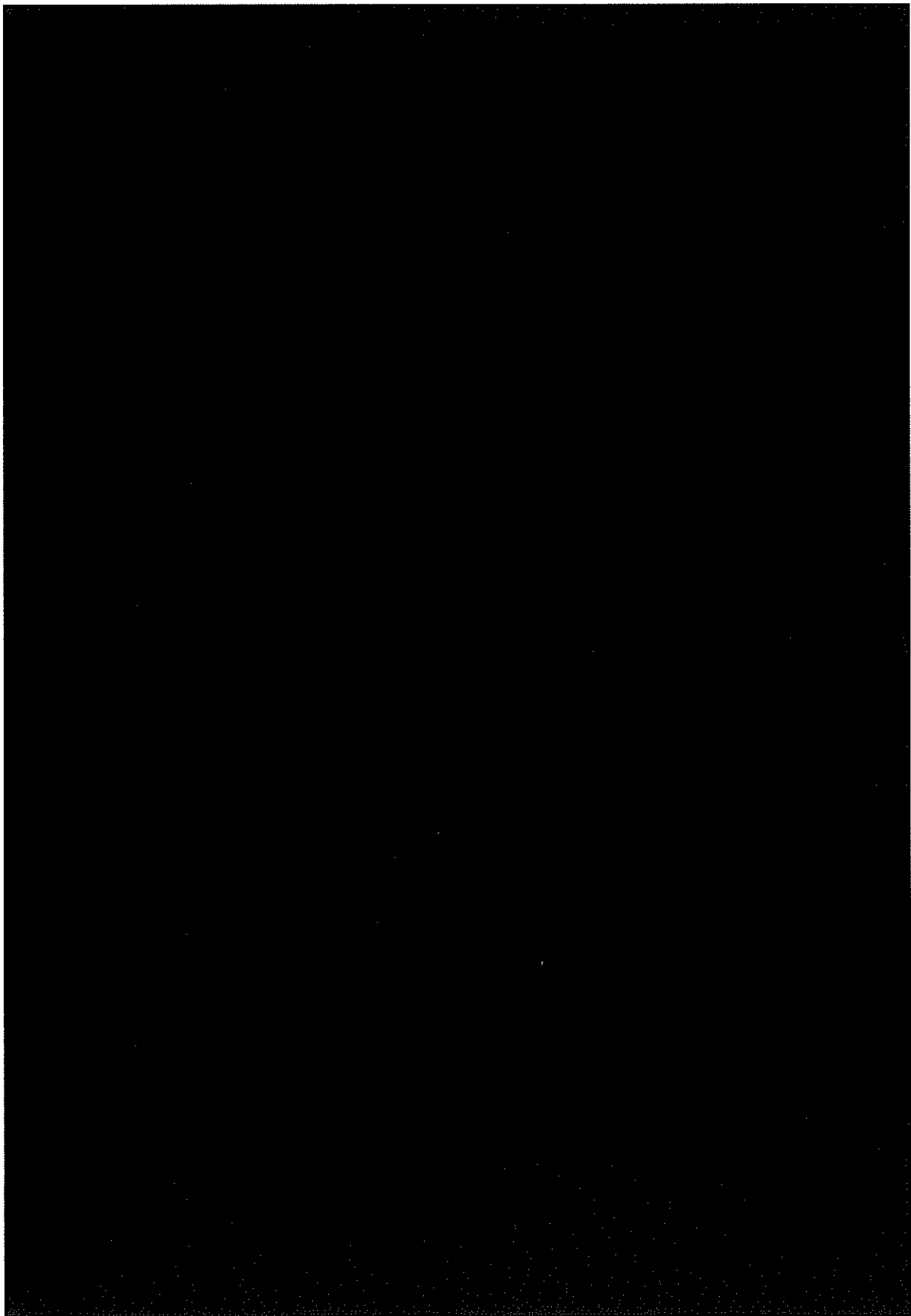
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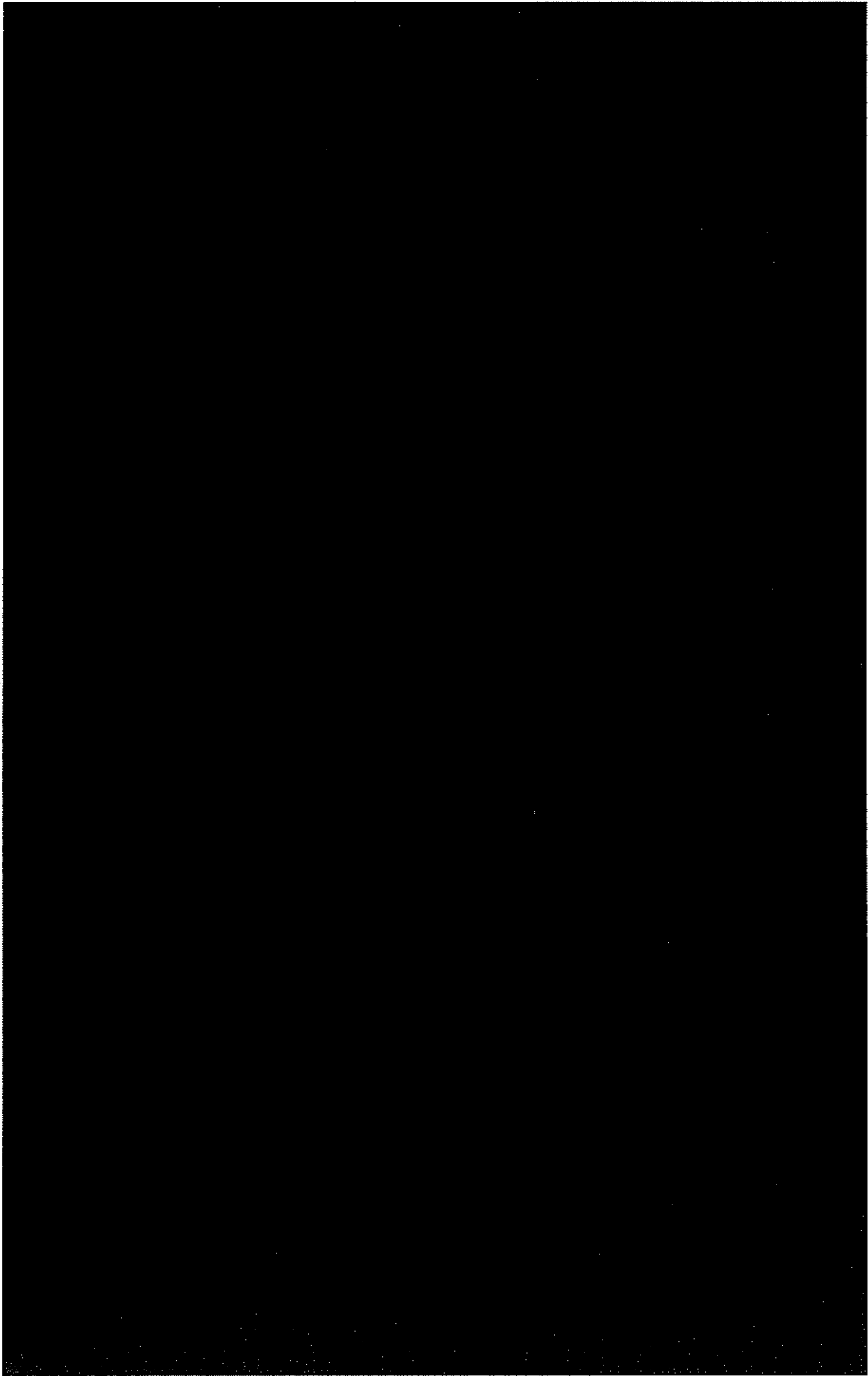
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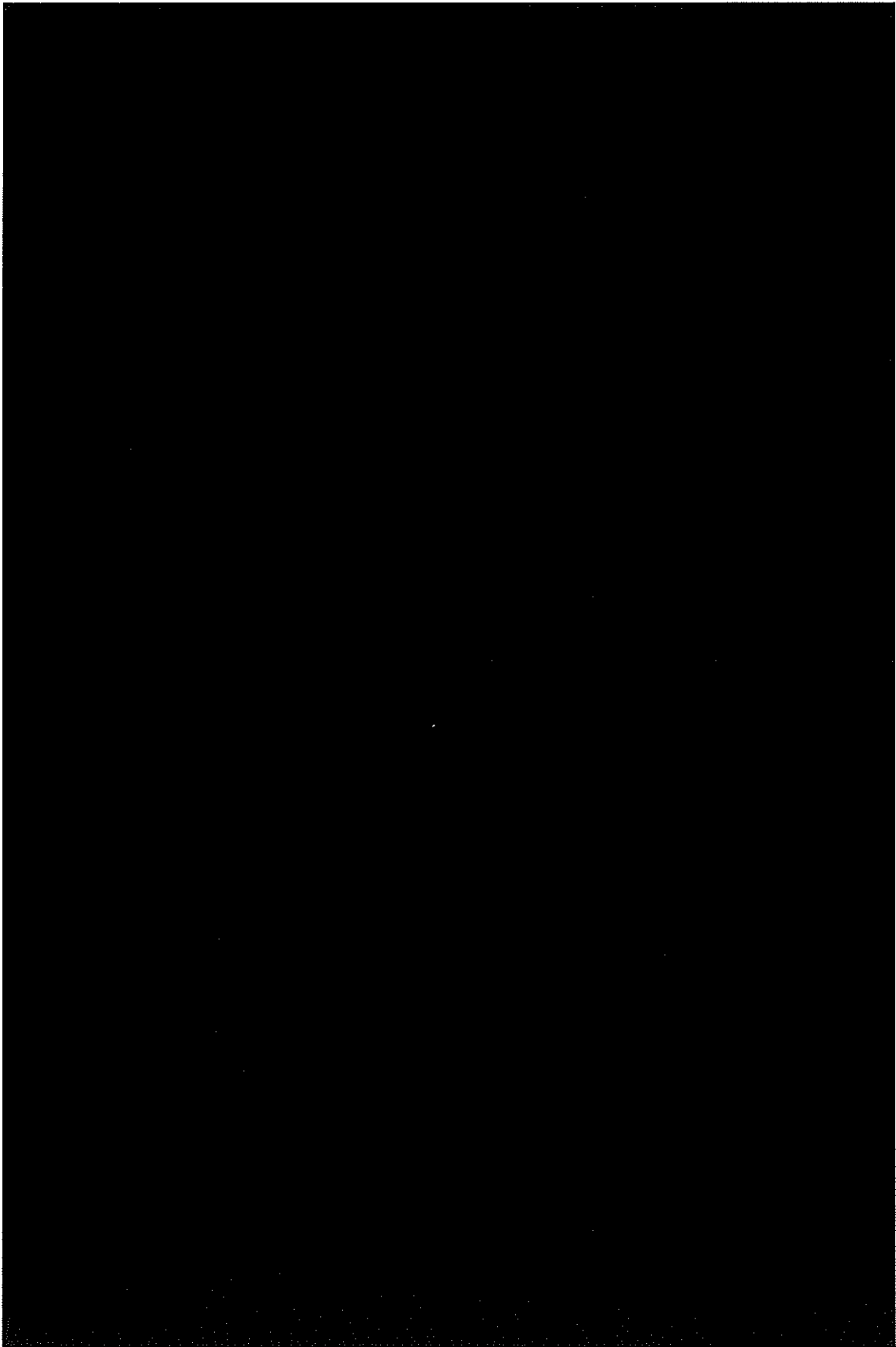
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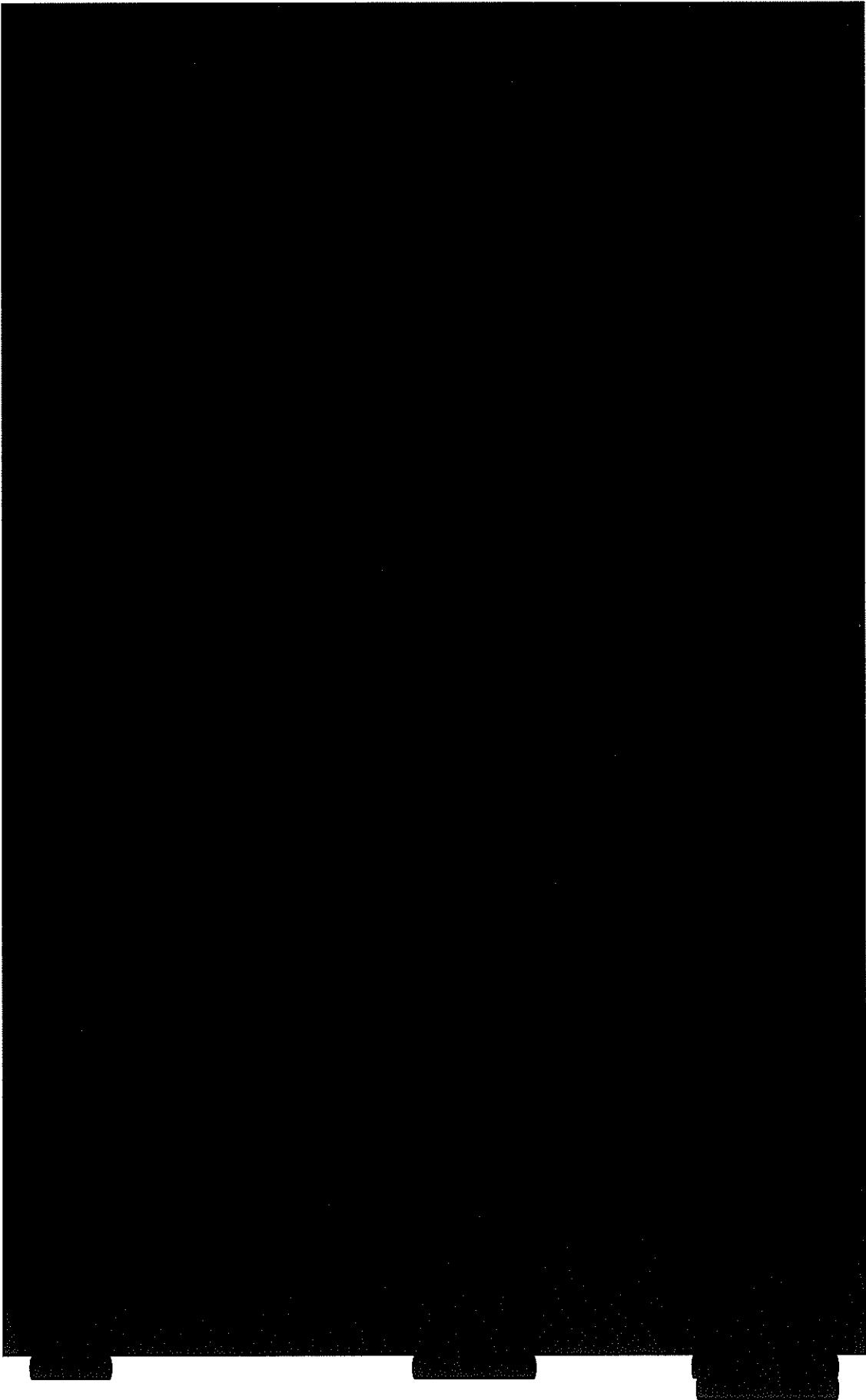
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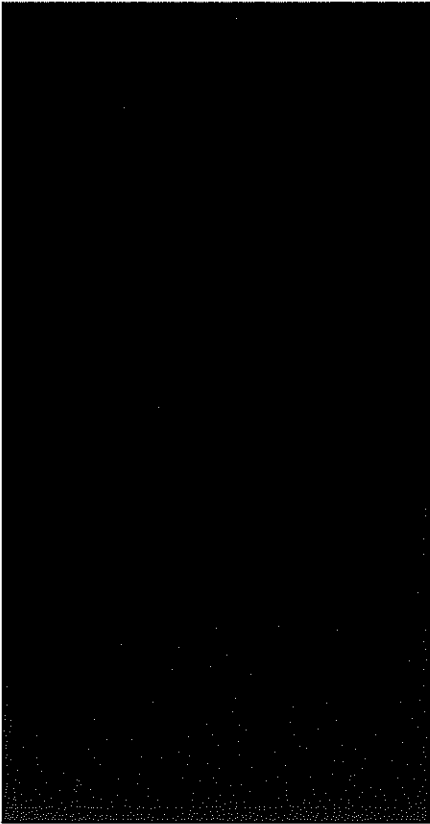
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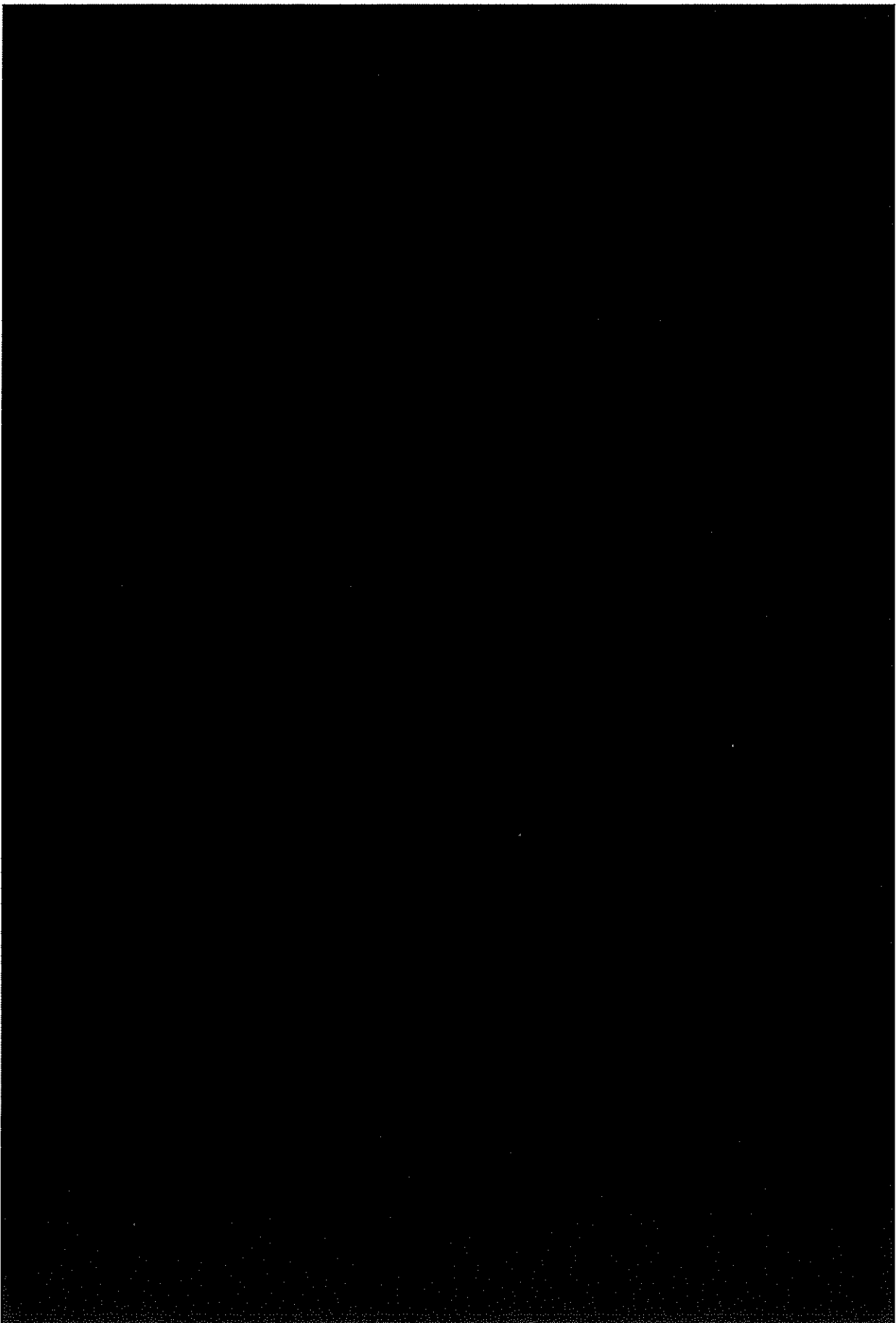


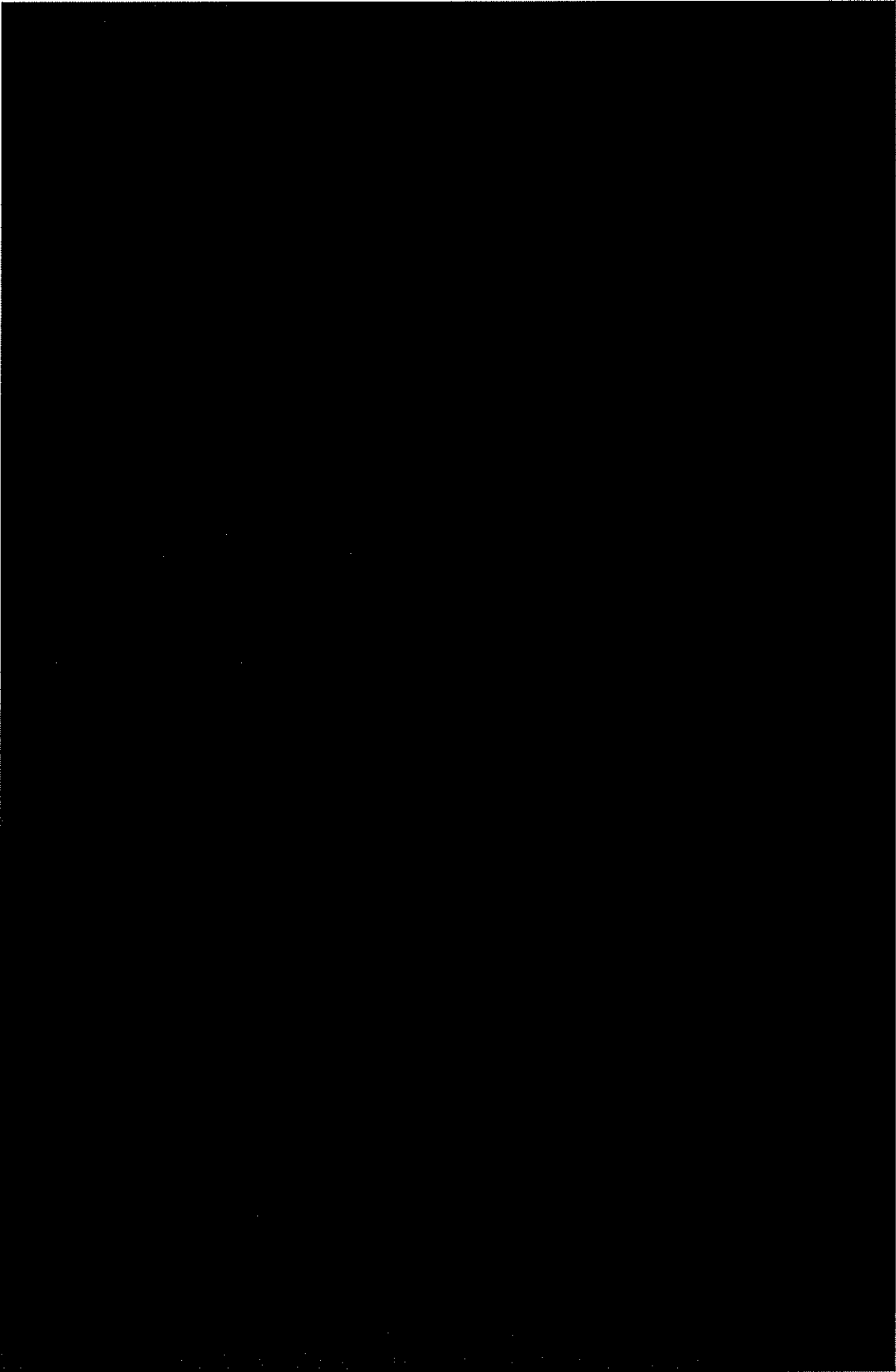
Vertical black bar

Vertical black bar

Vertical black bar







CHAPTER 19

SELF-DEFENCE WEAPON MOUNT

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NOTE

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REMOVAL OF MOUNT FROM UNIT

- 1 Lock swing arms and cradle and dismount weapon as described in Cat 201 Chap 2-1.
- 2 Pull out and hold out spring loaded index plunger in separator assembly.
- 3 Lift mount free of separator base.

REPLACE FRICTION WASHERS**WARNING**

CRADLE AND YOKE ASSEMBLY IS SPRING LOADED. DO NOT DISMANTLE. REPLACE FRICTION WASHERS.

- 4 Friction washers need to be replaced when worn down or permanently deformed to less than 1.0 mm thick.

Replacement of friction washers in mounting base and knuckle joint**NOTE**

Procedure is the same for base and knuckle locations on swing arm mount.

- 5 Select an 8 mm Allen key from rear ammunition tray holder.
- 6 Remove hand-tensioning knob.
- 7 Lift top or bottom arm away from the lower assembly.
- 8 Remove old friction washer and discard appropriately.
- 9 Fit new friction washer.
- 10 Reassemble and tighten joint to required operating tension.
- 11 Replace tool in rear ammunition tray holder.

Replacement of friction washer under yoke assembly

- 12 Select an 8 mm Allen key from rear ammunition tray holder.
- 13 Hold handle on ammunition tray and, using 8 mm Allen key, remove yoke pin.
- 14 Lift cradle and yoke assembly off arm.
- 15 Remove old friction washer and discard appropriately.
- 16 Fit new friction washer.
- 17 Reassemble and tighten Yoke pin to required tension.
- 18 Replace tool in rear ammunition tray holder.

REPLACEMENT OF BEARINGS

Replacement of bearing for yoke

- 19 Select the following tools.
 - 19.1 4 mm pin punch.
 - 19.2 8 mm Allen key.
- 20 Using 8 mm Allen key, remove Yoke pin from yoke and withdraw yoke from top arm.
- 21 Remove friction washer and discard if less than 1.0 mm thick.
- 22 Using 4 mm pin punch, alternately through two holes provided in rear of bearing housing. Lightly tap with hammer to remove bearing from arm. Discard old bearing.
- 23 Wipe clean the bearing housing.
- 24 Smear light grease in bore of housing.
- 25 Press in new single row ball bearing.
- 26 Fit yoke and tighten Yoke pin to required operating tension.
- 27 Replace tools.

Replacement of bearings for knuckle joint and mounting base

- 28 Select the following tools.
 - 28.1 4 mm pin punch.
 - 28.2 8 mm Allen key.
- 29 Remove hand-tensioning knob.
- 30 Separate swing arms.
- 31 Remove friction washers and discard if less than 1.0 mm thick.
- 32 Using 4 mm pin punch, alternately through two holes provided in rear of each bearing housing. Lightly tap with hammer to remove bearing from arm. Discard old bearing.
- 33 Wipe clean the bearing housings.
- 34 Smear light grease in bore of housings.
- 35 Press in new double row spherical roller bearings.
- 36 Carefully reassemble the swing arms.
- 37 Use Allen key to tighten locking screw.
- 38 Replace tools.

REPLACEMENT OF DAMAGED CRADLE**WARNING**

PERSONAL INJURY. CRADLE IS SPRING LOADED. DISMANTLE WITH CARE.

Remove cradle from yoke

- 39 Cradle assembly is spring loaded, dismantle with care.
- 40 Using an 8 mm Allen key, loosen cradle pivot screw.
- 41 With assistant holding cradle firmly, push against coil of spring and remove pivot screw, and slowly release spring.
- 42 Remove friction washers from both locations and discard if less than 1.0 mm thick.

Fit new cradle to yoke

- 43 With assistance from another person, fit spring into cradle/yoke assembly, as follows:
 - 43.1 Locate cradle in yoke and insert friction washers.
 - 43.2 Align pivot holes in yoke, cradle and washers and insert screw until it just protrudes into space for spring.
 - 43.3 Position spring for insertion so that short leg of spring is against arm of yoke and long leg of spring is against base of cradle.
 - 43.4 With your assistant holding the cradle firmly, push coil of spring into position and push pivot axle through centre of spring coil, cradle, second friction washer and into second arm of yoke.
 - 43.5 Using an 8 mm Allen key, tighten pivot screw until required friction is achieved.

REPLACEMENT OF AMMO TRAY(S)**Remove trays**

- 44 Using a 5 mm Allen key, remove eight mounting screws.
- 45 Repair or discard damaged trays.

Fit new tray

- 46 To fit new/repaired tray secure M249 tray in rear position and M240 tray in the forward position with the eight lock washers and screws.

REPLACEMENT OF LOCKING ARM

Remove locking arm

- 47 With swing arms in open position, using a 4 mm pin punch knock out the 4 mm roll pin from locking arm.
- 48 Remove locking lever handle.
- 49 Remove locking arm from lower swing arm.

Fit new locking arm

- 50 Fit new locking arm into lower swing arm so that the tab extension protrudes from the base of the lower arm.
- 51 Align hole in locking arm with holes in lower swing arm and insert locking lever handle.
- 52 Insert new 4 mm roll pin.

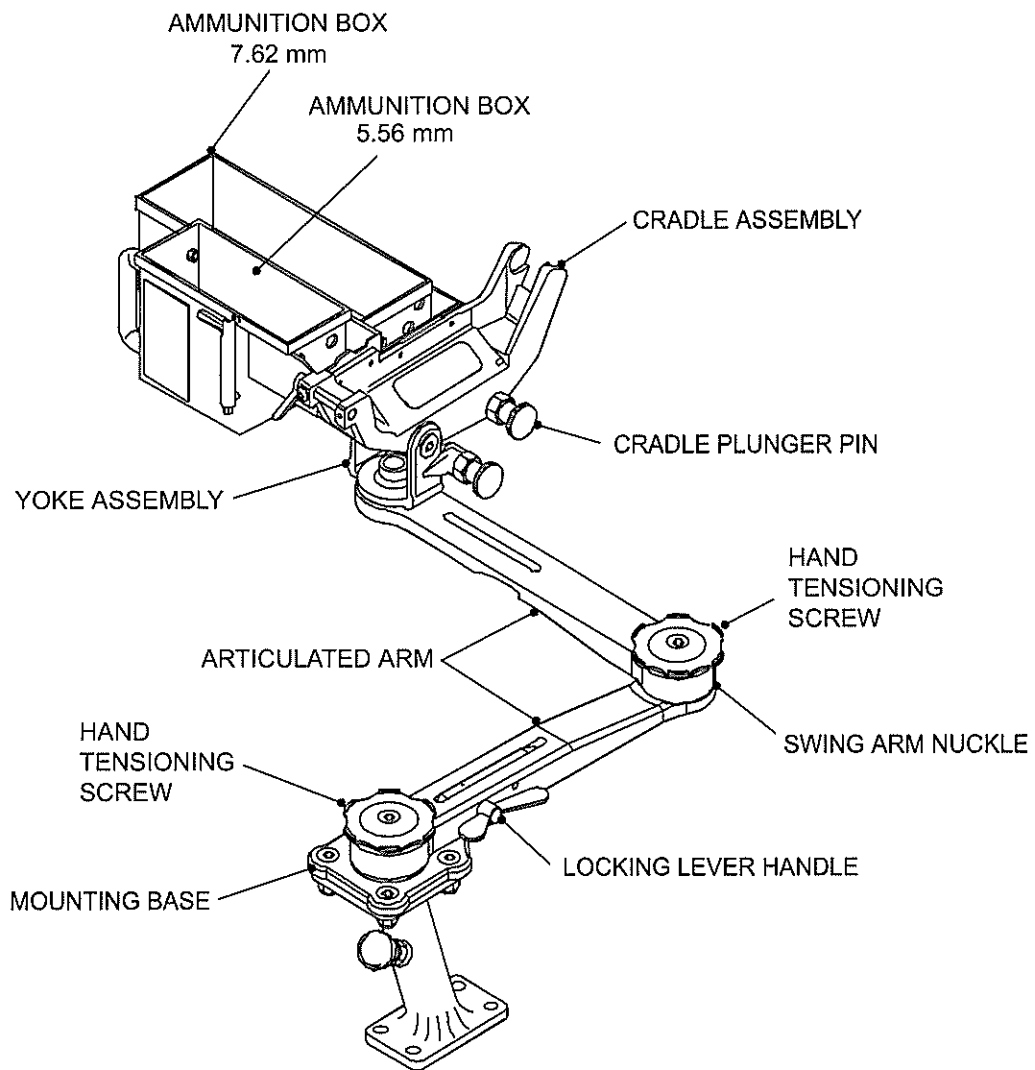


Fig 1 Swing arm mount general assembly

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