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LAND ROVER 90/110/127 ALL VARIANTS
(Excluding APV, ■ and 127 Crash Rescue Ambulance)
REPRINTED JAN 1993 INCORPORATING AMDT Nos 1 AND 2

FAILURE DIAGNOSIS

This publication contains information covering the
requirements of Sub-Category 5-1 at information
Levels 2, 3 and 4

BY COMMAND OF THE DEFENCE COUNCIL

Ms. Gindan

Ministry of Defence

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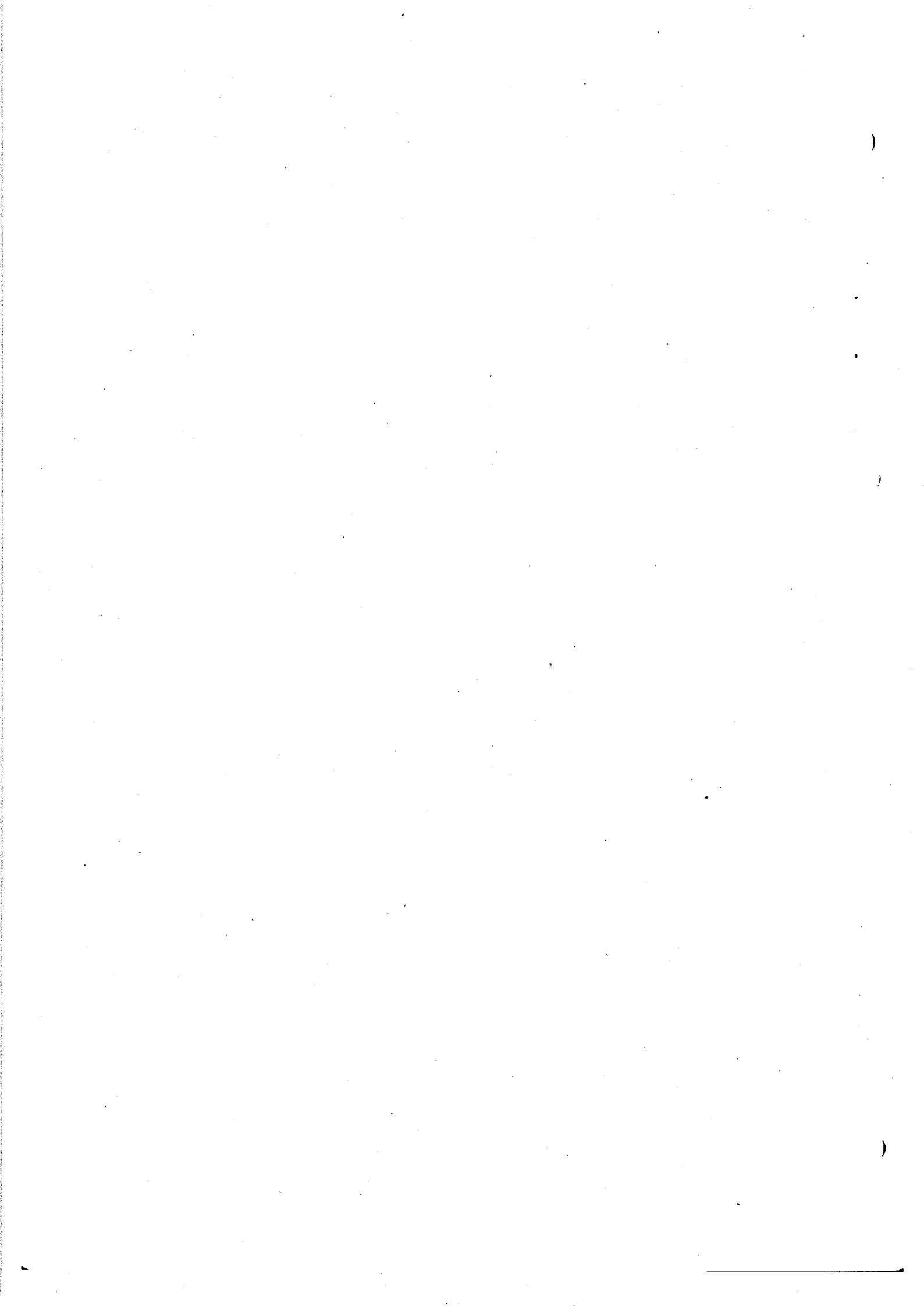
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AMENDMENT RECORD

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PREFACE

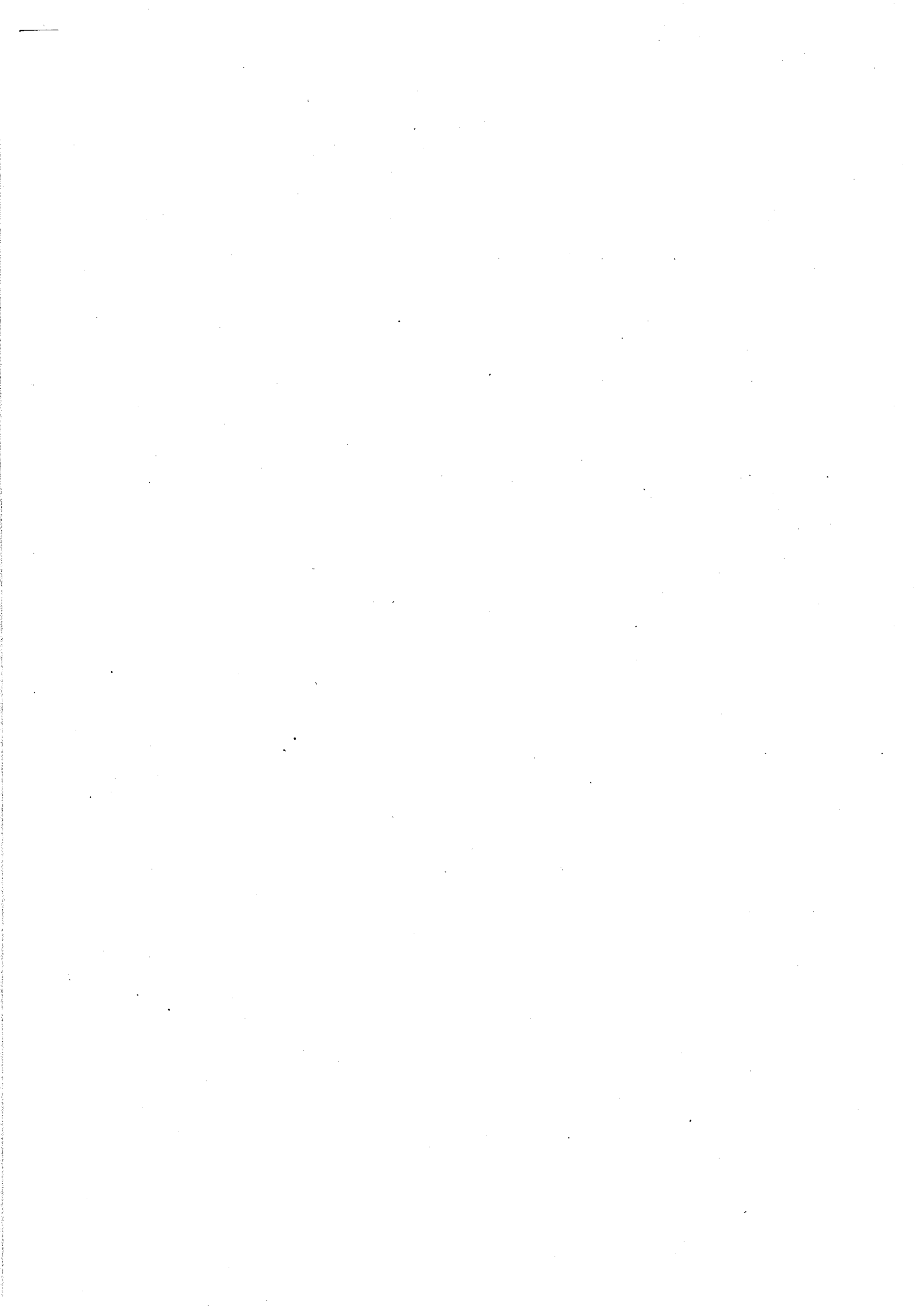
AMENDMENT IDENTIFICATION

1 Amendments are identified by marginal side lining.

COMMENTS ON THIS PUBLICATION

2 Comments on this publication are to be forwarded in accordance with AESP 0100-P-011-013 to Vehicles & Weapons Branch REME, Chobham Lane, Chertsey, Surrey KT16 0EE.

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Vehs & Wpns Br



Chapter 1-1

ENGINE 2,5 LITRE DIESEL

FAILURE DIAGNOSIS

CONTENTS

<u>Table</u>		<u>Page</u>
1	Engine failure diagnosis	2

TABLE 1 - ENGINE FAILURE DIAGNOSIS

Serial No (1)	Fault (2)	Possible cause (3)	Remedy (4)
1	Difficulty starting	Lack of fuel	Check fuel level in tank, replenish as necessary with correct grade of fuel
2		Stop solenoid faulty	Check audible operation when switched. Check electric supply, if satisfactory, replace solenoid
3		Wrong starting procedure	Check starting procedure—throttle closed and heater plugs in operation
4		Air in fuel system	Check all joints and unions are tight
5		Fuel inlet restriction	Check filter not choked and feed pipes clear
6		Fuel contamination	Check diesel fuel being used not petrol, free of water, dirt, ice or waxing
7		Low cranking speed	Check battery and starter cable connections. Check correct grade engine lubricating oil
8		Starting aid ineffective	Check functioning of heater plugs
9		Injection timing incorrect	Re-time DPS pump to engine
10		Timing belt slipped	Check belt condition and tension. Check DPS pump rotor not seized

(Continued)

Table 1 - Engine failure diagnosis (continued)

Serial No (1)	Fault (2)	Possible cause (3)	Remedy (4)
11	Difficulty starting (cont'd)	Back leakage restricted	Check return to tank clear, flow from cam box valve when cranking
12		Fuel circuit incorrect	Check inlet and back leak pipes correct way round
13		Fuel atomisation	Check injectors are correct type check opening pressure and spray condition
14		Fuel tank blockage	Check tank vent and outlet for restriction
15		HP pipe leaking	Check connections are tight
16		Engine condition	Check compression all cylinders, valve timing and clearances. Air filter not blocked
17		DPS pump defective	If all other relevant checks are satisfactory replace DPS pump
18	Irregular idle	Air in fuel system	Check all joints and unions are tight
19		Fuel inlet restriction	Check filter not choked and feed pipes clear
20		Back leakage restricted	Check return to tank clear, flow from cam box valve when cranking
21		Fuel tank blockage	Check tank vent and outlet for restriction

(Continued)

Table 1 - Engine failure diagnosis (continued)

Serial No (1)	Fault (2)	Possible cause (3)	Remedy (4)
22	Irregular idle (cont'd)	HP pipe restriction	Check HP pipes kinked or bore reduced at nipples
23		Idling speed incorrect	Reset to correct speed
24		Anti-stall incorrect	Check recovery from acceleration with warm engine
25		Manual idle advance faulty	Check cable and lever operation satisfactory
26		Accelerator linkage faulty	Check lever tight on pump, reaches stop screw, linkage wear, adjustment
27		DPS pump loose	Check tightness of pump mounting bolts and rear support bracket nut and bolt
28	Erratic running or surging	Fuel circuit incorrect	Check inlet and back leak pipes correct way round
29		Fuel atomisation	Check injectors are correct type check opening pressure and spray condition
30		Fuel tank blockage	Check tank vent and outlet for restriction
31		Accelerator linkage faulty	Check lever tight on pump, reaches stop screw, linkage wear, adjustment

(Continued)

Table 1 - Engine failure diagnosis (continued)

Serial No (1)	Fault (2)	Possible cause (3)	Remedy (4)
32	Erratic running or surging (cont'd)	Engine vibration	Check engine mountings tight and effective
33		DPS pump loose	Check tightness of pump mounting bolts and rear support bracket nut and bolt
34		DPS pump defective	If all other relevant checks are satisfactory replace DPS pump
35	Excessive smoke	Fuel contamination	Check diesel fuel being used not petrol, free of water, dirt, ice or waxing
36		Injection timing incorrect	Re-time DPS pump to engine
37		Engine condition	Check compression all cylinders, valve timing and clearances. Air filter not blocked
38		Fuel atomisation	Check injectors are correct type check opening pressure and spray condition
39		DPS pump defective	If all other relevant checks are satisfactory replace DPS pump
40	Excessive noise	Injection timing incorrect	Re-time DPS pump to engine
41		Fuel atomisation	Check injectors are correct type check opening pressure and spray condition

(Continued)

Table 1 - Engine failure diagnosis (continued)

Serial No (1)	Fault (2)	Possible cause (3)	Remedy (4)
42	Excessive noise (cont'd)	DPS pump loose	Check tightness of pump mounting bolts and rear support bracket nut and bolt
43		Engine vibration	Check engine mountings tight and effective
44	Lack of power	Air in fuel system	Check all joints and unions are tight
45		Fuel inlet restriction	Check filter not choked and feed pipes clear
46		Injection timing incorrect	Re-time DPS pump to engine
47		Back leakage restricted	Check return to tank clear, flow from cam box valve when cranking
48		Fuel circuit incorrect	Check inlet and back leak pipes correct way round
49		Fuel atomisation	Check injectors are correct type check opening pressure and spray condition
50		Fuel tank blockage	Check tank vent and outlet for restriction
51		HP pipe leaking	Check connections are tight
52		HP pipe restriction	Check HP pipes kinked or bore reduced at nipples

(Continued)

Table 1 - Engine failure diagnosis (continued)

Serial No (1)	Fault (2)	Possible cause (3)	Remedy (4)
53	Lack of power (cont'd)	Accelerator linkage faulty	Check lever tight on pump, reaches stop screw, linkage wear, adjustment
54		Maximum speed incorrect	Check seal intact, adjust setting
55		Engine condition	Check compression all cylinders, valve timing and clearances. Air filter not blocked
56		Vehicle brakes binding transmission brake	Check brake freedom all wheels and
57		Exhaust system defective	Check system unrestricted
58		LP leakage	Check feed and return pipes, filter and tank for leaks
59	Excessive fuel consumption	Injection timing incorrect	Re-time DPS pump to engine
60		Engine condition	Check compression all cylinders, valve timing and clearances. Air filter not blocked
61		Fuel atomisation	Check injectors are correct type check opening pressure and spray condition
62		HP pipe leaking	Check connections are tight

(Continued)

Table 1 - Engine failure diagnosis (continued)

Serial No (1)	Fault (2)	Possible cause (3)	Remedy (4)
63	Excessive fuel consumption (cont'd)	Idling speed incorrect	Reset to correct speed
64		Vehicle brakes binding	Check brake freedom all wheels and transmission brake
65		DPS pump defective replace DPS pump	If all other relevant checks are satisfactory
66	Stalling	Air in fuel system	Check all joints and unions are tight
67		Fuel inlet restriction	Check filter not choked and feed pipes clear
68		Injection timing incorrect	Re-time DPS pump to engine
69		Back leakage restricted	Check return to tank clear, flow from cam box valve when cranking
70		Idling speed incorrect	Reset to correct speed
71		Anti-stall incorrect	Check recovery from acceleration with warm engine
72		DPS pump defective replace DPS pump	If all other relevant checks are satisfactory
73	Slow engine die down	Anti-stall incorrect	Check recovery from acceleration with warm engine

(Continued)

Table 1 - Engine failure diagnosis (continued)

Serial No (1)	Fault (2)	Possible cause (3)	Remedy (4)
74	Slow engine die down (cont'd)	Accelerator linkage faulty	Check lever tight on pump, reaches stop screw, linkage wear, adjustment
75	Engine will not shut-off	Stop solenoid faulty	Check audible operation when switched. Check electric supply, if satisfactory, replace solenoid
76	Excessive knocking (detonation)	Injection timing incorrect	Re-time DPS pump to engine
77		Engine condition	Check compression all cylinders, valve timing and clearances. Air filter not blocked
78		Injectors sticking	Check injectors individually. Overhaul injectors
79		Lack of coolant in radiator	Check coolant level, if if satisfactory check thermostat functioning and radiator not blocked
80		Lack of oil in engine	Check oil level top up as necessary
81		Lubrication system over filled	Drain oil to correct level, check air filter for contamination
82	Engine overheating	Thermostat faulty	Test and replace if faulty
83		Cylinder head cracked	Replace if faulty

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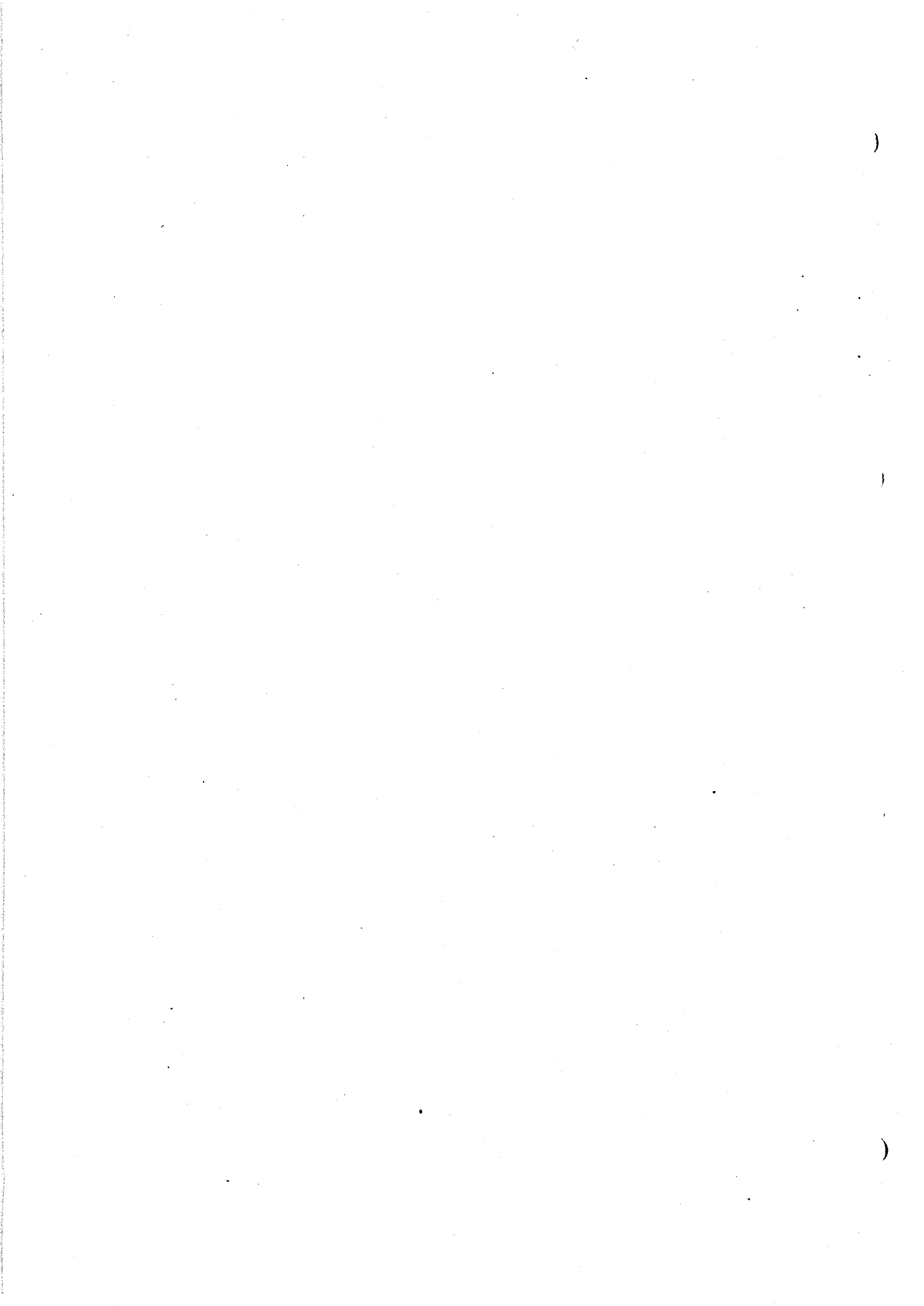
Table 1 - Engine failure diagnosis (continued)

Serial No (1)	Fault (2)	Possible cause (3)	Remedy (4)
84	Low oil pressure, warning light remains on, engine running	Thin or diluted oil	Drain and refill with correct grade of oil and renew filter
85		Choked oil pump	Clean strainer
86		Faulty relief valve	Rectify or renew
87		Excessive main bearing clearance or worn bearings	Adjust clearances renew bearings as necessary
88		Oil pressure switch faulty	Renew
89		Electrical fault	Check circuit
90		Oil pump rotors worn	Overhaul oil pump
91		Faulty skew gear assembly	Overhaul skew gear assembly
92	Rattle in lubrication system	Oil pressure relief plunger sticking	Remove and clean
93	Noisy valve mechanism	Worn timing gears or belt	Overhaul timing mechanism

(Continued)

Table 1 - Engine failure diagnosis (continued)

Serial No (1)	Fault (2)	Possible cause (3)	Remedy (4)
94	Mechanical noises		
94.1	Low pitch knock	Big-end bearing slack or run	
94.2	Low pitch thud	Main bearing slack or run	
94.3	Intermittent thuds	Loose flywheel or excessive crankshaft end-float	
94.4	High pitch tap	Worn gudgeon pins	
94.5	Light tapping	Excessive valve clearance	
94.6	Slapping	Excessive piston clearance, more apparent with cold engine	



Chapter 1-2

ENGINE 3.5 LITRE V8 PETROL

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INTRODUCTION

1 This Chapter gives the Fault diagnosis for the 3.5 litre V8 petrol engine fitted to the Land Rover 110 and 127 vehicles.

General

2 The information given is applicable to both left and right hand drive vehicles.

TABLE 1 ENGINE FAILS TO START

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Incorrect starting procedure	See owners handbook
2	Starter motor speed too slow	Check battery condition and connectors
3	Faulty ignition system	Check each system component
4	Water or dirt in fuel system	Flush out system with clean fuel
5	Carburettor(s) flooding	Check float chamber needle valve

(continued)

TABLE 1 ENGINE FAILS TO START (continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
6	Defective fuel pump	Remove, overhaul or renew
7	Defective starter motor	Overhaul or renew
8	Starter pinion not engaging	Overhaul starter motor

TABLE 2 ENGINE FAILS TO IDLE

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Incorrect carburetter setting	Adjust carburetter(s)
2	Faulty fuel pump	Remove, overhaul or renew
3	Sticking valves	Overhaul cylinder head(s)
4	Faulty cylinder head gasket	Renew

TABLE 3 ENGINE STALLS

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Low idling speed	Adjust carburetter(s)
2	Faulty spark plugs	Clean and test or renew
3	Faulty coil or condenser	Renew
4	Faulty distributor points	Rectify or renew
5	Incorrect mixture	Adjust carburetter(s)
6	Foreign matter in fuel system	Investigate source and clean as necessary

TABLE 4 ENGINE STARTS, BUT STOPS IMMEDIATELY

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Faulty electrical connection	Check HT leads for cracked insulation; also check low tension circuit

(continued)

TABLE 4 ENGINE STARTS, BUT STOPS IMMEDIATELY (continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
2	Foreign matter in fuel system	Investigate source and clean as necessary
3	Faulty fuel pump	Remove, overhaul or renew
4	Fuel level in tank too low	Replenish

TABLE 5 ENGINE MISFIRES ON ACCELERATION

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Distributor points setting incorrect	Set to correct dwell angle
2	Faulty coil or condenser	Renew
3	Faulty spark plugs	Clean and test or renew
4	Faulty carburetter(s)	Overhaul
5	Vacuum pipes disconnected or damaged at inlet manifold	Check all vacuum pipe connections. Renew faulty pipes.

TABLE 6 ENGINE RUNS ERRATICALLY

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Faulty electrical connection	Check security of all ignition connections
2	Faulty spark plugs	Clean and test or renew
3	Low battery charge	Recharge battery and test
4	Faulty distributor	Remove and overhaul
5	Faulty fuel pump	Remove, overhaul or renew
6	Foreign matter in fuel system	Investigate source and clean as necessary
7	Sticking valves	Overhaul cylinder head(s)
8	Defective valve springs	Overhaul cylinder head(s)

(continued)

TABLE 6 ENGINE RUNS ERRATICALLY (continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
9	Incorrect ignition timing	Check and adjust timing
10	Worn valve guides or valves	Overhaul cylinder head(s)
11	Faulty cylinder head gaskets	Check and renew gaskets
12	Damaged exhaust system	Rectify or renew
13	Vacuum pipes disconnected at inlet manifold, distributor or gearbox	Renew

TABLE 7 ENGINE LACKS POWER

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Poor cylinder compression	Faulty piston rings or valves Low pressure in adjoining cylinders indicates faulty cylinder head gasket
2	Badly seated valves	Overhaul cylinder head(s)
3	Faulty exhaust silencer	Renew
4	Incorrect ignition timing	Check and adjust timing
5	Leaks or restriction in fuel system	Check through system
6	Faulty spark plug	Clean, test and renew
7	Excessive carbon deposits	Decarbonize
8	Brakes binding	Adjust brakes or overhaul
9	Faulty coil condenser or battery	Renew faulty component(s)

TABLE 8 ENGINE KNOCKS

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Ignition timing advanced	Reset the timing

(continued)

TABLE 8 ENGINE KNOCKS (continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
2	Excessive carbon deposit	Decarbonise
3	Incorrect carburetter setting	Adjust carburetter(s)
4	Unsuitable fuel	Adjust ignition timing to suit octane rating
5	Worn pistons or bearings	Overhaul engine
6	Distributor advance mechanism faulty	Renew capsule and recheck
7	Defective spark plugs	Clean and test or renew

TABLE 9 ENGINE BACKFIRES

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Faulty ignition component	Check each system component
2	Carburetter fault	Overhaul carburetter(s)
3	Sticking valve	Overhaul cylinder head
4	Weak valve springs	Overhaul cylinder head
5	Badly seated valves	Overhaul cylinder head
6	Excessively worn valve stems and guides	Overhaul cylinder head
7	Excessive carbon deposits	Overhaul cylinder head
8	Incorrect spark plug gap	Clean and reset
9	Air leak in induction or exhaust systems	Renew any faulty gaskets or components

TABLE 10 BURNED VALVES

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Sticking valves	Overhaul cylinder head
2	Weak valve springs	Overhaul cylinder head (continued)

TABLE 10 BURNED VALVES (continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
3	Excessive deposits on valve seats	Overhaul cylinder head
4	Distorted valves	Overhaul cylinder head
5	Excessive mileage between overhauls	Overhaul cylinder head

TABLE 11 NOISEY VALVE MECHANISM

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Excessive oil in sump causing air bubbles in the hydraulic tappets	Drain and refill to the correct level on dipstick
2	Worn or scored parts in valve operating mechanism	Replace faulty components
3	Valves and seats cut down excessively, raising end of valve stem 1.27 mm (0.05 in) above normal position	Grind off end of valve stem or replace components
4	Sticking valves	Overhaul cylinder head
5	Weak valve springs	Overhaul cylinder head
6	Worn timing chain or chain wheels	Renew worn components

TABLE 12 MAIN BEARING RATTLE

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Low oil level in sump	Replenish to high mark on dipstick
2	Low oil pressure	Remove, inspect, renew
3	Excessive bearing clearance	Renew bearings; grind crankshaft
4	Burnt out bearings	Renew and investigate cause of failure

(continued)

TABLE 12 MAIN BEARING RATTLE (continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
5	Loose bearing caps	Tighten to correct torque

TABLE 13 ENGINE OVERHEATING

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Low coolant level	Check for leaks and refill
2	Faulty cooling system	Check fan and drive belts, water pump and radiator fins for blockage
3	Faulty thermostat	Test and renew if necessary
4	Incorrect timing	Check and adjust timing
5	Defective lubrication system	Renew filter, check pump and clean strainer

TABLE 14 LOW OIL PRESSURE WARNING LIGHT REMAINS ON

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Thin or diluted oil	Drain and refill with correct oil and renew filter
2	Low oil level	Replenish to high mark on dipstick
3	Chocked pump strainer	Clean
4	Faulty release valve	Rectify
5	Excessive bearing clearance	Rectify
6	Oil pressure switch faulty system	Renew clean as necessary
7	Electrical fault	Check circuit
8	Relief valve sticking	Clean, test or renew
9	Weak relief valve spring	Renew

(continued)

TABLE 14 LOW OIL PRESSURE WARNING LIGHT REMAINS ON (continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
10	Pump rotors excessively worn	Overhaul oil pump
11	Excessively worn bearings; main, con-rod, big end, etc	Identify faulty bearings and replace

Chapter 1-3

2.5 LITRE DIESEL ENGINE BREATHER SYSTEM

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	2	General	
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INTRODUCTION

1 This Chapter gives the Failure diagnosis for the 2.5 litre diesel engine breather system fitted to the Land Rover 90 and 110.

General

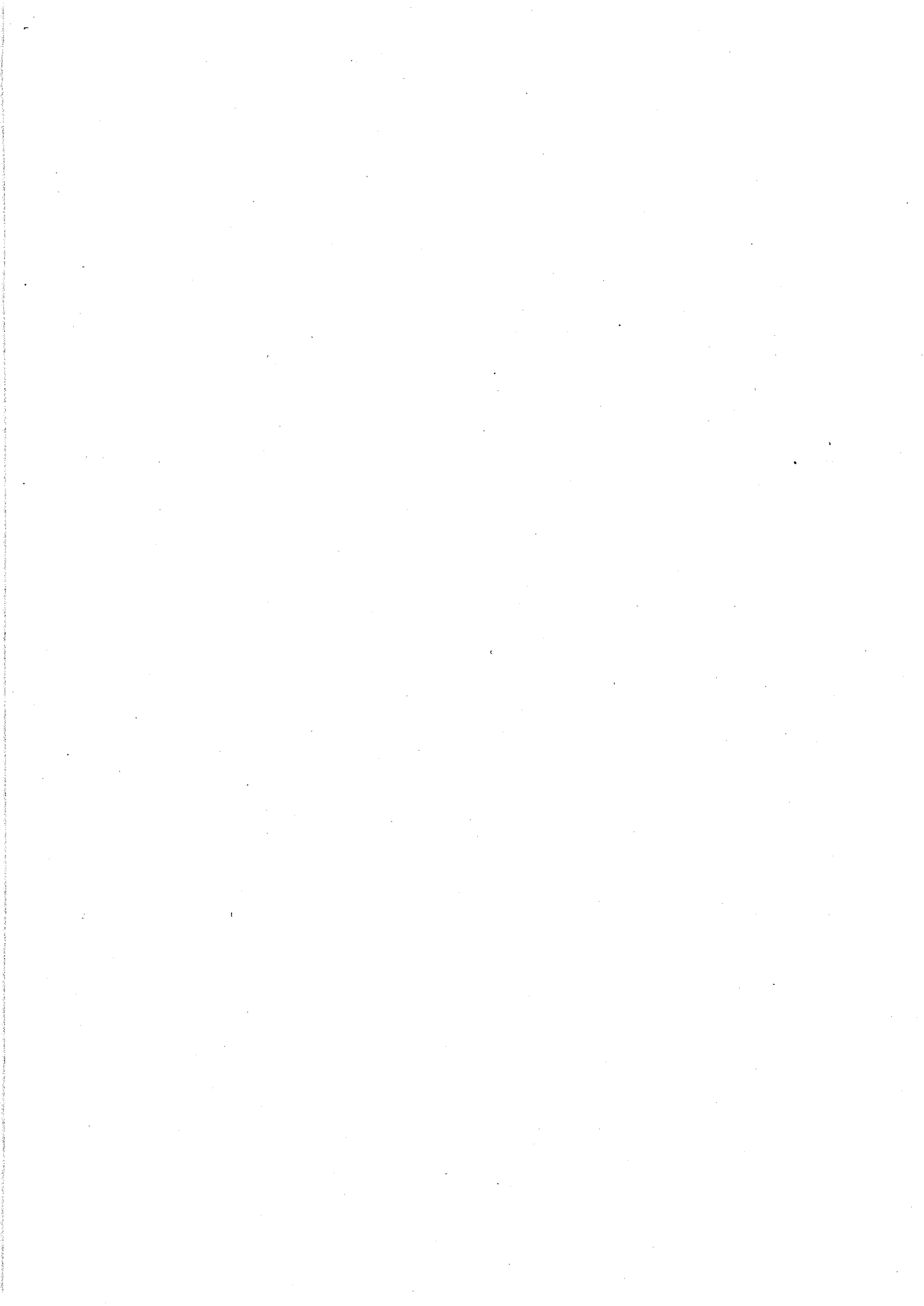
2 The information given is applicable to both left and right hand drive vehicles.

TABLE 1 ENGINE BURNING LUBRICATION OIL

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Damaged or worn oil drain to sump hose/clips	Replace oil drain to sump hose/clips
2	Cyclone unit clogged with oil	Remove and clean cyclone unit
3	Faulty depression regulator	Replace depression regulator

TABLE 2 ENGINE SPEED HIGHER THAN ACCEPTED LEVEL

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Damaged or worn induction inlet hose/clips	Replace induction inlet hose/clips



Chapter 2

CLUTCH

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- 1 Introduction
- 2 General

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- 1 Clutch slippage
- 2 Clutch drag
- 3 Clutch fierce
- 4 Clutch judder

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INTRODUCTION

1 This Chapter gives the Fault diagnosis for the clutch fitted to Land Rover 90 and 110 vehicles.

General

2 The information given is applicable to both left and right hand drive vehicles.

TABLE 1 CLUTCH SLIPPAGE

Ser	Possible cause	Possible fault	Action
(1)	(2)	(3)	(4)
1	Release mechanism.	Height setting incorrect. Tight on shaft.	Checking/adjust pedal height. Free off and lubricate.
2	Hydraulic piston.	Seized or sticking.	Check, repair or renew slave cylinder. Check, repair or renew master cylinder.
3	Clutch assembly.	Damaged or oil contaminated.	Remove, examine clutch plate. Worn, damaged; renew plate. Oil contaminated; renew plate repair oil leak. Sticking on splines; free off Diaphragm cracked, distorted; renew pressure plate.

TABLE 2 CLUTCH DRAG

Ser	Possible cause	Possible fault	Action
(1)	(2)	(3)	(4)
1	Pedal	Travel obstructed Tight on shaft	Remove obstruction Free off and lubricate
2	Hydraulic system	2.1 Insufficient fluid 2.2 Leaking externally 2.3 Leaking internally	Check reservoir to master cylinder hose for obstruction kinking; correct as necessary Check master, slave cylinders pipe unions for leaks; repair or renew as necessary. Check master, slave cylinders for damaged cups, bores, renew as necessary.
3	Release mechanism	Sticking or obstructed	Free off or clear obstruction
4	Hydraulic piston	Seized or obstructed	Check, repair or renew slave cylinder. Check, repair or renew master cylinder.
5	Clutch assembly	Damaged or oil contaminated.	Remove, examine clutch plate. Worn, damaged; renew plate. Oil contaminated; renew plate repair oil leak. Sticking on splines; free off Diaphragm cracked, distorted; renew pressure plate.

TABLE 3 CLUTCH FIERCE

Ser	Possible cause	Possible fault	Action
(1)	(2)	(3)	(4)
1	P dal	Sticking on shaft	Free off and lubricate
2	Hydraulic system	2.1 Insufficient fluid 2.2 Leaking externally 2.3 Leaking internally	Check reservoir tyo master cylinder hose for obstruction kinking; correct as necessary Check master, slave cylinders pipe unions for leaks; repair or renew as necessary. Check master, slave cylinders for damaged cups, bores, renew as necessary.
3	Release mechanism	Sticking or obstructed	Fr e off or clear obstruction (continued)

TABLE 3 CLUTCH FIERCE (continued)

Ser	Possible cause	Possible fault	Action
(1)	(2)	(3)	(4)
4	Hydraulic piston	Seized or sticking	Check, repair or renew slave cylinder. Check, repair or renew master cylinder
5	Clutch assembly	Damaged or oil contaminated.	Remove, examine clutch plate. Worn, damaged; renew plate. Oil contaminated; renew plate repair oil leak. sticking on splines; free off Diaphragm cracked, distorted; renew pressure plate.

TABLE 4 CLUTCH JUDDER

Ser	Possible cause	Possible fault	Action
(1)	(2)	(3)	(4)
1	Power unit mountings	Worn or loose	Check mountings, tighten or renew.
2	Drive shafts	Worn or damaged	Repair or renew drive shafts.
3	Pedal	Sticking on shaft	Free off and lubricat .
4	Hydraulic system	4.1 Insufficient fluid	Check reservoir to master cylinder hose for obstruction kinking; correct as necessary.
		4.2 Leaking externally	Check master, slave cylinders pipe unions for leaks; repair or renew as necessary.
		4.3 Leaking internally	Check master, slave cylinders for damaged cups, bor s, renew as necessary.
5	Release mechanism	Sticking or obstructed.	Free off or clear obstruction
6	Hydraulic piston	Seized or sticking.	Check, repair or renew slave cylinder. Check, repair or renew master cylinder.
7	Clutch assembly	Damaged or oil contaminated	Remove, examine clutch plate. Worn, damaged; renew plat . Oil contaminated; renew plate repair oil leak.

(Continued)

TABLE 4 CLUTCH JUDDER (continued)

Ser	Possible cause	Possible fault	Action
(1)	(2)	(3)	(4)
			Sticking on splines; free off Diaphragm cracked, distorted; renew pressure plate.

Chapter 3

5 SPEED GEARBOX

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- 2 General

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- 1 Difficult gear engagement
- 2 Oil leaks
- 3 Gear jumps out of engagement
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- 2
- 2

INTRODUCTION

1 This Chapter gives the Fault diagnosis for the gearbox fitted to Land Rover 90 and 110 vehicles.

General

2 The information given is applicable to both left and right hand drive vehicles.

TABLE 1 DIFFICULT GEAR ENGAGEMENT

Ser	Possible cause	Possible fault	Action
(1)	(2)	(3)	(4)
1	Gearbox	Oil level low.	Check for leaks and damage, rectify; top up oil level. Disconnect linkage from gearbox and assess feel of linkage.
2	Gear linkage	2.1 Sticking or seized. 2.2 Fixings loose. 2.3 Mountings worn or damaged	Free off or renew components. Tighten fixings. Renew mountings.
3	Clutch plate	Sticking or seized.	See Chapter 2 Category 512.
4	Selector forks	Bent, damaged, pads missing.	Renew selector forks.

TABLE 2 OIL LEAKS

Ser	Possible cause	Possible fault	Action
(1)	(2)	(2)	(3)
1	Oil pressure	1.1 Oil level high. 1.2 Incorrect type of oil. 1.3 Blocked breather.	Drain off excess oil. Refill with correct type. Clear breather.
2	Oil seal	Damaged or worn.	Locate faulty seal and renew. Top up oil level.
3	End cover	3.1 Loose, damaged. 3.2 Damaged seal	Tighten cover fixings, renew cover. Renew seal

TABLE 3 GEAR JUMPS OUT OF ENGAGEMENT

Ser	Possible cause	Possible fault	Action
(1)	(2)	(3)	(4)
1	Selector fork	1.1 Bent, damaged or worn. 1.2 Weak detent spring.	Renew fork. Renew fork.
2	Selector detent	Worn detent ball.	Renew detent ball and spring assembly.
3	Synchro unit	3.1 Worn sleeve or hub. 3.2 Worn gear cone.	Renew synchro unit. renew mainshaft gear.

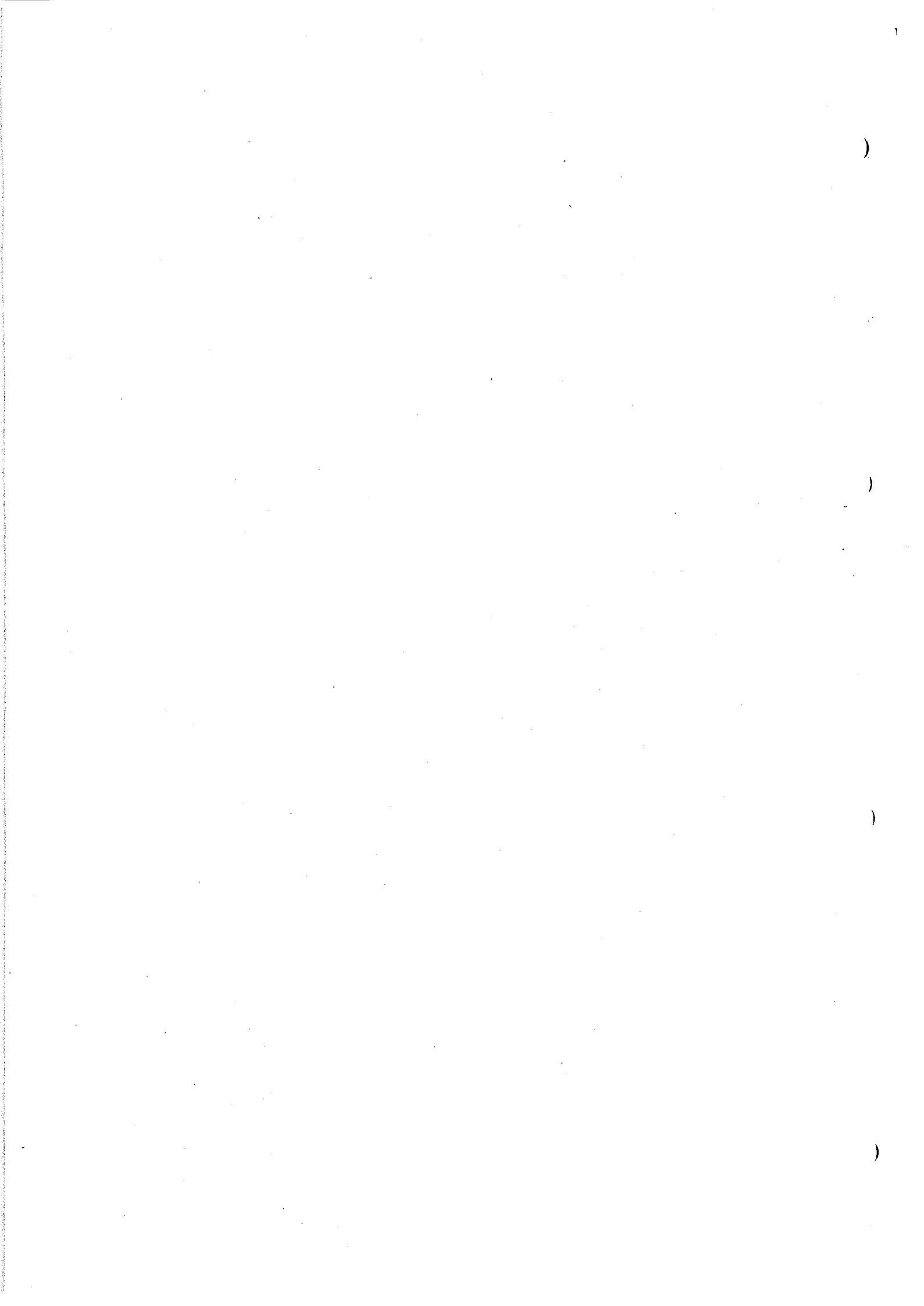
TABLE 4 GEARBOX NOISE

Ser	Possible cause	Possible fault	Action
(1)	(2)	(3)	(4)
1	Inadequate lubrication	1.1 Oil level low. 1.2 Blocked oilways.	Check for leaks, top up oil level. Overhaul gearbox.
2	Gears	Worn or damaged.	Renew gears.
3	Synchro unit	Worn or damaged.	Renew synchro unit and gear.
4	Bearings	Worn.	Renew bearings.

(continued)

TABLE 4 GEARBOX NOISE (continued)

Ser	Possible cause	Possible fault	Action
(1)	(2)	(3)	(4)
5	Mainshaft	Excessive end float	Check bearing retaining plate and screws. Renew and secure as necessary.



Chapter 3-2

LT85 PUMPED FIVE SPEED MANUAL GEARBOX

CONTENTS

Frame	Para		
	1	Introduction	
	2	General	
	Table		Page
	1	Difficult gear engagement	1
	2	Oil leaks	2
	3	Gear jumps out of engagement	2
	4	Gearbox noise	2

INTRODUCTION

1 This Chapter gives the Failure diagnosis for the LT85 pumped five speed manual gearbox fitted to the Land Rover 127 vehicles.

General

2 The information given is applicable to both left and right hand drive vehicles.

TABLE 1 DIFFICULT GEAR ENGAGEMENT

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Low oil level	Check for leaks and damage, rectify; top up oil level.
2	Sticking or seized linkage	Check linkage, free off or renew any faulty components
3	Loose fittings on linkage	Check gear linkage. Adjust if necessary
4	Gear linkage mountings worn or damaged	Check mountings and renew mountings where necessary
5	Clutch plate sticking or seized	See Chap 2, Cat 512
6	Bent or damaged selector forks	Renew/repair as necessary

TABLE 2 OIL LEAKS

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	High oil pressure	Check oil level; drain off any excess oil Check that correct grade of oil is being used Check gearbox breather; clean if necessary
2	Faulty oil seal(s)	Locate and renew faulty seal. Top up oil level
3	Loose top cover	Tighten cover fixings, renew oil seal if necessary

TABLE 3 GEAR JUMPS OUT OF ENGAGEMENT

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Selector fork damaged	Renew selector fork
2	Weak selector fork detent spring	Renew detent spring
3	Worn selector detent ball	Renew detent ball and spring assembly
4	Worn sleeve or hub on synchro unit	Renew synchro unit
5	Worn synchro unit gear cone seized	Renew mainshaft gear

TABLE 4 GEARBOX NOISE

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Low oil level	Check for leaks and damage, rectify; top up oil level.
2	Inadequate lubrication caused by faulty oil pump	Repair/renew gearbox oil pump
3	Inadequate lubrication caused by blocked oilways	Overhaul gearbox

(continued)

TABLE 4 GEARBOX NOISE (continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
4	Worn or damaged gears	Renew gears
5	Worn or damaged synchro unit	Renew synchro unit and gear
6	Worn bearings	Renew
7	Excessive mainshaft end float	Check bearing retaining plate and screws. Renew and secure as necessary



Chapter 3-3

LT85 LIGHTWEIGHT DIVIDED CASE GEARBOX

CONTENTS

Frame	Para		Page
	1	Introduction	
	2	General	
	Table		
	1	Difficult gear engagement	1
	2	Oil leaks	2
	3	Gear jumps out of engagement	2
	4	Gearbox noise	2

INTRODUCTION

1 This Chapter gives the Failure diagnosis for the LT85 light-weight divided case gearbox fitted to the Land Rover 110 vehicles.

General

2 The information given is applicable to both left and right hand drive vehicles.

TABLE 1 DIFFICULT GEAR ENGAGEMENT

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Low oil level	Check for leaks and damage, rectify; top up oil level.
2	Sticking or seized linkage	Check linkage, free off or renew any faulty components
3	Loose fittings on linkage	Check gear linkage. Adjust if necessary
4	Gear linkage mountings worn or damaged	Check mountings and renew mountings where necessary
5	Clutch plate sticking or seized	See Chap 2, Cat 512
6	Bent or damaged selector forks	Renew/repair as necessary

TABLE 2 OIL LEAKS

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	High oil pressure	Check oil level; drain off any excess oil Check that correct grade of oil is being used Check gearbox breather; clean if necessary
2	Faulty oil seal(s)	Locate and renew faulty seal. Top up oil level
3	Loose or damaged end cover	Tighten cover fixings, renew cover
4	Faulty end cover seal	Renew seal

TABLE 3 GEAR JUMPS OUT OF ENGAGEMENT

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Selector fork damaged	Renew selector fork
2	Weak selector fork detent spring	Renew detent spring
3	Worn selector detent ball	Renew detent ball and spring assembly
4	Worn sleeve or hub on synchro unit	Renew synchro unit
5	Worn synchro unit gear cone seized	Renew mainshaft gear

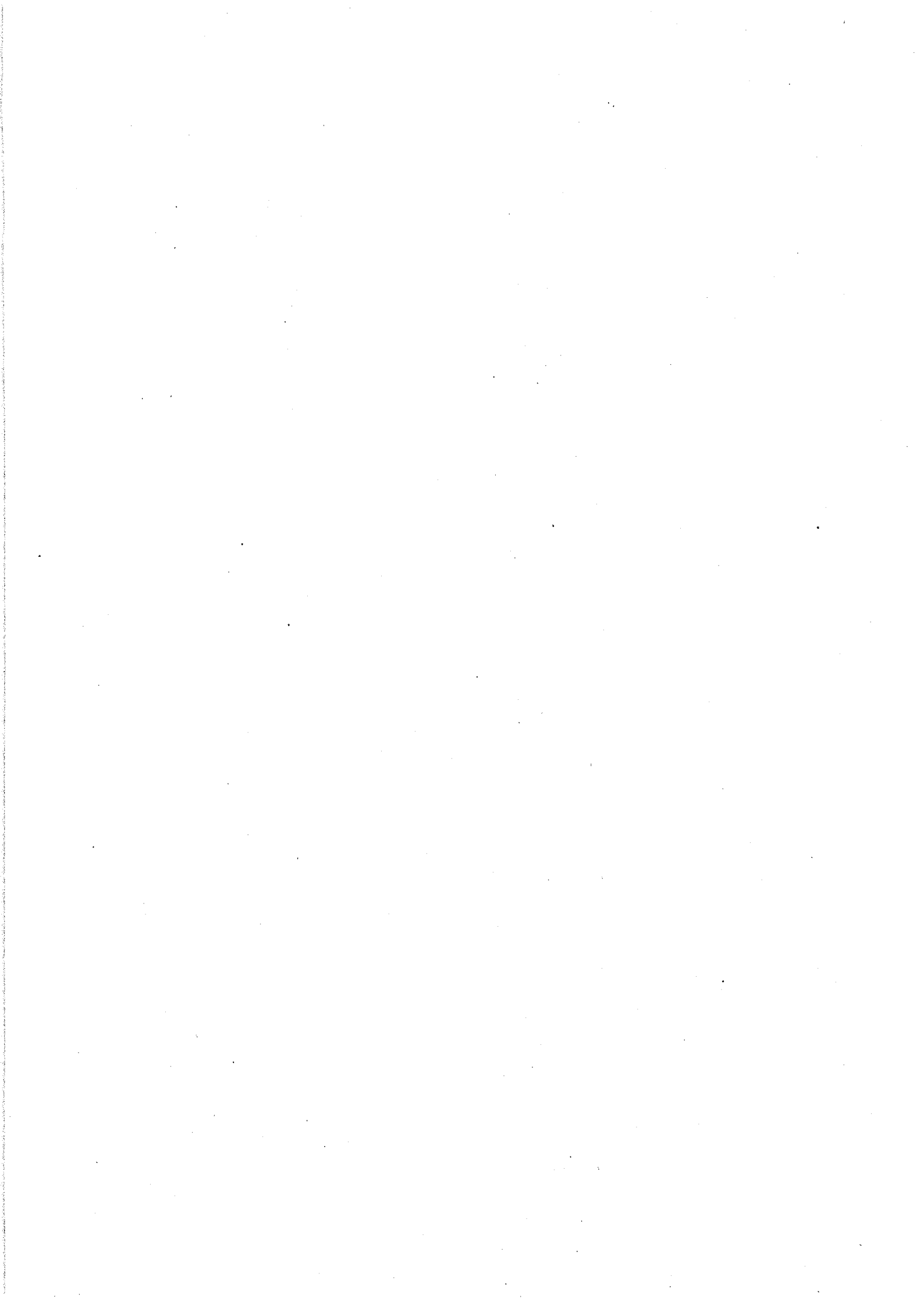
TABLE 4 GEARBOX NOISE

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Low oil level	Check for leaks and damage, rectify; top up oil level.
2	Inadequate lubrication caused by blocked oilways	Overhaul gearbox
3	Worn or damaged gears	Renew gears

(continued)

TABLE 4 GEARBOX NOISE (continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
4	Worn or damaged synchro unit	Renew synchro unit and gear
5	Worn bearings	Renew
6	Excessive mainshaft end float	Check bearing retaining plate and screws. Renew and secure as necessary.



Chapter 4

TRANSMISSION

TRANSFER GEARBOX AND PROPELLER SHAFTS

FAILURE DIAGNOSIS

CONTENTS

Table		Page
1	Transmission system failure diagnosis	2

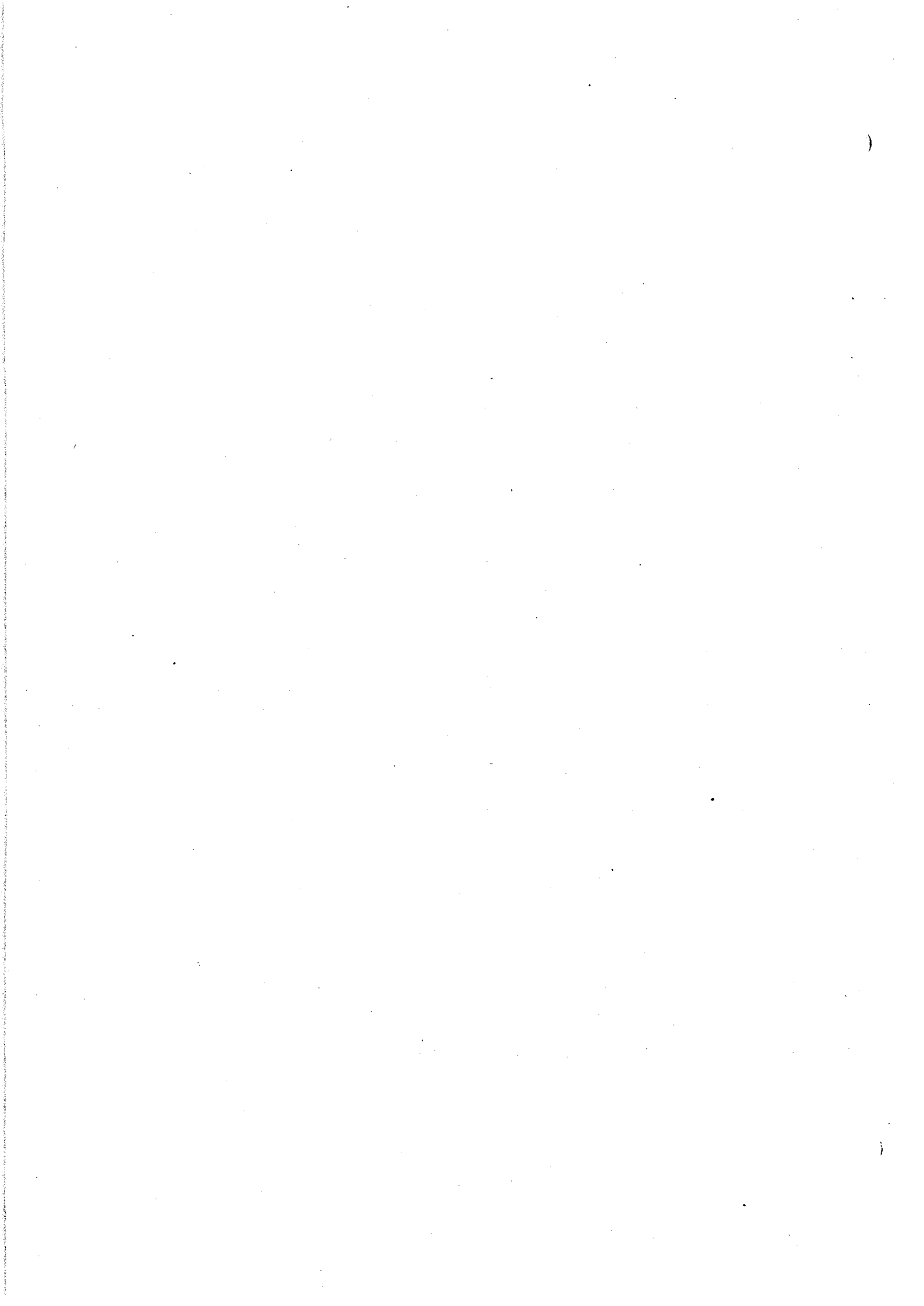
TABLE 1 - TRANSMISSION FAILURE DIAGNOSIS

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
1	Transfer box noisy transfer box	Insufficient oil in replenish	Check oil level, as necessary
2		Incorrect grade of lubricating oil.	Drain and replenish with correct grade
3		Excessive end float on intermediate gear assembly	Adjust end float to correct setting
4		Worn components in transfer gearbox differential	Replace components as necessary
5		Worn bearings in intermediate gears assembly	Renew bearings
6	Differential lock warning light fails to illuminate	Bulb failure	Check bulb, renew as necessary
7		Switch incorrectly set	Adjust switch as necessary
8	Vibrating propeller shaft	Fixings loose	Tighten fixings to correct torque
9		Shaft incorrectly assembled	Check alignment of balance marks. Realign if incorrect
10		Worn needle roller bearings	Check bearings and renew as necessary
11		Worn splines	Check splines with dial test indicator, if unsatisfactory fit new shaft assembly

(Continued)

TABLE 1 TRANSMISSION FAILURE DIAGNOSIS (continued)

Serial (1)	Fault (2)	Possible cause (3)	Remedy (4)
12		Shaft out of balance	Fit new shaft ass mby
13	Noisy universal joints	Lack of lubrication	Lubricate
14		Fixings loose	Tighten fixings to correct torque
15		Worn needle roller bearings	Check bearings and renew as necessary
16		Worn splines	Check splines with dial test indicator, if unsatisfactory fit new shaft assembly



Chapter 5

REAR AXLES

CONTENTS

Frame Para

- 1 Introduction
- 2 General

Table

- 1 Fault diagnosis

Page

1

INTRODUCTION

1 This Chapter gives the Fault diagnosis for the rear axles fitted to Land Rover 90 and 110 vehicles.

General

2 The information given is applicable to both left and right hand drive vehicles.

TABLE 1 FAULT DIAGNOSIS

Ser	Symptom	Possible cause	Action
(1)	(2)	(3)	(4)
1	Oil leaks	1.1 Loose or missing drain and filler plugs.	Check drain plug at und rside of differential case and filler plugs in front cover. Tighten or fit new plugs as applicable.
		1.2 Axle case breather inoperative resulting in internal pressure.	Ensure that the breather pipe is not obstructed. Undo breather from axle case and clean or fit new breather, then rectify leak.
		1.3 Differential cover gasket damaged.	Fit a new gasket.
		1.4 Pinion oil seal damaged.	Fit new pinion oil seal.
		1.5 Oil level too high.	Drain oil to correct level.
2	Whine from differential	2.1 Incorrect setting of crownwheel and pinion.	Remove differential, check and adjust as necessary.
		2.2 Oil level too low	Top up as necessary.
3	Rattle from differential	3.1 Differential oil level too low or incorrect grade.	Drain and replenish with correct grade of oil.

(continued)

TABLE 1 FAULT DIAGNOSIS (continued)

Ser	Symptom	Possible cause	Action
(1)	(2)	(3)	(4)
1	Rattle from differential	<p>1.1 Incorrect bevel pinion bearing adjustment. (Salisbury axle only)</p> <p>1.2 Differential worn or incorrect internal settings.</p>	<p>Fit and adjust a new collapsible spacer.</p> <p>Overhaul differential.</p>
2	No drive at road wheels	Broken rear axle shaft. (Rear propeller rotating with front propeller shaft stationary. If opposite to this, suspect broken front half shaft.)	With engine stopped and gearbox/transfer box in neutral, jack each rear wheel separately and turn by hand if propeller shaft does not also turn, remove the applicable axle shaft for inspection. Fit new axle shaft as necessary.

Chapter 6

FRONT AXLE

CONTENTS

Frame Para

- 1 Introduction
- 2 General

Table

- 1 Fault diagnosis

Page

1

INTRODUCTION

1 This Chapter gives the Fault diagnosis for the front axle fitted to Land Rover 90 and 110 vehicles.

General

2 The information given is applicable to both left and right hand drive vehicles.

TABLE 1 FAULT DIAGNOSIS

Ser	Symptom	Possible cause	Action
(1)	(2)	(3)	(4)
1	Oil leaks	1.1 Loose or missing drain and filler plugs	Check drain plug at underside of differential case and filler plugs in front cover. Tighten or fit new plugs as applicable.
		1.2 Axle case breather inoperative resulting in internal pressure.	Ensure that the breather pipe is not obstructed. Undo breather from axle case and clean or fit new breather, then rectify leak.
		1.3 Differential cover gasket damaged.	Fit a new gasket.
		1.4 Pinion oil seal damaged.	Fit new pinion oil seal.
		1.5 Oil level too high.	Drain oil to correct level.
2	Whine from differential	2.1 Incorrect setting of crownwheel and pinion.	Remove differential, check and adjust as necessary.
		2.2 Oil level too low	Top up as necessary.
3	Rattle from differential	3.1 Differential oil level too low or incorrect grade.	Drain and replenish with correct grade of oil.

(continued)

TABLE 1 FAULT DIAGNOSIS (continued)

Ser	Symptom	Possible cause	Action
(1)	(2)	(3)	(4)
3	Rattle from differential	3.2 Differential worn or incorrect internal settings.	Overhaul differential.
4	No drive at road wheels	Broken front half shaft (Front propeller rotating with rear propeller shaft stationery. If opposite to this, suspect broken rear axle shaft.)	With engine stopped and gearbox/transfer box in neutral, jack each front wheel separately and turn by hand, if propeller shaft does not also turn, remove the applicable half shaft for inspection. Fit new half shaft as necessary.

Chapter 7-1
STEERING SYSTEM
FAILURE DIAGNOSIS
CONTENTS

Table		Page
1	Steering system failure diagnosis	2

TABLE 1 STEERING SYSTEM FAILURE DIAGNOSIS

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
1	Excessive slackness or backlash in the steering	Steering rocker shaft incorrectly adjusted or badly worn	Check adjustment, fit new parts as necessary
2		Linkage loose or worn	Check ball joints for security and wear, rectify or renew
3		Steering box fixings loose	Tighten or replace as required
4		Swivel pins and bearings loose or worn	Adjust or fit new parts as required
5		Front wheel bearings loose or worn	Adjust or renew hub bearings as necessary
6	Tight steering	Low or unequal tyre pressures	Check and adjust pressures as necessary
7		Steering box oil level low	Replenish as necessary
8		Steering rocker shaft to tight	Adjust as necessary
9		Ball joints partially seized or incorrectly set	Check ball joints, ensure rubber boots are in place and joints move freely. Fit new parts as necessary
10		Swivel pins dry or partially seized	Adjust and lubricate as necessary
11	Rattle in steering box	Steering rocker shaft incorrectly adjusted or badly worn	Check adjustment, fit new parts as necessary

(Continued)

TABLE 1 STEERING SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
12	Vehicle pulls to one side	Incorrect camber	Check for settled road springs, worn bushes or damage to front axle
13		Incorrect or unequal castor or swivel pin inclination	Check front wh l alignment also for settled road springs and damage to front axle
14		Uneven tyre pressures or worn tyres	Check pressures and wear condition
15		Dragging brake	Check brake adjustment
16		Swivel pins tight	Dismantle and check swivel pins
17		Tight or dirty front wheel bearings	Remove hubs and check bearings
18		Incorrect front wheel toe-in	Check wheel alignment
19	Vehicle wanders	Incorrect tyre or worn tyres	Check pressures and wear condition
20		Incorrect front wheel toe-in	Check wheel alignment
21		Tight steering box	Check and adjust as necessary
22		Front wheel bearings loose or worn	Adjust or renew hub bearings as necessary
23		Worn swivel pins and bearings	Fit new parts as necessary

(Continued)

TABLE 1 STEERING SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
24	Vehicle wanders (cont'd)	Incorrect castor	Check for settled road springs or damage to front suspension and axle
25		Bent or broken chassis	Check chassis alignment
26	Wheel wobble	Steering column loose at dash	Check fixings and securely tighten
27		Incorrect tyre pressures or worn tyres	Check pressures and wear condition
28		Eccentric wheels and tyres	Check tyre concentricity line and wheel pressing for damage or distortion
29		Wheel bearings or worn bearings	Adjust or renew hub as necessary
30		Worn swivel pins and bearings	Fit new parts as necessary
31		Loose engine mountings	Check fixings and securely tighten
32		Worn constant velocity joints	Remove axle half shafts, overhaul joints
33		Incorrect castor	Check for settled road springs or damage to front suspension and axle

Chapter 7-2

POWER STEERING SYSTEM - LAND ROVER 127 VEHICLES

CONTENTS

Frame	Para		Page
	1	Introduction	
	2	General	
	Table		
	1	Insufficient power assistance when parking	1
	2	Poor handling when vehicle is in motion	2
	3	Hydraulic fluid leaks	2
	4	Excessive noise	2
	5	Cracked steering box	3
	6	High pressure	3
	7	Low pressure	3

INTRODUCTION

1 This Chapter gives the Failure diagnosis for the power steering system fitted to the Land Rover 127 vehicles.

General

2 The information given is applicable to both left and right hand drive vehicles.

TABLE 1 INSUFFICIENT POWER ASSISTANCE WHEN PARKING

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Lack of fluid	Check hydraulic fluid level If low, fill and then bleed the system
2	Engine idling speed too low	Try steering at fast idle. If necessary, reset idling
3	Driving belt slipping	Check belt tension. Adjust if necessary
4	Faulty steering pump and/or pressure relief valve	Test pump and relief valve with a pressure gauge and renew/repair as necessary

TABLE 2 POOR HANDLING WHEN VEHICLE IS IN MOTION

Ser no. (1)	Possible cause/fault (2)	Action (3)
1	Lack of castor angle	Ensure that the rocker shaft backlash adjusting screw on steering box top is adjusted correctly
2	Steering too light and/or over sensitive	Check for loose torsion bar fixings on steering box valve and worm assembly. Repair/renew as necessary

TABLE 3 HYDRAULIC FLUID LEAKS

Ser no. (1)	Possible cause/fault (2)	Action (3)
1	Damaged pipework, loose connecting unions, etc	Visually inspect all pipe runs for evidence of leaks. Renew any damaged pipes and tighten any loose joints
2	Damaged or faulty steer box	This type of leak tends to show up under low pressure conditions; ie. engine idling with no pressure on steering wheel. Renew box

TABLE 4 EXCESSIVE NOISE

Ser no. (1)	Possible cause/fault (2)	Action (3)
1	Pressure hose coming into contact with body shell or uninsulated body mount	Check the hose runs and alter the route or insulate any hose that contacts the body shell or mounts
2	Noise from hydraulic pump	Check oil level and bleed the system. If not cured, change hydraulic pump

TABLE 5 CRACKED STEERING BOX

Ser no. (1)	Possible cause/fault (2)	Action (3)
1	Excessive pressure due to faulty relief valve in hydraulic pump	Check by visual inspection Fit new steering box and repair hydraulic pump or replace as necessary

TABLE 6 HIGH PRESSURE

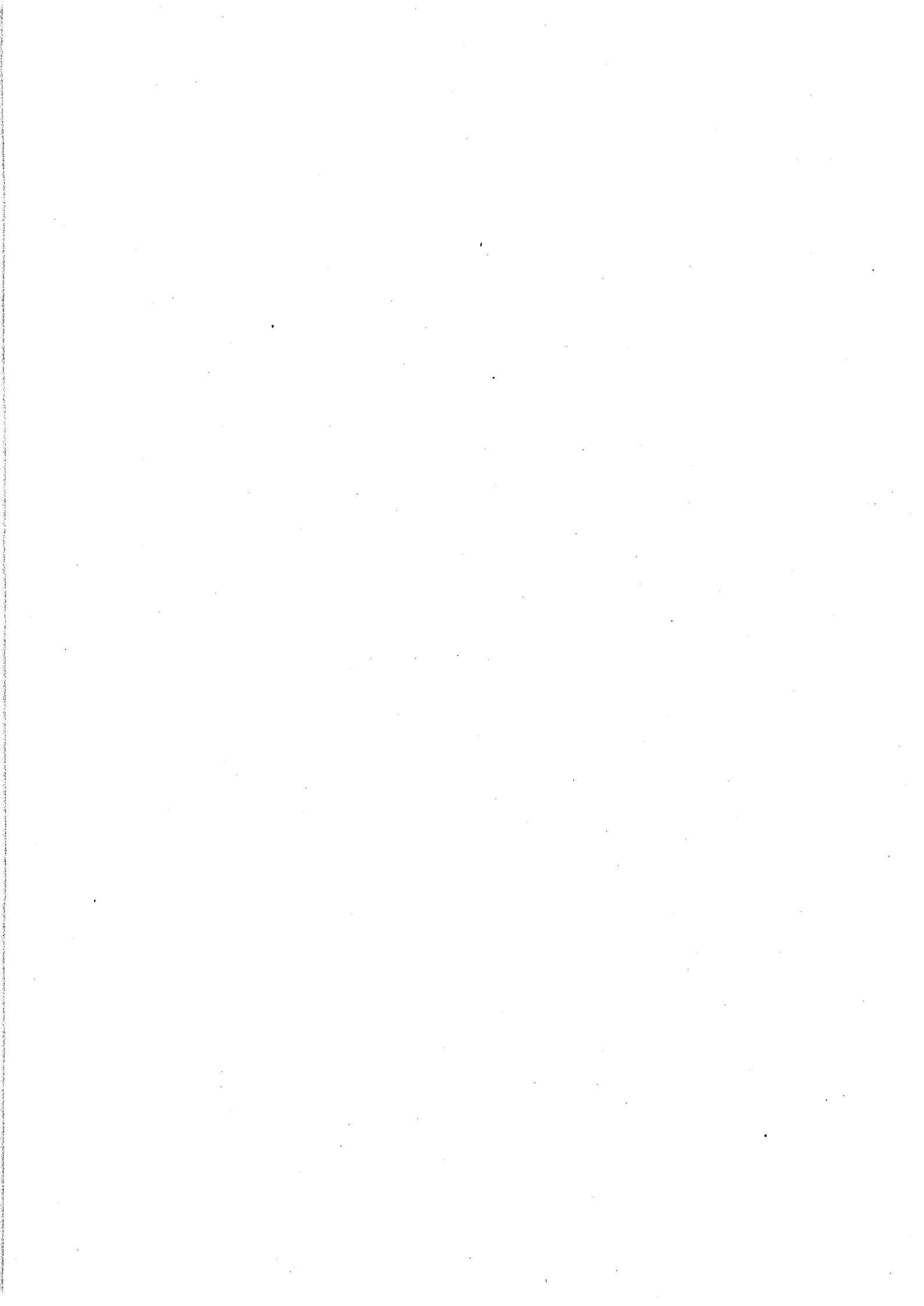
Ser no. (1)	Possible cause/fault (2)	Action (3)
1	In general it may be assumed that excessive pressure is due to a faulty relief valve in the hydraulic pump	Repair or replace valve

TABLE 7 LOW PRESSURE

Ser no. (1)	Possible cause/fault (2)	Action (3)
1	Low fluid in reservoir	Fill and bleed system
2	Pump drive belt slipping	Adjust drive belt
3	Leaks in the steering system	Locate and rectify
4	Faulty relief valve in pump	Repair/renew as necessary
5	Fault in steer box valve and worm assembly	Repair/renew as necessary
6	Leak at piston seal in steer box	Renew piston seal
7	Worn components in either steer box or hydraulic pump	Repair/renew as necessary

Note ...

Never hold the steering wheel on full lock for more than 30 seconds in any one minute, otherwise the oil will overheat and possibly damage the seals.



Chapter 8

SUSPENSION

FAILURE DIAGNOSIS

CONTENTS

Table		Page
1	Suspension failure diagnosis	2

TABLE 1 SUSPENSION FAILURE DIAGNOSIS

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
1	Front end noisy	Worn shock absorber mounting bushes	Renew bushes
2		Worn shock absorbers	Check shock absorber damping, renew as necessary
3		Looseness in front suspension	Check all mountings and rubber bushes for wear and security. Check panhard rod and radius arms for security and damage. Check wheel alignment
4		Broken or settled road springs	Check springs and renew as necessary
5	Vehicle wanders	Incorrect castor	Check for settled road springs or damage to front suspension and axle unit
6	Noisey rear end	Worn shock absorber mounting bushes	Renew bushes
7		Worn shock absorbers	Check shock absorber damping, renew as necessary
8		Looseness in rear suspension	Check all mountings, and rubber bushes. Check pivot bracket and ball joint and upper and lower links for wear and security
9		Broken or settled road	Check springs and renew springs as necessary

Chapter 10

BRAKING SYSTEM

FAILURE DIAGNOSIS

CONTENTS

Table		Page
1	Braking system failure diagnosis	2

TABLE 1 - BRAKING SYSTEM FAILURE DIAGNOSIS

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
1	Fade	Incorrect linings	Renew brake shoes
2		Incorrectly set or distorted shoes	Adjust or renew brake shoes, as necessary
3		Old brake fluid	Drain and replenish fluid
4		Over loaded vehicle	Decrease load
5	Spongy pedal action	Air in fluid system	Bleed system
6		Incorrectly set or distorted shoes	Adjust or renew brake shoes, as necessary
7		Faulty drums	Check and replace as necessary
8		Weak master cylinder mounting	Check mounting security
9	Long pedal (Disc brakes)	Discs running out pushing pads back	Check run out does not exceed 0,10 mm (0.004 in)
10	Long pedal (drum brakes)	Brakes require adjustment	Adjust as necessary
11		Fluid leak in system	Fit new parts as necessary, bleed system
12		Fluid contamination, worn or swollen seals in master cylinder	Renew seals and change fluid
13		Blocked fluid filler cap vent	Check vent for clearance

(Continued)

TABLE 1 BRAKING SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
14	Hard brake pedal poor braking	Incorrect adjustment	Adjust as necessary
15		Incorrect or glazed linings	Fit new shoes, or if glazed lightly rub down with coarse glasspaper
16		Grease, oil or fluid soaked linings	Fit new shoes, check slave cylinder for leaks, renew seals
17		Servo unit inoperative	Check servo renew as necessary
18		Seized caliper pistons	Check caliper for damage, repair as necessary
19		Worn shock absorbers	Fit new shock absorbers
20	Brakes pulling	Incorrect tyre pressures	Check pressures and rectify as necessary
21		Grease, oil or fluid soaked linings	Fit new shoes, check slave cylinder for leaks, renew seals
22		Variation in lining thicknesses	Fit new shoes
23		Faulty brake drums	Check drums, renew as necessary
24		Fluid contamination, worn or swollen seals	Renew seals and change fluid in master cylinder
25		Worn shock absorbers	Fit new shock absorbers

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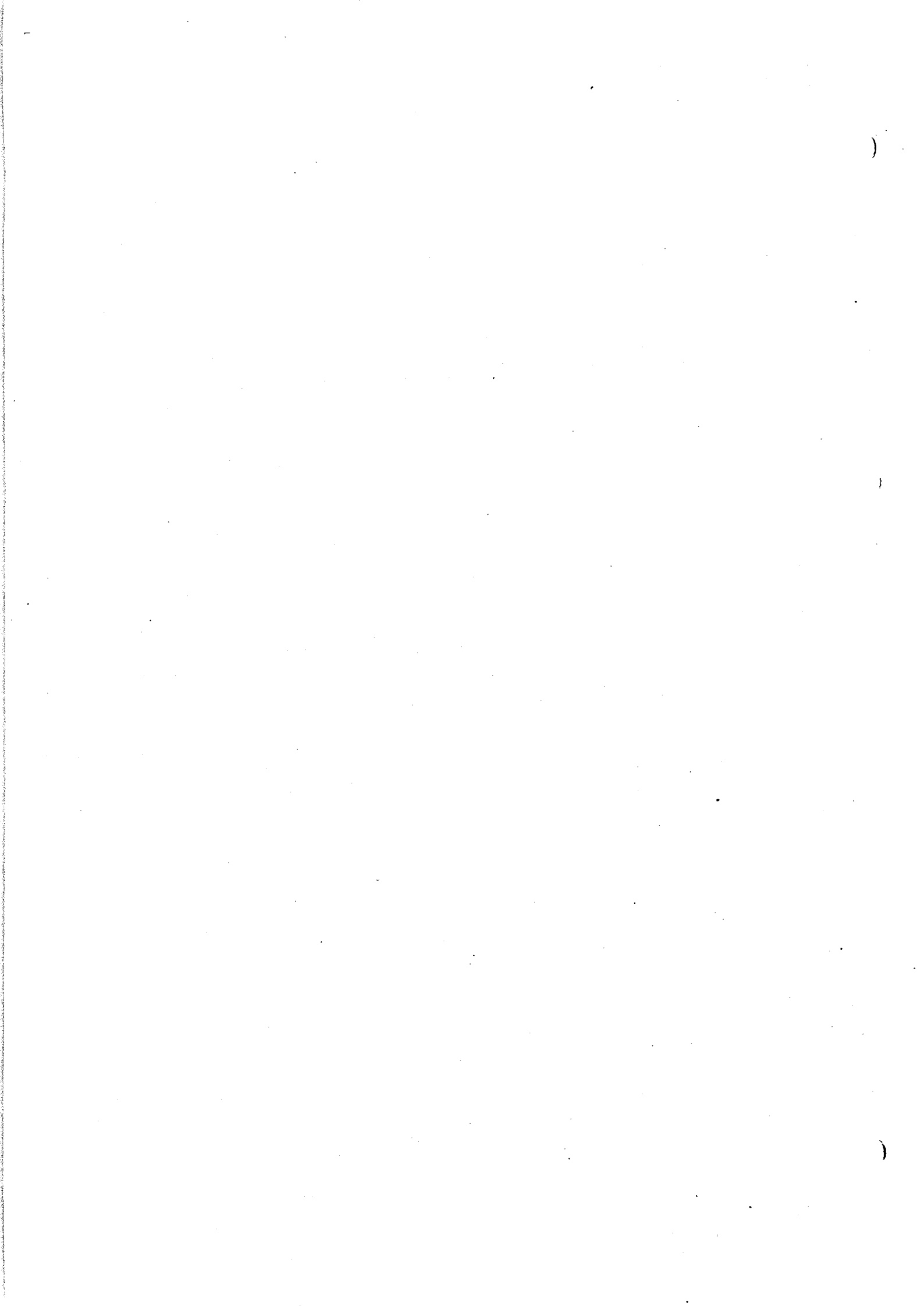
TABLE 1 BRAKING SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
26	Brakes pulling	Damaged or worn suspension or steering	Check suspension and steering, repair as necessary
27	Brakes binding	Incorrect adjustment	Adjust as necessary
28		Shoe springs weak or broken	Check springs replace as necessary
29		No clearance at master cylinder/servo push rod	Check clearance, adjust as necessary
30		Fluid contamination, worn or swollen seals	Renew seals and change fluid in master cylinder
31		Seized caliper pistons	Check caliper for damage, repair as necessary
32		Servo faulty	Check servo, repair or renew
33	Fall in fluid level	Worn disc pads	Check pads for wear
34		Leak in brake fluid system	Check for leaks, repair as necessary
35	Disc brake squeal/pad rattle	Worn retaining pins	Renew, retaining pins, apply disc brake lubricant to back of pads
36		Worn discs	Renew discs
37	Uneven or excessive pad wear	Incorrect friction material	Fit correct type pads

(Continued)

TABLE 1 - BRAKING SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
38	Uneven or excessive pad wear (cont'd)	Pads scored	Fit new pads
39		Discs corroded or badly scored	Check discs and renew as necessary.



Chapter 11-1

FUEL AND EXHAUST SYSTEM 2,5 LITRE DIESEL ENGINE

FAILURE DIAGNOSIS

CONTENTS

Table		Page
1	Fuel and exhaust system failure diagnosis	2

TABLE 1 FUEL AND EXHAUST SYSTEM FAILURE DIAGNOSIS

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
1	Difficulty starting	Lack of fuel	Check fuel level in tank, replenish as necessary with correct grade of fuel
2		Stop solenoid faulty	Check audible operation when switched. Check electric supply, if satisfactory, replace solenoid
3		Wrong starting procedure	Check starting procedure, throttle closed and heater plugs in operation
4		Air in fuel system	Check all joints and unions are tight
5		Fuel inlet restriction	Check filter not choked and feed pipes clear
6		Fuel lift pump	Remove inlet pipe, place finger over inlet aperture, operate priming lever, distinct suction should be felt
7		Fuel contamination	Check diesel fuel being used not petrol, free of water, dirt, ice or waxing
8		Injection timing incorrect	Re-time DPS pump to engine
9		Timing belt slipped	Check belt condition and tension. Check DPS pump rotor not seized
10		Fuel circuit incorrect	Check inlet and back line pipes correct way round

(Continued)

TABLE 1 FUEL AND EXHAUST SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
11	Difficulty starting (cont'd)	Back leakage restricted	Check return to tank clear, flow from cam box valve when cranking
12		Fuel atomisation	Check injectors are correct type check opening pressure and spray condition
13		Fuel tank blockage	Check tank vent and outlet for restriction
14		HP pipe leaking	Check connections are tight
15		DPS pump defective	If all other relevant checks are satisfactory replace DPS pump
16	Irregular idle	Air in fuel system	Check all joints and unions are tight
17		Fuel inlet restriction	Check filter not choked and feed pipes clear
18		Back leakage restricted	Check return to tank clear, flow from cam box valve when cranking
19		Fuel tank blockage	Check tank vent and outlet for restriction
20		HP pipe restriction	Check HP pipes kinked or bore reduced at nipples
21		Idling speed incorrect	Reset to correct speed
22		Anti-stall incorrect	Check recovery from acceleration with warm engine

(Continued)

TABLE 1 FUEL AND EXHAUST SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
23	Irregular idle (cont'd)	Manual idle advance faulty	Check cable and lever operation satisfactory
24		Accelerator linkage faulty	Check lever tight on pump, reaches stop screw, linkage wear, adjustment
25		DPS pump loose	Check tightness of pump mounting bolts and rear support bracket nut and bolt
26	Erratic running or surging	Fuel circuit incorrect	Check inlet and back leak pipes correct way round
27		Fuel atomisation	Check injectors are correct type check opening pressure and spray condition
28		Fuel tank blockage	Check tank vent and outlet for restriction
29		Accelerator linkage faulty	Check lever tight on pump, reaches stop screw, linkage wear, adjustment
30		DPS pump loose	Check tightness of pump mounting bolts and rear support bracket nut and bolt
31		DPS pump defective	If all other relevant checks are satisfactory replace DPS pump
32	Excessive smoke	Fuel contamination	Check diesel fuel being used not petrol, free of water, dirt, ice or waxing

(Continued)

TABLE 1 FUEL AND EXHAUST SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
33	Excessive smoke (cont'd)	Injection timing incorrect	Re-time DPS pump to engine
34		Fuel atomisation	Check injectors are correct type check opening pressur and spray condition
35		DPS pump defective	If all other relevant checks are satisfactory replace DPS pump
36	Excessive noise	Injection timing incorrect	Re-time DPS pump to engine
37		Fuel atomisation	Check injectors ar correct type check opening pressure and spray condition
38		DPS pump loose	Check tightness of pump mounting bolts and rear support bracket nut and bolt
39	Lack of power	Air in fuel system	Check all joints and unions are tight
40		Fuel inlet restriction	Check filter not choked and feed pipes clear
41		Injection timing incorrect	Re-time DPS pump to engine
42		Back leakage restricted	Check return to tank clear, flow from cam box valve when cranking
43		Fuel circuit incorrect	Check inlet and back leak pipes correct way round

(Continued)

TABLE 1 - FUEL AND EXHAUST SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
44	Lack of power	Fuel atomisation	Check injectors are correct type check opening pressure and spray condition
45		Fuel tank blockage	Check tank vent and outlet for restriction
46		HP pipe leaking	Check connections are tight
47		HP pipe restriction	Check HP pipes kinked or bore reduced at nipples
48		Accelerator linkage faulty	Check lever tight on pump, reaches stop screw, linkage wear, adjustment
49		Maximum speed setting incorrect	Check seal intact, adjust setting
50		Vehicle brakes binding	Check brake freedom all wheels and transmission brake
51		Exhaust system defective	Check system unrestricted
52		LP leakage	Check feed and return pipes, filter and tank for leaks
53	Excessive fuel consumption	Injection timing incorrect	Re-time DPS pump to engine
54		Fuel atomisation correct type check	Check injectors are opening pressure and spray condition

(Continued)

TABLE 1 FUEL AND EXHAUST SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
55	Excessive fuel (cont'd)	HP pipe leaking	Check connections are tight
56		Idling speed incorrect	Reset to correct speed
57		Vehicle brakes binding	Check brake freedom all wheels and transmission brake
58		DPS pump defective	If all other relevant checks are satisfactory replace DPS pump
59	Stalling	Air in fuel system	Check all joints and unions are tight
60		Fuel inlet restriction	Check filter not choked and feed pipes clear
61		Injection timing incorrect	Re-time DPS pump to engine
62		Back leakage restricted	Check return to tank clear, flow from cam box valve when cranking
63		Idling speed incorrect	Reset to correct speed
64		Anti-stall incorrect	Check recovery from acceleration with warm engine
65		DPS pump defective	If all other relevant checks are satisfactory replace DPS pump
66	Slow engine die down	Anti-stall incorrect	Check recovery from acceleration with warm engine

(Continued)

TABLE 1 FUEL AND EXHAUST SYSTEM FAILURE DIAGNOSIS (continued)

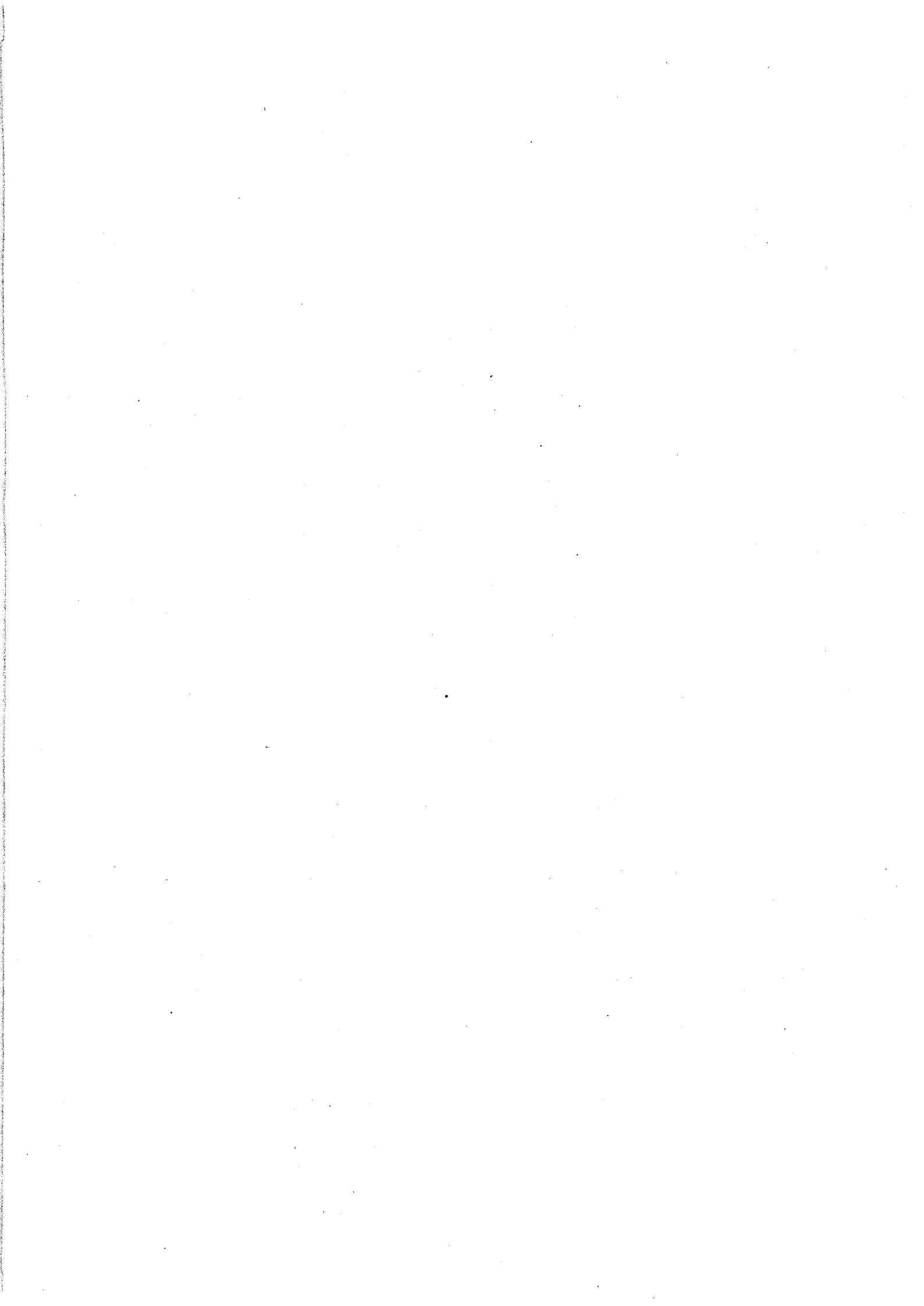
Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
67	Slow engine die down	Accelerator linkage faulty	Check lever tight on pump, reaches stop screw, linkage wear, adjustment
68	Engine will not shut-off	Stop solenoid faulty	Check audible operation when switched. Check electric supply, if satisfactory, replace solenoid
69	Excessive knocking (detonation)	Injection timing incorrect	Re-time DPS pump to engine
70		Injectors sticking	Check injectors individually. Overhaul injectors

Chapter 11-2

PETROL FUEL AND EXHAUST SYSTEM

FAILURE DIAGNOSIS

1 For details of the failure diagnosis for the petrol fuel and exhaust system fitted to Land Rover 3.5 litre petrol 110 and 127 vehicles, refer to Cat 512 Chap 1-2.



Chapter 12
COOLING SYSTEM
FAILURE DIAGNOSIS
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1	Cooling system failure diagnosis	2

TABLE 1 COOLING SYSTEM FAILURE DIAGNOSIS

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
1	External leakage	Leakage at hoses or joint faces	Check for loose hose fixings, defective hoses and leaks at component joints. Repair or replace as necessary
2		Water pump seals ineffective	Overhaul water pump replacing worn parts as necessary
3		Leakage at core plugs	Tighten or replace as necessary
4		Damaged radiator	Fit new radiator
5	Internal leakage	Defective cylinder head gasket	Renew gasket. Check engine oil for water contamination, flush and refill as necessary
6		Loose cylinder head bolts	Tighten in correct sequence to the correct torque loading. Check engine oil for water contamination, flush and refill as necessary
7		Cracked cylinder	Replace cylinder block
8	Water loss	System over filled	Refer to Category 2 for correct filling procedure
9		Boiling off	Ascertain the cause of engine overheating and rectify.
10		Restricted radiator or inoperative thermostat	Flush radiator, check thermostat function

(Continued)

TABLE 1 COOLING SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
11	Water loss (cont'd)	Radiator filler cap defective	Replace components or sealing washer as necessary
12	Poor circulation	Restriction in system	Check hoses for crimping, flush system
13		Insufficient coolant	Check coolant lev l, replenish as necessary
14		Loose fan belt	Check and reset belt tension
15		Thermostat inoperative	Check operation renew as necessary
16		Water pump inoperative	Repair or renew as necessary
17	Corrosion	Infrequent flushing and draining	Drain and flush system at recommended intervals
18		Incorrect anti-freeze	Use only recommended solutions
19		Excessive impurity in water	Use only clean water when mixing coolant solution
20	Overheating	Poor circulation	Refer to poor circulation in this diagnosis
21		Air locks in system	Clear air locks and replenish coolant
22		Air flow through radiator obstructed	Remove obstructions using air pressure applied from engine side of radiator

(Continued)

TABLE 1 COOLING SYSTEM FAILURE DIAGNOSIS (continued)

Serial	Fault	Possible cause	Remedy
(1)	(2)	(3)	(4)
23	Overheating (cont'd)	Low engine oil level	Replenish as necessary
24		Dirty oil or sludge in lubrication system	Drain, flush and replenish system
25		Engine settings incorrect	Check DPS pump settings (Diesel), ignition timing (Petrol). Reset as necessary
26		Exhaust choked or damaged necessary	Rectify or replace as
27		Braking system faulty	Check for dragging or binding brakes
28		Vehicle operating faults a. Overloaded vehicle b. Engine labouring on gradients c. Excessive low gear work d. Excessive engine idling	Remedy in the hands of the operator
29	Overcooling	Defective thermostat	Check operation replace as necessary
30		Inaccurate temperature gauge	Check by substitution replace as necessary

Chapter 12-3

WINTERISED COOLING SYSTEM

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Frame Para

- 1 Introduction
- 2 General

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- 2 Heater is not producing enough heat 3
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- 4 Overheat fuse blows 4

INTRODUCTION

1 This Chapter gives the Failure diagnosis for the winterised cooling system fitted to the Land Rover 2.5 litre diesel powered 90 and 110 vehicles.

General

2 Land Rover winterised 90 and 110 vehicles have been specifically designed to operate in extreme sub-zero climatic conditions. In order to meet the required specification, a Webasto DBW 46 water heater has been incorporated as an aid to engine cold start procedure.

TABLE 1 HEATER DOES NOT COME ON, EVEN AFTER REPEAT STARTING

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Water temperature above 78 degrees centigrade	None. System operating correctly.
2	Operating lamp H1 fault	Check electric leads, lamp H1 and fuse F2.
3	Battery fault	Check battery charge state and security of leads.
4	Failure of fuse F1	Check electric leads and earth contact. Check glow plug. Replace fuse.

(continued)

TABLE 1 HEATER DOES NOT COME ON, EVEN AFTER REPEAT STARTING
(continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
5	Failure of fuse F2	Check circulating pump, combustion air fan, vehicle fan relay and power leads for earth contact and short circuiting . Replace fuse
6	Glow plug fault	Check plug leads and plug. Check control unit and temperature sensor.
7	Dosing pump not pulsing (after 30 seconds glow time)	If start process goes to fault lock-out, check flame detector and leads for earth contact and short-circuiting. If heater cycle continues, check overheat fuse and electric leads. Check the control unit. Check the dosing pump.
8	Exhaust pipe remains cold combustion not taking place	Dosing pump not delivering any fuel, is tank empty. Check fuel connection (suction height, low tank pressure). Check fuel lines for kinks or leaks. Check dosing pump with a damper. Check air intake silencer for free passage. Check exhaust pipe for free passage.
9	Flame detector fault	Check flame detector and electric leads.
10	Heater functions incorrectly after burning for a short time (flame dies down)	Check fuel delivery rate of the dosing pump. Check CO2 value and adjust if necessary. Replace combustion fan air if necessary.

TABLE 2 HEATER IS NOT PRODUCING ENOUGH HEAT

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Circulating pump failure	Check pump and supply leads Check control unit.
2	Circulating pump rotating in wrong direction	Check pump rotation, if wrong check polarity.
3	Vehicle fan not operating at water temp over 55 deg C.	Check vehicle fan. Check leads to control unit/relay for vehicle and fan switch. Check temperature sensor and control unit.
4	Blockage in water circuit	Set heating lever to 'warm' and check water circuit when shut-off mechanisms are activated. Bleed water circuit. Check heater connection to the water circuit.
5	Check CO2 reading	Check for blockages in air intake silencer and exhaust Check dosing pump delivery (is pump installation OK). Adjust CO2 value. Replace combustion air fan.

TABLE 3 HEATER GOES TO FAULT LOCK-OUT (DURING HEATING)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Heater location/setting incorrect	Check dosing pump is fitted in the right place. Observe ambient temp when engine is hot. Check CO2 value. See Table 2 fault 5.
2	Heater fails to work properly when switched from VL to TL	Check part load resistor and electric leads. Check control unit.

TABLE 4 OVERHEAT FUSE BLOWS

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	No continuity at the over-heat fuse	Bleed the water circuit. Check temperature sensor and control unit.

Chapter 13-1

12 VOLT ELECTRICAL SYSTEM

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INTRODUCTION

1 This Chapter covers the Failure diagnosis for the electrical systems fitted to Land Rover 90 and 110 vehicles having 2.5 litre diesel engines. The information given is applicable to both left and right hand drive vehicles.

FAILURE DIAGNOSIS

Introduction

2 For efficiency and economy, fault diagnosis must be accurate and should also be carried out in the shortest possible time using the minimum amount of equipment. It is the aim of this chapter to present a logical sequence of tests that may be carried out on the various electrical systems of a vehicle whilst the components are still in situ.

3 The majority of procedures involve circuit testing and the principle used will be that for checking "voltage drop" where a voltmeter is connected in parallel with the particular circuit to be tested.

4 As voltage drop exists only when current is flowing and varies according to the amount of current, it is essential that the circuit is checked "underload", i.e. whilst passing its normal current. In certain instances this current will be measured using a test ammeter.

5 The acceptable volt drop figure for most circuits is 10% of system voltage (1.2 volts on a 12 volt system) but there are exceptions to this rule as in the case of the starter circuit where the maximum voltage drop allowed is 0.5 volts.

6 Throughout the procedures wherever an exception applies this figure will be clearly stated.

BATTERY

7 As a battery fault can have adverse effects on the operation of the various systems, particularly the starting system, some knowledge of battery testing is an essential part of fault diagnosis.

7.1 The charging, handling and use of lead-acid batteries is not dangerous providing appropriate care is taken.

7.2 It is vital that no source of ignition can exist close to the batteries.

WARNINGS ...

- (1) DO NOT SMOKE.
- (2) NO NAKED FLAMES.
- (3) AVOID SHORT CIRCUITS

- (4) SWITCH OFF CURRENT BEFORE MAKING/BREAKING ELECTRICAL CONNECTIONS, ESPECIALLY DURING CHARGING.
- (5) IF ELECTROLYTE COMES INTO CONTACT WITH SKIN, DRENCH AFFECTED AREA WITH WATER AND REMOVE ANY CONTAMINATED CLOTHING. IF ACID COMES INTO CONTACT WITH EYES, WASH OUT WITH CLEAN WATER AND SEEK MEDICAL ATTENTION IMMEDIATELY.
- (6) IF ELECTROLYTE IS SPILT ON TO PAINTWORK/METALWORK, WASH DOWN WITH COPIOUS SUPPLIES OF WATER AND THEN TREAT AFFECTED AREAS WITH SUITABLE ANTI-ACID MATERIAL I.E. HOUSEHOLD AMMONIA ETC. BEFORE REPAINTING.

7.3 Keep the battery, particularly the top, clean and dry. Water spillage must be immediately wiped away.

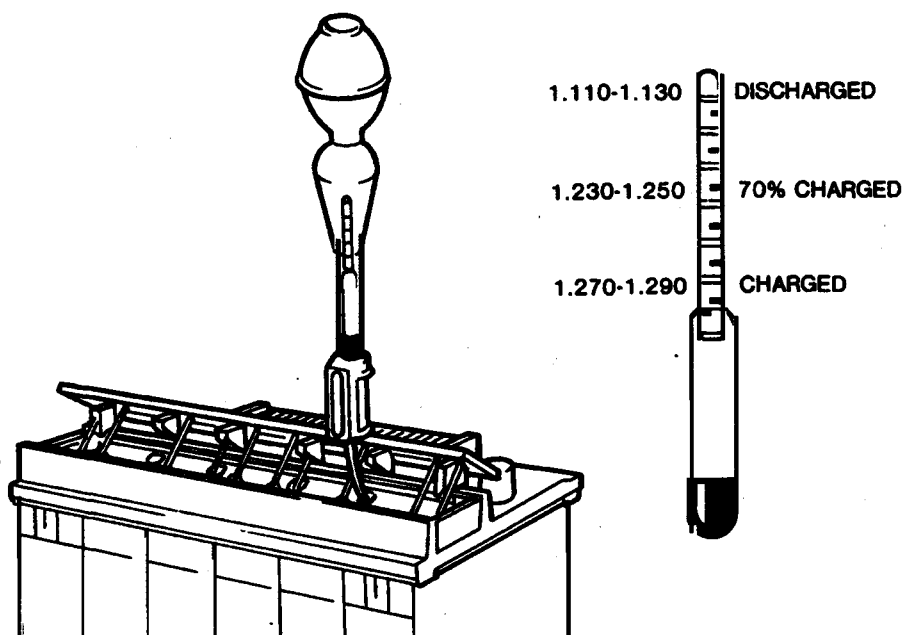
7.4 The electrolyte must be maintained at the correct level which is normally at the tops of the separators or the splashguard.

7.5 When the electrolyte falls below the correct level, top up using only distilled water or de-ionised water.

7.6 The battery must never be left in a discharged state. A battery in a poor state of charge i.e. below 70% should be removed and charged from an independent source at the normal recharge rate. Otherwise the plates may become sulphated (hardened) making it difficult to accept a charge, with the consequent early failure of the battery.

7.7 The battery must be securely clamped (not overtight) to prevent damage by vibration, which may cause shedding of active material from the plates, resulting in a loss of capacity or short-circuit between the plates.

BATTERY TESTING - HYDROMETER



LR 4478M

Fig 1 Battery testing with hydrometer

8 Testing should commence at the source of supply; the battery itself. If the battery is discharged or unserviceable, the readings in the other tests will be affected.

9 There is a relationship between the state of battery charge and the strength of the electrolyte. As the battery becomes discharged, the specific gravity (SG) of the electrolyte becomes lower. The SG of the electrolyte is measured by means of a hydrometer. This instrument consists of a glass tube, with a rubber bulb fitted on one end. Inside the tube, there is a float, which is calibrated from 1.130 to 1.300.

10 When the end of the hydrometer is inserted in the battery cell, as shown in Fig 1, and the rubber bulb is pressed and then released, a small quantity of the electrolyte is drawn into the tube. The position of the float is determined by the specific gravity of the electrolyte. When the specific gravity is high, the float maintains a high position inside the tube, and if the specific gravity is low the float sinks to a lower position.

Specific Gravity Readings

11 From the specific gravity (SG) readings, a fairly accurate indication of the battery state of charge can be obtained.

State of Charge	Climates	Climates
	normally below 25°C (77°F)	normally above 25°C (77°F)
Fully charged	1.270-1.290	1.210-1.230
70% charged	1.230-1.250	1.170-1.190
Discharged	1.110-1.130	1.050-1.070

Electrolyte temperature correction

For every 10°C (18°F) below 15°C (60°F) subtract 0.007

For every 10°C (18°F) above 15°C (60°F) add 0.007

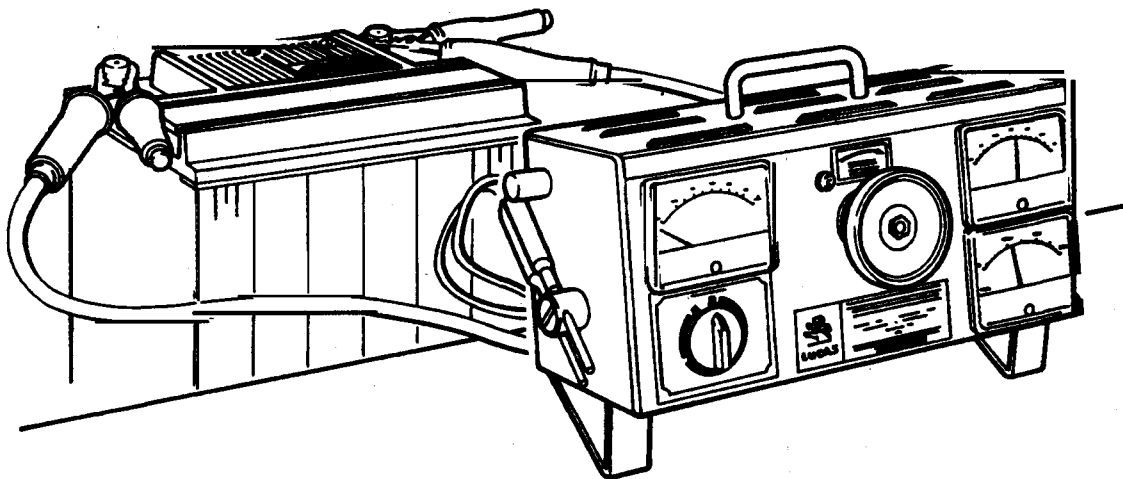
12 The hydrometer gives an accurate indication of the battery condition. If there is a variation of more than 40 points (0.040) between any cells, the battery is suspect and should be thoroughly checked.

13 If the battery is less than 70% charged, it should be recharged from an external source.

Battery testing - heavy discharge test

14 This test should be carried out as a further check of the battery condition. A heavy discharge tester should be applied to the battery terminals as shown in Fig 2 (Heavy discharge tester). The test ensures that the battery is capable of supplying the heavy currents required by the starter at the moment of starting the engine.

15 The tester should be set to discharge the battery at 3 times the ampere hour rate (20 hr rate) for 15 seconds. (Example: If the battery has a capacity of 50 Ah (20 hr rate), the tester should be set to 150 amps on the ammeter). Observe the voltmeter during the battery discharge. If the voltmeter reading is above 9.6V, the battery is considered satisfactory. If the voltage falls below 9.6V, the battery is suspect and should be removed for further testing.



LR 4479M

Fig 2 Heavy discharge tester

ALTERNATORS

Introduction

16 The alternator produces alternating current which is converted to direct current before being connected to the vehicle electrical system. In this respect the alternator and dynamo are similar, since the current generated in the armature windings of the dynamo is also alternating current which has to be converted to direct current before it can be used to charge the vehicle battery.

17 In the case of the dynamo, the alternating current is rectified by means of a commutator and brush-gear. The output of the alternator is rectified by semi-conductor devices, which allows electricity to flow in one direction only; and so supply uni-directional current to the vehicle electrical system.

18 The alternator output is controlled by a voltage regulator which is completely electronic, having no vibrating contacts. The use of printed circuits and semi-conductor devices make this type of regulator more reliable and more stable than the conventional type of mechanical regulator used with dynamos.

19 No cut-out is required with this type of control since the semi-conductor devices prevent reverse currents from flowing. Also, the self-regulating properties of the alternator limit the output current to a safe value so that there is no need for a current regulator.

20 The latest alternators represent an important development in design as the alternator and voltage regulator are combined to form a single unit, the regulator being housed within the end cover of the alternator. This simplifies the charging circuit without changing the operating principles.

21 Alternator design construction allows a wider speed range and utilisation of higher pulley ratios, which in turn enables the battery to be charged at lower engine speeds. This can be beneficial in high density traffic conditions and on modern vehicles with high electrical loads.

Test Equipment

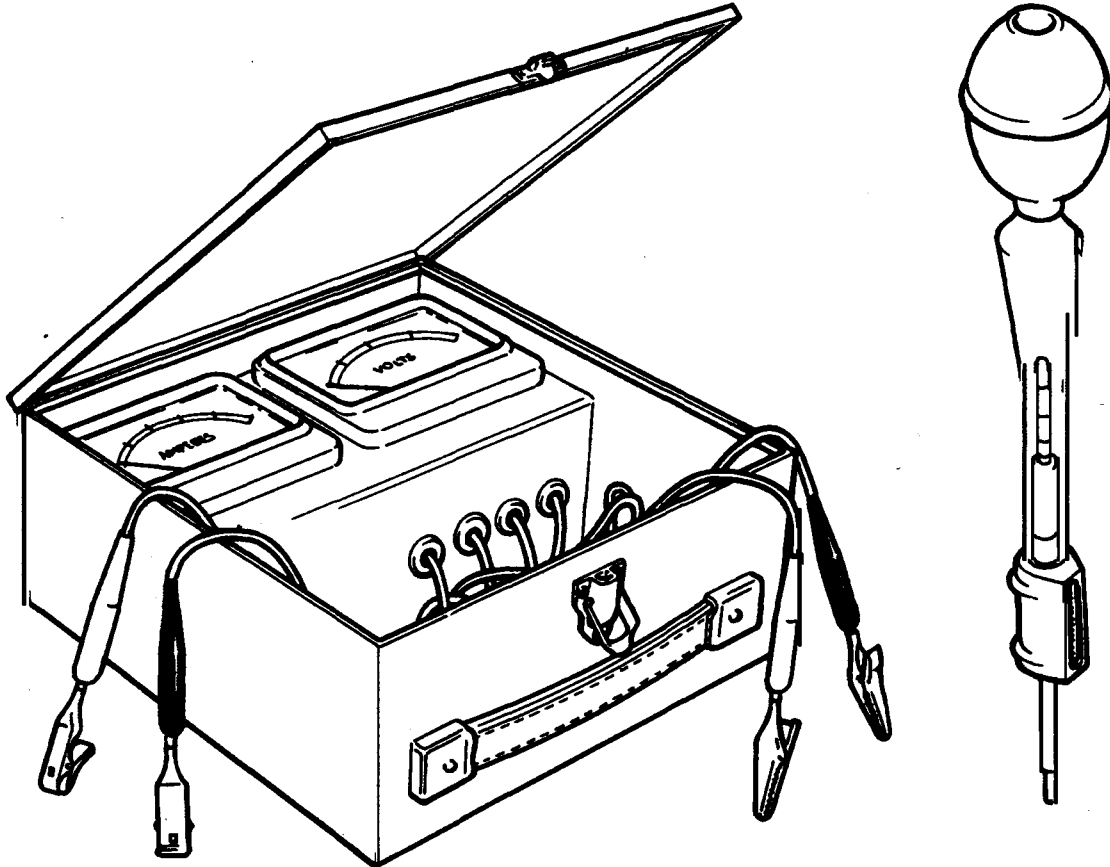
22 Basic test equipment required for fault diagnosis on an AC charging system is:

22.1 Hydrometer

22.2 Voltmeter, scale 0-20V for nominal 12V systems (Fig 3).

22.3 Ammeter, scale 0-100A (Fig 3).

22.4 Small jump lead.



LR 4477M

Fig 3 Test equipment

Preliminary Checks

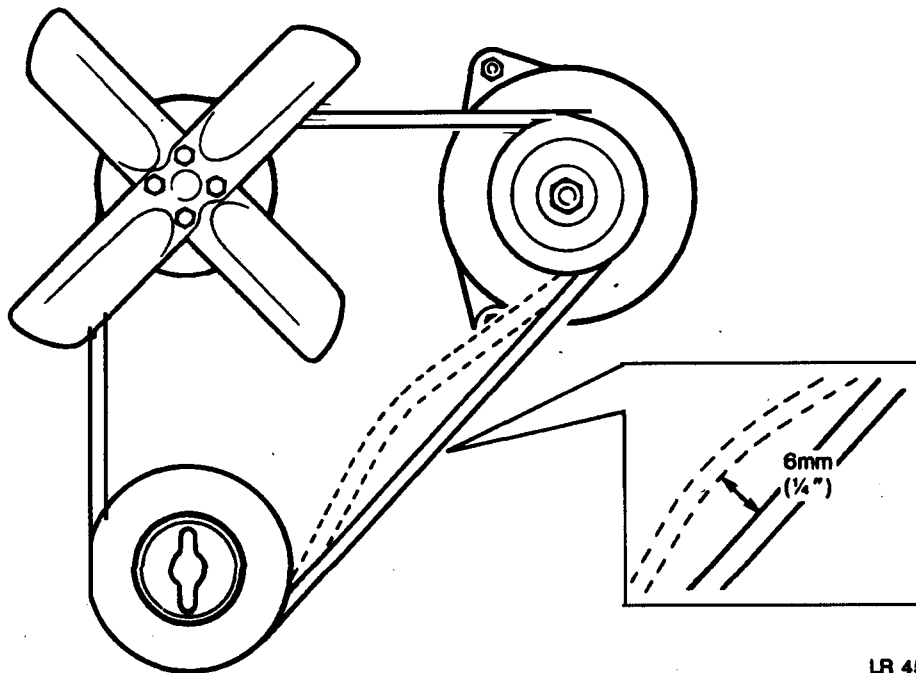
23 Check all connections within the charging system. Inspect generator drive belt for signs of splitting or wear. Renew if required.

Battery Test

24 Using a hydrometer, check that the battery is at least 70% charged, refer to the full battery test procedure as outlined under paragraphs 7 to 11 "Batteries".

Drive Belt Tension

25 Allow 6.0 mm (0.25") in play when moderate finger pressure is applied to the longest run of belt (Fig 4).



LR 4507M

Fig 4 Drive belt tension

25.1 The alternator will not charge the battery if the drive belt is too slack. On the other hand, an excessively tight belt may damage the bearings of the alternator itself, the water pump or both.

25.2 If the belt is worn or oily, it should be replaced.

Connections

26 Ensure that all leads are in position and that all connections are clean and tight (Fig 5).

Cable Continuity (Fig 6)

26.1 Remove all the connections from the alternator terminals.

26.2 Switch on the ignition, or equivalent.

26.3 Connect the voltmeter between a good earth and each of the disconnected leads in turn.

27 The voltmeter should indicate battery voltage, except where an additional earth terminal is used on the alternator. The voltmeter reading for that connection should be zero. Continuity of the earth lead should be checked with an ohmmeter.

27.1 A zero reading otherwise indicates open-circuit lead(s) or a blown bulb if "IND" lead.

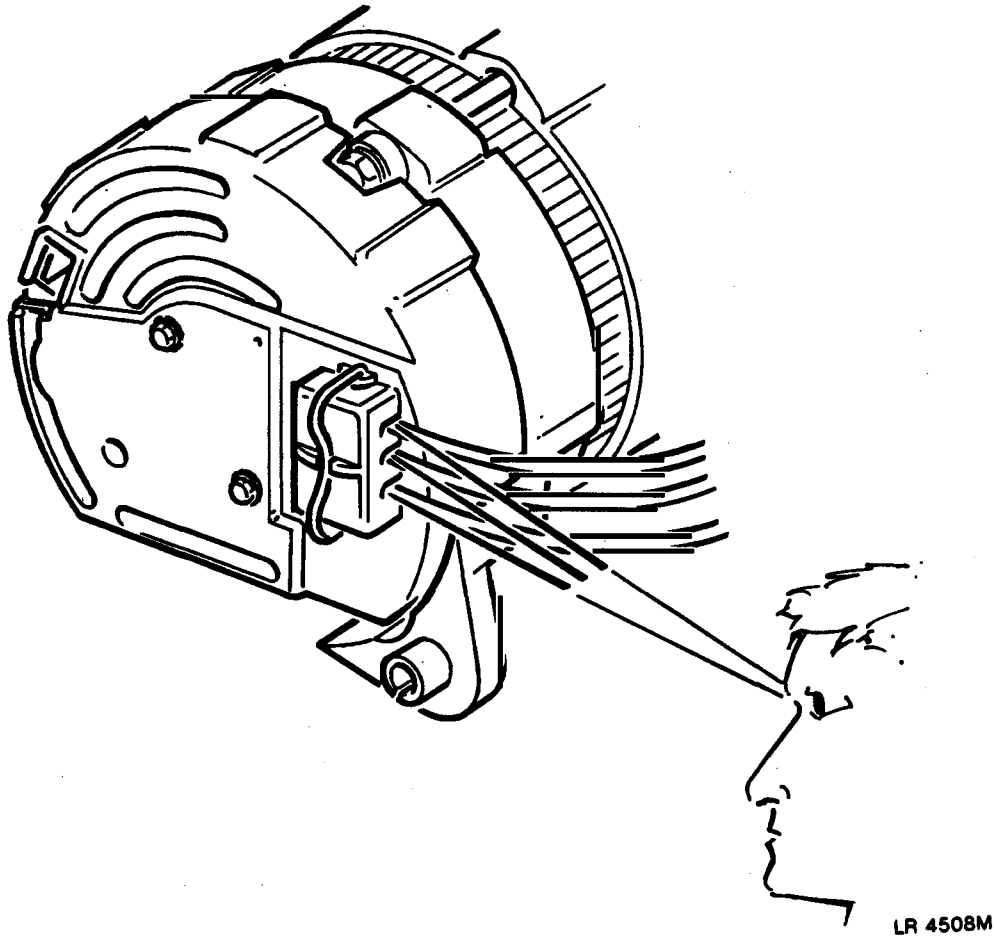


Fig 5 Checking the connections

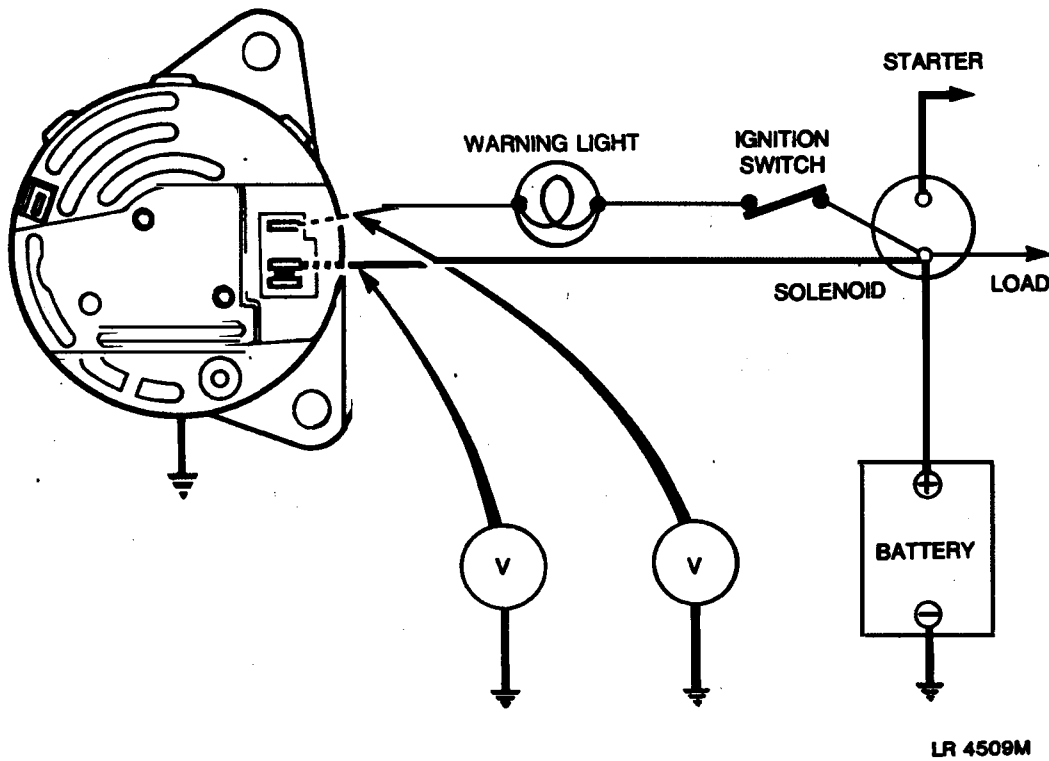


Fig 6 Cable continuity

28 On replacing the connections, failure or the warning light to illuminate indicates a faulty alternator field circuit or regulator. If the warning light is illuminated, proceed to "Checking Alternator Maximum Output".

Checking Alternator Maximum Output (Fig 7)

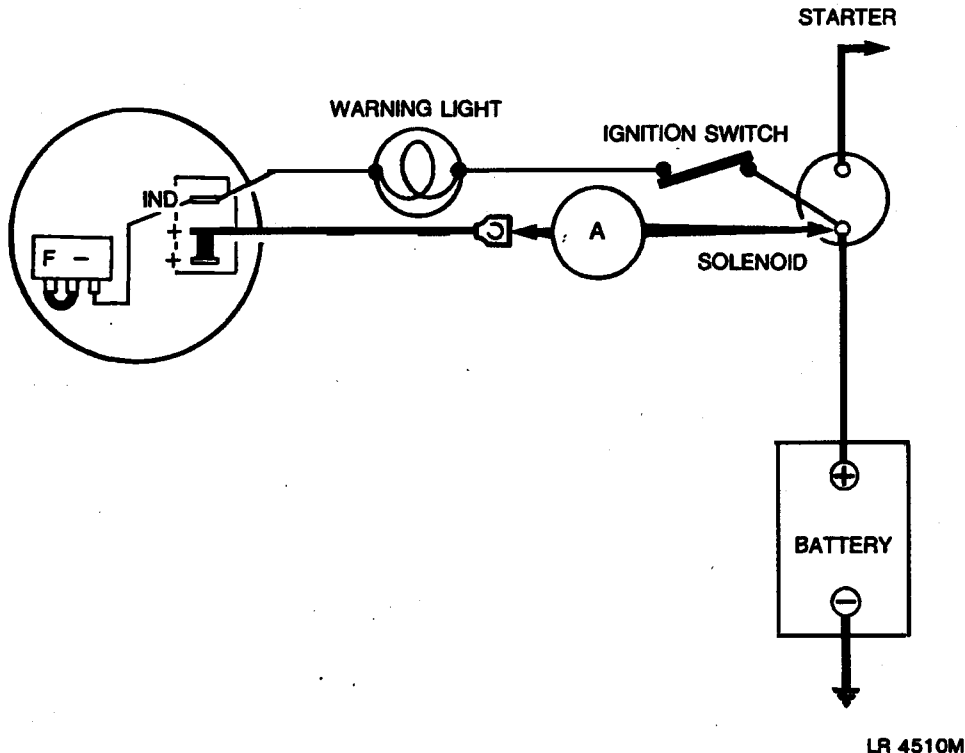


Fig 7 Checking alternator maximum output.

29 The alternator should be run for a few minutes to ensure that the tests are carried out at the normal operating temperature. Then, stop the engine.

29.1 Disconnect the battery earth cable.

29.2 Connect an ammeter between the starter solenoid terminal and the alternator main output cable.

29.3 Remove the connections at the alternator and then the moulded cover. Remake the connections. Use a jumper lead to short together the "F" and "-" connections of the regulator.

29.4 Reconnect the battery earth cable.

29.5 Switch on the ignition (or auxiliary switch for diesel vehicles) and check that the warning light comes on.

29.6 Start the engine and slowly increase speed. At approx. 3,000 engine rev/min, the ammeter reading should equal the maximum rated output of the alternator.

29.7 If the ammeter reading is low, transfer the ammeter connection from the alternator main output cable and connect direct to the alternator "+" terminal.

29.8 If the ammeter reading is now normal, high resistance in the main output circuit is indicated. Rectify, then transfer the ammeter connection back to the alternator main output cable and repeat test. If now satisfactory, proceed to "Checking Voltage Drop in Charging Circuit".

Checking Voltage Drop in Charging Circuit (Fig 8)

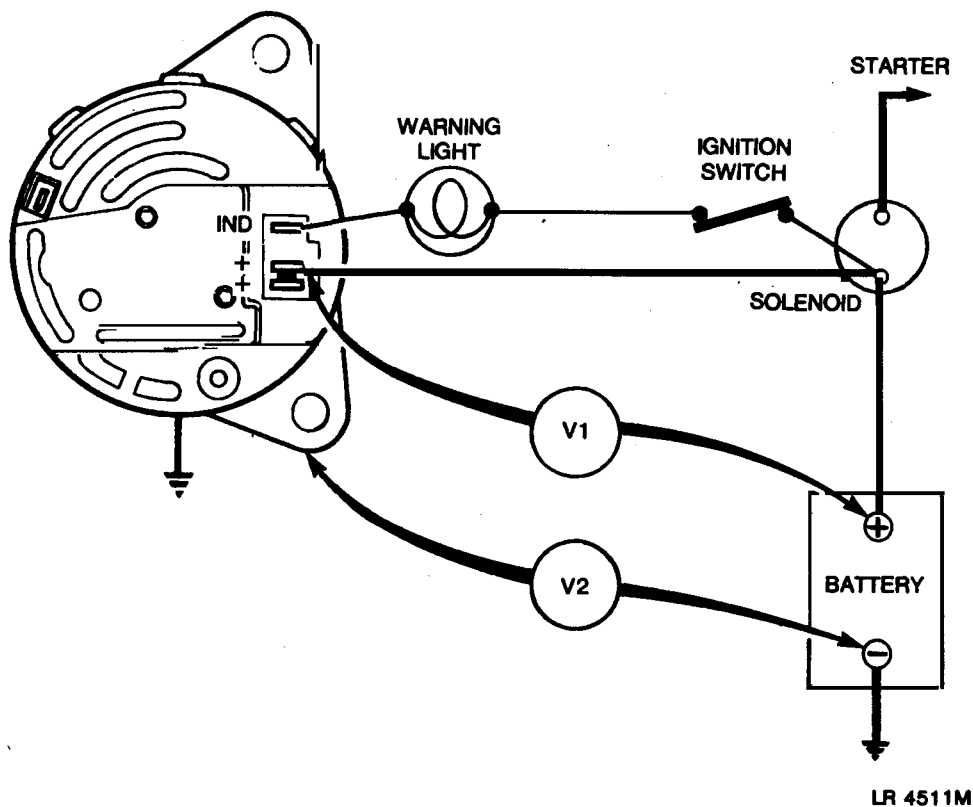


Fig 8 Checking voltage drop in charging

30 Use a voltmeter to check for high resistance in the charging circuit.

30.1 Connect a voltmeter (V1) between the battery insulated terminal and the alternator main output terminal.

30.2 Switch on the vehicle lighting load (headlamps on main beam). Start and run engine at approx. 3,000 rev/min. The voltmeter reading should not exceed 0.5V.

30.3 Transfer the voltmeter connections (V2) to the battery earth terminal and the alternator body, or "-" terminal.

30.4 Start and run the engine as in (b). The voltmeter reading should not exceed 0.25V.

30.5 If the readings are higher, then there is a high resistance in the circuit which must be located and rectified.

Checking Voltage Regulator Setting (Fig 9)

31 Before checking the voltage regulator, it is essential that a battery in a well charged condition is fitted to the vehicle.

31.1 Disconnect the battery earth cable.

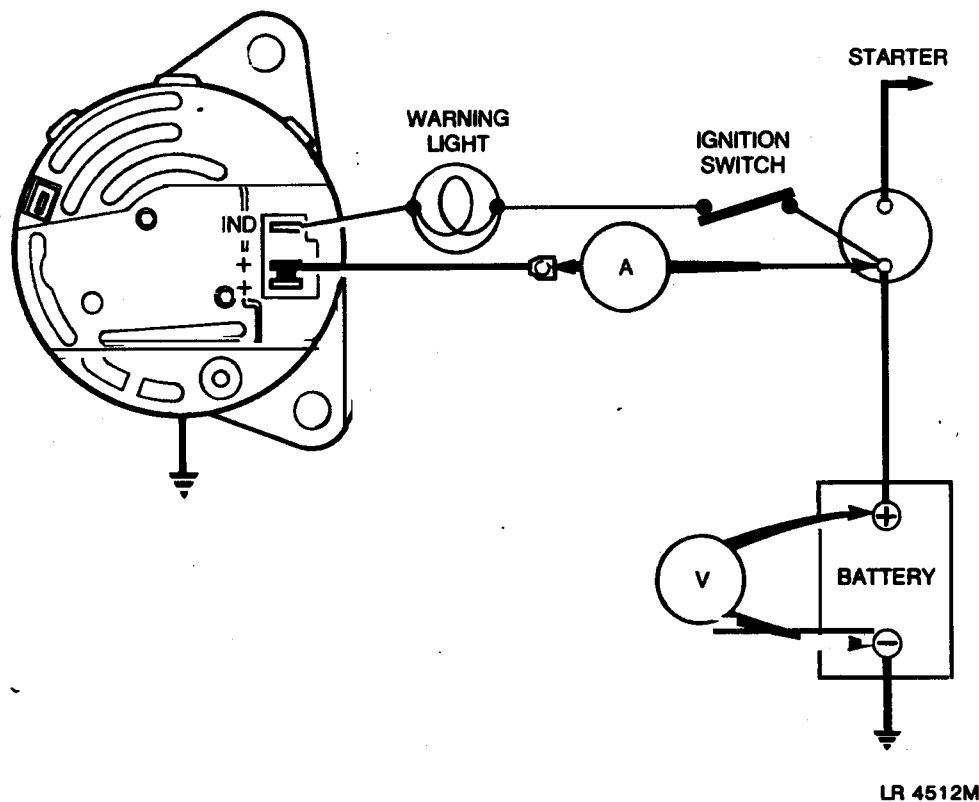


Fig 9 Checking voltage regulator setting

31.2 Connect an ammeter between the starter solenoid terminal and the alternator main output cable. Connect a voltmeter across the battery terminals.

31.3 Reconnect the battery earth cable.

31.4 Start and run the engine at approx. 3,000 rev/min until the ammeter reading is less than 10 amperes.

31.5 The voltmeter reading should be within the limits 13.6-14.4V.

31.6 If the reading is unstable or outside the specified limits, the voltage regulator is faulty and should be replaced.

BENCH TESTING (Alternator A115)

32 The following fault diagnosis test procedures are for when the alternator is taken out of the vehicle and tested on the bench. The equipment required to proceed with testing is as follows:

32.1 Electrical test bench incorporating provision for driving the alternator and measuring speeds between 0-6000 rev/min.

32.2 Provision for applying a variable resistance loading of 70 Amp.

32.3 Moving-coil ammeter 0 - 70 Amp range.

32.4 Moving coil voltmeter 0 - 30 Volt range.

32.5 Warning light 12V 2.2 Watt

32.6 12 Volt Battery.

32.7 Test circuit wiring with a cable specification 84/0.30 mm on the Alternator + and FRAME; 14/0.25 mm on the Alternator IND.

CAUTIONS ...

- (1) Ensure that the polarity is correct.
- (2) Do not disconnect while the alternator is running.
- (3) Limit the use of the variable resistance, see "alternator performance".

Rotor field circuit (Fig 10)

33 Remove alternator S.R.E. moulded cover to expose regulator/brush-box connections.

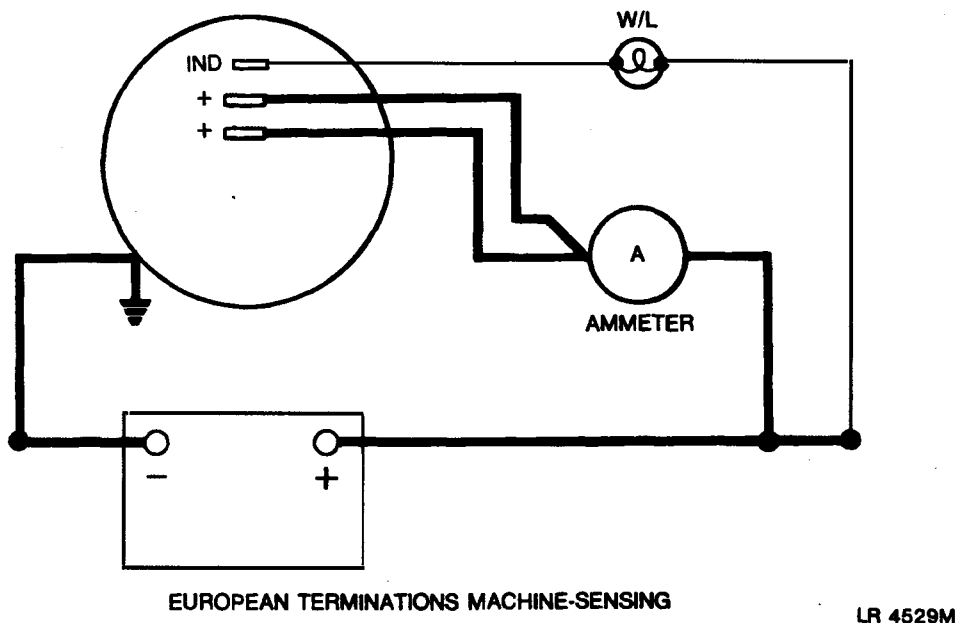


Fig 10 Rotor field circuit (A115)

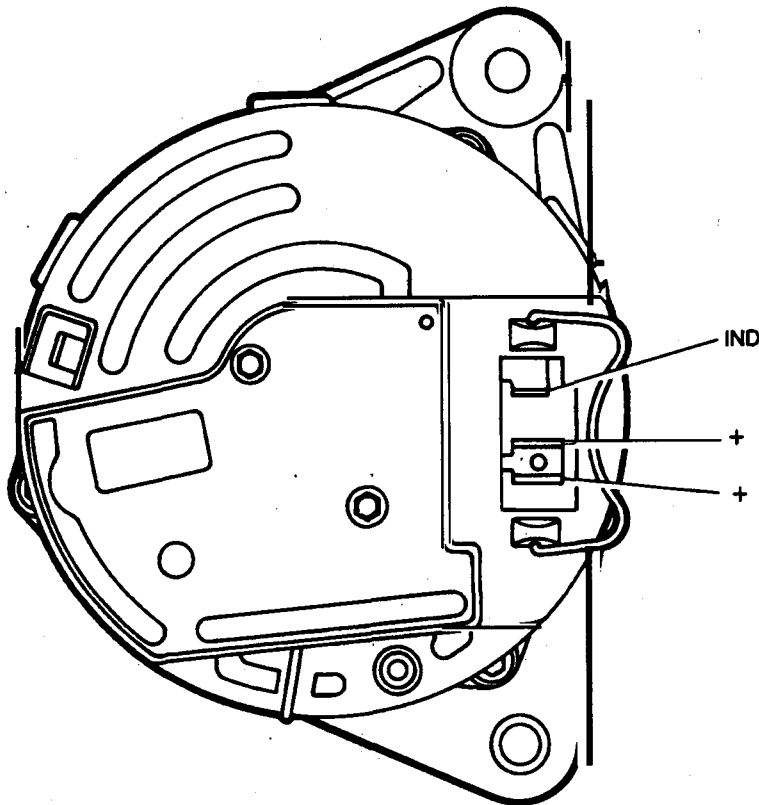
34 Clamp alternator in test bench, connect appropriate test circuit but do not run the alternator (Fig 11).

35 Illumination of the warning light confirms the rotor field circuit is satisfactory. Proceed to "Alternator performance".

36 Non-illumination of the warning light confirms the rotor field circuit is inoperative. Check the regulator, brushes, slip rings, and continuity of the rotor windings.

37 Connect the test link to the regulator but do not run the alternator. If this results in the warning light now being illuminated, the regulator is proved to be faulty and must be renewed. Refer to Cat 524 Alternator Overhaul.

38 If the regulator is not the cause of the fault, remove the brush box assembly and check the brushes, slip rings, and continuity of the rotor windings.



LR 4527M

Fig 11 Rear of Alternator (A115)

Alternator performance (Fig 12)

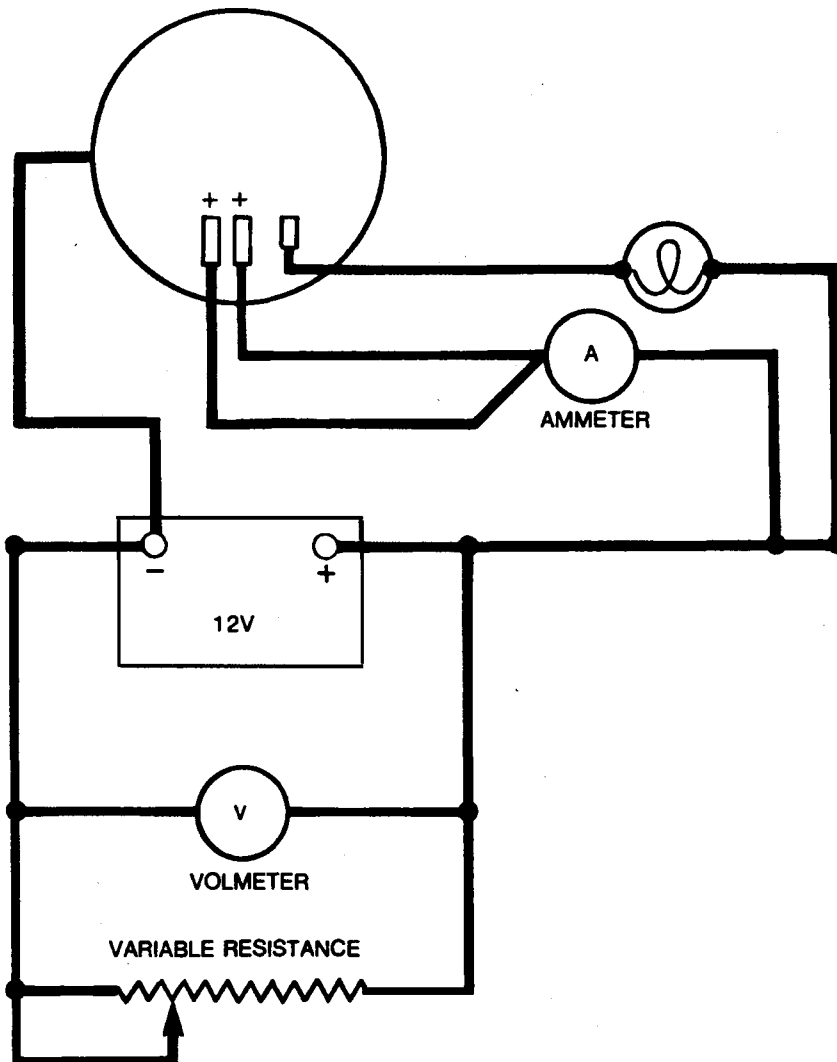
- 39 Connect the appropriate circuit but do not run the alternator.
- 40 Run alternator at slowly increasing speed.
- 41 At approximately 1500 rev/min and 13.5V the warning light should be extinguished. At 6000 rev/min, adjust the variable resistance until the voltmeter registers 13.6V.
- 42 The ammeter should then register 45 Amps. (Alternator maximum rated output).
- 43 Testing satisfactory: Remove the test link from the regulator and disconnect the variable resistance and proceed to "Alternator control".
- 44 Testing unsatisfactory: Refer to Cat 524 Alternator overhaul and check rectifier diodes, rotor resistance and stator windings.

Note ...

If suppression capacitor is fitted, disconnect and repeat test.

44.1 Testing satisfactory: Replace suppression capacitor.

44.2 Testing unsatisfactory: Refer to paragraph 40.



LR 4530M

Fig 12 Alternator performance (A115)

Alternator control

45 Run the alternator at 6000 rev/min. If necessary, maintain alternator speed until the ammeter registers below 10A. The voltmeter should then register 13.6 - 14.4V.

46 Testing unsatisfactory: Renew the regulator assembly. Refer to Cat 524 Alternator overhaul.

BENCH TESTING (Alternator A127)

47 The following fault diagnosis test procedures are for when the alternator is taken out of the vehicle and tested on the bench. The equipment required to proceed with testing is as follows:

47.1 Electrical test bench incorporating provision for driving the alternator and measuring speeds between 0-6000 rev/min.

47.2 Provision for applying a variable resistance loading of 70 Amp.

47.3 Moving-coil ammeter 0 - 70 Amp range.

47.4 Moving coil voltmeter 0 - 30 Volt range.

47.5 Warning light 12V 2.2 Watt

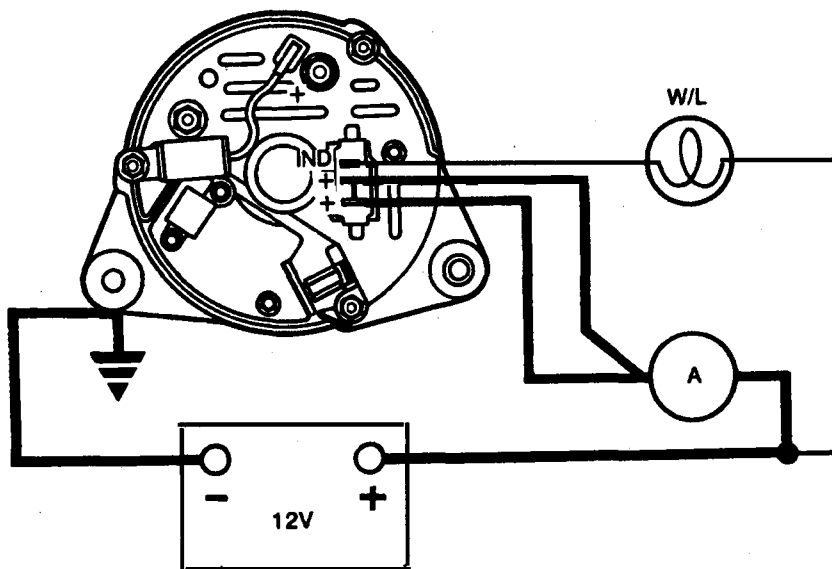
47.6 12 Volt Battery.

47.7 Test circuit wiring with a cable specification 120/0.30mm on the Alternator + and FRAME; 14/0.25 mm on the Alternator IND.

CAUTIONS ...

- (1) Ensure that the polarity is correct.
- (2) Do not disconnect while the alternator is running.
- (3) Limit the use of the variable resistance, see "alternator performance".

Rotor field circuit (Fig 13)



LR 4505M

Fig 13 Rotor field circuit (A127)

48 Clamp alternator in test bench, connect appropriate test circuit but do not run the alternator (Fig 14).

49 Illumination of the warning light confirms the rotor field circuit is satisfactory. Proceed to "Alternator performance".

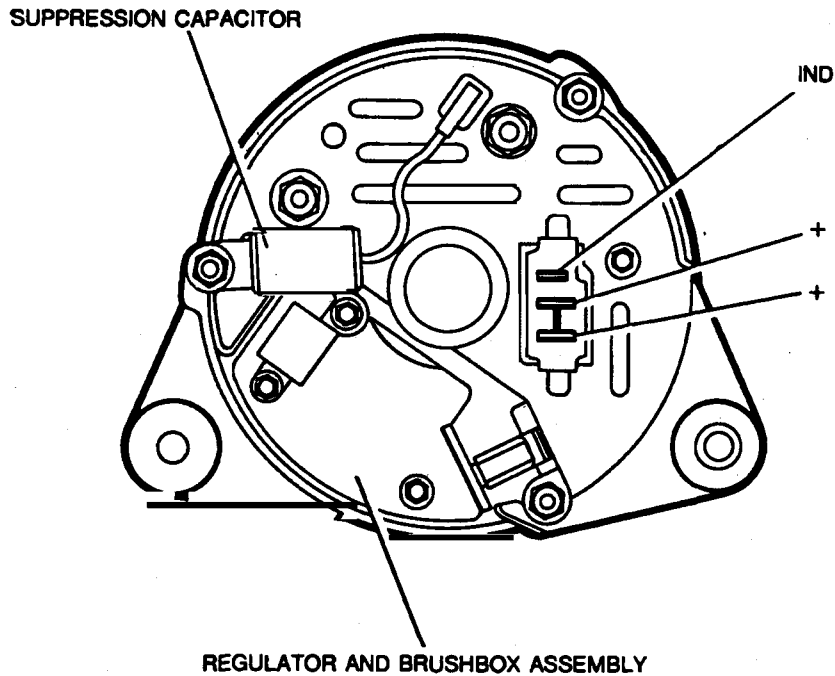
50 Non-illumination of the warning light confirms the rotor field circuit is inoperative. Check brushes, slip rings, and continuity of the rotor windings. Refer to Cat 524 Alternator Overhaul, if the parts prove to be satisfactory, the regulator is suspect.

Alternator performance (Fig 15)

51 Connect the appropriate circuit but do not run the alternator.

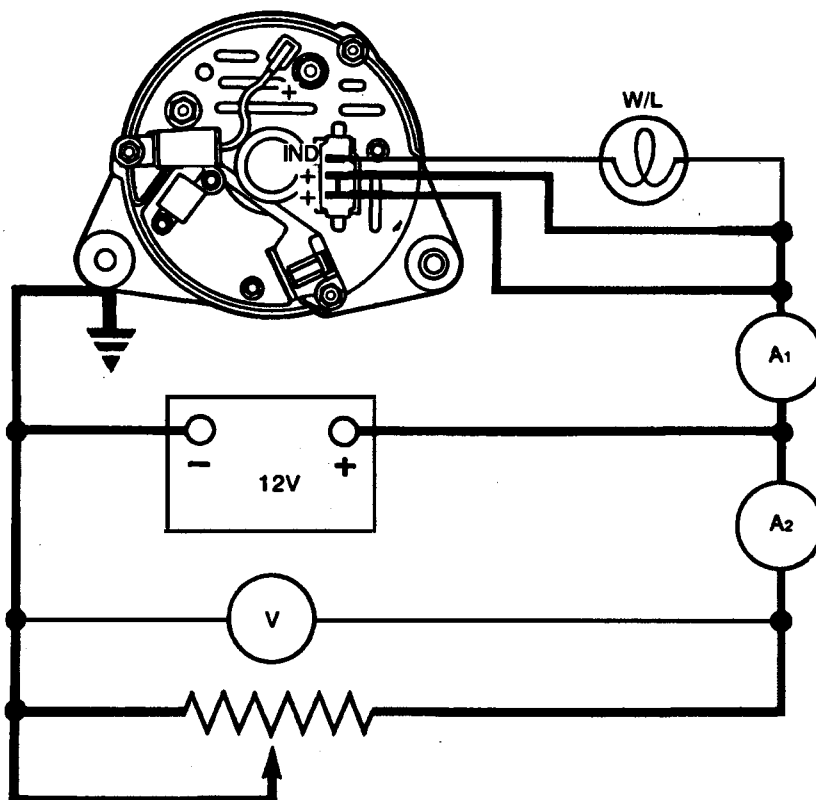
52 Adjust variable resistance until ammeter 2 registers equal to, or just above the alternator maximum rated output.

53 Run alternator at slowly increasing speed.



LR 4513M

Fig 14 Rear of alternator (A127)



LR 4506M

Fig 15 Alternator performance

54 At approximately 1500 rev/min and 13.5V the warning light should be extinguished. At 6000 rev/min, ammeter 1 should register 45A, (Alternator maximum rated output).

55 Testing satisfactory: Disconnect variable resistance and proceed to "Alternator control".

56 Testing unsatisfactory: Refer to Cat 524 Alternator overhaul and check rectifier diodes, rotor resistance and stator windings.

Note ...

If suppression capacitor is fitted, disconnect and repeat test.

56.1 Testing satisfactory: Replace suppression capacitor.

56.2 Testing unsatisfactory: Refer to paragraph 52.

Alternator control

57 Run the alternator at 6000 rev/min. If necessary, maintain alternator speed until the ammeter (A1) registers below 10A. The voltmeter should then register 13.6 - 14.4V.

58 Testing unsatisfactory: Renew the regulator and brushbox assembly. Refer to Cat 524 Alternator overhaul.

Diode fault system

59 Failure of one or more of the diodes will be indicated by the output of the alternator and in some instances by an abnormally high temperature and noise level. The following fault system chart shows how diode failure will influence alternator test results.

TABLE 1 DIODE FAULT SYSTEM

Warning Light	Temperature	Noise	Output	Probable Fault (Associated Damage)
(1)	(2)	(3)	(4)	(5)
Illuminated at standstill, extinguished at cut-in speed (1500 rev/min) but at higher speeds becomes partially illuminated again and gets progressively brighter	High	Normal	Higher than normal at 6000 rev/min Around 40A	Live-side main output diode open circuit. May damage rotor field winding and regulator, overheat brushboxes and fuse warning light bulbs.
Not illuminated between zero at 1500 rev/min	High	Excessive	Very low at 6000 rev/min Around 10A	Live-side main output diode open circuit. May damage associated 'field' diode.
Illuminated at standstill, dims appreciably at cut-in speed (1500 rev/min) and gets progressively dimmer or may be extinguished at higher speeds.	Normal	Excessive	Poor at low speed Slightly below normal at 6000 rev/min Around 32A	Earth-side main output diode open circuit.

(continued)

TABLE 1 DIODE FAULT SYSTEM (continued)

Warning light	Temperature	Noise	Output	Probable fault (Associated Damage)
(1)	(2)	(3)	(4)	(5)
Illuminated at standstill, dims appreciably at cut-in speed (1500 rev/min) and gets progressively dimmer or may be extinguished at higher speeds.	Normal	Normal	Lower than normal at 6000 rev/min Around 29A	Field diode open circuit.
Illuminated at standstill, dims at cut-in speed (1500 rev/min) and remains dim, but may be extinguished at very high speeds.	Normal	Excessive	Very low at all speeds above cut-in 1500 rev/min	Earth-side main output diode short-circuit, or stator winding short-circuit to earth
Illuminated at standstill, dims at cut-in speed (1500 rev/min) and remains dim, but may be extinguished at very high speeds	Normal	Excessive	Very low at 6000 rev/min Around 7A	Field diode short-circuit

Alternator fault and diagnosis

60 Check each item in turn and rectify if necessary before proceeding to next item.

TABLE 2 ALTERNATOR FAULT AND DIAGNOSIS

Symptom	Possible cause	Cure
(1)	(2)	(3)
Alternator does not charge	Worn or slack belt Worn or dirty brushes Broken or faulty rotor winding Break in charging circuit Open circuit or faulty field diode Faulty regulator 2 or 3 rectifier diodes of same polarity faulty	Renew or adjust Rectify or Renew Renew Rectify Rectify or Renew Renew Renew
Alternator not charging correctly	Worn or slack belt, Worn or dirty brushes, One or more defective rectifier diodes Open or short-circuited stator Faulty regulator Faulty connections	Renew or adjust Rectify or renew Renew Renew Rectify

(continued)

TABLE 2 ALTERNATOR FAULT AND DIAGNOSIS (continued)

Symptom	Possible cause	Cure
(1)	(2)	(3)
Overcharge	Faulty regulator Faulty connections between alternator and regulator	Renew Renew
Noisy alternator	Damaged or loose pulley Loose alternator mountings Misalignment of pulleys Faulty bearing One or several rectifier diodes open or short-circuited Short-circuited stator	Renew or Rectify Rectify Rectify Renew Renew Renew

CHARGING SYSTEMTest equipment

61 The following equipment is required to check the faults listed in the table below.

61.1 Voltmeter 0 - 20 Volts moving coil.

61.2 Ammeter 5 - 0 - 60 Amps moving coil.

61.3 Hydrometer

TABLE 3 CHARGING SYSTEM

Fault	Test	Rectification
(1)	(2)	(3)
Battery will not hold charge.	Check continuity of leads, tightness and cleanliness of connections. Check battery charge using a hydrometer. Check heavy voltage discharge: less than 9.6 Volts. Charge the battery for 3 minutes at the stated Ah capacity (20 hour rate) or at 40A, whichever is the lowest. With battery still on charge, record overall voltage and the inter cell readings using the cadmium sticks. Subtract the lowest inter cell reading from the highest. Inter cell voltage variation more than 0.15V - defective battery. Battery voltage below 15.5V inter cell variation less than 0.15V - Battery satisfactory but discharged.	Clean, renew as necessary. Charge battery and recheck or renew. If unsatisfactory check intercell voltage. Renew battery Charge battery

(continued)

TABLE 3 CHARGING SYSTEM (continued)

Fault	Test	Rectification
(1)	(2)	(3)
Battery will not hold charge.	Battery voltage above 15.5V, inter cell voltage variation less than 0.15V - Battery discharged and may be sulphated.	Charge battery and re-test
Battery not being charged.	<p>Check continuity of leads, tightness and cleanliness of connections.</p> <p>Check battery charge using a hydrometer.</p> <p>Check heavy voltage discharge: less than 9.6 Volts.</p> <p>Charge the battery for 3 minutes at the stated Ah capacity. (20 hour rate) or at 40A, whichever is the lowest. With battery still on charge, record overall voltage and the inter cell readings using the cadmium sticks. Subtract the lowest cell reading from the highest. Inter cell voltage variation more than 0.15V - Defective battery.</p> <p>Battery voltage below 15.5V, inter cell voltage variation less than 0.15V - Battery satisfactory but discharged</p> <p>Battery voltage above 15.5V, inter cell voltage variation less than 0.15V - Battery discharged and may be sulphated.</p> <p>Alternator output - Ammeter reading 0</p> <p>Ammeter reading below 10 Amps and voltmeter reading below 13.6 Volts</p> <p>Ammeter reading above 10 Amps and voltmeter reading above 14.6 Volts.</p>	<p>Clean, renew as necessary.</p> <p>Charge battery and recheck or renew. If unsatisfactory check intercell voltage.</p> <p>Renew battery</p> <p>Charge battery</p> <p>Charge battery and re-test.</p> <p>Overhaul alternator</p> <p>Renew voltage regulator</p> <p>Renew voltage regulator</p>
Warning light stays on.	<p>Check continuity of leads, tightness and cleanliness of connections.</p> <p>Check battery charge using a hydrometer.</p> <p>Check heavy voltage discharge: less than 9.6 Volts.</p>	<p>Clean, renew as necessary.</p> <p>Charge battery and recheck or renew. If unsatisfactory check intercell voltage.</p>

(continued)

TABLE 3 CHARGING SYSTEM (continued)

Fault	Test	Rectification
(1)	(2)	(3)
<p>Warning light stays on.</p>	<p>Charge the battery for 3 mins at the stated Ah capacity (20 hour rate) or at 40A, whichever is the lowest. With battery still on charge, record overall voltage and the inter cell readings using the cadmium sticks. Subtract the lower cell reading from the higher Inter cell voltage variation more than 0.15V - Defective battery. Battery voltage below 15.5V inter cell voltage variation less than 0.15V - Battery satisfactory but discharged Battery voltage above 15.5V, inter cell voltage variation less than 0.15V - battery discharged and may be sulphated. Drive belt is not broken or split Disconnect IND lead from alternator, start engine and run above idle speed Warning light stays on Warning light goes out</p>	<p>Renew battery Charge battery Charge battery and re-test Adjust or renew Renew or repair Check alternator output.</p>
<p>Warning light does not function when ignition is switched on.</p>	<p>Check continuity of leads, tightness and cleanliness of connections. Check battery charge using a hydrometer Check heavy voltage discharge: less than 9.6 volts Charge battery for 3 mins at the stated Ah capacity (20 hour rate) or at 40A, whichever is the lowest. With battery still on charge, record overall voltage and the inter cell readings using the cadmium sticks. Subtract the lowest inter cell reading from the highest. Inter cell voltage variation more than 0.15V - defective battery. Battery voltage below 15.5V, inter cell voltage variation less than 0.15V - battery satisfactory but discharged.</p>	<p>Clean, renew as necessary. Charge battery and recheck or renew. If unsatisfactory check intercell voltage. Renew battery. Charge battery.</p>

(continued)

TABLE 3 CHARGING SYSTEM (Continued)

Fault	Test	Rectification
(1)	(2)	(3)
Warning light does not function when ignition is switched on.	Battery voltage above 15.5V, inter cell voltage variation less than 0.15V - battery discharged and may be sulphated Check warning light: Bulb faulty Bulb not faulty Remove plug from alternator, switch on ignition and connect a voltmeter between earth and each terminal in turn: Voltmeter reads 12 Volts. Voltmeter does not read 12 Volts	re-test. Renew Check alternator plug connections. Check alternator output Check cable continuity; repair or renew.

STARTERSIntroduction

62 The starter is a motor which converts electrical energy, supplied from the battery, into mechanical energy for the purpose of cranking the engine.

63 The pre-engaged type is used on the Land Rovers and is suitable for diesel engines, because of the intermittent firing characteristics and cranking speed surges (high compression).

64 By the operation of a solenoid the starter pinion is engaged with the flywheel ring gear before the starter is energised, after which the pinion is being driven at high speed by the flywheel, the armature is protected against overspeeding by the freewheel action of a roller or plate clutch.

Test equipment

65 The equipment required for the following tests are:

65.1 Hydrometer

65.2 Moving coil voltmeter scale 0 - 20 Volts for nominal 12 Volt systems.

Preliminary checks

66 Inspect all connections in the starter system. Ensure that battery connections are clean and tight. If necessary, disconnect and remove all traces of corrosion. Remake connections after smearing terminal posts/lugs with petroleum jelly.

Battery Test

67 Using a hydrometer, check that the battery is at least 70% charged. The full battery test procedure is outlined in paragraphs 8 to 11.

Note ...

A battery in poor condition will cause difficult starting.

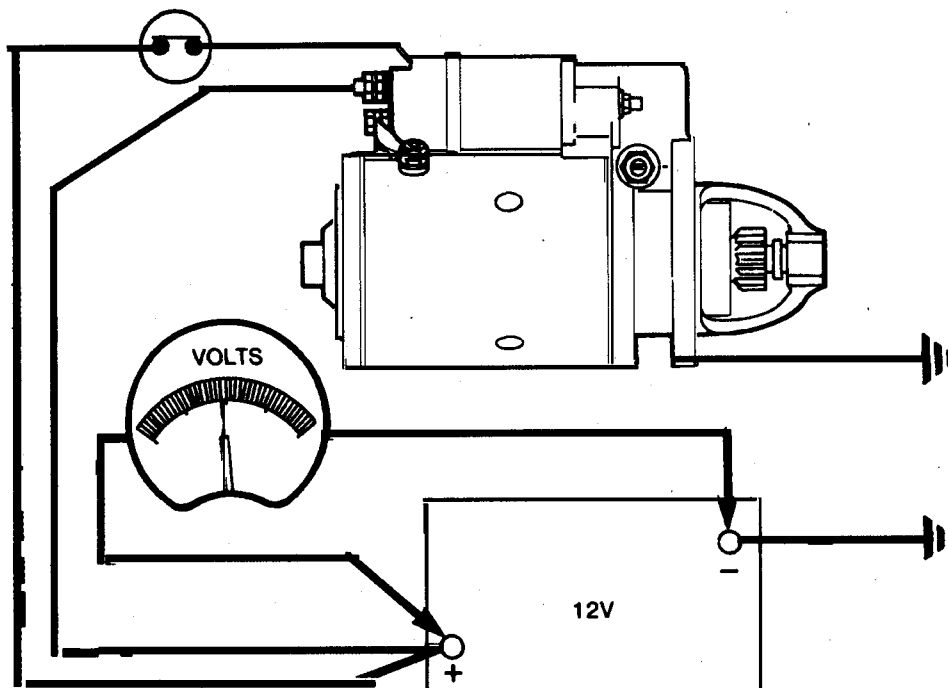
Checking the Starter System

68 The procedure for checking for excessive voltage drop in the starter circuit is as follows:

Checking the battery terminal voltage under load conditions

69 Connect the voltmeter across the terminals as shown in Fig 16, and operate the starter switch. The readings for a 12 volt system depends on the engine capacity, battery size (Ah). A typical figure is about 9.0 Volt.

69.1 A low voltage reading would indicate excessive current flow in the circuit. The starter should then be removed for bench testing.



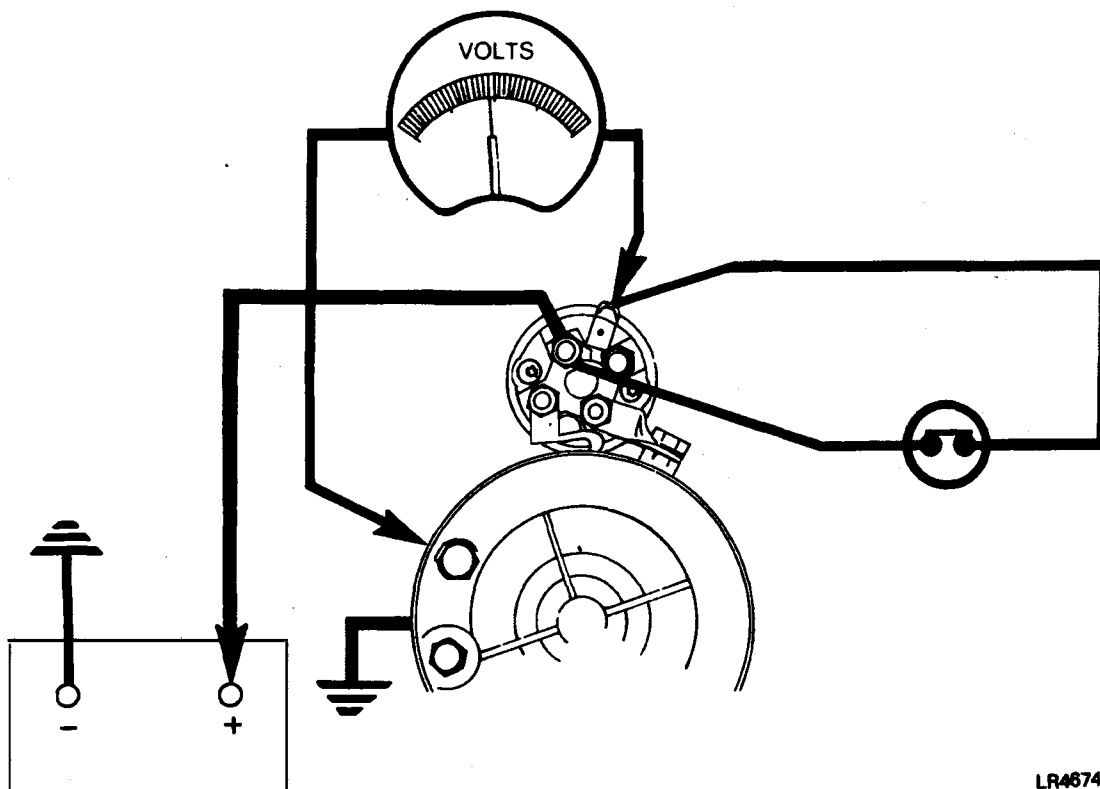
LR 4480M

Fig 16 Checking the battery terminal voltage

70 If the solenoid operates intermittently during the test or the engine is cranked at a low or irregular speed, there may be insufficient voltage at the solenoid operating winding terminal or the solenoid is faulty.

71 To check the switching circuit for high resistance, connect the voltmeter between the solenoid operating winding terminal and earth (commutator end bracket) Fig 17.

72 When the switch contacts are closed, the reading on the voltmeter should be slightly less than the reading in "Checking the battery terminal voltage". A satisfactory reading indicates a negligible voltage drop in the circuit and consequently the fault may be in the solenoid.



LR4674M

Fig 17 Checking the switching circuit

73 If the reading is appreciably lower than in "Checking the battery terminal voltage", check the switching circuit for high resistance or faulty connections. Check the cable size is as recommended, i.e. 28/0.30 mm (28/.012").

Checking the starter terminal voltage under load conditions

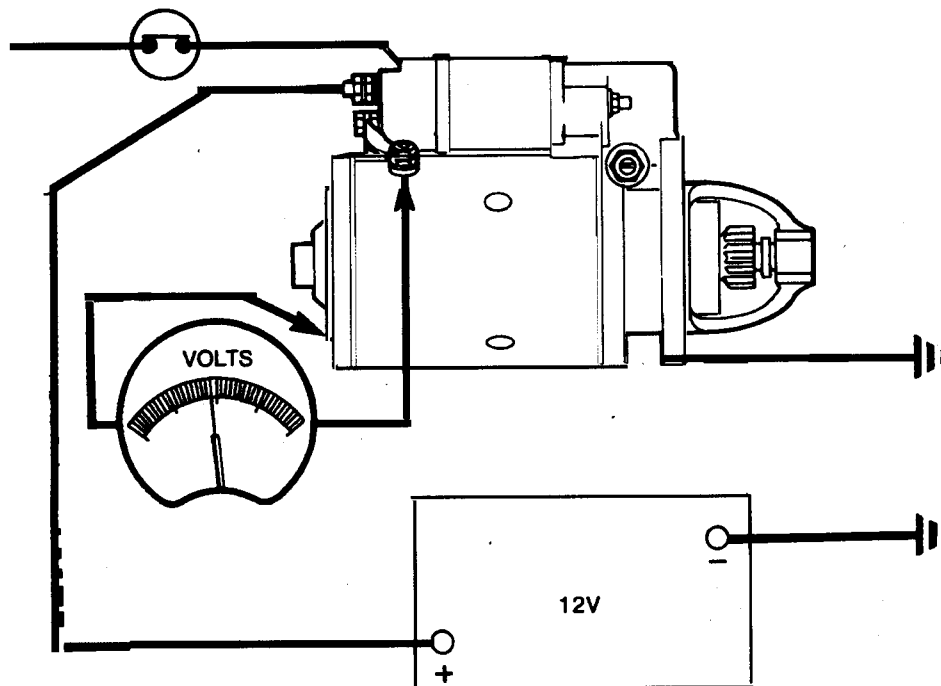
74 Having ascertained the battery voltage under load, the voltage across the starter is checked. The illustration (Fig 18) shows a voltmeter connected between the starter input terminal and earth (commutator end bracket). When the operating switch is closed, the difference between this reading and that taken at the battery should not exceed 0.5V.

75 If the reading is within this limit, the starter circuit is satisfactory. If there is a low reading across the starter, but the voltage at the battery is satisfactory, it indicates a high resistance in the starter circuit.

Checking the voltage drop on the insulated line

76 The voltage drop on the insulated line is then checked. The illustration (Fig 19) shows the voltmeter connected between the starter input terminal and the battery (insulated) terminal.

77 When the operating switch is open, the voltmeter should register battery voltage. When the operating switch is closed, the voltmeter reading should be practically zero. A high voltage reading indicates a high resistance in the insulated line.



LR 4481M

Fig 18 Checking the starter terminal voltage

78 All insulated connections at battery, solenoid and starter should be checked. If all connections are in order, the starter solenoid contacts must be checked, proceed to "Checking the voltage drop across the solenoid contacts".

Checking the voltage drop across the solenoid contacts

79 To check the voltage drop across the solenoid contacts, connect the voltmeter across the two main solenoid terminals. When the operating switch is open, the voltmeter should register battery voltage. When the operating switch is closed, The voltmeter reading should fall to a fractional value.

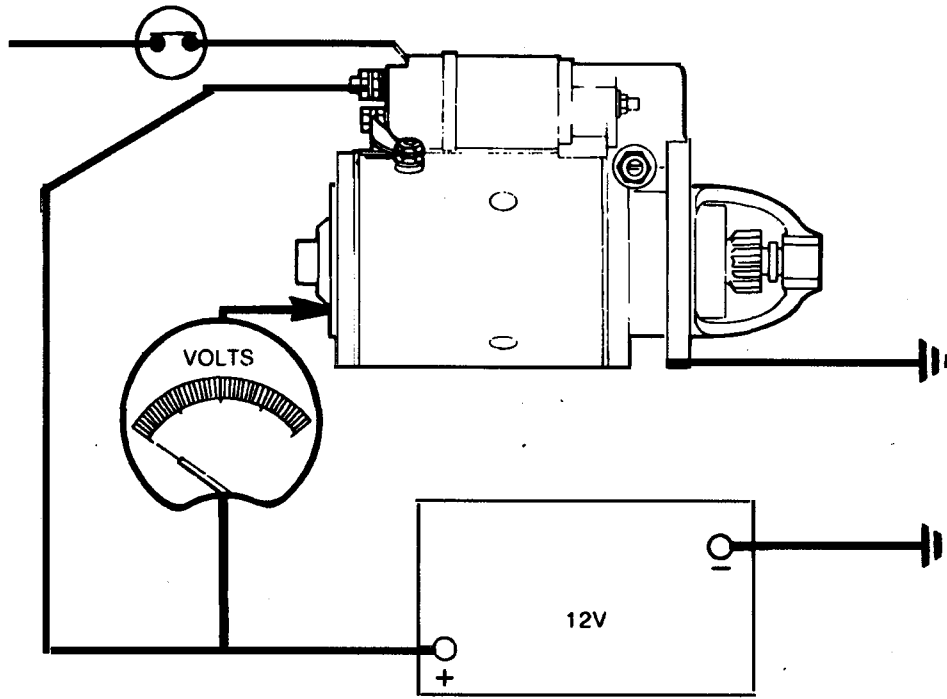
80 A zero or fractional reading on the voltmeter indicates that the high resistance deduced in checking the voltage drop on the insulated line must be due to either high resistance starter cables or soldered connections. A high reading, similar to that in checking the voltage drop on the insulated line, indicates faulty solenoid contacts.

Checking the voltage drop on the earth line

81 Check the voltage drop on the earth line. Connect the voltmeter between the battery earth terminal and the starter earth (commutator end bracket) Fig 20. Note the reading which should be almost zero.

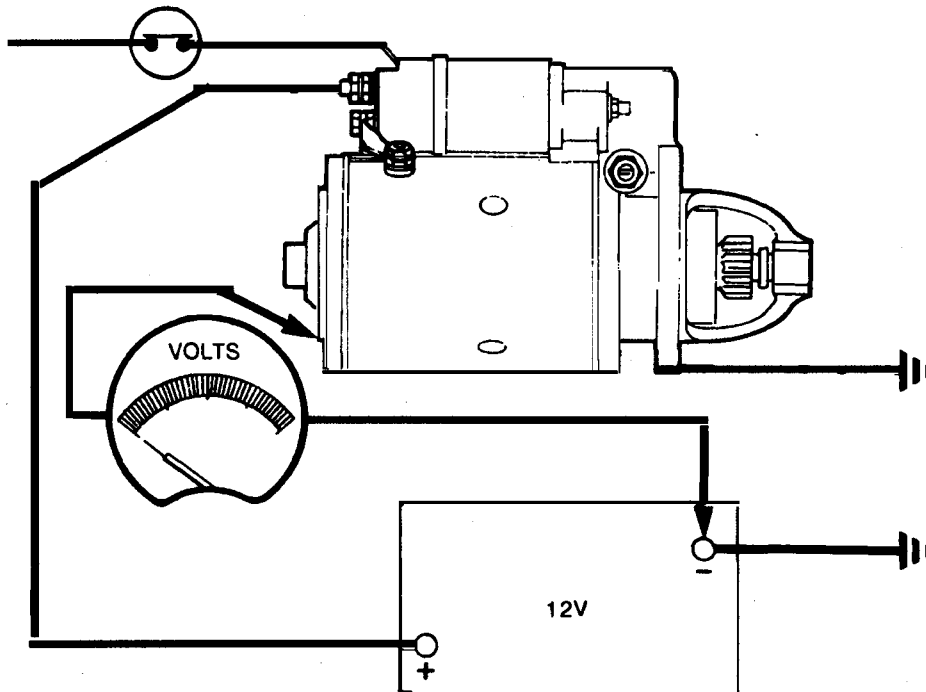
Notes ...

- (1) Check earth connections and bonding straps.
- (2) The total voltage drop in the starting circuit i.e. insulated line and earth line, must not exceed 0.5V.



LR 4482M

Fig 19 Checking the voltage on the insulated line



LR 4483M

Fig 20 Checking the voltage drop on the earth line

Checking the bonding strap

82 The vehicle engine is rubber mounted, therefore the bonding strap must make a good electrical connection between the engine block and the chassis. The units mounted on the engine block must have an efficient earth connection in order to function correctly.

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83 If the bonding strap is incorrectly fitted or frayed, it will have a serious effect on the performance of the starter, and may even immobilise the vehicle.

Notes ...

- (1) The total voltage drop on the starter installation must not exceed 0.5V.
- (2) If a higher reading is obtained, check for loose, frayed or damaged wiring connections.
- (3) Ensure that all cables used are of the correct rating.

Starter system

Test equipment

84 The equipment required for the following tests are as follows:

- 85 Voltmeter 0 - 20V moving coil
- 86 Ammeter 5.0 - 60A moving coil
- 87 Hydrometer
- 88 Lock torque clamps
- 89 Spring balance

TABLE 4 STARTER SYSTEM

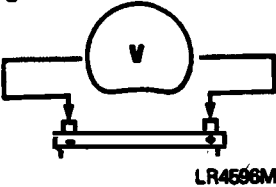
Fault	Test	Rectification	Results
(1)	(2)	(3)	(4)
Starter will not operate; Engine cranking speed low; Engine will not start;	Battery voltage: Connect voltmeter between battery terminals - below 12V. 	Charge or renew battery	Voltage above 12V proceed to battery charge test.
Starter will not operate; Engine cranking speed low; Engine will not start;	Battery charge: Take hydrometer readings - below 70% charged. Wiring: a) Check that all connections are clean and tight.	Charge battery Renew wiring and connectors	Battery charged proceed to check wiring test. (continued)

TABLE 4 STARTER SYSTEM (continued)

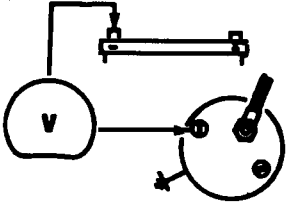
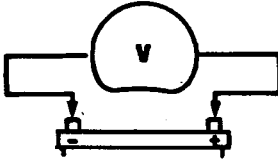
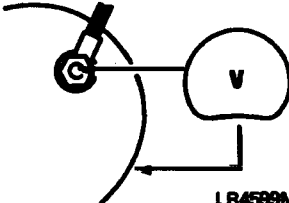
Fault	Test	Rectification	Results
(1)	(2)	(3)	(4)
	<p>b) Disconnect coil negative lead. Voltmeter between battery negative and starter end bracket bolt - operate starter above 0.5V</p>  <p style="text-align: center;">LR4597M</p>	<p>Clean and tighten all earth connections, battery, engine starter Tighten starter through bolts, remove starter, clean motor and backplate faces.</p>	<p>If retification is made and fault still occurs, proceed to Battery on load test.</p>
<p>Starter will operate; Engine crank speed low; Engine will start;</p>	<p>Battery on load: Disconnect coil negative lead, Voltmeter as "Battery voltage" - operate starter a) Below 10V - starter or circuit taking too much current. b) Between 10V to 12V but crankshafts turn slowly.</p>  <p style="text-align: center;">LR4598M</p>	<p>Check circuit - renew or overhaul starter. Carry out battery voltage at starter test</p>	
<p>Starter will not operate;</p>	<p>Battery voltage at starter on load: Disconnect coil negative lead. Voltmeter starter terminal to earth on motor, operate starter - a) Above 9.5V b) Below 9.5V c) Below 9.5V</p>  <p style="text-align: center;">LR4599M</p>	<p>Starter satisfactory Starter unsatisfactory Solenoid operating</p>	<p>Carry out voltage at solenoid test Carry out starter voltage test. Carry out drive faulty test.</p> <p style="text-align: right;">(continued)</p>

TABLE 4 STARTER SYSTEM (continued)

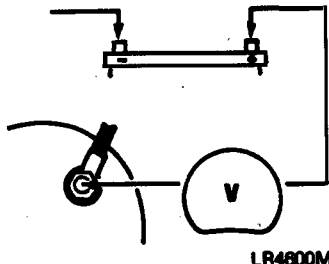

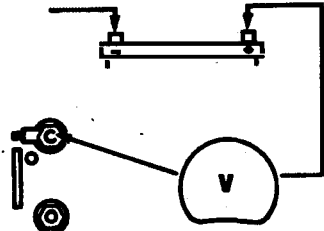
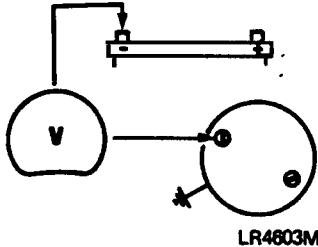
Fault	Test	Rectification	Results
(1)	(2)	(3)	(4)
<p>Starter will not operate;</p>	<p>Starter voltage - on load: Voltmeter starter terminal to battery positive. Switch on ignition, battery voltage. Disconnect coil negative operate starter. a) Below 0.5V b) Above 0.5V</p>  <p style="text-align: center;">LR4600M</p>	<p>a) Cable and connections satisfactory b) Resistance between battery and starter</p>	<p>Carry out voltage at solenoid test Check all connections and cables</p>
<p>Starter will not operate;</p>	<p>Voltage drop across solenoid switch: Voltmeter between starter solenoid terminals. Switch on ignition, battery voltage. Disconnect coil negative lead, operate starter. a) Below 0.5V b) Above 0.5V</p>  <p style="text-align: center;">LR4601M</p>	<p>a) Cable and connections satisfactory b) Faulty switch or connections.</p>	<p>Carry out voltage at solenoid test. Change switch or connections</p>
<p>Engine cranking speed low; Starter operates but crankshaft stationary;</p>	<p>Voltage at solenoid - on load: Disconnect coil negative lead. Voltmeter between solenoid feed terminal and battery positive, operate starter. a) 9V to 10V b) Above 12V</p>  <p style="text-align: center;">LR4602M</p>	<p>a) Result of voltage drop across solenoid switch test. Was above 0.5V b) Starter does not operate.</p>	<p>Change solenoid Clean earth, re-test - renew solenoid.</p> <p style="text-align: right;">(continued)</p>

TABLE 4 STARTER SYSTEM (continued)

Fault	Test	Rectification	Results
(1)	(2)	(3)	(4)
Engine cranking speed low; Engine will not start; Starter operates but crankshaft stationary;	<p>Voltage drop in earth line: Disconnect coil negative lead. Voltmeter between starter through bolt and battery negative: negative: Above 0.5V</p> 	<p>a) Clean and tighten all connections, battery, starter, engine b) Tighten starter through bolts c) Remove starter, clean motor and backplate faces.</p>	<p>Renew battery or connections. Renew starter through bolts. Renew motor.</p>
Engine cranking speed low; engine will not start; starter operates crankshaft stationary	<p>Drive faulty: a) Remove starter - b) Check that crankshaft rotates freely c) Lock torque, free running speed and current</p>	<p>a) Check condition of pinion and starter ring gear. b) Check for engine fault, tight or seized c) Check brushes -</p>	<p>Renew pinion or ring gear. Renew crankshaft or correct engine fault. Overhaul starter</p>

BENCH TESTING

90 The following fault diagnosis test procedures are for when the starter motor is taken out of the vehicle and tested on the bench. The equipment required to proceed with testing is as follows:

Test equipment

91 Electrical test bench incorporating provision for driving the starter motor and measuring speeds between 0-8000 rev/min.

92 Moving-coil ammeter

93 Moving-coil voltmeter

Light running current speed

94 100A maximum at 5000 to 7500 rev/min, proceed to "Lock torque/running torque".

95 Excess current - Starter faulty, replace/repair.

96 Low current, proceed to "Checking the solenoid".

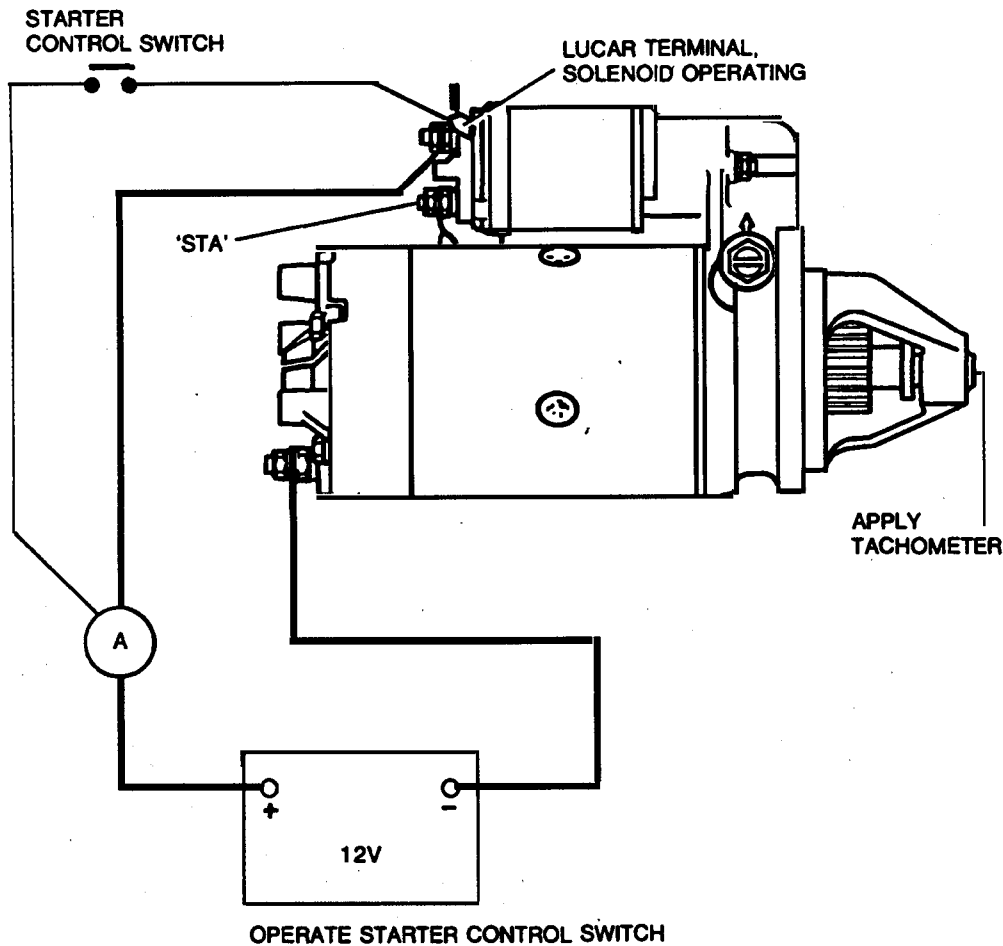


Fig 21 Light running current and speed

97 Starter fails to operate and no audible operation of solenoid; connect ammeter to "STA" terminal:

97.1 Motor should run, repair/renew solenoid.

97.2 Motor does not run, repair/renew starter.

98 Starter fails to operate and there is audible operation of solenoid, proceed to "Proving the solenoid".

Checking the solenoid

99 Continuity of contacts

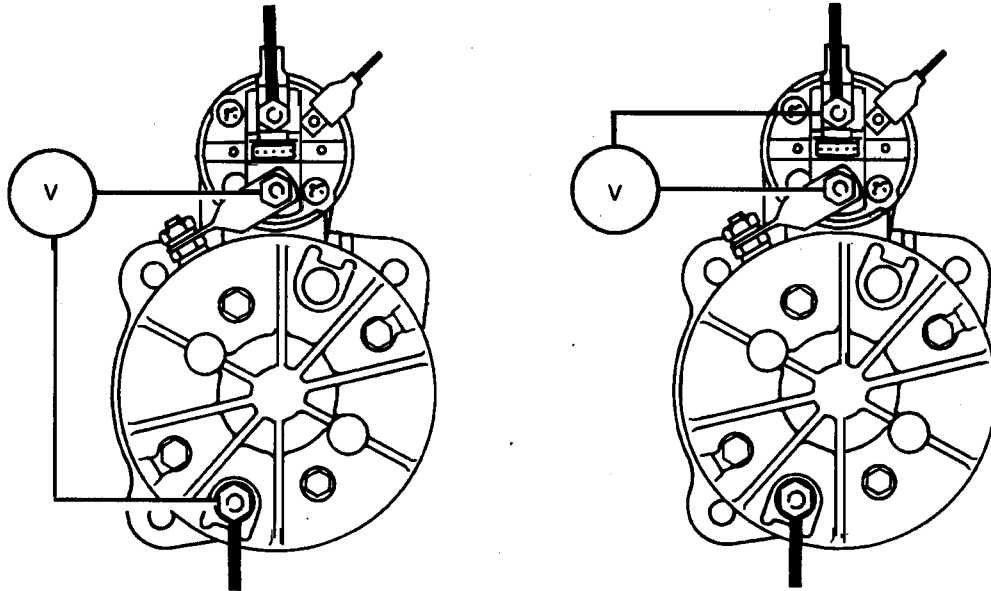
99.1 No voltage: solenoid faulty, repair/renew.

99.2 12V but starter fails to operate: starter motor faulty, repair.

99.3 12V and starter operates satisfactory so far, proceed to "voltage drop across contacts" test.

100 Voltage drop across contacts

100.1 Voltage across terminals should be zero, if more than solenoid is faulty, renew/repair.



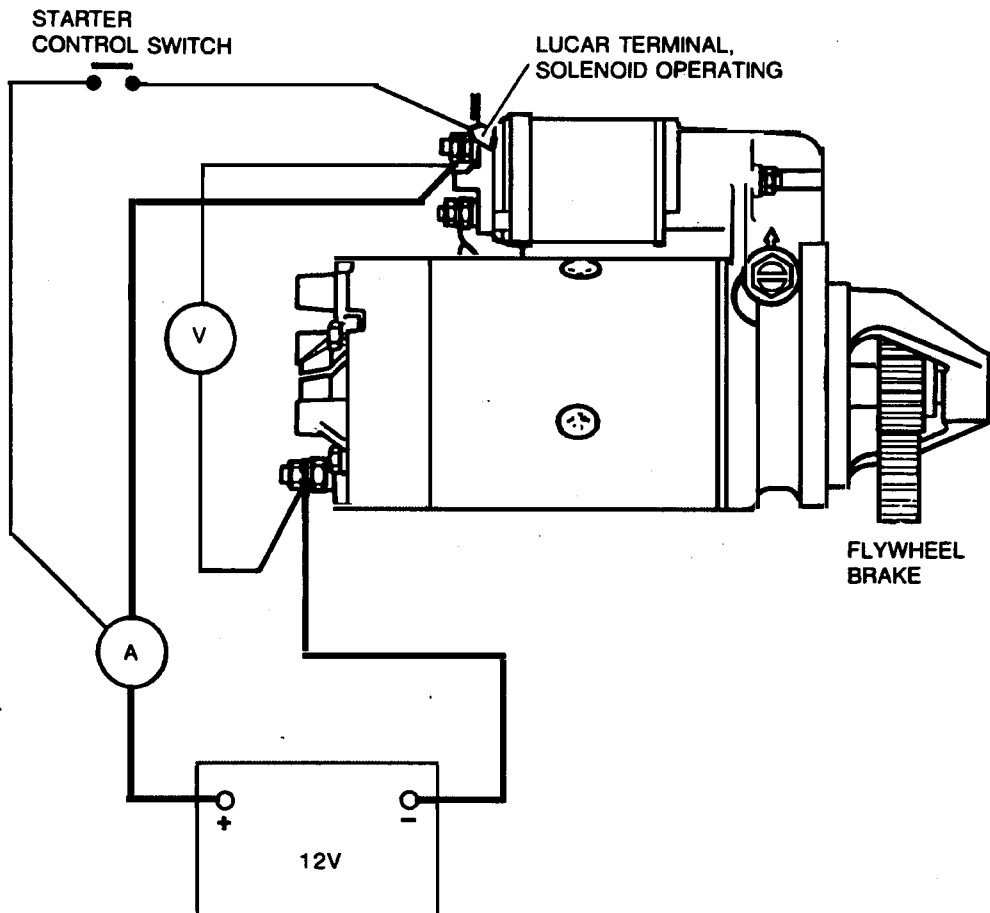
LR 4485M

Continuity of solenoid contacts

Volt drop across contacts

Operate starter control switch

Fig 22 Circuit connections for checking the solenoid



OPERATE STARTER CONTROL SWITCH
AND APPLY TORQUE BRAKE

LR 4486M

Fig 23 Lock torque/running torque

100.2 No voltage across terminals, solenoid is satisfactory, proceed to "Lock torque/running torque".

101 Lock torque/running torque

101.1 Lock torque: 39.4 Nm (29.0 lbft) at 940A maximum at 6.5V minimum.

101.2 Torque at 1000 rev/min: 14.9 Nm (11.0 lbft) at 540A maximum at 8.0V minimum.

Test results

101.3 Torque low, Voltage low or Current high - Starter faulty: check armature, field coils and bearings.

101.4 Torque low, Current low, Voltage high - Check solenoid unit as (Volt drop across contacts).

101.5 If solenoid satisfactory: check brush-gear and commutator.

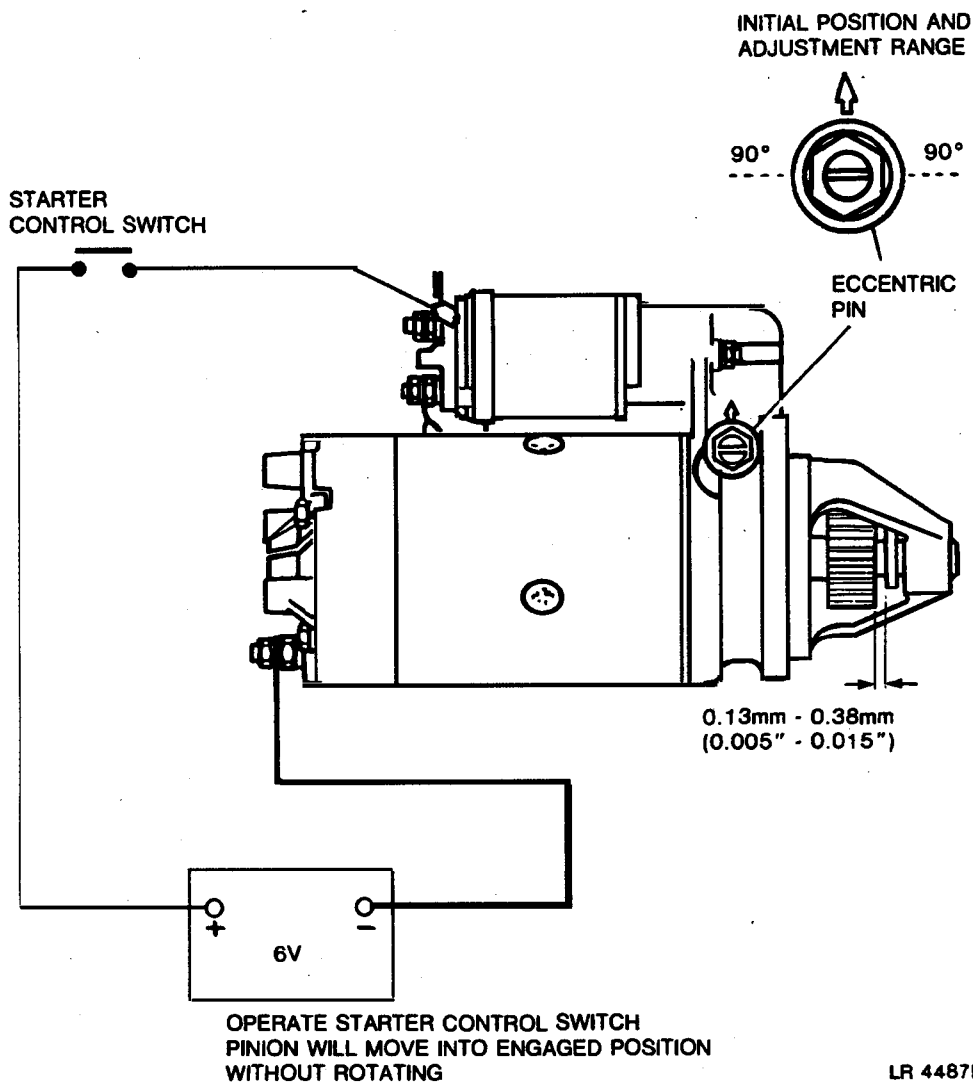


Fig 24 Pinion setting

Pinion setting

102 The initial position of the eccentric pivot pin is as follows:

102.1 Screw pivot pin fully into casting, slacken one full turn and position as illustrated (Fig 24). This provides a starting point for final adjustment.

103 Checking and adjustment is as follows:

103.1 Maintain pinion in engaged position press pinion back towards yoke and insert gauge between pinion end-face and jump ring collar.

103.2 If necessary adjust pivot pin to provide a pinion setting 0.13 to 0.38 mm (0.005 to 0.015 in) and tighten lock nut to 20 Nm (15 lbft). Finally, apply laquer around threads of pivot pin and lock nut.

LIGHTING

Introduction

104 In order to comply with legal requirements, all motor vehicles must be fitted with certain forms of lighting which must be maintained in working condition. The present requirements are as follows:

105 Headlights (two minimum).

106 Side, rear and number plate lights.

107 Direction indicator lights.

108 Stop lights.

109 Rear fog lights.

110 Apart from the legal aspect, efficient lighting will enable the driver to "see and be seen", and a driver using defective or incorrectly aligned lights is not only a danger to himself but also to other road users.

111 Additional lights may be fitted to a vehicle, but they must comply with the regulations governing those particular types of lights.

112 When testing lighting circuits the "volt drop" principle will be used. This will involve checking the "supply voltage available" under load (at the battery) then the voltage available at the actual light involved, with the light lit. Where the difference in voltage exceeds the permitted limits the voltmeter will be connected in parallel with both the supply and return sides of the circuit to determine where the fault exists. The exact procedure will be stated in this section.

113 In the case of direction indicator circuits, it must be remembered that voltage readings will only be valid when the indicator lights are illuminated (battery under load).

Note ...

Some vehicles have separate fuses for LH and RH sidelight circuit.

Test Equipment

114 Basic test equipment required is:-

115 Hydrometer.

116 Moving coil voltmeter, scale 0-20V.

117 Moving coil ammeter, scale 0-10A.

Preliminary Checks

Visual Inspection

118 Inspect all cables and connections in the lighting system. All connections should be clean and tight.

Battery Checks

119 Ensure that there is no corrosion or oxidation at the battery terminals.

120 Using the hydrometer, check the state of charge of the battery, see Paragraph for details.

Note ...

All voltmeter connections mentioned in these tests are for negative (-ve) earth systems.

Side and Tail Circuit

121 All tests with side and tail lamps switched on. Refer to Fig 25 for voltmeter positions.

Voltage at the Battery under Load (Fig 25)

122 Connect voltmeter across the battery terminals and note the reading (V1).

Voltage at Bulb Connections (Fig 25)

123 Connect the voltmeter across the bulb connections (V2). Note the reading. The difference between readings (V1) & (V2) (volt drop) should not exceed 10% of the system voltage. If the volt drop is excessive, proceed to "Voltage drop on insulated line".

Voltage Drop on Insulated Line (Fig 25)

124 Connect one side of voltmeter to the battery insulated terminal and the other side to the bulb insulated connection (V3).

Voltage Drop on Earth Line (Fig 25)

125 Connect one side of the voltmeter to the battery earth terminal and the other side to the bulb earth connection (V4). Note the reading.

126 If the total of the readings for (74.3) and (74.4) exceeds 10% of the system voltage, a high resistance exists on either the insulated or earth lines or possibly both.

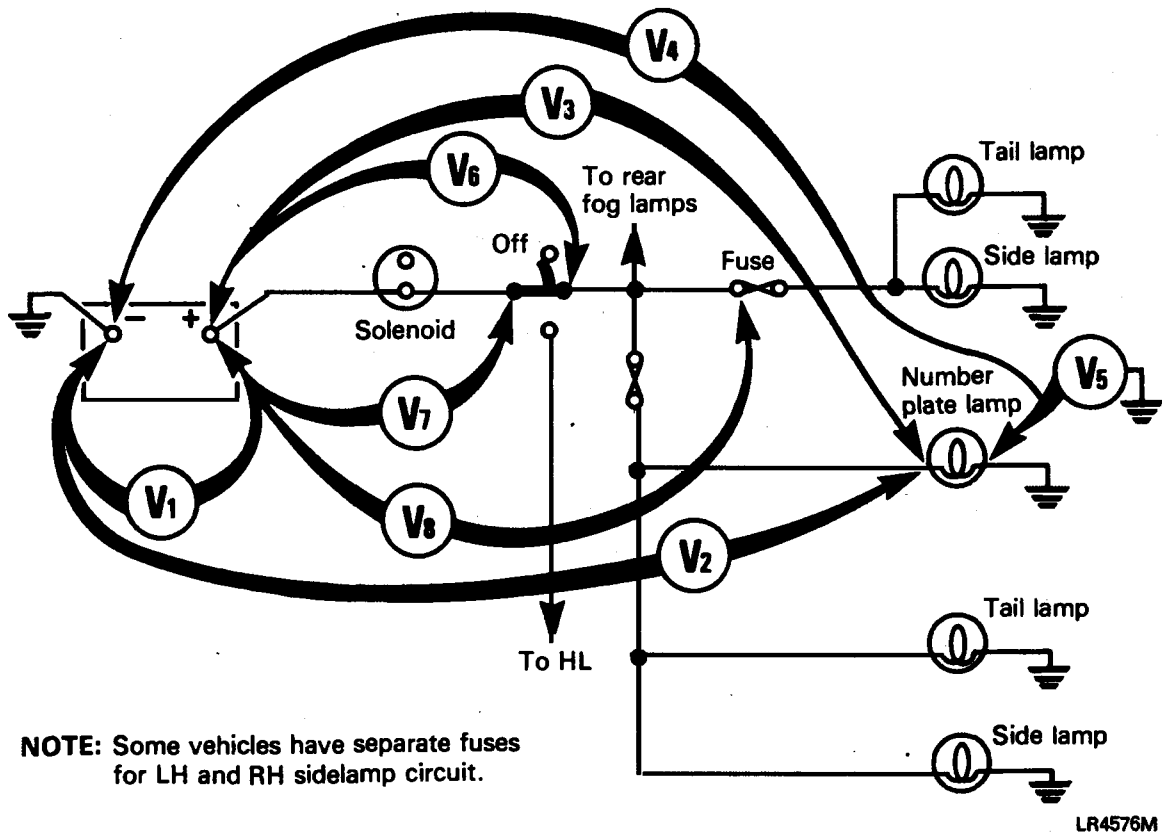


Fig 25 Side and tail lights circuit

127 Bearing in mind that the total volt drop allowed is 10% (approx 1.2V for a 12 volt system), it is permissible to have all this drop on one line or the other or as a combination of both lines.

Bulb Earth Connection (Fig 25)

128 If the volt drop figure on the earth side is the higher, it is probably due to a bad connection between the lamp body and earth. To check, conn ct the voltmeter between the bulb earth connection and a good vehicle earth (V5). Any reading indicates volt drop.

Note ...

If reading is the same as battery voltage, open circuit earth is indicated.

Checking Insulated Line (Fig 25)

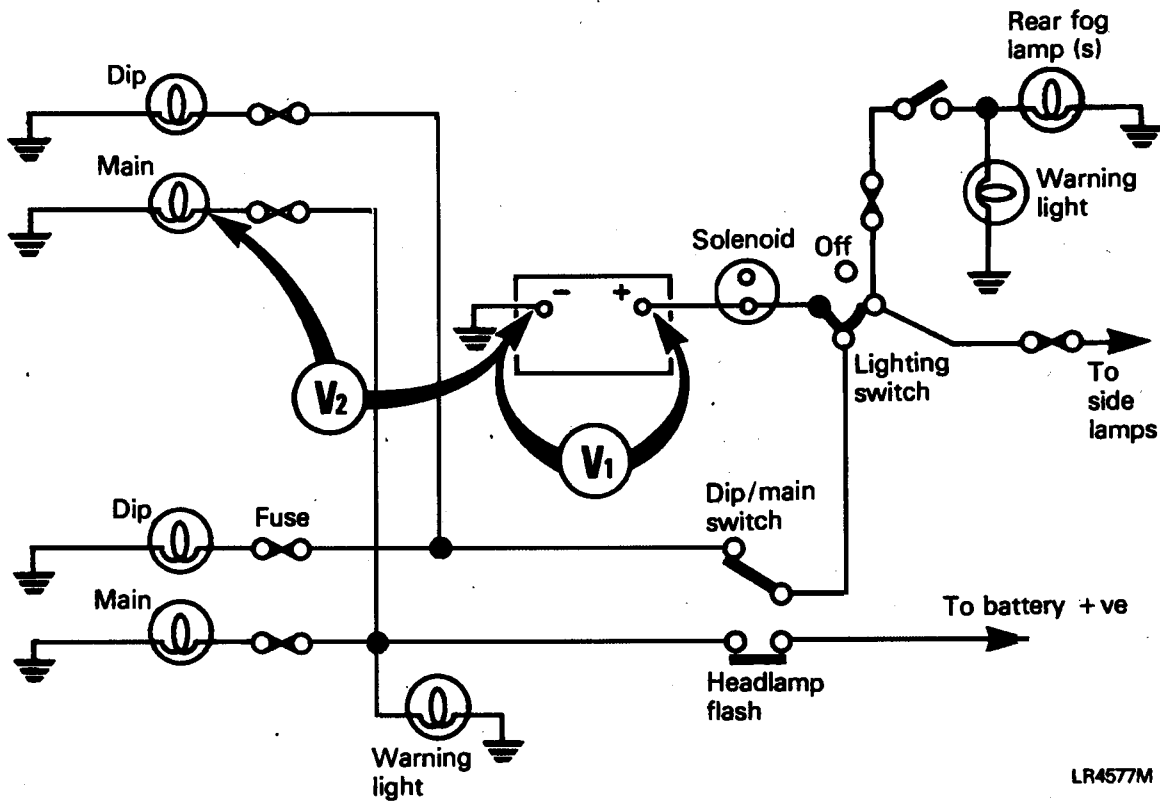
129 To check volt drop on the insulated line connect one voltmeter lead to the battery insulated terminal and move the other voltmeter connection (V6), (V7), (V8), etc. until the faulty section is located.

Headlights, Stoplamps and Rear Fog Lights Circuits

130 These circuits are checked using the same method as for the side/tail light circuit but referring to Figs 26 and 27.

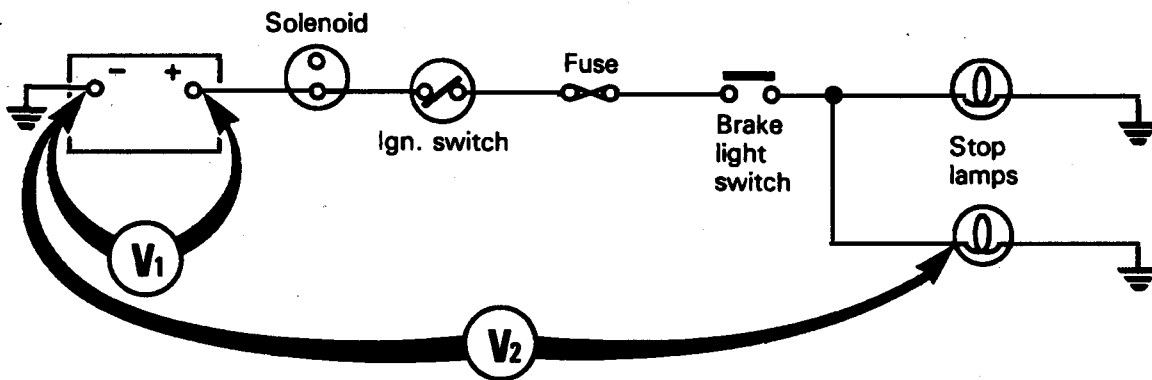
Note ...

Voltmeter connections for (V3) to (V8) are not shown on this circuit.



LR4577M

Fig 26 Headlights, stop lights and rear fog lights circuit



LR4581M

Fig 27 Stop light circuit

Direction Indicator Circuit

131 The direction indicator circuit is first checked using the same method as for the side/tail lamp circuit but referring to the Fig 28. It will be necessary to carry out the test twice, once for each side.

Notes ...

- (1) Meaningful readings will only be obtained when the appropriate indicator bulbs are illuminated.

- (2) When testing indicator circuits, do not make direct earth connections to any of the indicator lamp insulated connectons (bulb contacts).
- (3) All voltmeter connections for sequential testing not shown in this illustration.

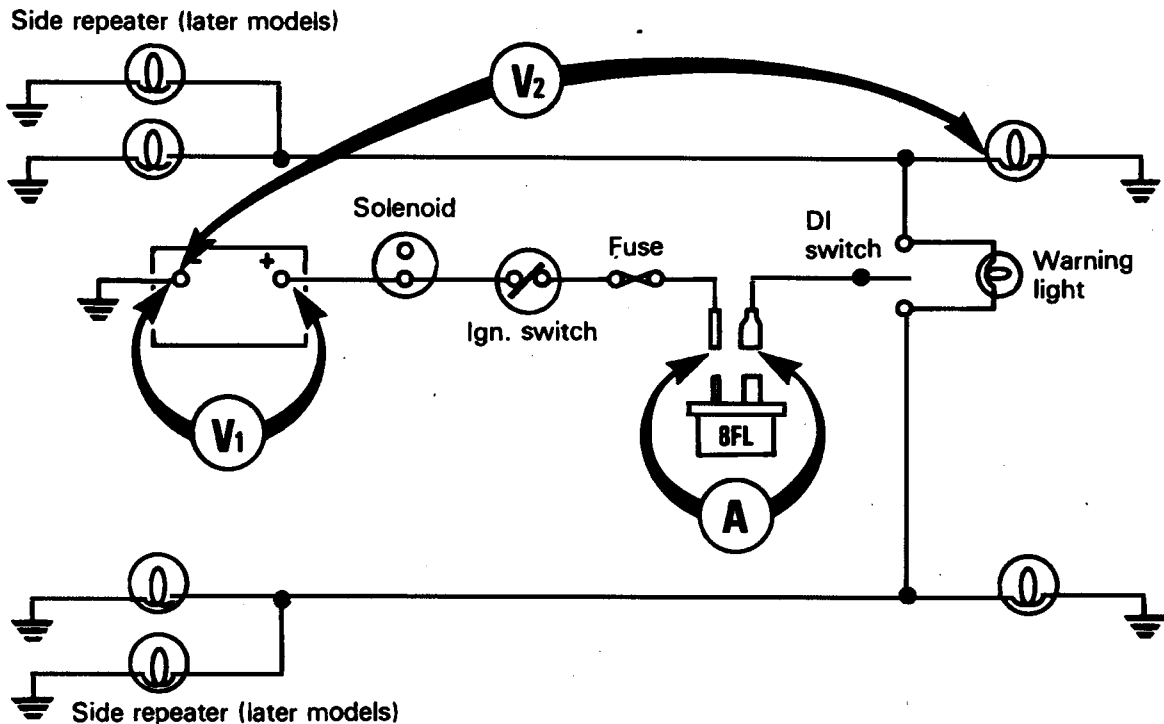


Fig 28 Direction indicator lights circuit

LR4578M

132 To check the current loading of the flasher unit (important in the case of electro-mechanical flasher units where flash rate is dependent on current draw), disconnect the flasher unit from the harness and connect an ammeter in series with the leads as shown in Fig 28.

133 With the indicator switch in either the left or right hand position, the indicator lamps on that side should light and the ammeter current should correspond with the flasher unit rating eg. 3.6A, 4.1A or 4.3A.

134 The test should be carried out for both right and left hand sides. If the current consumption on one or both sides does not match that specified on the flasher unit, the rate of flash may be incorrect. This is caused by one of the following:

135 The wrong flasher unit has been fitted.

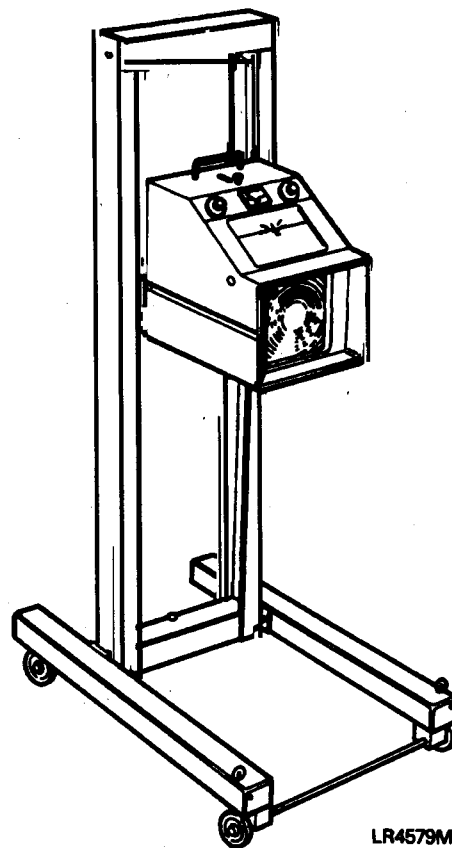
136 Bulbs of incorrect wattage have been fitted.

137 One bulb is faulty. (Check visually).

138 A high resistance exists in the circuit, this should be located using the volt drop test procedure.

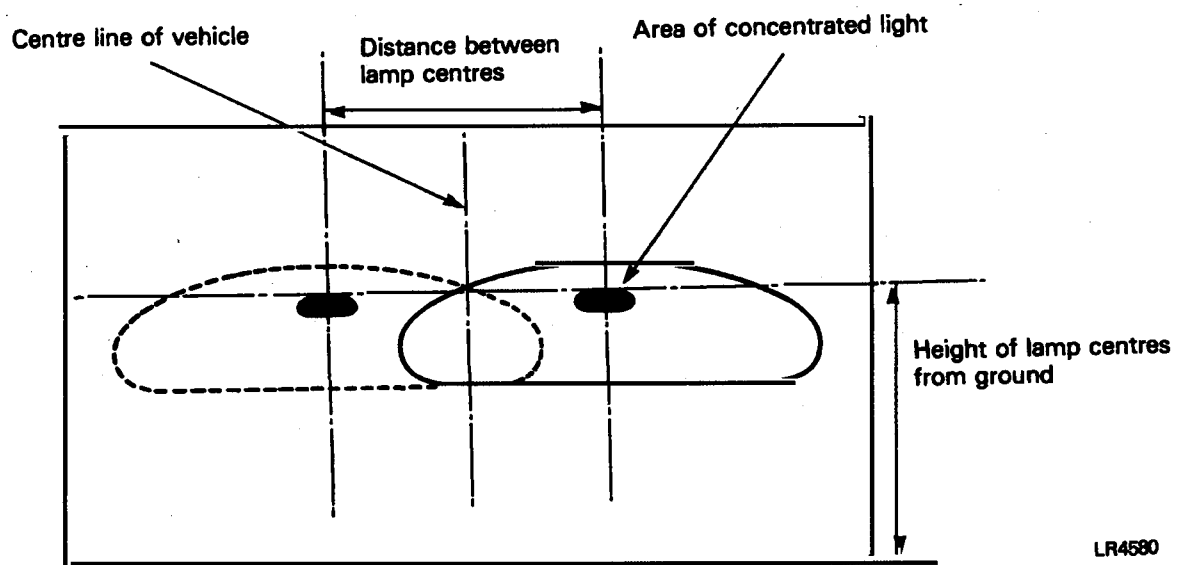
Headlamp Alignment

139 As previously stated, the headlamps can only be fully efficient when correctly aligned.



LR4579M

Fig 29 Beamtester



LR4580

Fig 30 Headlamp Alignment

140 The beam tester (Fig 29) is an instrument designed specifically for the accurate checking and alignment of all types of vehicle headlamps.

In the absence of a beamtester, an alternative but less accurate method of checking the alignment is as follows:

142 Position the vehicle on a piece of level ground 25 ft. from the wall (or door) to be used as a screen. (25 ft. is required in order to obtain a suitable beam pattern).

143 The vehicle must, as far as possible, be at right-angles to the wall (or door).

144 Crosses are marked on the wall (Fig 30) corresponding to the same centres as the headlamps (ie. same distance apart and from the ground). These marks are then used as a guide line for the correct alignment of the main beam.

WIPER MOTOR

Introduction

145 The wiper motor is a two-speed action. The high speed requirements are provided by a second positive brush position to which the supply is connected when the higher speed is required.

146 A further feature of the motor is its dynamic regenerative braking when the wiper switch is moved to the park position. The control for this operation is on the gearbox casting. This motor is a "Self-switching" version.

147 The "Self-switching" unit will stop at the end of its normal wiping arc.

Test equipment

148 Basic test equipment required is:

149 Hydrometer.

150 12 volt supply.

151 Moving coil Ammeter.

Preliminary checks

Visual Inspection

152 Inspect all cables and connections in the wiper system. All connections should be clean and tight.

Battery checks

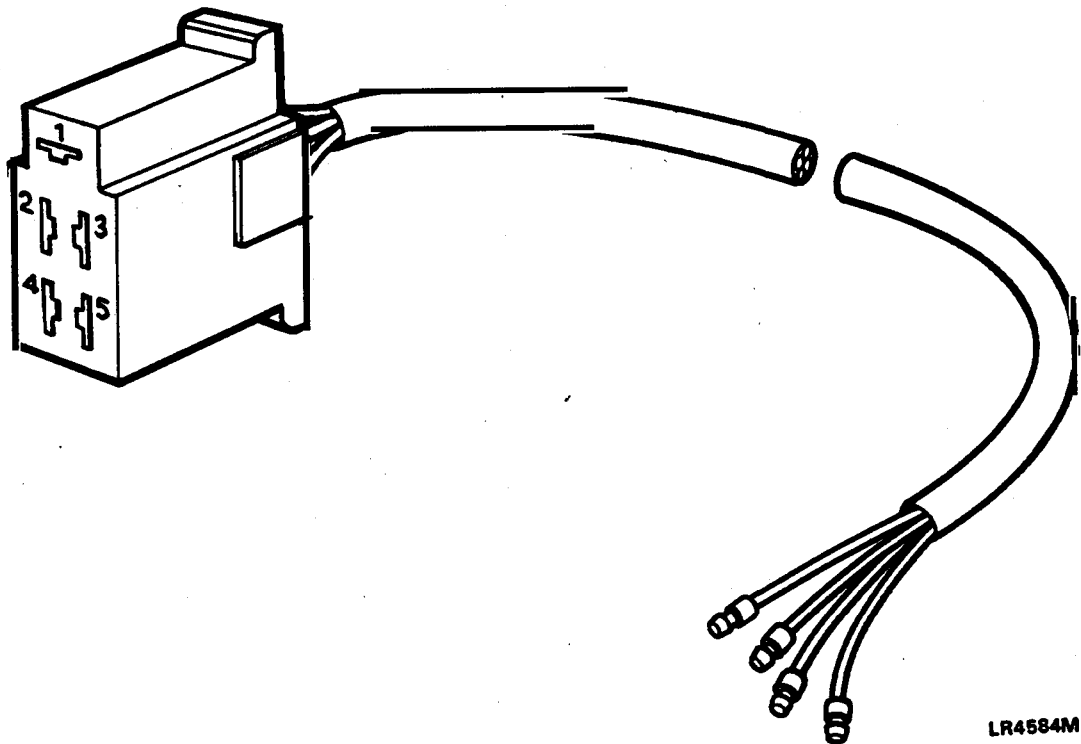
153 Ensure that there is no corrosion or oxidation at the battery, see Paragraph 7 for details.

Note ...

All connections shown in the following tests are for negative (-ve) earth systems.

Wiper motor testing

154 Use a 5 pin wiper motor plug prewired (Fig 31) linking pins 1 & 2 at rear of plug (brown/green lead).



LR4584M

Fig 31 Wiper motor test plug

155 Remove the wiper motor plug on the vehicle and insert the test plug. By connecting a 12V supply, with an ammeter in series, across the various combinations of the test plug leads as shown in the following tests it will be possible to determine:

156 That the motor is operating correctly.

157 The current consumption of the motor (2-4 amperes) is correct.

Test procedure

Note ...

All tests to be carried out with the screen wet.

TABLE 5 WIPER MOTOR SYSTEM

CONNECTIONS		RESULT
BATT. "+"	BATT. "-"	
(1)	(2)	(3)
*Fig 32 Red/Green (RG)	Brown/Green (NG)	Motor should run at normal speed
*Fig 33 Blue/Green (UG)	Brown/Green (NG)	Motor should run at high speed
*Fig 34 Red/Green (RG)	Green (G)	Motors should run park position then stop

* Do not disconnect battery supply from plug while the wiper blades are not in parked position.

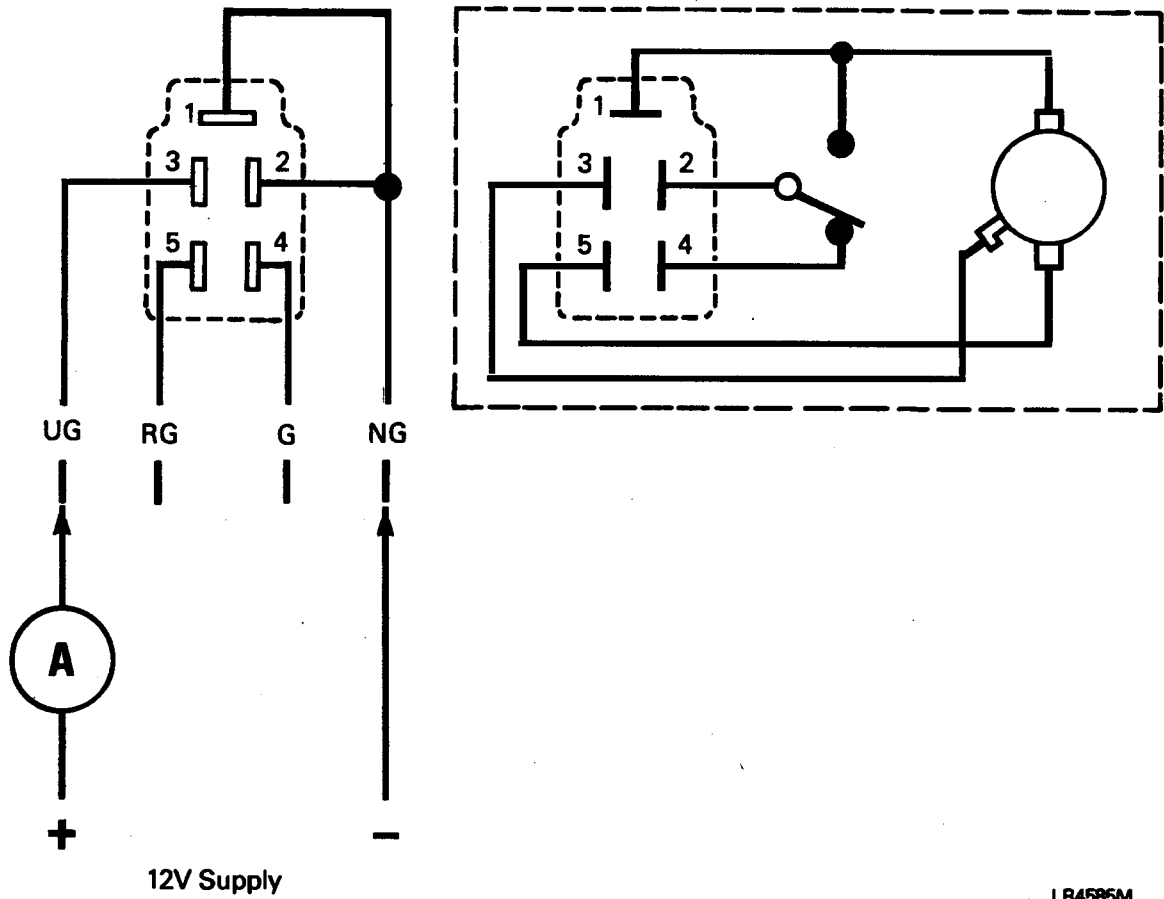


Fig 32 Normal speed

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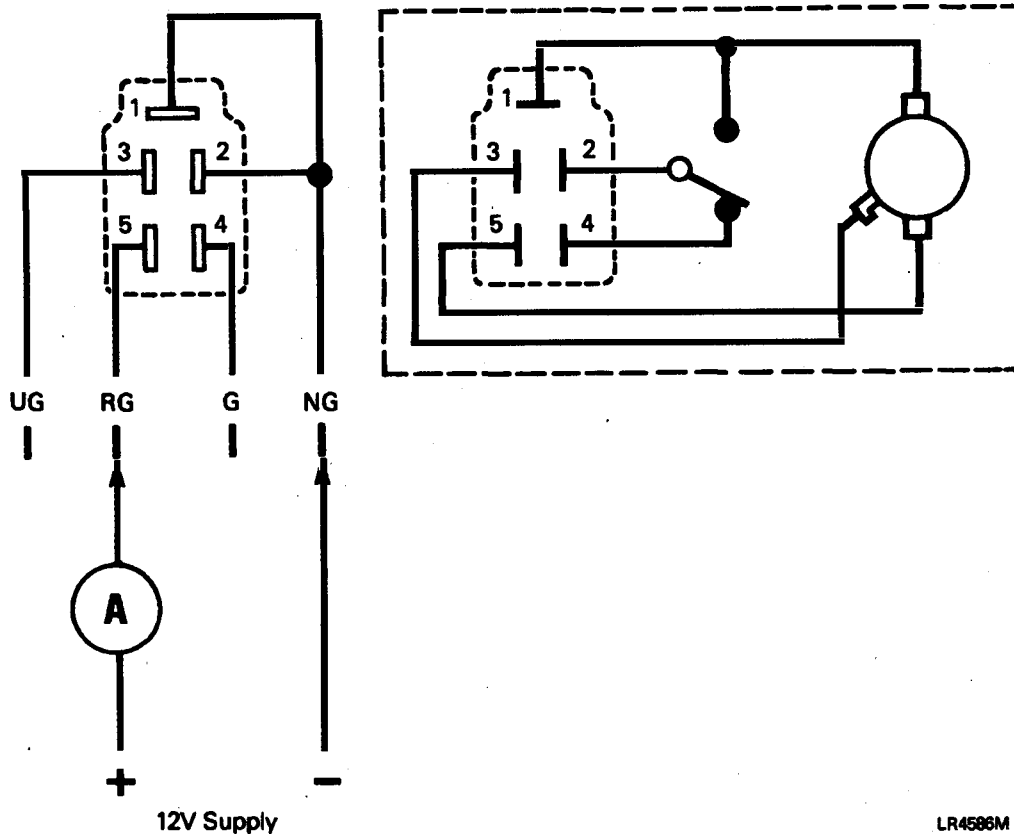


Fig 33 High speed

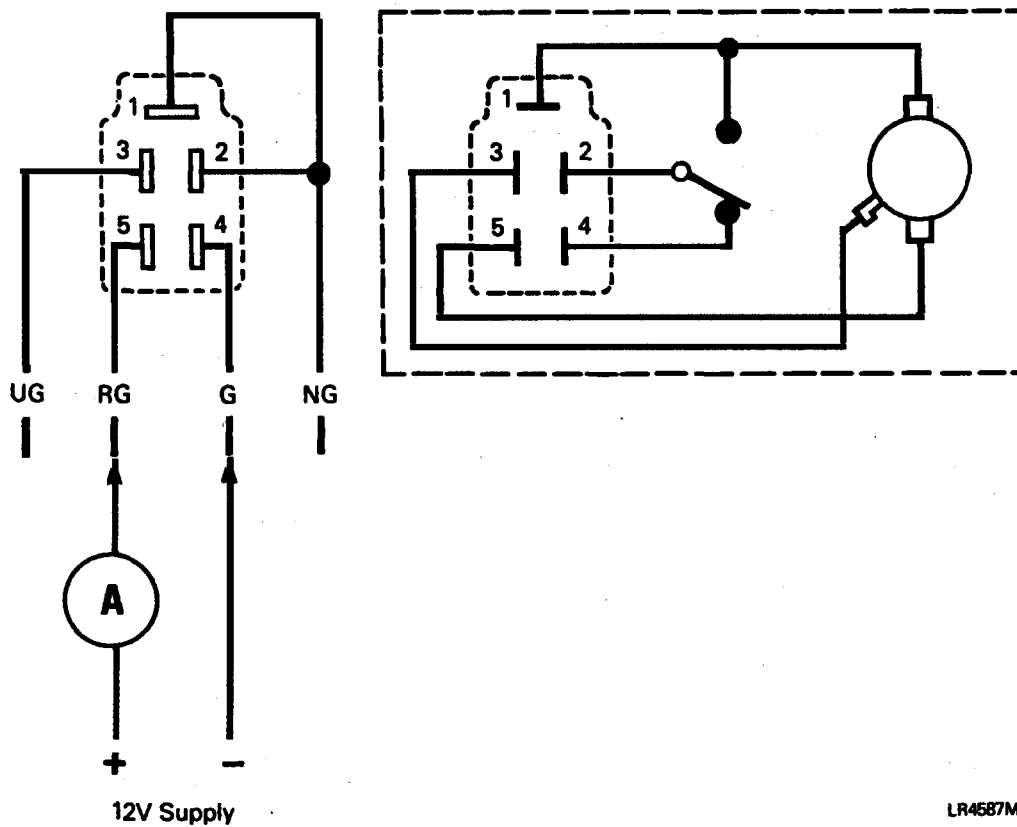


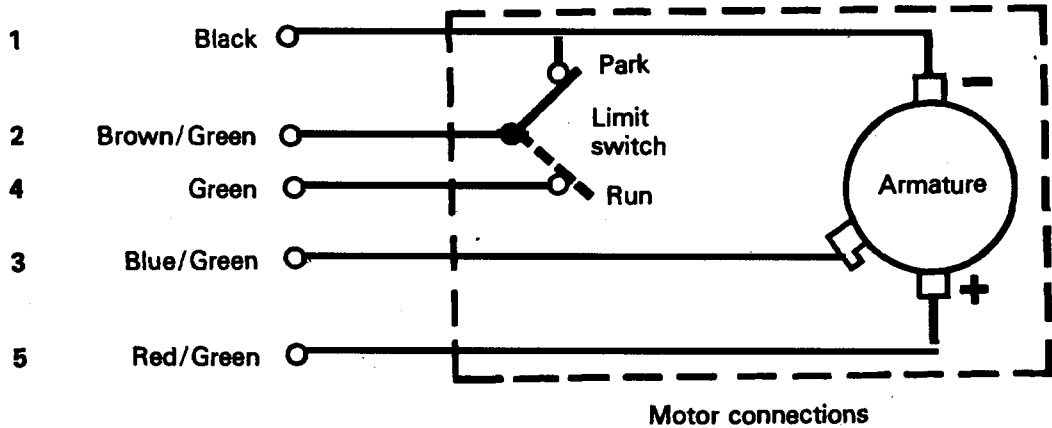
Fig 34 Park position and stop

Additional tests

Note ...

It is most important to observe correct polarity and connections (Fig 35).

Pin No-s typical
5-pin socket assy.



LR4589M

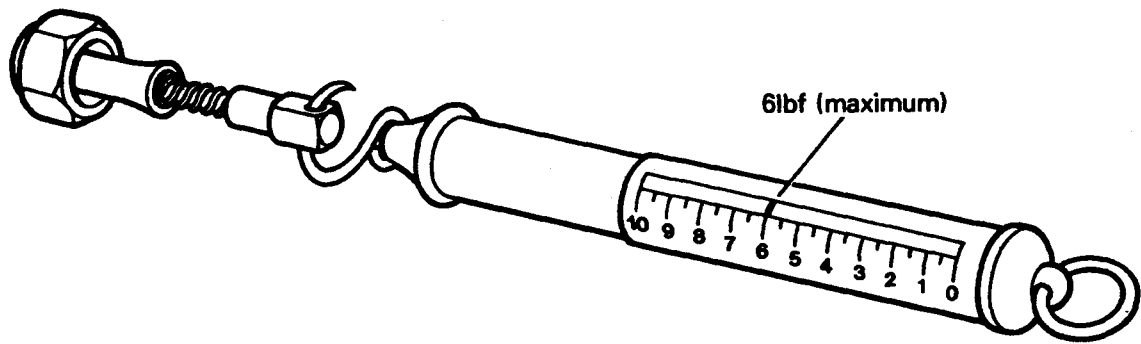
Fig 35 Wiper motor connections

158 If the motor fails to function in any one or more of the previous tests, a faulty motor is indicated. If, however, the motor is satisfactory, the fault lies in the switch or wiring on the vehicle.

159 Should the current consumption during the tests exceed 4 amperes, remove the wiper arms and blades and repeat test. If current is still high this could indicate excessive friction in the rack or link drive mechanism. Disconnect the drive from the motor and again check current consumption. A high current reading now indicates a faulty motor. On the rack-type drive a pull of 6lbf. applied to the crosshead with a spring balance (Fig 36) should be sufficient to move the crosshead within the outer casing. If not, the assembly must be examined for faults.

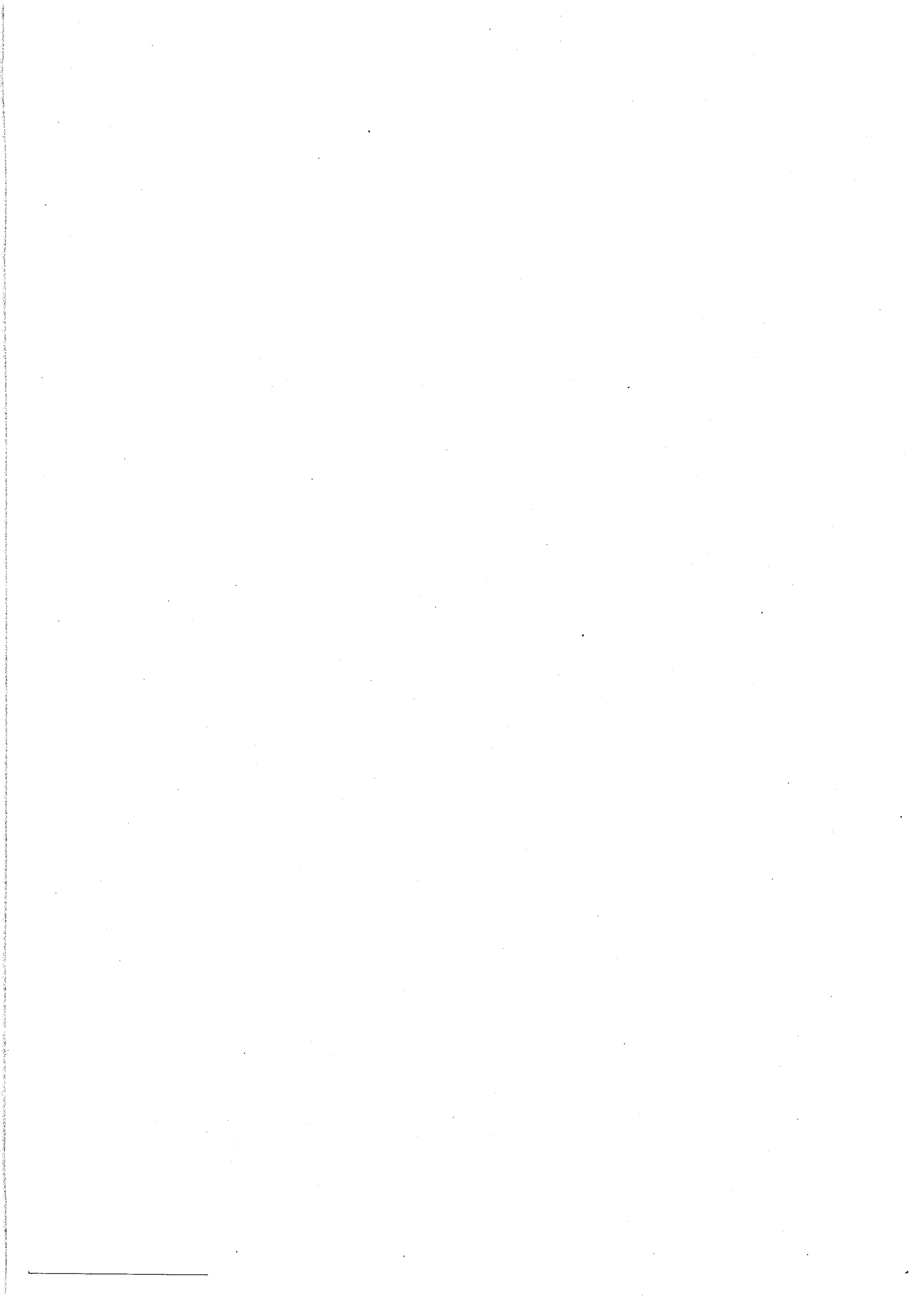
Notes ...

- (1) It should be remembered that where excessive friction exists, overloading will result. Replacing the motor will not solve the problem.
- (2) In cases where removal of the arms and blades lowers the current consumption the fault is due to either a contaminated screen or faulty arms or blades.



LR4590M

Fig 36 Checking wiper motor transmission



Chapter 13-2

24 VOLT ELECTRICAL SYSTEM

CONTENTS

Frame	Para		Page
	1	Introduction	
		Failure diagnosis	
	2	Introduction	
		Alternator	
	7	Introduction	
	8	Test equipment	
	10	Static tests - regulator	
	16	Stator	
	18	Stator volt drop test	
	20	Rotor and field coil	
	25	Testing diodes	
		Testing the alternator	
	29	Test equipment	
	30	Alternator static tests (WARNING)	
	33	Performance testing (WARNING)	
	43	Terminal voltage radio frequency interference measurements	
		Radio circuit	
	48	Fast fuse	
	49	Ammeter	
		Terminal box	
		Radio table and battery box	
		Table	
	1	Test equipment	2
	2	Testing diodes	4
	3	Test equipment	5
	4	Radio circuit	7
		Fig	
	1	Voltage regulator test circuit	3
	2	Alternator test circuit	6

INTRODUCTION

1 This Chapter details the Failure diagnosis for the 24 volt electrical systems fitted to Land Rover 90 and 110 vehicles having 2.5 litre diesel engines. The information given is applicable to both left and right hand vehicles.

FAILURE DIAGNOSIS

Introduction

2 For efficiency and economy, fault diagnosis must be accurate and should also be carried out in the shortest possible time using the minimum amount of equipment. It is the aim of this chapter to present a logical sequence of tests that may be carried out on the various electrical systems of a vehicle whilst the components are still in situ.

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Chapter 13-3

12 VOLT 3.5 L PETROL ELECTRICAL SYSTEM

CONTENTS

Frame	Para		
	1	Introduction	
	Table		Page
	1	Battery will not hold charge	1
	2	Battery not being charged	2
	3	Ignition warning light stays on	2
	4	Ignition warning light will not function	2
	5	Engine will not fire	2
	6	Starter will not operate or cranking speed too low	3
	7	Starter operates but crankshaft stationery	3

INTRODUCTION

1 This Chapter gives the Failure diagnosis for the 12 volt electrical system fitted to the Land Rover 3.5 litre petrol powered 110 and 127 vehicles.

TABLE 1 BATTERY WILL NOT HOLD CHARGE

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Loose or dirty connections preventing battery lead continuity	Tighten, clean or renew battery leads
2	Battery cell specific gravity low	Check battery cell charge state using hydrometer and renew battery if necessary
3	Voltage discharge low	Check voltage discharge with heavy test equipment. Renew battery if reading is less than 9.6 V, otherwise proceed to check No. 4
4	Incorrect intercell voltage	Check intercell voltage and charge or renew battery as necessary

TABLE 2 BATTERY NOT BEING CHARGED

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Battery will not hold charge	Refer to TABLE 1
2	Faulty alternator	Overhaul alternator (Refer to Cat 524 Chap 13-1)

TABLE 3 IGNITION WARNING LIGHT STAYS ON

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Battery will not hold charge	Refer to TABLE 1
2	Alternator drive belt broken or slipping	Adjust or renew alternator drive belt
3	Faulty IND lead	Disconnect IND lead and run engine. Repair or renew if light stays on
4	Faulty alternator	Overhaul alternator (Refer to Cat 524 Chap 13-1)

TABLE 4 IGNITION WARNING LIGHT WILL NOT FUNCTION

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Battery will not hold charge	Refer to TABLE 1
2	Faulty warning light bulb	Replace warning light bulb
3	Faulty alternator plug connections	Check each terminal voltage and repair or renew
4	Faulty alternator	Overhaul alternator (Refer to Cat 524 Chap 13-1)

TABLE 5 ENGINE WILL NOT FIRE

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Engine cranking speed too low	Refer to TABLE 7

(continued)

TABLE 5 ENGINE WILL NOT FIRE (continued)

Ser. no. (1)	Possible cause/fault (2)	Action (3)
2	Faulty/dirty spark plug electrodes or incorrect gaps	Clean, set gaps or renew spark plugs
3	Incorrect ignition timing	Adjust ignition timing (Refer to Cat 522 Chap 13-3 Para 16)
4	Faulty ignition system	Check ignition system (Refer to Cat 522 Chap 13-3 Para 17 to 25)

TABLE 6 STARTER WILL NOT OPERATE OR CRANKING SPEED TOO LOW

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Battery charge state low	Refer to TABLE 1 and 2
2	Dirty starter motor drive spindle and pinion	Remove and clean
3	Faulty starter motor	Overhaul starter motor (Refer to Cat 524 Chap 13-3 Para 14)
4	Faulty ignition system	Check ignition system (Refer to Cat 522 Chap 13-3 Para 17 to 25)

TABLE 7 STARTER OPERATES BUT CRANKSHAFT STATIONERY

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Faulty starter motor solenoid or brushes	Check solenoid and brushes (Refer to cat. 524 Chap 13-3 Para 14)
2	Faulty starter motor drive spindle and pinion	Remove and clean or repair
3	Damaged starter ring gear	Renew starter ring gear
4	Faulty ignition system	Check ignition system (Refer to Cat 522 Chap 13-3 Para 17 to 25)



Chapter 17

ELECTRIC WINCH

CONTENTS

Frame	Para		Page
	1	Introduction	
	2	General	
	Table		
	1	Winch lacks power or will not run at all	1
	2	Winch operates in one direction only	2
	3	Winch brake slipping	2
	4	Winch will not free spool easily	2

INTRODUCTION

1 This Chapter gives the Failure diagnosis for the electric winch fitted to the Land Rover 127 vehicles.

General

2 The information given is applicable to both left and right hand drive vehicles.

TABLE 1 WINCH LACKS POWER OR WILL NOT RUN AT ALL

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Check battery charge state	Recharge or replace battery
2	Check that all connections are tight and free from corrosion	Clean and tighten any loose connections
3	Check that the ground cable from the winch is correctly connected to the battery ground cable	Clean and tighten cable connectors if loose
4	Motor faulty	Inspect motor for damage and repair as necessary

TABLE 2 WINCH OPERATES IN ONE DIRECTION ONLY

Ser no. (1)	Possible cause/fault (2)	Action (3)
1	Check remote lead for continuity	Repair or replace lead

(continued)

TABLE 2. WINCH OPERATES IN ONE DIRECTION ONLY (continued)

Ser no. (1)	Possible cause/fault (2)	Action (3)
2	Loose solenoid mounting bolt causing poor grounding	Check solenoid bolts and tighten to ensure good ground contact
3	Faulty solenoid(s)	Check each solenoid for continuity and correct operation. Renew if faulty

TABLE 3 WINCH BRAKE SLIPPING

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Oil ingress	Remove brake and inspect for evidence of seal failure
2	Worn friction pads	Remove, inspect and renew if necessary

TABLE 4 WINCH WILL NOT FREE SPOOL EASILY

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Brake dragging	Check brake is functioning correctly. Replace any worn or defective parts
2	Winch incorrectly aligned to its mounting plate	Slacken case mounting bolts reposition drum to a position where the drum rotates freely
3	Drum shaft sticking	Clean the bushing and drum shaft, grease lightly and reassemble

Chapter 18-1

WINTERISED HEATING AND VENTILATION SYSTEM

CONTENTS

Frame	Para		
	1	Introduction	
	Table		Page
	1	Internal radiators not hot enough	1/2
	2	Internal radiators producing knocking sounds	1/2

INTRODUCTION

1 This Chapter gives the Failure diagnosis for the winterised heating and ventilation system fitted to the Land Rover 2.5 litre diesel powered 90 and 110 vehicles.

TABLE 1 INTERNAL RADIATORS NOT HOT ENOUGH

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Stop valve in 'off' position	Rotate stop valve to 'on' position
2	Faulty engine radiator thermostat valve	Test and renew if necessary
3	Faulty engine cooling system	Check fan and drive belts, water pump and engine radiator fins for blockage
4	Air in system	Bleed system
5	Low coolant level	Check for leakage, refill and bleed system
6	System blockage	Locate blockage and flush system

TABLE 2 INTERNAL RADIATORS PRODUCING KNOCKING SOUNDS

Ser. no. (1)	Possible cause/fault (2)	Action (3)
1	Air in system	Bleed system
2	Low coolant level	Check for leakage, refill and bleed system

