



Ministry
of Defence

DE&S Secretariat
Defence Equipment & Support
Maple 0a, #2043
MOD Abbey Wood
Bristol BS34 8JH



Email: DESSEC-FOI@mod.uk

Mr Martin Dalton
request-327638-
ab1293b2@whatdotheyknow.com

Please reply to:

Our Reference:
FOI2016/04156
Date:
6th May 2016

Dear Mr Dalton,

Thank you for your email of 11th April 2016 which I can confirm is considered to be a request for information under the Freedom of Information Act (FOIA) 2000. You requested information:

"Can you please provide me with aesp 2320-d-128-522 which will give me the necessary information in order to effect the repairs"

Please find enclosed a copy of the AESP.

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Defence Equipment & Support

Act. Please note that the Information Commissioner will not investigate your case until the MOD internal review process has been completed. Further details of the role and powers of the Information Commissioner can be found on the Commissioner's website, <https://ico.org.uk/>.

Yours sincerely,

Secretariat
Defence Equipment & Support



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TRUCK UTILITY LIGHT (TUL) HS, TRUCK UTILITY MEDIUM (TUM) HS AND (TUM) AMBULANCE HS, ALL VARIANTS

REPAIR INSTRUCTION

This publication contains information covering the requirements of
Categories 5-2 at information levels

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**UNITED KINGDOM MINISTRY OF DEFENCE
AND ARMED FORCES**

By

Operational Support Vehicle Programme (OSVP)

DE&S Abbey Wood
BRISTOL
BS34 8JH

AMENDMENT RECORD

Amdt No.	Incorporated By (Signature)	Date	Amdt No.	Incorporated By (Signature)	Date
1	[REDACTED]	10/11	32		
2	[REDACTED]	10/12	33		
3	-	-	34		
4	[REDACTED]	12/13	35		
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8			39		
9			40		
10			41		
11			42		
12			43		
13			44		
14			45		
15			46		
16			47		
17			48		
18			49		
19			50		
20			51		
21			52		
22			53		
23			54		
24			55		
25			56		
26			57		
27			58		
28			59		
29			60		
30			61		
31			62		

CONTENTS

PRELIMINARY MATERIAL	Page
Front Cover (title page)	(i)/(ii)
Amendment record	(iii)/(iv)
Contents (this list)	(v)
Preface	(vii)
Introduction	(vii)
Equipment identity	(vii)
Related and associated publications	(xi)
Related publications	(xi)
Associated publications	(xii)
Warnings	(xiii/xiv)
Comment(s) on AESP	(F inal leaf)

OPERATING INFORMATION

Chapter

- 1 Engines
 - 1-1 2.5 Litre 300Tdi direct injected diesel engine
 - 1-2 Winter/water
 - 1-3 Tropicalised
- 2 Clutch
 - 3 Five speed manual gearbox
 - 4 LT230T Transfer box and propeller shafts
- 5 Front axle
 - 5-1 Front axle
- 6 Rear axles
 - 6-1 Heavy duty rear axle
 - 6-2 Standard rear axle
- 7 Power assisted steering system
- 8 Suspension
 - 8-1 (TUL) HS (all vehicles) and (TUM) HS (GS only) suspension system
 - 8-2 (TUM) HS (FFR only vehicles) and (TUM) Ambulance HS suspension system
- 9 Wheels and tyres
 - 9-1 Wheels
- 10 Braking system
 - 10-1 Braking system
 - 10-2 Winter/water
- 11 Fuel and exhaust system
 - 11-1 Fuel and exhaust system – Non EEGR
 - 11-2 Electronic exhaust gas recirculation (EEGR)
 - 11-3 Winter/water
 - 11-4 Winterised
- 12 Cooling system
 - 12-1 Cooling system
 - 12-2 Winterised
- 13 Electrical system
 - 13-1 Vehicle electrical system
 - 13-2 Fitted For Radio (FFR)
 - 13-3 Field Ambulance
 - 13-4 Winter/water
 - 13-5 Winterised
 - 13-6 Tropicalised
 - 13-7 Winterised/waterproofed ambulance
 - 13-8 Winterised/waterproofed ambulance

(continued)

CONTENTS (continued)

Chapter

- 14 Not taken up
- 15 Chassis
- 16 Body cab and fittings
 - 16-1 TUL/TUM and FFR
 - 16-2 Field Ambulance
 - 16-3 Winter/water
 - 16-4 Winterised
 - 16-5 Tropicalised
 - 16-6 Helicopter Support Platform
- 17 Electric winch
 - 18 Heating and ventilation
 - 18-1 TUL/TUM Field Ambulance cab
 - 18-2 Field Ambulance rear body
 - 18-3 Winter/water
 - 18-4 Winterised
 - 18-5 Tropicalised

Table

Page

1	Equipment identity	(vii)
---	--------------------------	-------

PREFACE

Sponsor:

OSVP
File ref: D/DGES(A) 548/3/4

Publication

Agency:

OSVP
Project No:ES52c/4356

INTRODUCTION

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

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

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

EQUIPMENT IDENTITY

4 The details are listed in Table 1.

TABLE 1 EQUIPMENT IDENTITY

Serial No	NOMENCLATURE	NSN	ASSET CODE
1.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR)	2310-99-893-9746	NB 1047 3100
2.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2310-99-893-9971	NB 1047 3101
3.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) with Medical Monitoring IK	2310-99-908-6496	NB 1047 3102
4.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR with Bowman NH	2310-99-908-6890	NB 1047 3160
5.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2310-99-908-6891	NB 1047 3161
6.	Ambulance Battlefield (HS) 4 Stretcher LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2310-99-893-9970	NB 1047 8100
7.	Ambulance Battlefield (HS) 4 Stretcher LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2310-99-908-6892	NB 1047 8160
8.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) Semi Water (Proofed for 600mm Depth)	2310-99-908-5445	NB 1048 3100
9.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) Semi Water (Proofed for 600mm Depth) with Bowman NH	2310-99-908-6893	NB 1048 3160
10.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR)Tropical	2310-99-908-5446	NB 1049 3100
11.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR)Tropical with Medical Monitoring IK	2310-99-908-6497	NB 1049 3101

continued

TABLE 1 EQUIPMENT IDENTITY (Continued)

12.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR)Tropical with Medical Monitoring IK	2310-99-908-6550	NB 1049 3102
13.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR) Desert with Medical Monitoring IK	2310-99-908-6705	NB 1049 3103
14.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) Desert with Medical Monitoring IK	2310-99-908-6706	NB 1049 3104
15.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR)Tropical with Bowman NH	2310-99-908-6894	NB 1049 3160
16.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (EEGR)Tropical with Bowman NH & Medical Monitoring IK	2310-99-908-6895	NB 1049 3161
17.	Ambulance Battlefield (HS) 4 Stretcher RHD 4x4 Land Rover 2.5 Tdi (Non EEGR)Tropical With Bowman NH & Medical Monitoring IK	2310-99-908-6896	NB 1049 3162
18.	Truck Utility Light (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water	2320-99-893-9933	NB 4219 3100
19.	Truck Utility Light (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9741	NB 4220 3100
20.	Truck Utility Light (HS) GS (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9964	NB4220 8100
21.	Truck Utility Light (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9934	NB4223 3100
22.	Truck Utility Light (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter	2320-99-908-5441	RB 4224 3100
23.	Truck Utility Light (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9742	NB 4225 3100
24.	Truck Utility Light (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9965	NB 4225 8100
25.	Truck Utility Light (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water	2320-99-893-9935	NB 4226 3100
26.	Truck Utility Light (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9936	NB 4228 3100
27.	Truck Utility Light (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Air Dropable	2320-99-908-5442	NB 4232 3100
28.	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Heli Support	2320-99-908-5449	RB 5006 3100
29.	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Talon Support Vehicle	2320-99-908-6885	NB 5007 3100
30.	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water	2320-99-893-9938	NB 5008 3100
31.	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water with Bowman NH	2320-99-908-7023	NB 5008 3160
32.	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water	2320-99-893-9939	NB 5009 3100
33.	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water with Bowman NH	2320-99-908-6924	NB 5009 3160
34.	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water with Bowman SH	2320-99-908-7024	NB 5009 3170
35.	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (Non EEGR)	2320-99-893-9743	NB 5010 3100
36.	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9963	NB 5010 3101
37.	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2320-99-908-6902	NB 5010 3160
38.	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) with Bowman NH	2320-99-908-6904	NB 5010 3161
39.	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman SH	2320-99-908-6903	NB 5010 3170

continued

TABLE 1 EQUIPMENT IDENTITY (Continued)

40.	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) with BOWMAN SH	2320-99-908-6905	NB 5010 3171
41.	Truck Utility Medium (HS) GS (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (Non EEGR) Trial Vehicle	2320-99-908-5511	NB 5010 3199
42.	Truck Utility Medium (HS) GS (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9966	NB 5010 8100
43.	Truck Utility Medium (HS) GS (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2320-99-908-6906	NB 5010 8160
44.	Truck Utility Medium (HS) GS (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman SH	2320-99-908-6907	NB 5010 8170
45.	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9940	NB 5017 3100
46.	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) With Bowman NH	2320-99-908-6910	NB 5017 3160
47.	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) With Bowman FF LAS	2320-99-908-6925	NB 5017 3190
48.	Truck Utility Medium (HS) GS (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9967	NB 5017 8100
49.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9744	NB 5020 3100
50.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with ODETTE DF IK	2320-99-908-5944	NB 5020 3101
51.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with ODETTE IC IK	2320-99-908-5945	NB 5020 3102
52.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with ODETTE TCAD IK	2320-99-908-5946	NB 5020 3103
53.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with WILDCAT IK	2320-99-908-6066	NB 5020 3104
54.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with SPICE IK	2320-99-908-6417	NB 5020 3107
55.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2320-99-908-6913	NB 5020 3160
56.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with ODETTE DF IK & BOWMAN NH	2320-99-908-6915	NB 5020 3161
57.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman SH	2320-99-908-6914	NB 5020 3170
58.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with BOWMAN BF LAS	2320-99-908-6911	NB 5020 3180
59.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with BOWMAN FF LAS	2320-99-908-6912	NB 5020 3190
60.	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9968	NB 5020 8100
61.	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with ODETTE DF IK	2320-99-908-5947	NB 5020 8101
62.	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with ODETTE IC IK	2320-99-908-5948	NB 5020 8102
63.	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with ODETTE TCAD IK	2320-99-908-5949	NB 5020 8103
64.	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with NBC Support	2320-99-908-6492	NB 5020 8104
65.	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2320-99-908-6918	NB 5020 8160
66.	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman SH	2320-99-908-6919	NB 5020 8170
67.	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman BF LAS	2320-99-908-6916	NB 5020 8180

continued

TABLE 1 EQUIPMENT IDENTITY (Continued)

68.	Truck Utility Medium (HS) FFR (Hard Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman FF LAS	2320-99-908-6917	NB 5020 8190
69.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water	2320-99-893-9941	NB 5021 3100
70.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter Water with Bowman NH	2320-99-908-6926	NB 5021 3160
71.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water with Bowman SH	2320-99-908-6927	NB 5021 3170
72.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water with Bowman BF LAS	2320-99-908-6928	NB 5021 3180
73.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter / Water with Bowman FF LAS	2320-99-908-6920	NB 5021 3190
74.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Commanders IK	2320-99-908-5720	NB 5022 3100
75.	Truck Utility Medium (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9745	NB 5031 3100
76.	Truck Utility Medium (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman NH	2320-99-908-6922	NB 5031 3160
77.	Truck Utility Medium (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman SH	2320-99-908-6923	NB 5031 3170
78.	Truck Utility Medium (HS) FFR (Soft Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) with BF LAS	2320-99-908-6921	NB 5031 3180
79.	Truck Utility Medium (HS) FFR (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR)	2320-99-893-9969	NB 5031 8100
80.	Truck Utility Medium (HS) FFR (Soft Top) LHD 4x4 Land Rover 2.5 Tdi (EEGR) with Bowman SH	2320-99-908-7025	NB 5031 8160
81.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) (SIGS)	2320-99-908-5272	NB 5035 3100
82.	Truck Utility Medium (HS) GS (S/Wagon) RHD 4x4 Land Rover 2.5 Tdi (EEGR) 110 Media Operations Support Vehicle	2320-99-908-6976	NB 5040 3100
83.	Truck Utility Medium (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) 130 Media Operations Base Vehicle	2320-99-908-6948	NB 5041 3100
84.	Truck Utility Medium 130 (HS) GS (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) 130 Defence Monitoring System	2320-99-908-7384	NB 5041 3101
85.	Truck Utility Medium (HS) FFR (Hard Top) RHD 4x4 Land Rover 2.5 Tdi (EEGR) Winter Heli Support vehicle	2320-99-908-5450	RB 5042 3100
86.	Truck Utility Medium (HS) FFR 4X4 Land Rover 2.5 Tdi W/EEGR Scout	2320-99-908-7633	NB 5033 3100
87.	Truck Utility Medium (HS) FFR 4X4 Land Rover 2.5 Tdi W/EEGR Scout Bowman NH	2320-99-908-7635	NB 5033 3160
88.	Truck Utility Medium (HS) FFR 4X4 Land Rover 2.5 Tdi W/EEGR Scout Bowman SH	2320-99-908-7636	NB 5033 3170
89.	Truck Utility Medium (HS) FFR 4X4 LHD Land Rover 2.5 Tdi W/EEGR Scout	2320-99-908-7634	NB 5033 8100
90.	Truck Utility Medium (HS) 4X4 Land Rover WMIK Trainer (TWMIK)	2320-99-908-7710	NB 5034 3100
91.	Truck Utility Medium (HS) FFR 4X4 (Soft Top) Land Rover 2.5 Tdi W/EEGR TETHYS IK	2320-99-490-5237	NB 5037 3100
92.	Truck Utility Medium (HS) 4X4 GS (Hard Top) Land Rover 130 2.5 Tdi Double Cab Pick Up (DCPU)	2320-99-908-7750	NB 5045 3100
93.	Truck Utility Medium (HS) 4X4 GS (Soft Top) Land Rover 130 2.5 Tdi Double Cab Pick Up (DCPU)	2320-99-908-7876	NB 5046 3100

5 Manufacturer:

5.1 Land Rover, Solihull, England

RELATED AND ASSOCIATED PUBLICATIONS

Related publications

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

Category/Sub category		Information Level			
		1 User/ Operator	2 Unit Maintenance	3 Field Maintenance	4 Base Maintenance
0	Purpose and Planning information	101	*	*	*
1	Equipment Support Policy directives	111	*	*	*
0	Operating Information	201	*	*	*
2	Aide Memoire	*	*	*	*
2	Training Aids	*	*	*	*
3	Technical Description	201	302	**	
4	Installation Instruction	*	*	*	*
2	Preparation for Special Environments	*	*	*	*
1	Failure Diagnosis	*	512	512	*
5	Repair instructions	*	522	523	524
3	Inspection Standards	*	532	532	533
4	Calibration Procedures	*	*	*	*
6	Maintenance Schedules	601	*	*	*
1	Illustrated Parts Catalogue	711	*	*	*
2	Commercial Parts Lists	721	*	*	*
7	Complete Equipment Schedule Production	731 *		*	*
4	Complete Equipment Schedule Service Edition (Simple Equipment)	741 *		*	*
5	Complete Equipment Schedule Service Edition (Complex Equipment)	751 *		*	*
1	Modification Instructions	*	*	*	*
8	General Instructions, Special Technical Instructions and Servicing Instructions	*	*	*	*
3	Service Engineered modification Instructions (RAF only)	**		*	*

* Category/Sub category not published

Associated publications

7 References Title

JSP 341

Road Transport Regulations

AP 3260 Book 1

Mechanical Transport Maintenance Regulations for the
Royal Air Force

AESP 2610-A-409 Octad

Pneumatic tyres, tubes, associated roadwheels

WARNINGS

- (1) HAZARDOUS SUBSTANCES. BEFORE USING ANY HAZARDOUS SUBSTANCE OR MATERIAL, THE USER MUST BE CONVERSANT WITH THE SAFETY PRECAUTIONS AND FIRST AID INSTRUCTIONS DETAILED ON ITS CONTAINER, THE RELEVANT SAFETY DATA SHEET AND IN LOCAL SAFETY ORDERS AND REGULATIONS.**
- (2) VENTILATION. EXHAUST FUMES ARE HIGHLY TOXIC. WHEN UNDERTAKING REPAIR OPERATIONS THAT REQUIRE THE ENGINE TO BE RUN, ALWAYS ENSURE THAT EXHAUST EXTRACTION EQUIPMENT IS USED, OR THAT THE WORK AREA HAS ADEQUATE VENTILATION.**
- (3) WORKING UNDER A VEHICLE. WHEN WORKING ON A VEHICLE THAT IS JACKED UP, ALWAYS ENSURE THAT IT IS ADEQUATELY SUPPORTED BY AXLE STANDS OR BLOCKS. NEVER VENTURE UNDER A VEHICLE THAT IS SOLEY SUPPORTED BY JACKS.**

COMMENT(S) ON AESP*

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794

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AESP Form 10 (Issue 5 dated Feb 01)

CHAPTER 1

ENGINES

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

1 This chapter details the Unit repair of the engine systems as fitted to Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles.

General

2 This chapter has been sub-chaptered to allow for the various types of vehicle engines as detailed below.

- 2.1 Chapter 1-1 Engine.
- 2.2 Chapter 1-2 Winter/water.
- 2.3 Chapter 1-3 Tropicalised

CHAPTER 1-1

2.5 LITRE 300TDI DIRECT INJECTED DIESEL ENGINE

CONTENTS

Para	
1	Introduction Engine Torque list Engine mounting brackets
2	Removal
3	Refitting
	CYLINDER HEAD ASSEMBLY
4	Preparation for removal (CAUTION)
5	Removal Dismantling
6	Cylinder head
7	Rocker shaft assembly
8	Cleaning Examination
9	Cylinder head (CAUTION)
10	Rocker shaft assembly
11	Valves and valve springs
12	Push rods Repairs and replacement
13	Refacing cylinder head valve seat inserts
14	Reface valve seats
15	Lap-in valves
16	Rocker lever bushes Reassembly
17	Rocker shaft assembly
18	Valves to cylinder head
19	Cylinder head assembly to cylinder block (CAUTION)
20	Valve clearances (WARNING)
21	Rocker cover
22	Manifolds
23	Thermostat housing
24	Heater plugs
25	Fuel injectors
26	Crankcase ventilator
27	Reconnection of parts disturbed
28	Cooling and lubrication system (CAUTIONS) Drive belt and pulleys
29	Removal
30	Refitting Oil sump
31	Removal
32	Refitting Oil pump pressure relief valve
33	Removal
34	Refitting

(continued)

CONTENTS (continued)

Para

	OIL COOLER
35	Removal
36	Refitting
	OIL FILTER HEAD
37	Removal
38	Refitting
	OIL TEMPERATURE CONTROL VALVE
39	Removal
40	Refitting
	OIL DRAIN PIPE TO BLOCK
41	Removal
42	Refitting
	ENGINE BREATHER SIDE COVER
43	Removal
44	Refitting

Table

Page

1	Special tools	3
2	Sealants, adhesives and lubricants	3
3	Gasket thicknesses	16

Fig

1	Engine mountings	4
2	Disconnection points prior to cylinder head removal	6
3	Heater plug removal	8
4	Exploded view of cylinder head	11
5	Cross-section through rocker lever	14
6	Rocker shaft assembly	15
7	Valve assemblies	16
8	Piston protrusion for gasket selection	17
9	Bolt locations and tightening sequence for cylinder head	18
10	Torque tightening cylinder head bolts, degree disc	19
11	Tappet clearances	20
12	Drive belt and pulley location	22
13	Oil cooler and hoses	24
14	Oil temperature control valve and filter head	26

INTRODUCTION

1 This chapter details the Unit repairs for Truck Utility Light (HS), Truck Utility Medium (HS), and Field Ambulance (HS) vehicles with 2.5 Litre 300 Tdi direct injected turbocharged diesel engines.

ENGINE

TORQUE LIST

Cylinder head bolts	40 Nm/29 lbf ft
Rocker shaft retaining nuts and bolts	25 Nm/18 lbf ft
Tappet adjusting screw locknut	16 Nm/12 lbf ft
Rocker cover nuts	10 Nm/7 lbf ft
Inlet manifold nuts and bolts	25 Nm/18 lbf ft
Exhaust manifold nuts	45 Nm/ lbf ft
Thermostat housing to cylinder head	25 Nm/18 lbf ft
Heater plugs 20	Nm/15 lbf ft
Crankcase ventilator 9	Nm/7 lbf ft
Crankshaft pulley bolt	80 Nm/59 lbf ft +90°
Fan pulley to adaptor on timing cover	25 Nm/18 lbf ft
Auto tensioner to mounting bracket	45 Nm/33 lbf ft
Sump securing bolts	25 Nm/ lbf ft
Sump drain plug	35 Nm/26 lbf ft
Oil filter head 45	Nm/33 lbf ft
Oil temperature control valve	9 Nm/7 lbf ft
Oil drain pipe to cylinder block	25 Nm/18 lbf ft
Fuel injection pump support bracket to cylinder block	25 Nm/18 lbf ft

NOTE

The special tools listed in the following table will be referred to in the text, where used, by the serial number shown in the table.

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	LRT-12-501	6MT2/5120-99-726-2735	Handle set - valve seat cutter
2	LRT-12-505	6MT2/5120-99-808-5919	Valve seat cutter - Inlet
3	LRT-12-007	6MT2/5120-99-301-4247	Cylinder head bolt degree plate
4	LRT-12-080	6MT2/5120-99-662-7366	Crankshaft pulley retainer

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	OX90	9510-99-361-7232	Engine oil
2	RTV	8030-99-224-6527	Black sealant

ENGINE MOUNTING BRACKETS**Removal**

- 2 To remove the engine mounting brackets proceed as follows:
 - 2.1 Using a suitable hoist, fit chains to lifting brackets, and support engine.
 - 2.2 Remove the fixings securing the front engine mountings (Fig 1 (1)) to the chassis (2).
 - 2.3 Remove the fixings securing the mountings to the engine.
 - 2.4 Remove the mountings.

Refitting

- 3 To refit the mounting brackets is the reverse of the removal procedure.

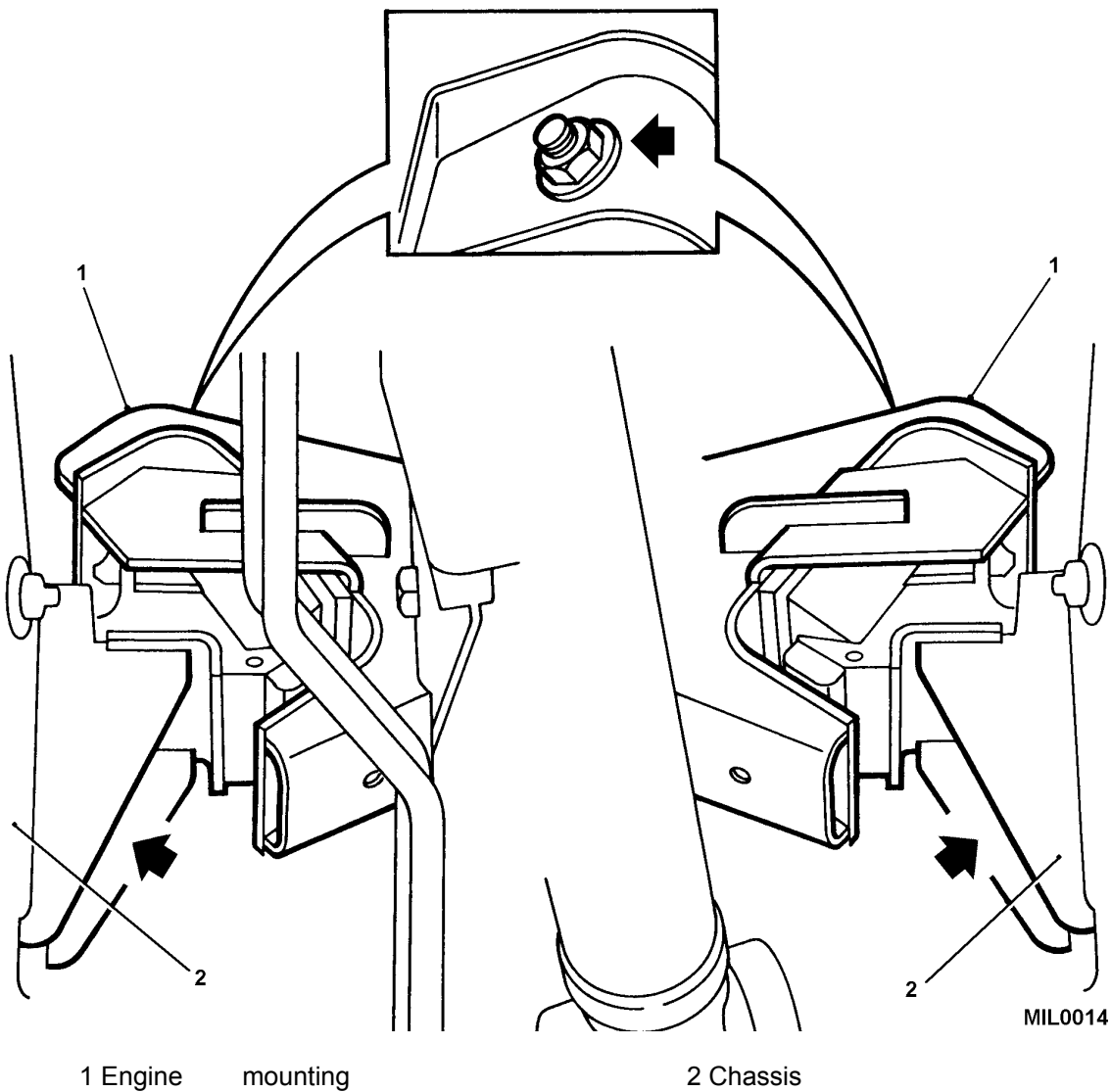


Fig 1 Engine Mountings

CYLINDER HEAD ASSEMBLY

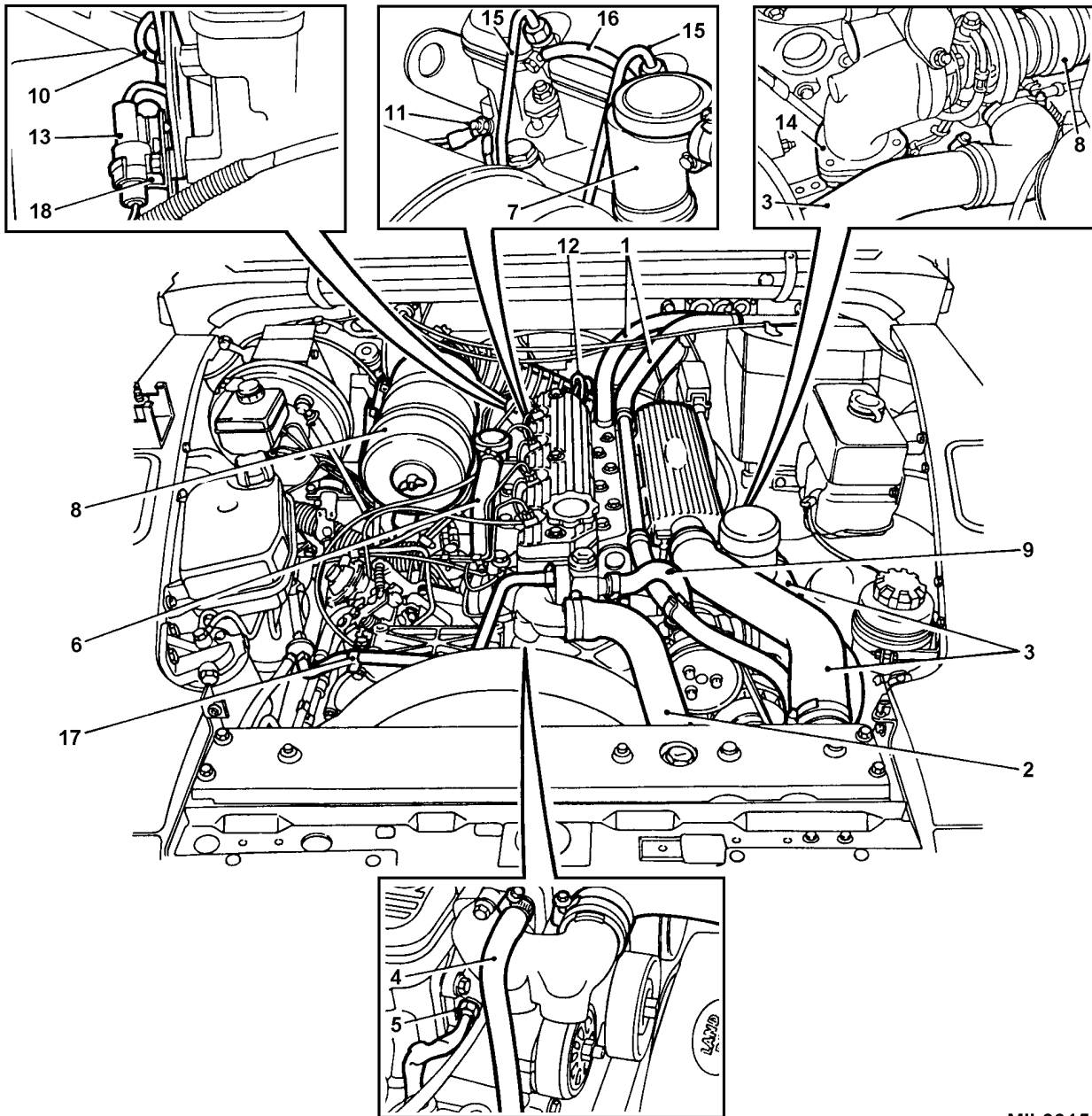
PREPARATION FOR REMOVAL

4 Before the cylinder head can be removed the following ancillary items must be removed for access and safety:

- 4.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted for Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 4.2 Disconnect the earth bonding straps and remove the bonnet (refer to Chap 16).
- 4.3 On FFR vehicles remove the 50 amp alternator (refer to Chap 13-2).
- 4.4 Drain the cooling system (refer to Chap 12-1).
- 4.5 Remove the air cleaner assembly including hoses (Fig 2 (8)) (refer to Chap 11-1).
- 4.6 Detach the cylinder block ventilation valve (7) and the breather hose (6) from the rocker cover.

CAUTION

INJECTORS. The injectors and heater plugs protrude below the combustion face of the cylinder head. It is important that they are removed before the removal of the cylinder head to avoid the possibility of damage to them.



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- | | |
|------------------------------------|---|
| 1 Heater hoses | 10 Brackets-transmission breather pipes |
| 2 Radiator top hose | 11 Heater plug connection |
| 3 Intercooler hoses | 12 Breather pipes |
| 4 Expansion tank pipe | 13 Multi-plug |
| 5 Coolant temperature sensor | 14 Exhaust down pipe |
| 6 Cylinder block breather hose | 15 Fuel injector pipes |
| 7 Cylinder block ventilation valve | 16 Spill rail |
| 8 Air cleaner | 17 Bracket-vent hose |
| 9 By-pass hose | 18 Harness clips |

Fig 2 Disconnection points prior to cylinder head removal

- 4.7 Remove fuel injection pipes (15) (refer to Chap 11-1).
- 4.8 Disconnect spill rail (16) from fuel injectors (refer to Chap 11-1).
- 4.9 Remove fuel injectors and sealing washers. Identify each injector to the location from which it is removed (refer to Chap 11-1).
- 4.10 Remove the inter-connecting harness wiring (Fig 3 (1)) from the heater plugs.
- 4.11 Remove the heater plugs (2) (refer to Cat 11-1).
- 4.12 Remove the radiator top hose (Fig 2 (2)).
- 4.13 Disconnect the by-pass hose (9) from the thermostat.
- 4.14 Disconnect the expansion tank hose (4).
- 4.15 Disconnect the coolant temperature sensor lead (5).
- 4.16 Remove the inter-cooler to induction manifold hose (3) (refer to Cat 11-1).
- 4.17 Remove the induction manifold rear heat shield and slacken induction manifold lower securing nuts (refer to Cat 11-1).
- 4.18 Remove upper securing bolts and withdraw induction manifold (refer to Cat 11-1).
- 4.19 Undo the three nuts to release the down pipe from the exhaust manifold and remove the turbo-charger assembly (refer to Chap 11-1).
- 4.20 Disconnect heater hose (1) from heater rail and remove heater rail hose from its retaining clip at the water pump.
- 4.21 Move heater rail aside.
- 4.22 Disconnect heater hose (1) from rear of cylinder head.
- 4.23 Remove bolt securing air cleaner mounting bracket to support strut.
- 4.24 Remove bolt securing harness bracket to cylinder head.
- 4.25 Remove rear lifting bracket to release engine and transmission breather pipe bracket (10) and multi-plug (13).

REMOVAL

- 5 The cylinder head assembly removal procedure is as follows:
 - 5.1 Remove the rocker cover (Fig 4 (1)).
 - 5.2 Slacken the tappet adjusting screw locknuts (31) and turn the screws (32) to release them from the push rods (24).
 - 5.3 Remove the rocker shaft retaining nuts (33) and bolts (35), withdraw the rocker shaft assembly.

NOTE

To prevent the rocker shaft assembly from falling apart, prior to dismantling, insert a suitable bolt through each of the rocker retaining end blocks (25) and its corresponding hole in the shaft and secure with nuts.

- 5.4 Withdraw the push rods and identify them as to the locations from which they were removed.
- 5.5 Remove the valve stem caps (19).
- 5.6 Evenly slacken, then remove the cylinder head retaining bolts (41)(42)(58), in the reverse order to the tightening sequence (refer to Fig 9), two of which also secure the air cleaner mounting bracket.
- 5.7 Remove cylinder head (Fig 4 (10)) and discard the gasket (11).

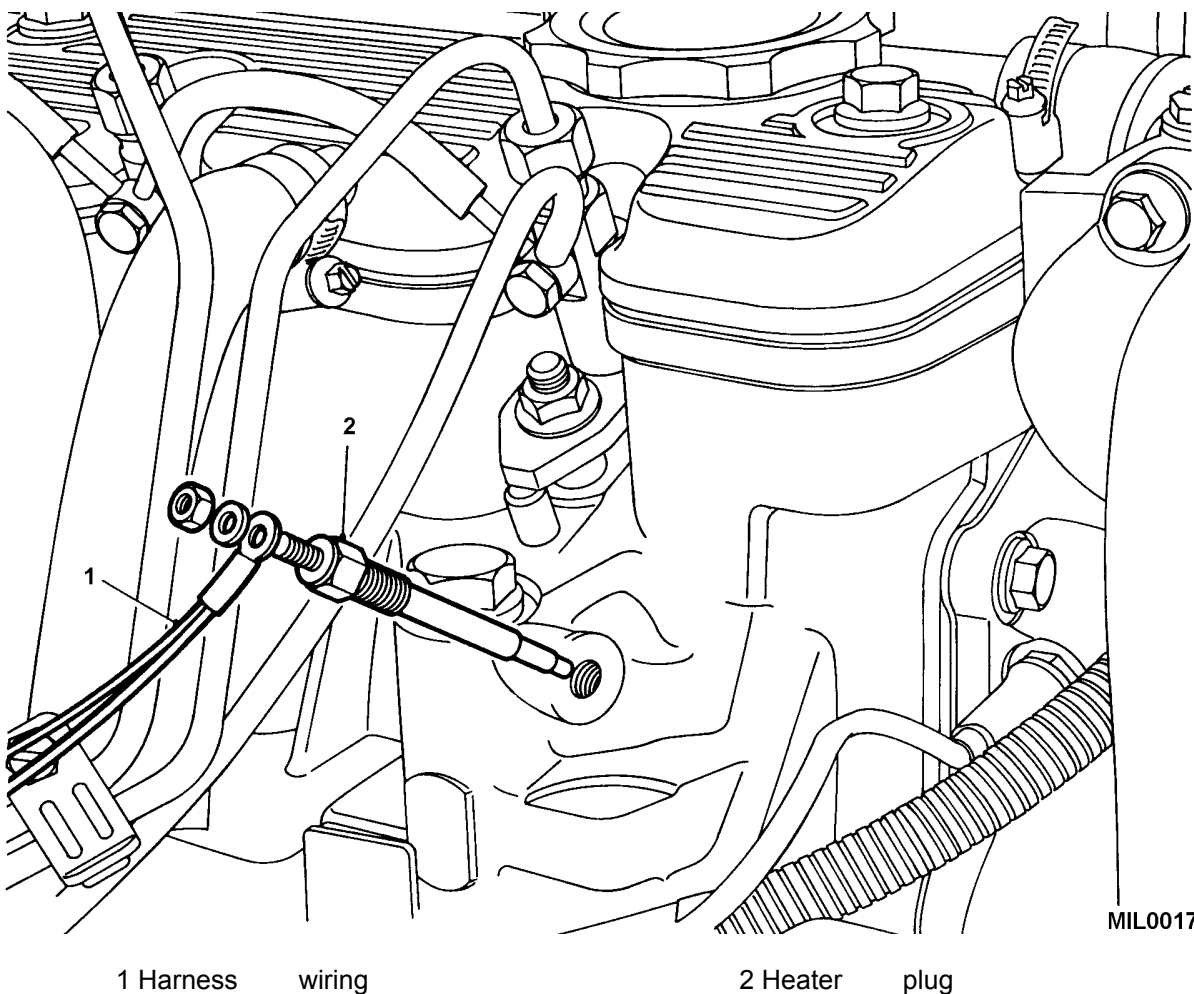


Fig 3 Heater plug removal

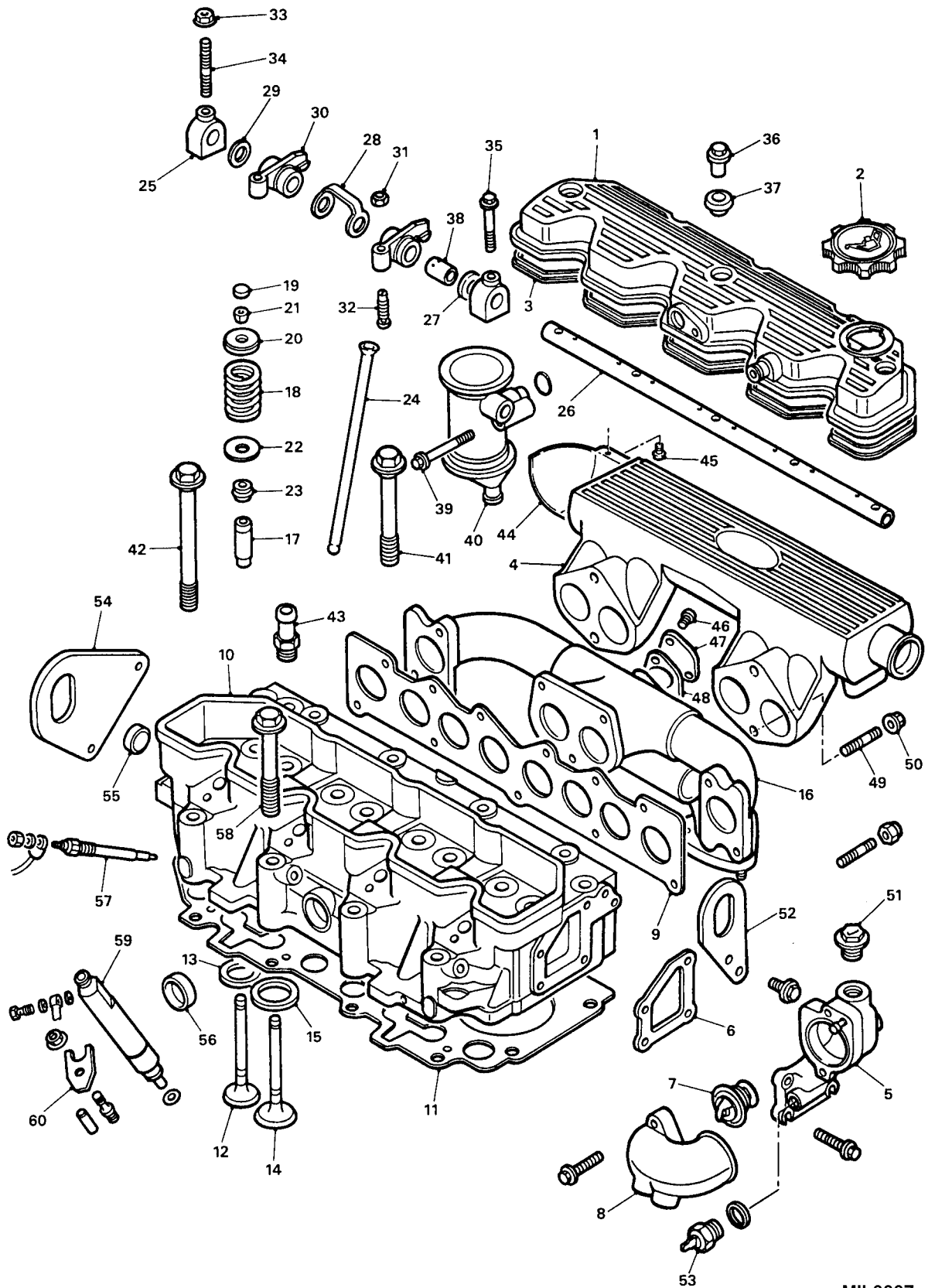
DISMANTLING**Cylinder head**

- 6 To dismantle the cylinder head (10) carry out the following:
 - 6.1 Remove the thermostat housing (5) complete with gasket (6).

- 6.2 Remove the front engine lifting bracket (52).
- 6.3 Using a valve spring compressor, remove the valves (12)(14) and spring assemblies, keeping them identified with their original locations.
- 6.4 Discard the oil seals (13)(15).

KEY TO FIG 4

1	Rocker cover	31	Locknut
2	Oil filler cap	32	Adjusting screw
3	Gasket-rocker cover	33	Retaining nut
4	Inlet manifold	34	Stud
5	Thermostat housing	35	Retaining bolt
6	Gasket	36	Cover nut
7	Thermostat	37	Cover nut sealing washer
8	Heater hose adapter	38	Rocker lever bush
9	Manifold gasket	39	Bolt
10	Cylinder head	40	Oil separator
11	Cylinder head gasket	41	Cylinder head bolt
12	Exhaust valve	42	Cylinder head bolt (long)
13	Exhaust valve seat	43	Heater hose adapter
14	Inlet valve	44	Heat shield
15	Inlet valve seat	45	Heat shield bolt
16	Exhaust manifold	46	Set screw
17	Valve guide	47	Blanking plate
18	Valve spring	48	Gasket
19	Valve cap	49	Manifold stud
20	Valve spring retainer	50	Nut
21	Split collets	51	Thermostat housing plug
22	Spring protection washer	52	Lifting eye (front)
23	Oil seal- valve guide	53	Temperature sensor
24	Push rod	54	Lifting eye (rear)
25	Rocker retaining block	55	Blanking plug (rear)
26	Rocker shaft	56	Blanking plug (side)
27	Spacer	57	Heater plug
28	Spring	58	Cylinder head bolt (short)
29	Spacer	59	Fuel injector
30	Rocker lever	60	Fuel injector clamp plate



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Fig 4 Exploded view of cylinder head

Rocker shaft assembly

7 To dismantle the rocker shaft assembly proceed as follows:

7.1 Withdraw all components from the shaft (Fig 4 (26)) and lay them out on a suitable work surface in the same order as removed.

7.2 Remove the adjusting screws (32) and locknuts (31) from the rockers (30).

Cleaning

8 Remove all carbon deposits from the valves and combustion chambers, degrease all components ready for examination. If scaling is apparent in the cylinder head water passages, remove using a descaling solution in accordance with the manufacturers instructions.

EXAMINATION

Cylinder head

9 The cylinder head should be thoroughly inspected for cracks before repair work is carried out.

CAUTION

CYLINDER HEAD DAMAGE. Since the cylinder head is manufactured from an aluminium alloy care must be taken to ensure that the combustion face, in particular, is not damaged or scratched by placing it on a hard or abrasive surface while carrying out any repair operations.

9.1 Closely examine the cylinder head for cracks particularly between the inlet and exhaust valve seats. Such cracking indicates that the engine has overheated, usually through lack of coolant and the cylinder head should be scrapped.

9.2 Examine the cylinder head for distortion.

9.3 Examine the valve seats for pitting and other damage.

9.4 Check the valve guides for wear by inserting a new valve in the appropriate guide and leaving a gap between the valve face and valve seat of 8.0 mm (0.315 in.). If movement across the head exceeds 0.15 mm (0.006 in.) the guide must be renewed.

Rocker shaft assembly

10 The rocker shaft assembly should be examined as follows:

10.1 Examine the rocker shaft for wear at the bearing surfaces, if the bearing surfaces are worn more than 0.025 mm (0.001 in.) a new shaft must be fitted.

10.2 If the shaft is acceptable for further use ensure that the oil lubrication drillings at the rocker lever locations are not blocked, and that the through bore is clear.

10.3 Examine the rocker levers for wear on the pads, if wear is apparent they must be renewed.

NOTE

It is not permissible to grind the pads, in an attempt to reclaim the rocker levers.

10.4 Check the clearance between the rocker lever bushes and the rocker shaft, if clearance exceeds 0.101 to 0.127 mm (0.004 in. to 0.005 in.) renew the bushes.

10.5 Examine the ball end adjusting screws and discard any that are worn. Check the threads for damage.

Valves and valve springs

11 The valves and valve springs should be examined as follows:

11.1 Examine the valves for cracks, damage and wear. Pitting or slight damage to the valve face can be removed by grinding.

11.2 Check the free length of each spring against the length of a new spring. If the valve springs are to be re-used examine them for squareness of ends.

Push rods

12 Check the push rods for damage and straightness.

REPAIRS AND REPLACEMENT

NOTES

(1) Gaskets, joints and seals are not to be re-used. Renew these items on reassembly. Valve springs, rocker springs and spacers should be renewed at every major overhaul.

(2) The cylinder head cannot be refaced, if there are any signs of distortion the cylinder head must be replaced.

Refacing cylinder head valve seat inserts

13 Cylinder head valve seat inserts can be refaced provided they are not abnormally wide due to repeated refacing operations. If the inserts are considered unsuitable for refacing, new inserts should be fitted.

NOTES

(1) Exhaust valve seat faces should be recut to 45°. Inlet valve seat faces should be recut to 60°.

(2) Cutter (refer to Table 1 Serial 1), is a double ended tool having cutters of 30° and 45°. Ensure that the 45° cutter is used in this application.

(3) Cutter (refer to Table 1 Serial 2), is a 60° cutting tool and is for the exhaust valve seat only.

Reface valve seats

14 Valves that are satisfactory for further service can be refaced.

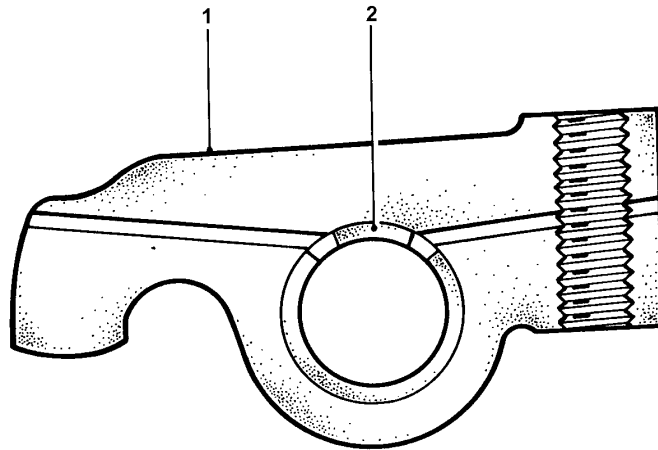
Lap-in valves

15 To ensure a gas tight seal between the valve face and seat it is necessary to lap-in the appropriate valve to its seat. It is essential to keep the valve identified with its seat once the lapping-in operation has been completed.

Rocker lever bushes

16 To renew the rocker bushes

- 16.1 Press out the worn bushes.
- 16.2 Press in the new bushes (Fig 5 (2)) ensuring that the lubrication drillings in the bushes align with those in the rocker lever (1).
- 16.3 Clear the swarf and burrs from the lubrication drillings.



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1 Rocker lever

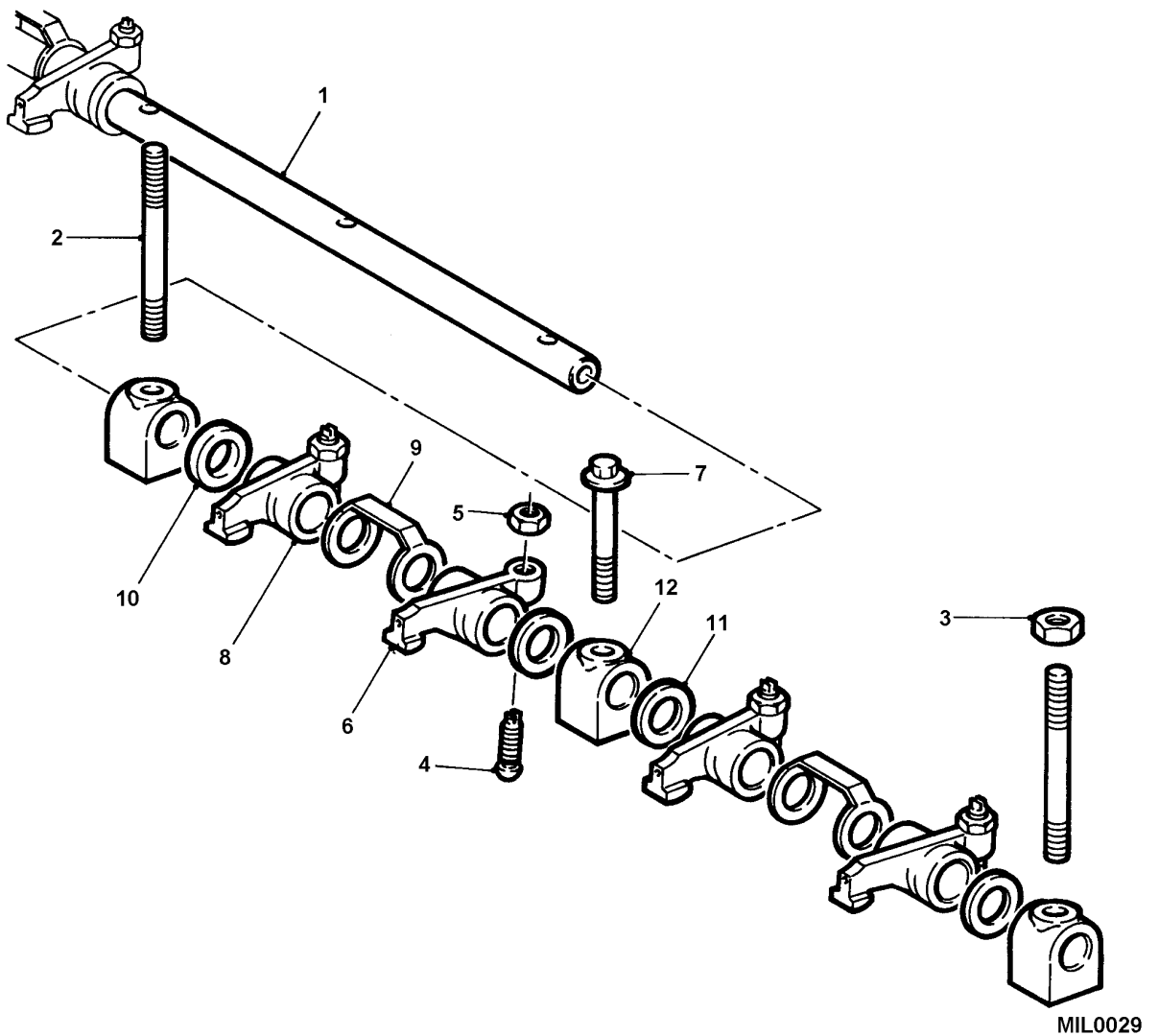
2 Bush

Fig 5 Cross-section through rocker lever.

REASSEMBLY**Rocker shaft assembly**

17 To assemble the rocker shaft assembly proceed as follows:

- 17.1 Assemble the rockers (Fig 6 (6)), retaining blocks (12) new springs (9), washers (11) and spacers (10) onto the rocker shaft (1) in the order from which they were removed.
- 17.2 Ensure the washers (11) are fitted, one either side of the centre retaining block.
- 17.3 Loosely assemble the tappet adjustment screws (4) and locknuts (5) to the rocker levers (8).
- 17.4 Hold the assembly together on the rocker shaft by inserting the retaining studs (2) through the fixing holes of No. 1 and No. 3 retaining blocks.



- | | |
|-------------------|--------------------|
| 1 Shaft | 7 Securing bolt |
| 2 Stud | 8 Rocker |
| 3 Securing nut | 9 Spring |
| 4 Adjusting screw | 10 Spacer |
| 5 Locknut | 11 Washer |
| 6 Locker lever | 12 Retaining block |

Fig 6 Rocker shaft assembly

Valves to cylinder head

18 To assemble the valves to the cylinder head proceed as follows:

- 18.1 Insert the valves to their respective guides and locate a spring protection washer (Fig 7 (4)) over each guide.
- 18.2 Fit new oil seals (5) to all the valve guides with the garter spring uppermost.
- 18.3 Ensure that the seals fully locate on the valve guides.
- 18.4 Fit a spring (3) and spring retainer (2) to each valve and compress with a valve spring compressor (6).

18.5 Secure with the multi-groove split collets (1) ensuring that they are fully located in the valve stem and spring retainer.

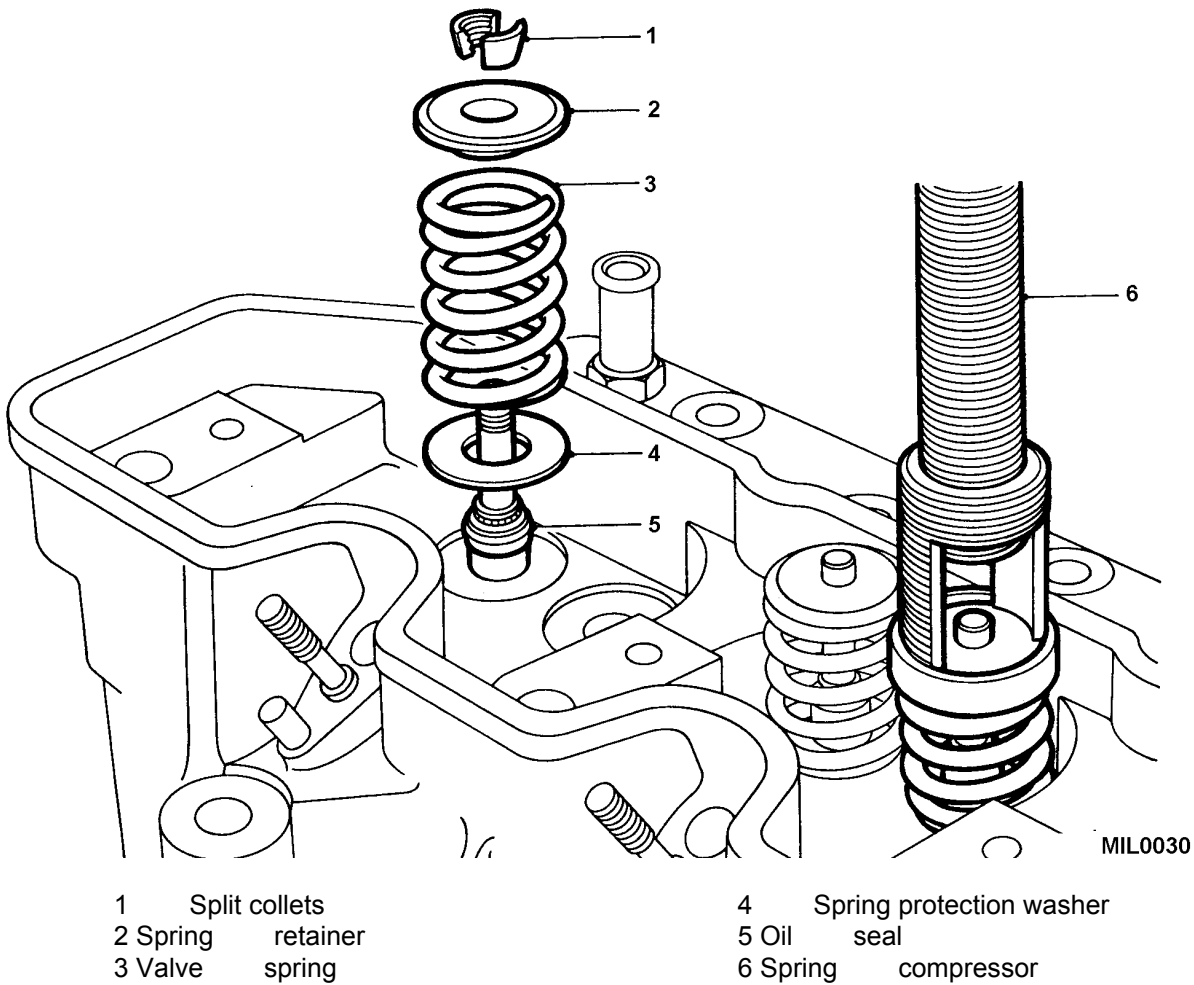


Fig 7 Valve assemblies

Cylinder head assembly to cylinder block

TABLE 3 GASKET THICKNESSES

Serial (1)	No. of holes (2)	Piston standup dimensions (3)		Gasket Part No (4)
1	1	0.50 mm to 0.60 mm	(0.0019 in. to 0.0023 in.)	ERR5261
2	2	0.61 mm to 0.70 mm	(0.0024 in. to 0.0027 in.)	ERR5262
3	3	0.71 mm to 0.80 mm	(0.0028 in. to 0.0031 in.)	ERR5263
4	4	0.81 mm to 0.90 mm	(0.0032 in. to 0.0035 in.)	ERR7154

19 To assemble the cylinder head to the cylinder block proceed as follows:

NOTE

Before fitting the cylinder head, the protrusion of the pistons above the block face must be checked in order that the correct thickness gasket may be selected, from the range of four.

19.1 The height of all pistons above the cylinder block must be measured, the thickness of the gasket selected is based upon the largest value of dimension "A" (Fig 8). This dimension, however, must not exceed 0.9 mm (0.0035 in.)

19.2 Four thicknesses of gasket (refer to Table 3) are available and each size can be recognised by the number of identification holes punched in the side of the gasket.

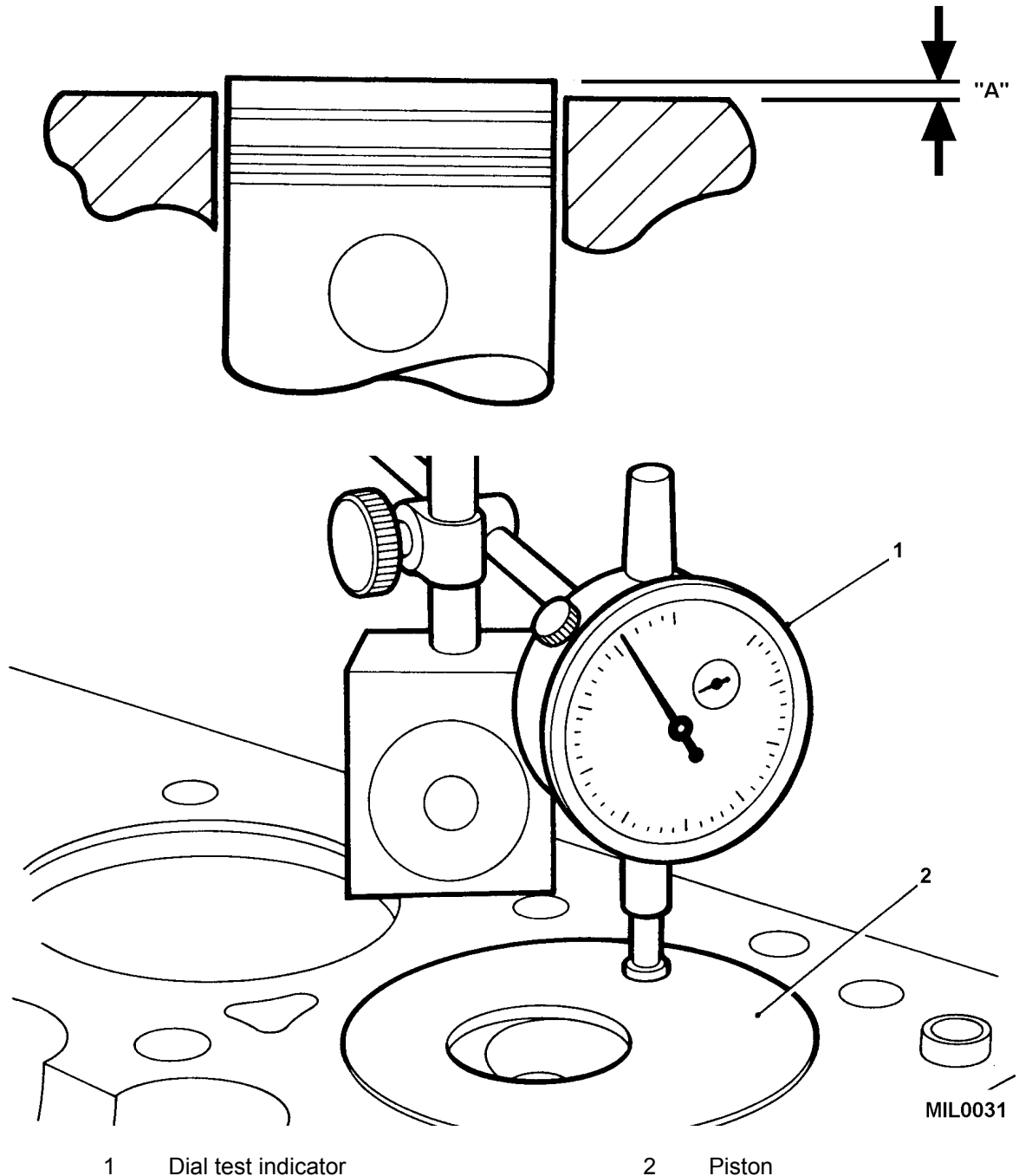


Fig 8 Piston protrusion for gasket selection

19.3 The thickness of gasket fitted can be seen when the cylinder head is fitted since the identification holes can be seen protruding from the right hand side of the engine towards the rear.

- 19.4 Clean the cylinder block combustion face and turn the crankshaft so that No. 1 and No. 4 pistons (Fig 8 (2)) are at Top Dead Centre (TDC).
- 19.5 Use a dial test indicator (1) to determine the highest travel of the piston then zero the gauge and move the stylus over to the cylinder block and note the reading.
- 19.6 Repeat the procedure on the remaining pistons.
- 19.7 The highest figure obtained will determine the gasket selected.
- 19.8 Place the new gasket selected in position on the cylinder block so that the identification holes are towards the rear on the right hand side and the word "TOP" is facing upwards.
- 19.9 Clean the cylinder head face and lower into position ensuring that the cylinder head locates over the two dowels in the cylinder block.
- 19.10 Lubricate the threads of new bolts, (refer to Fig 9) with light oil, and fit to their respective positions according to length and diameter.
- 19.11 Tighten the bolts down so that the heads just make contact with the cylinder head.

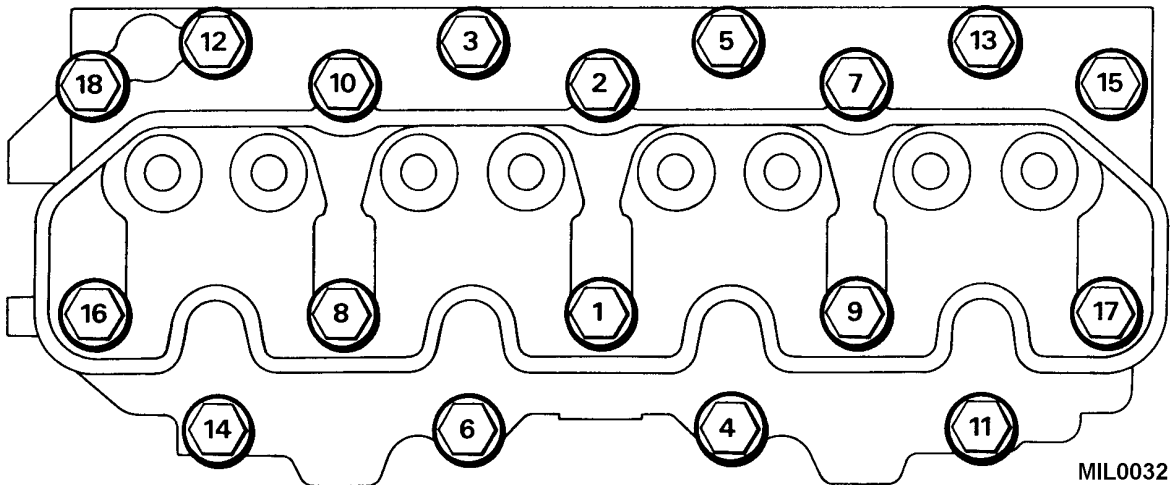


Fig 9 Bolt locations and Tightening sequence for cylinder head.

19.12 Bolt Sizes:

19.12.1 M10 locations 3,5,12 and 13.

19.12.2 M12 locations 1,2,4,6,7,8,9,10,11,14,15,16,17 and 18

19.13 Tighten the bolts to 40 Nm (29 lbf ft) in sequence (refer to Fig 9) using a suitable torque wrench.

19.14 Attach the special tool (refer to Table 1 Serial 3), (Fig 10 (1)) to a suitable socket and extension bar (2).

19.15 Make a suitable pointer from welding rod (3) and attach it to a bolt screwed into a rocker shaft securing bolt hole.

NOTE

Re-positioning of the pointer will be necessary for each bolt.

19.16 Tighten all the bolts down through an angle of 60 ° in the correct sequence. As each bolt is tightened scribe a line across the head with a piece of chalk or crayon to identify which bolts have been tightened.

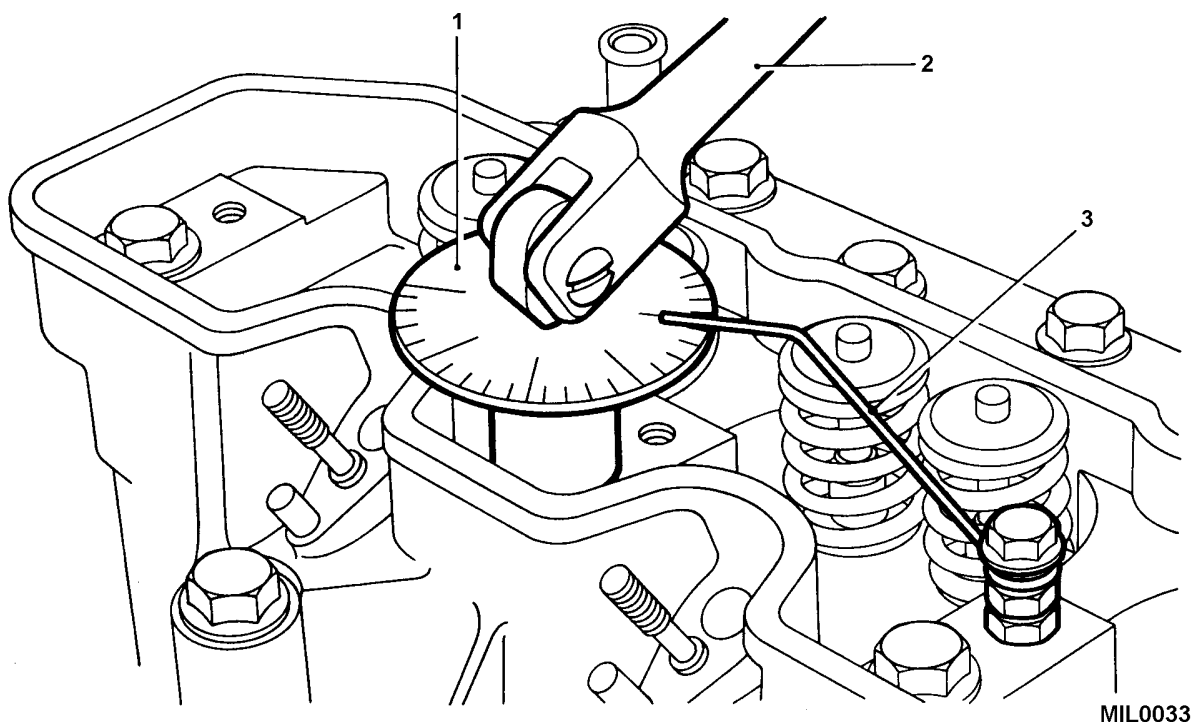
19.17 Tighten each bolt a further 60 ° again in the correct sequence to complete the tightening procedure.

CAUTION

CYLINDER HEAD DISTORTION. It is important that the double torquing procedure is observed and that on no account should the total angle of 120° be performed in one operation otherwise damage and distortion of the cylinder head may occur.

19.18 Fit the push rods to the engine ensuring that the ball-end locates properly in each cam follower slide.

19.19 Ensure that a new valve stem cap is fitted to each valve stem before fitting the rocker shaft.



MIL0033

1 Degree disc
2 Socket and extension bar
3 Pointer

Fig 10 Torque tightening cylinder head bolts, degree disc

19.20 Fit the rocker shaft to the cylinder head ensuring that the studs, retaining bolts and push rods locate correctly.

19.21 Tighten the rocker shaft retaining nuts and bolts to 25 Nm (18 lbf ft).

Valve clearances

20 To set the valve clearances proceed as follows:

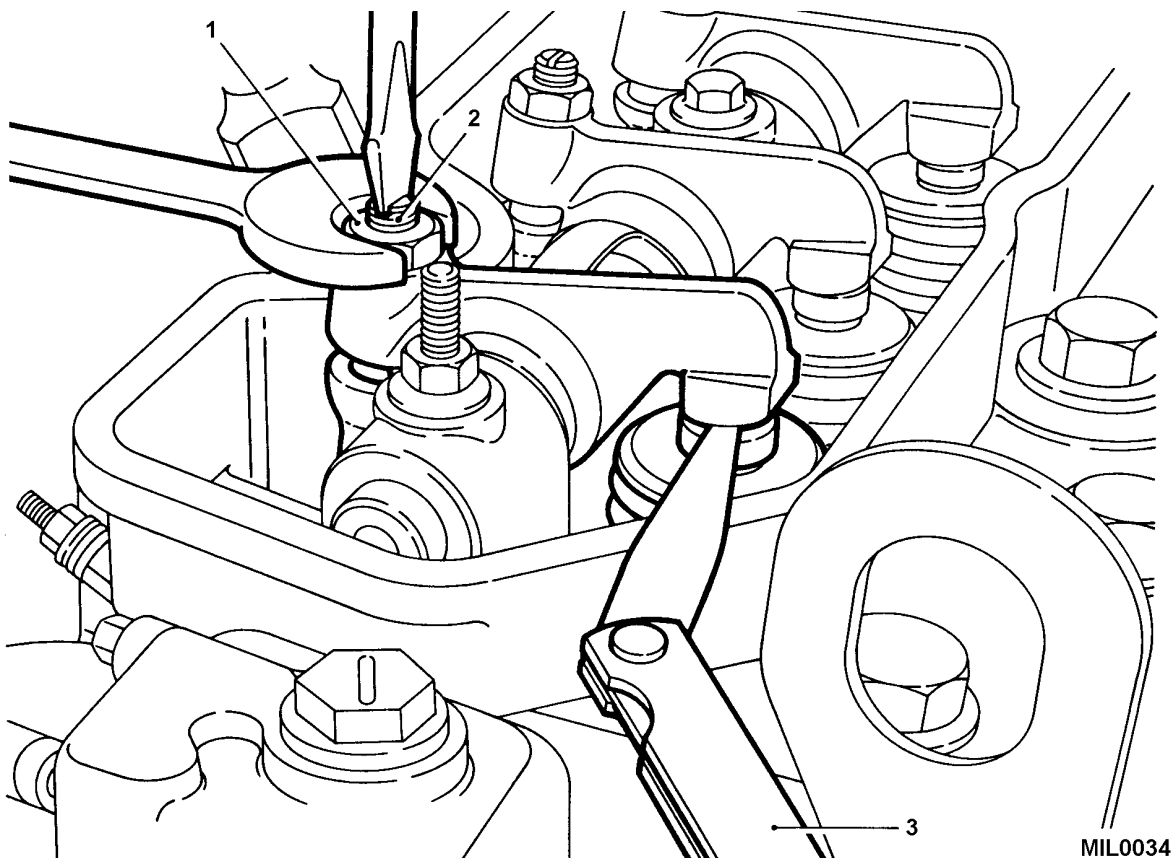
WARNING

VALVE CLEARANCE. IF THE CRANKSHAFT IS ROTATED WITH EXCESSIVE VALVE CLEARANCE, IT IS POSSIBLE THAT THE PUSH RODS MAY BECOME DISLODGED FROM THE CAM FOLLOWER SEATING AND FRACTURE THE CAM FOLLOWER SLIDE.

20.1 To prevent damage, eliminate all clearance from any loose rockers before turning the crankshaft to adjust clearances.

20.2 Turn the engine over until No. 8 valve (counting from the front of the engine) is fully open.

20.3 Using a 0.20 mm (0.008 in.) feeler gauge (Fig 11 (3)) adjust the clearance of No. 1 valve. Slacken the locknut (1) and turn the adjusting screw (2) clockwise to reduce the clearance and anti clockwise to increase.



2 1 Locknut
Adjusting screw 3 Feeler gauge

Fig 11 Tappet clearances

20.4 Tighten the adjusting screw locknut to a torque of 16 Nm (12 lbf ft).

20.5 Continue to adjust the remaining tappets in the following sequence:

20.5.1 Set No. 3 tappet with No. 6 valve fully open.

20.5.2 Set No. 5 tappet with No. 4 valve fully open.

- 20.5.3 Set No. 2 tappet with No. 7 valve fully open.
- 20.5.4 Set No. 8 tappet with No. 1 valve fully open.
- 20.5.5 Set No. 6 tappet with No. 3 valve fully open.
- 20.5.6 Set No. 4 tappet with No. 5 valve fully open.
- 20.5.7 Set No. 7 tappet with No. 2 valve fully open.

20.6 Recheck the clearances and adjust as necessary.

Rocker cover

21 Locate a new surround seal on the rocker cover and fit the cover to the cylinder head.

21.1 Secure the rocker cover using the special nuts and washers, tighten to a torque of 10 Nm (7 lbf ft).

Manifolds

22 Using a new gasket, fit the inlet and exhaust manifolds and secure with the retaining nuts and bolts. Tighten the Inlet manifold nuts and bolts to 25 Nm (18 lbf ft) and the exhaust manifold securing nuts to a torque of 45 Nm (33 lbf ft) (refer to Cat 11-1).

Thermostat housing

23 Fit the thermostat housing complete with thermostat to the cylinder head using a new gasket. Tighten the securing bolts to a torque of 25 Nm (18 lbf ft).

Heater plugs

24 Fit the heater plugs and tighten to a torque of 20 Nm (15 lbf ft) (refer to Cat 11-1).

24.1 Connect the electrical harness to the plugs and secure with the single nut and washers (refer to Cat 11-1).

Fuel injectors

25 Fit the fuel injectors (refer to Chap 11-1). Ensure that the injector and seat ing in the cylinder head is clean and that a new copper sealing washer is fitted to face of each injector (refer to Cat 11-1).

Crankcase ventilator

26 Fit the crankcase ventilator using a new rubber "O" ring, tighten securing bolt to 9 Nm (7 lbf ft).

Reconnection of parts disturbed

27 Reconnect all pipes, hoses and electrical connections disturbed or removed under preparation for removal (refer to Para 4).

Cooling and lubrication systems

28 Refill the cooling system and check the engine oil level as follows:

28.1 Refill the cooling system using the correct mix of coolant, (refer to Chap 12-1).

28.2 Check the engine oil level and top up as necessary with the correct grade of oil, (refer to Table 2 Serial 1).

CAUTION

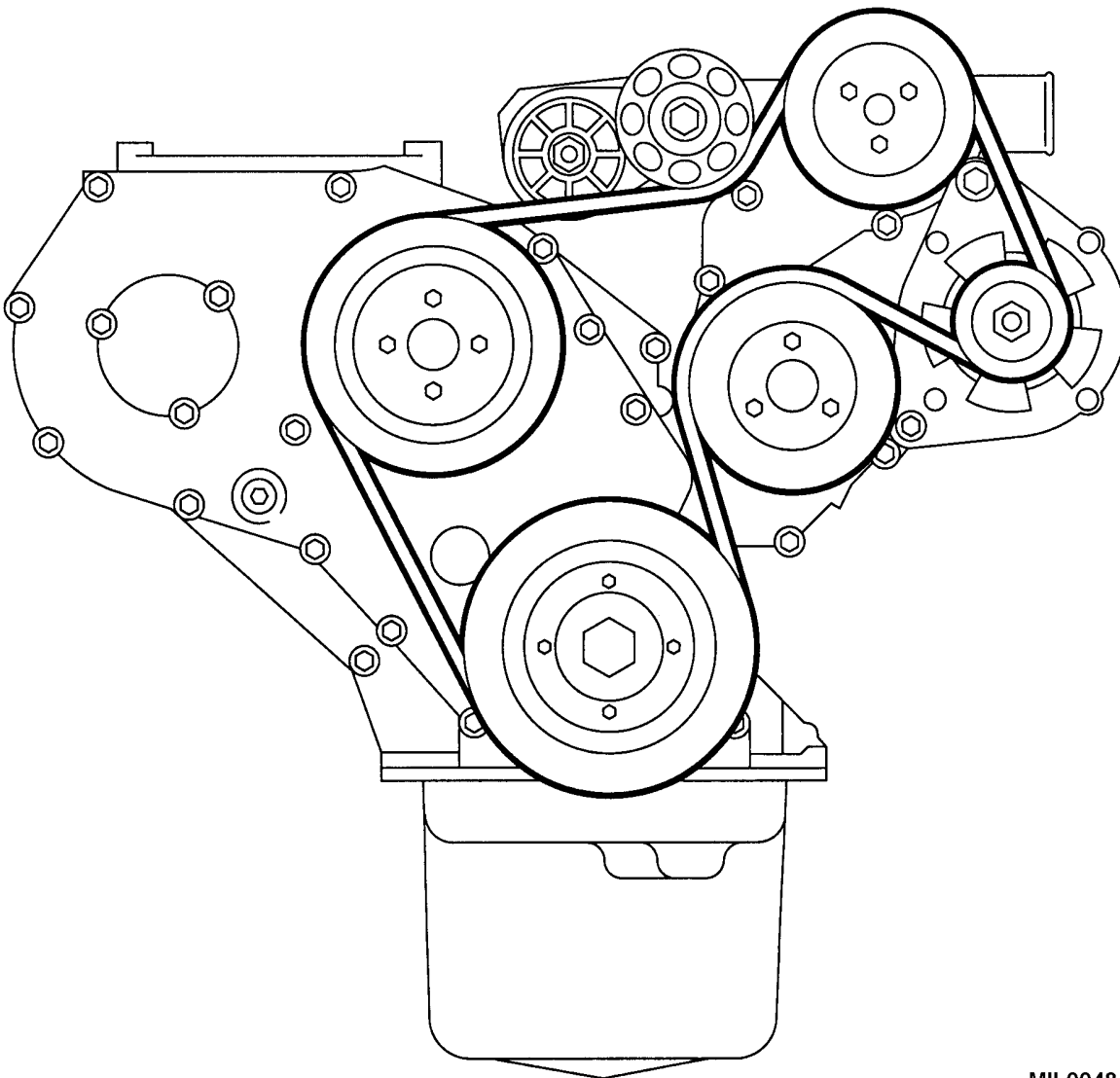
FFR BATTERY LEADS. On the FFR vehicles if the radio batteries are not fitted ensure that the battery leads are disconnected from the auxiliary terminal box before starting the engine.

28.3 Run the engine checking that the oil pressure warning light goes out. Check all fuel, oil and coolant connections for leaks.

28.4 Stop the engine. When cool check the coolant and oil levels, top up as necessary.

CAUTION

INJECTORS. The injectors and heater plugs protrude below the combustion face of the cylinder head. It is important that they are removed before the removal of the cylinder head to avoid the possibility of damage to them.



MIL0048

Fig 12 Drive belt and pulley location

DRIVE BELT AND PULLEYS

Removal

29 To remove the drive belt and pulleys proceed as follows:

- 29.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted for Radio (FFR) vehicles the radio batteries (refer to Chap 13-2) to prevent the engine being started whilst working on the fan assembly.
- 29.2 Remove the viscous coupling and fan assembly (refer to Chap 12-1).
- 29.3 Before removing the serpentine belt, slacken the fan pulley retaining bolts.
- 29.4 Using a hexagonal socket and tommy bar on the auto tensioner pulley nut, tension the auto-tensioning unit and remove the drive belt.
- 29.5 Remove the retaining bolts and detach the pulleys.

Refitting

30 To fit the drive belt and pulleys proceed as follows:

- 30.1 Lightly grease the crankshaft pulley spigot and fit the pulley onto the crankshaft with the pulley retainer washer and bolt.
- 30.2 Fit the crankshaft pulley retainer tool (refer to Table 1 Serial 4), and secure with four retaining bolts.
- 30.3 Using a suitable socket and extension bar tighten the crankshaft pulley bolt to a torque of 80 Nm (59 lbf ft)+ 90°. Remove the pulley retaining tool.
- 30.4 Fit the fan pulley to the adapter on the timing cover, tighten the retaining bolts to a torque of 25 Nm (18 lbf ft) and refit the auto-tensioner to the auxiliary mounting bracket, tighten the securing nut to 45 Nm (33 lbf ft).
- 30.5 Fit the drive belt to the fan pulley, crankshaft pulley, power steering pump pulley, alternator pulley, water pump pulley and auto tensioner. Apply a ring spanner to the tensioner pulley retaining bolt, carefully release the belt tension and feed the drive belt over the respective pulleys (refer to Fig 12).
- 30.6 When all pulleys are connected carefully release the pulley tension, release and remove the ring spanner.
- 30.7 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted for Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

OIL SUMP

REMOVAL

31 To remove the oil sump proceed as follows:

- 31.1 Remove the sump drain plug and allow the oil to drain into a container of suitable capacity.
- 31.2 Remove the bolts securing the sump to the crankcase and withdraw the sump.

31.3 Thoroughly clean all components ensuring removal of sealant from the sump, timing gear housing and cylinder block.

REFITTING

32 To refit the oil sump proceed as follows:

32.1 Apply a 2.0 mm bead of sealant (refer to Table 2 Serial 2) to the sump flange, ensuring the bead is applied in-board of the bolt holes. Fit the sump within 30 minutes of applying the sealant.

32.2 Tighten the sump securing bolts to a torque of 25 Nm (18 lbf ft).

32.3 Fit and tighten the sump drain plug to a torque of 35 Nm (26 lbf ft).

32.4 Refill the engine to the correct level with the correct grade of oil (refer to Table 2 Serial 1).

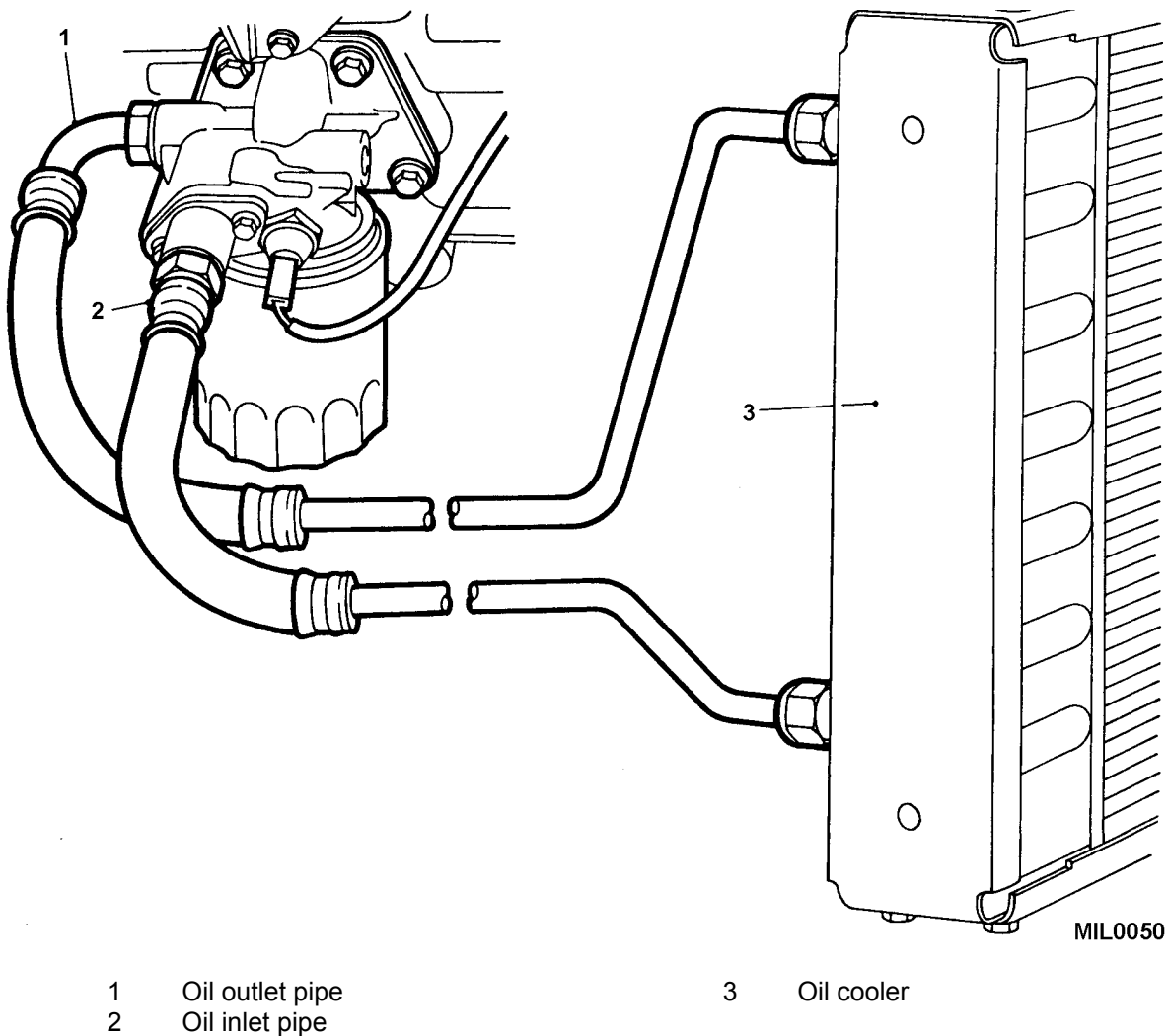


Fig 13 Oil cooler and hoses

OIL PRESSURE RELIEF VALVE

REMOVAL

33 To remove the oil pressure relief valve proceed as follows:

33.1 Remove the sump (refer to Para 31).

33.2 Remove the relief valve retaining plug from the timing gear housing and withdraw the valve spring and plunger.

REFITTING

34 To refit the oil pressure relief valve proceed as follows:

34.1 Insert the pressure relief valve plunger and spring into the base of the timing gear housing.

34.2 Locate the retaining plug onto the relief valve spring and screw the plug into the timing gear housing.

34.3 Fit the sump (refer to Para 32).

OIL COOLER

REMOVAL

35 To remove the oil cooler, which is part of the radiator assembly, carry out the following:

35.1 Disconnect the inlet (Fig 13 (2)) and outlet (1) oil cooler pipes from the radiator. Tape the ends of the pipes and their respective adapters on the oil cooler (3) to prevent the ingress of dirt.

35.2 Remove the radiator (refer to Chap 12-1).

REFITTING

36 The procedure for refitting the oil cooler is the reverse of the removal procedure.

OIL FILTER HEAD

REMOVAL

37 To remove the oil filter head proceed as follows:

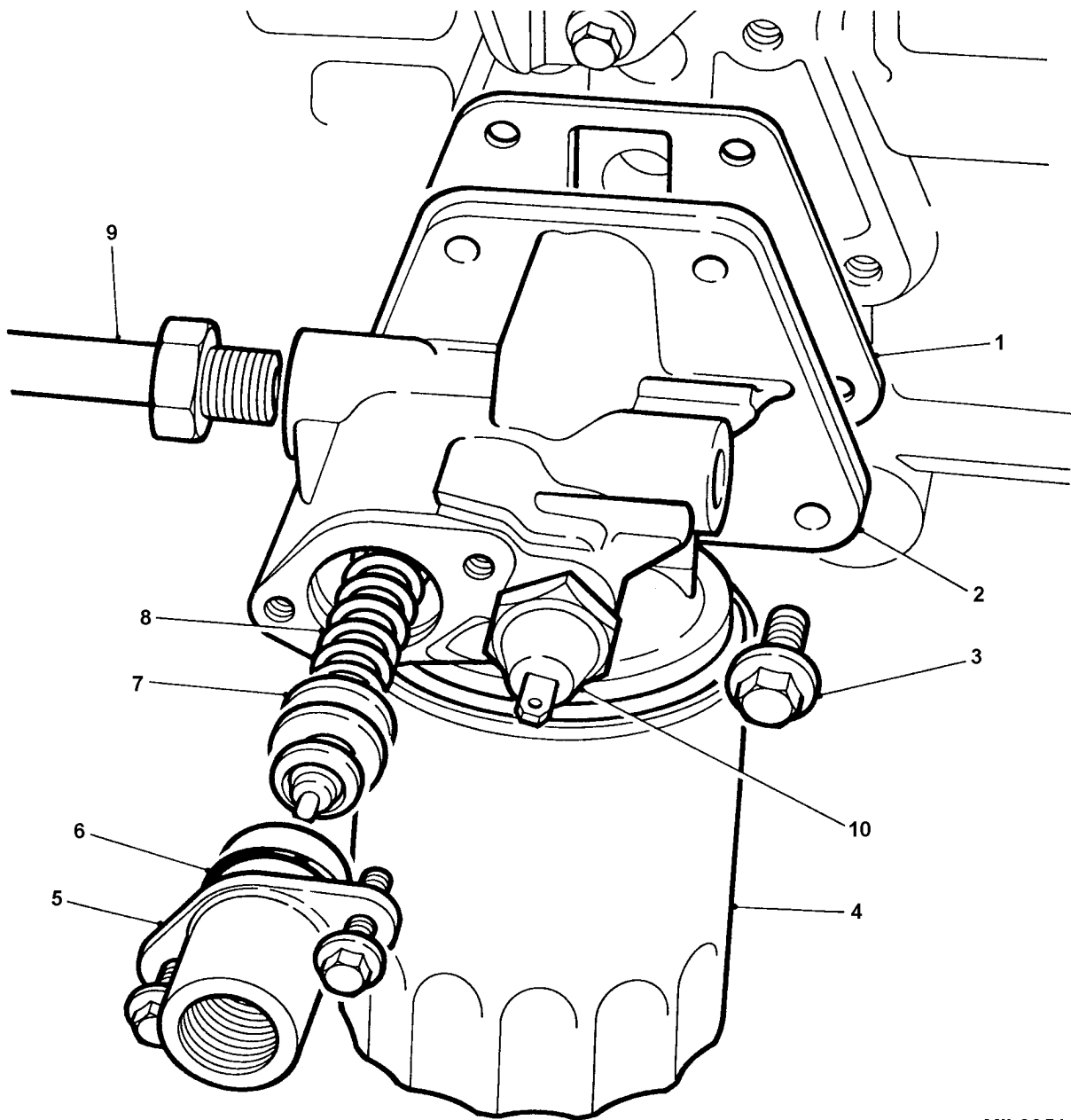
37.1 Disconnect the oil cooler pipes (refer to Para 35).

37.2 Disconnect the pressure switch lead (refer to Fig 14 (10)).

37.3 Remove the securing bolts (3) and withdraw the oil filter head (2) complete with gasket (1).

REFITTING

38 The procedure for refitting the oil filter head is the reverse of the removal procedure. Using a new gasket fit the filter head and tighten the securing bolts to 45 Nm (33 lbf ft).



MIL0051

- | | |
|--------------------------------|------------------------|
| 1 Gasket | 6 "O" ring |
| 2 Filter head | 7 Thermostat |
| 3 Retaining bolt | 8 Spring |
| 4 Oil filter | 9 Return pipe |
| 5 Thermostat extension housing | 10 Oil pressure switch |

Fig 14 Oil temperature control valve

OIL TEMPERATURE CONTROL VALVE**REMOVAL**

39 To remove the oil temperature control valve proceed as follows:

- 39.1 Disconnect oil cooler pipe from the thermostat extension housing (refer to Fig 14 (5)).

39.2 Remove the retaining bolts and carefully withdraw the thermostat at extension housing complete with "O" ring seal (6), thermostat (7), two washers and spring (8).

39.3 Thoroughly clean the adapter housing.

39.4 Inspect all components and renew as necessary.

REFITTING

40 The procedure for refitting the oil temperature control valve is the reverse of the removal procedure. Ensure the thermostat pin locates in the extension housing hole, fit new "O" ring seal and tighten securing bolts to 9 Nm (7 lbf ft).

OIL DRAIN PIPE TO BLOCK

REMOVAL

41 To remove the oil drain pipe to cylinder block proceed as follows:

41.1 Remove the hose from the oil drain return pipe.

41.2 Remove the bolts securing the pipe flange to the cylinder block.

41.3 Withdraw the oil drain pipe and discard the gasket.

REFITTING

42 The procedure for refitting the oil drain pipe to the cylinder block is the reverse of the removal procedure.

42.1 Fit a new gasket and tighten the securing bolts to 25 Nm (18 lbf ft).

ENGINE BREATHER SIDE COVER

REMOVAL

43 To remove the engine breather side cover proceed as follows:

43.1 Remove the hose from the engine breather side cover.

43.2 Remove the fuel injection pump rear support bracket nuts and bolts.

43.3 Remove the support bracket retaining bolts to the cylinder block and remove the bracket.

43.4 Remove the remaining engine breather side cover retaining bolts, withdraw the cover and gasket.

43.5 Clean thoroughly and check that the side cover baffle plate is secure.

REFITTING

44 The procedure for refitting the engine breather is the reverse of the removal procedure.

45 Using a new gasket fit the side cover and fuel injection pump support bracket to the cylinder block, tighten securing bolts to 25 Nm (18 lbf ft).

CHAPTER 1-2

WINTER/WATER

CONTENTS

Para

- 1 Introduction
ENGINE
Cylinder head assembly
- 2 Preparation for removal (CAUTION)
- 3 Refit
Cylinder head
- 4 Remove/refit

Fig

Page

- 1 Disconnection points prior to cylinder head removal 2

INTRODUCTION

1 This chapter details the Unit repairs for Truck Utility Light (TUL) HS, Truck Utility Medium (TUM), HS winter/water vehicles with 2.5 Litre 300 Tdi direct injected turbocharged diesel engines.

NOTE

This chapter also applies to the winterised vehicles as well.

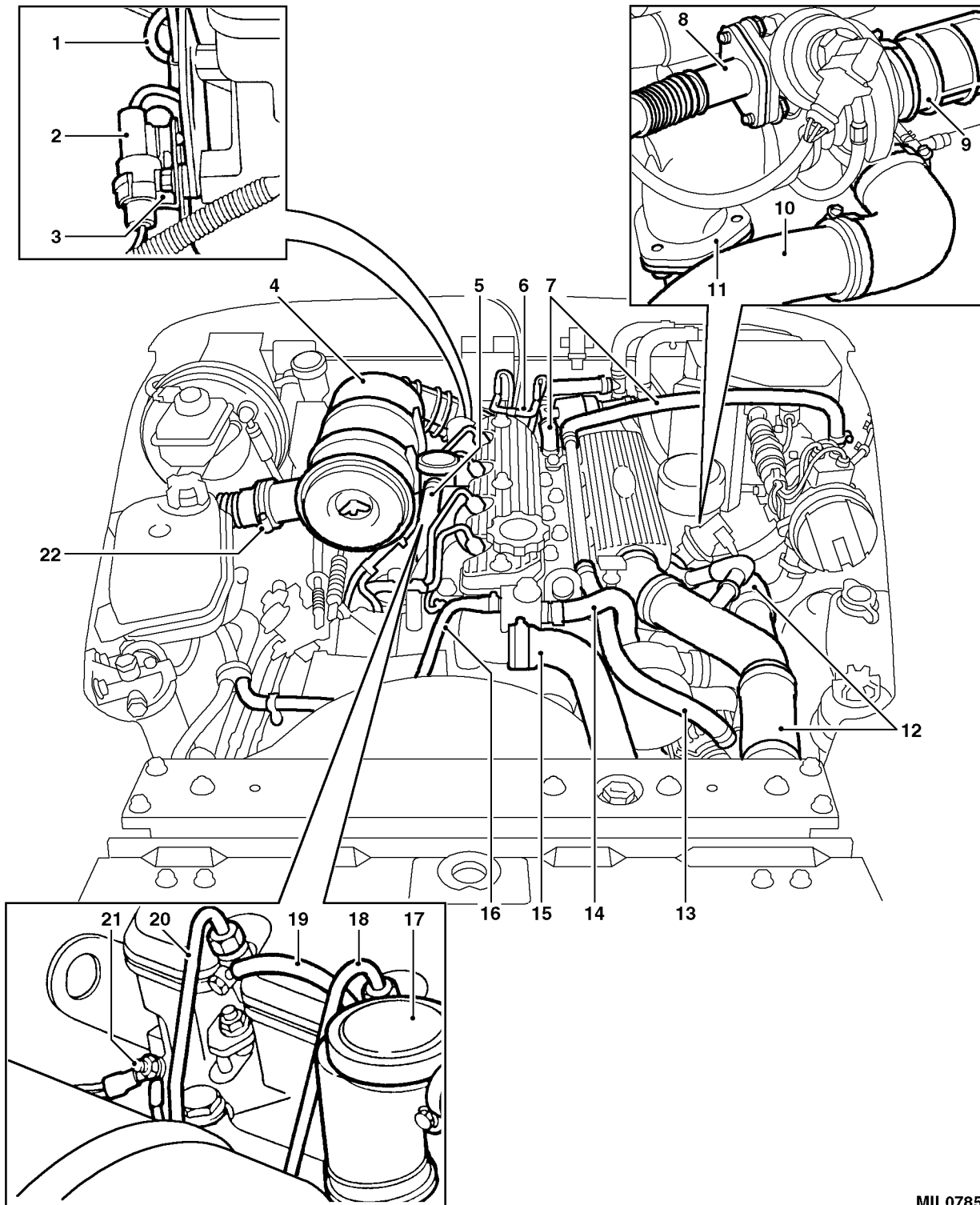
ENGINE

CYLINDER HEAD ASSEMBLY

Preparation for removal

2 Before the cylinder head can be removed the following ancillary items must be removed for access and safety:

- 2.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted for Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).



MIL0785

Fig 1 Disconnection points prior to cylinder head removal

KEY TO FIG 1

2	1	Transmission breather pipes bracket	12	Intercooler hoses
		Multi-plug	13	Heater hose
	3	Harness clips	14	By-pass hose
	4	Air cleaner	15	Radiator top hose
	5	Cylinder block breather hose	16	Expansion tank pipe
	6	Breather pipes	17	Cylinder block ventilation valve
	7	Heater hose	18	Fuel injector pipes
	8	EGR pipe	19	Spill rail
	9	Air cleaner hose	20	Fuel injector pipes
	10	Intercooler hose	21	Heater plug connection
	11	Exhaust down pipe		

2.2 Disconnect the earth bonding straps and remove the bonnet (refer to Chap 16-1).

2.3 On FFR vehicles remove the 50 amp alternator (refer to Chap 13-2).

2.4 Drain the cooling system (refer to Chap 12-2).

2.5 Remove the air cleaner assembly including hoses (Fig 1 (4)) (refer to Chap 11-3).

2.6 Detach the cylinder block ventilation valve (17) and the breather hose (5) from the rocker cover.

CAUTION

INJECTORS. The injectors and heater plugs protrude below the combustion face of the cylinder head. It is important that they are removed before the removal of the cylinder head to avoid the possibility of damage to them.

2.7 Remove fuel injection pipes (18, 20) (refer to Chap 11-1).

2.8 Disconnect spill rail (19) from fuel injectors (refer to Chap 11-1).

2.9 Remove fuel injectors and sealing washers. Identify each injector to the location from which it is removed (refer to Chap 11-1).

2.10 Remove the inter-connecting harness wiring (21) from the heater plugs.

2.11 Remove the heater plugs (refer to Chap 11-1).

2.12 Remove the radiator top hose (15).

2.13 Disconnect the by-pass hose (14) from the thermostat.

2.14 Disconnect the EGR pipe (8) from the turbo charger.

2.15 Remove the inter-cooler to induction manifold hose (12).

2.16 Remove the induction manifold rear heat shield and slacken induction manifold lower securing nuts.

2.17 Remove upper securing bolts and withdraw induction manifold.

2.18 Undo the three nuts to release the down pipe (11) from the exhaust manifold and remove the turbo-charger assembly (refer to Chap 11-1).

- 2.19 Disconnect heater hose (13) from heater rail and remove heater rail hose from its retaining clip at the water pump.
- 2.20 Move heater rail aside.
- 2.21 Disconnect heater hoses (7) from rear of cylinder head.
- 2.22 Remove bolt securing air cleaner mounting bracket to support strut.
- 2.23 Remove bolt securing harness bracket to cylinder head.
- 2.24 Remove rear lifting bracket to release engine and transmission breather pipes (1) bracket and multi-plug (2).
- 2.25 Ensure all ancillary items are disconnected before removing the cylinder head.

Refit

- 3 Reverse the above procedure when refitting the cylinder head ancillary items.

CYLINDER HEAD**Remove/Refit**

- 4 For remove and refit of the cylinder head assembly (refer to Chapter 1-1).

CHAPTER 1-3

TROPICALISED

CONTENTS

Para

- 1 Introduction
ENGINE
Cylinder head assembly
- 2 Preparation for removal (CAUTION)
- 3 Refit
Cylinder head
- 4 Remove/refit

Fig

Page

- 1 Disconnection points prior to cylinder head removal 2

INTRODUCTION

1 This chapter details the Unit repairs for (TUM) Ambulance HS tropicalised vehicle fitted with air conditioning and the 2.5 Litre 300 Tdi direct injected turbocharged diesel engine.

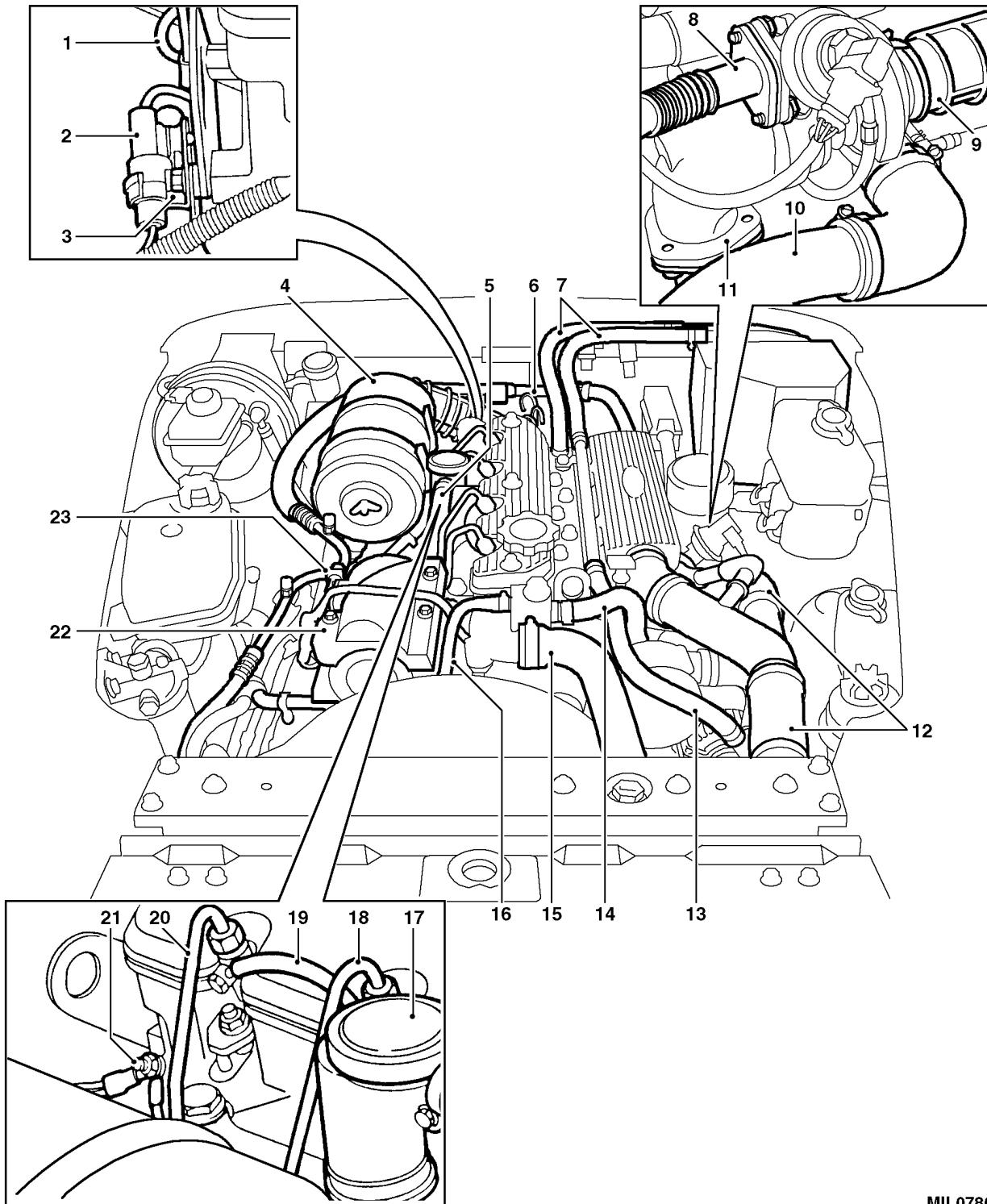
ENGINE

CYLINDER HEAD ASSEMBLY

Preparation for removal

2 Before the cylinder head can be removed the following ancillary items must be removed for access and safety:

- 2.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted for Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).



MIL0786

Fig 1 Disconnection points prior to cylinder head removal

KEY TO FIG 1

2	1	Transmission breather pipes bracket	13	Heater hose
		Multi-plug	14	By-pass hose
	3	Harness clips	15	Radiator top hose
	4	Air cleaner	16	Expansion tank pipe
	5	Cylinder block breather hose	17	Cylinder block ventilation valve
	6	Breather pipes	18	Fuel injector pipes
	7	Heater hoses	19	Spill rail
	8	EGR pipe	20	Fuel injector pipes
	9	Air cleaner hose	21	Heater plug connection
	10	Intercooler hose	22	Compressor
12	11	Exhaust down pipe	23	Compressor connections
		Intercooler hoses		

2.2 Disconnect the earth bonding straps and remove the bonnet (refer to Chap 16-1).

2.3 On FFR vehicles remove the 50 amp alternator (refer to Chap 13-2).

2.4 Drain the cooling system (refer to Chap 12-1).

2.5 Evacuate the air conditioning system and remove the compressor (Fig 1 (22)), (refer to Chap 18-5).

2.6 Remove the air cleaner assembly including hoses (4) (refer to Chap 11-3).

2.7 Detach the cylinder block ventilation valve (17) and the breather hose (5) from the rocker cover.

CAUTION

INJECTORS. The injectors and heater plugs protrude below the combustion face of the cylinder head. It is important that they are removed before the removal of the cylinder head to avoid the possibility of damage to them.

2.8 Remove fuel injection pipes (18, 20) (refer to Chap 11-1).

2.9 Disconnect spill rail (19) from fuel injectors (refer to Chap 11-1).

2.10 Remove fuel injectors and sealing washers. Identify each injector to the location from which it is removed (refer to Chap 11-1).

2.11 Remove the inter-connecting harness wiring (21) from the heater plugs.

2.12 Remove the heater plugs (refer to Chap 11-1).

2.13 Remove the radiator top hose (15).

2.14 Disconnect the by-pass hose (14) from the thermostat.

2.15 Disconnect the EGR pipe (8) from turbo charger.

2.16 Remove the inter-cooler to induction manifold hose (12).

2.17 Remove the induction manifold rear heat shield and slacken induction manifold lower securing nuts.

2.18 Remove upper securing bolts and withdraw induction manifold.

- 2.19 Undo the three nuts to release the down pipe (11) from the exhaust manifold and remove the turbo-charger assembly (refer to Chap 11-1).
- 2.20 Disconnect heater hose (13) from heater rail and remove heater rail hose from its retaining clip at the water pump.
- 2.21 Move heater rail aside.
- 2.22 Disconnect heater hoses (7) from rear of cylinder head.
- 2.23 Remove bolt securing air cleaner mounting bracket to support strut.
- 2.24 Remove bolt securing harness bracket to cylinder head.
- 2.25 Remove rear lifting bracket to release engine and transmission breather pipe bracket (1) and multi-plug (2).
- 2.26 Ensure all ancillary items are disconnected before removing the cylinder head.

Refit

- 3 Reverse the above procedure when refitting the cylinder head ancillary items.

CYLINDER HEAD**Remove/Refit**

- 4 For remove and refit of the cylinder head assembly (refer to Chapter 1-1).

CHAPTER 2

CLUTCH

CONTENTS

Para

1	Introduction
2	General (WARNING) Torque list SLAVE CYLINDER
3	Removal (CAUTION)
4	Dismantling
5	Cleaning
6	Examination
7	Repairs and replacement
8	Reassembly (CAUTION)
9	Refitting MASTER CYLINDER
10	Removal
11	Dismantling
12	Cleaning
13	Examination
14	Repairs and replacement
15	Reassembly
16	Refitting
17	Bleeding clutch hydraulic system (CAUTION)
18	Clutch pedal and master cylinder setting

Table

Page

1	Sealants, adhesives and lubricants	2
2	Replacement parts.....	2

Fig

1	Slave cylinder removal/installation.....	4
2	Exploded view of slave cylinder.....	6
3	Master cylinder removal.....	8
4	Push-rod and piston assembly	9
5	Removing piston from spring	10
6	Spring and valve assembly.....	11
7	Location of valve seal and bowed washer.....	12
8	Location of piston seal and spring retainer.....	13
9	Clutch pedal setting	15

INTRODUCTION

1 This chapter details the Unit repairs for clutches fitted to Truck Utility Light (TUL) HS, and Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles having a 2.5 litre 300 Tdi direct injected turbocharged diesel engine and 5 speed manual gearbox.

GENERAL

2 The clutch assembly is of the diaphragm spring type and no overhaul procedures are applicable. Repair is by replacement only.

TORQUE LIST

Pressure plate fixings	34 Nm/25 lbf ft	
Hose and pipe connections	15 Nm/11 lbf ft	
Bearing guide to bell housing	25 Nm/18 lbf ft	
Gear selector lever to shaft	25 Nm/18 lbf ft *	* New self locking nut must be used

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number Where applicable (3)	Designation (4)
1	OX 8	9150-99-220-2348	Hydraulic fluid
2	XG 250	6850-99-224-8408	Silicon grease
3	Hylomar Universal	8030-99-220-2370	Waterproof jointing compound

WARNING

CLUTCH REPLACEMENT PARTS. TO AVOID CATASTROPHIC FAILURE AND PERSONAL INJURY ONLY FIT REPLACEMENT CLUTCH PARTS WITH THE CORRECT SUFFIX AS LISTED IN TABLE 2 BELOW.

TABLE 2 REPLACEMENT PARTS

Serial (1)	NSN/Part Number (2)	Part No. (3)	Designation (4)	Gearbox Suffix (5)
1(1)	2520-99-363-2256	FTC2957	Shifter Fork, Vehicular	Suffix - J
1(2)	2520-99-177-7221	UTD100000	Shifter Fork, Vehicular	Suffix - K & L
2(1)	3110-99-313-8019	FTC5200	Bearing, Ball, Annular	Suffix - J
2(2)	3310-99-145-0765	UTJ100210	Bearing, Ball, Annular	Suffix - K & L
3(1)	2520-99-832-3404	FTC5199	Push Rod, Clutch	Suffix - J
3(2)	2520-99-641-7825	UUF100060	Push Rod, Clutch	Suffix - K & L

SLAVE CYLINDER

REMOVAL

CAUTION

SLAVE CYLINDER. If removing the slave cylinder with the gearbox in-situ, **DO NOT** remove the push rod and clip from the clutch lever.

3 To remove the slave cylinder carry out the following:

3.1 Using a suitable container and a length of tubing drain the clutch fluid system at the slave cylinder bleed valve (Fig 1 (1)).

3.2 Disconnect the fluid pipe (6), remove the two securing bolts (2) and withdraw the slave cylinder (5) and backing plate (3).

3.3 If the dust cover (4) is not withdrawn with the cylinder, withdraw it from the bell housing.

DISMANTLING

4 Dismantle the slave cylinder as follows:

4.1 Remove the dust cover (Fig 2 (6)).

4.2 Extract the assembled piston (5) and seal (4), applying low pressure air to the fluid inlet if necessary.

4.3 Withdraw the spring (3) from the cylinder body (2).

4.4 Remove the seal from the piston.

4.5 Remove the bleed valve (1) from the cylinder body (2).

CLEANING

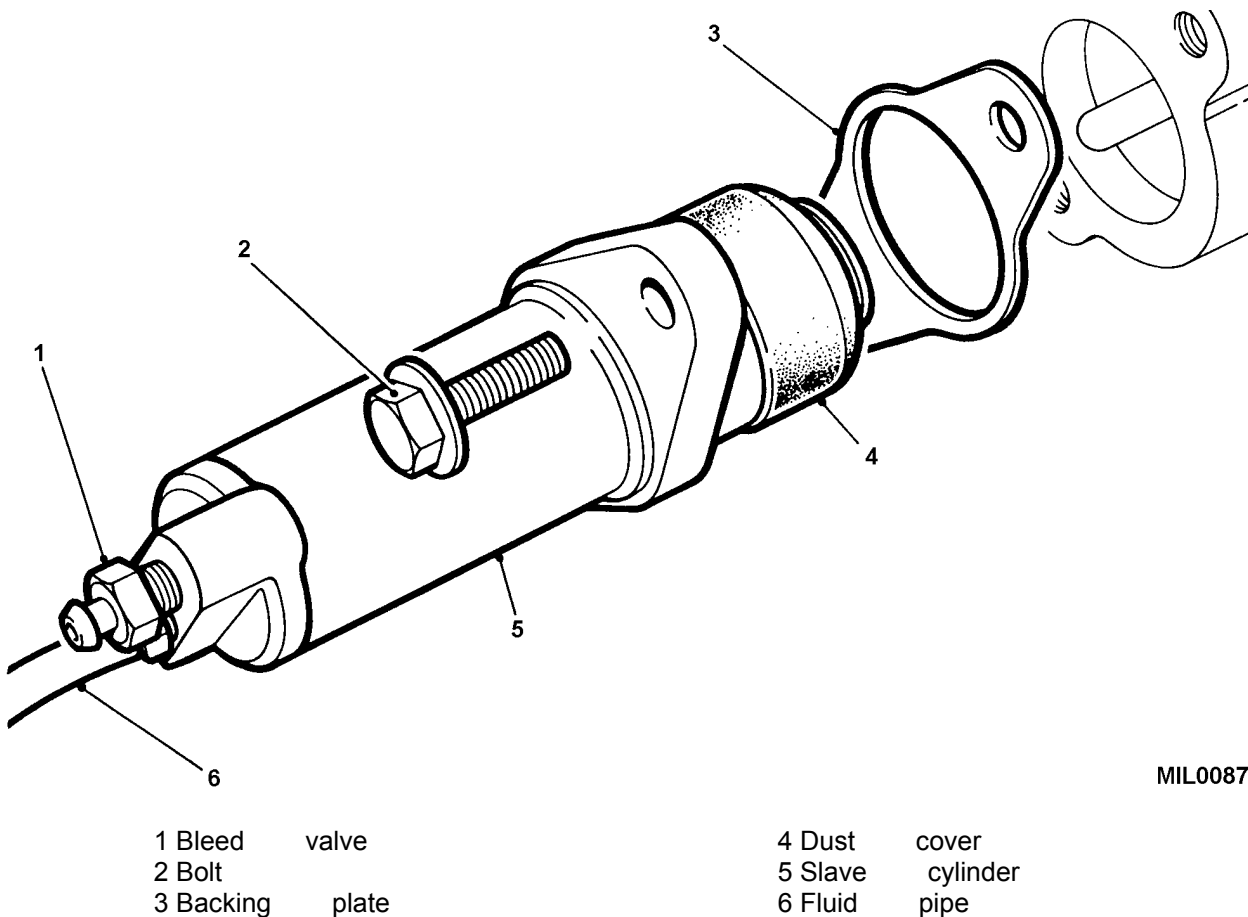
5 Thoroughly clean all of the components using new hydraulic fluid (refer to Table 1 Serial 1) and dry using a lint-free cloth.

EXAMINATION

6 Examine the cylinder bore and piston which must be free from corrosion, scores and ridges.

REPAIRS AND REPLACEMENT

7 Renew the seal and dust cover using a repair kit.



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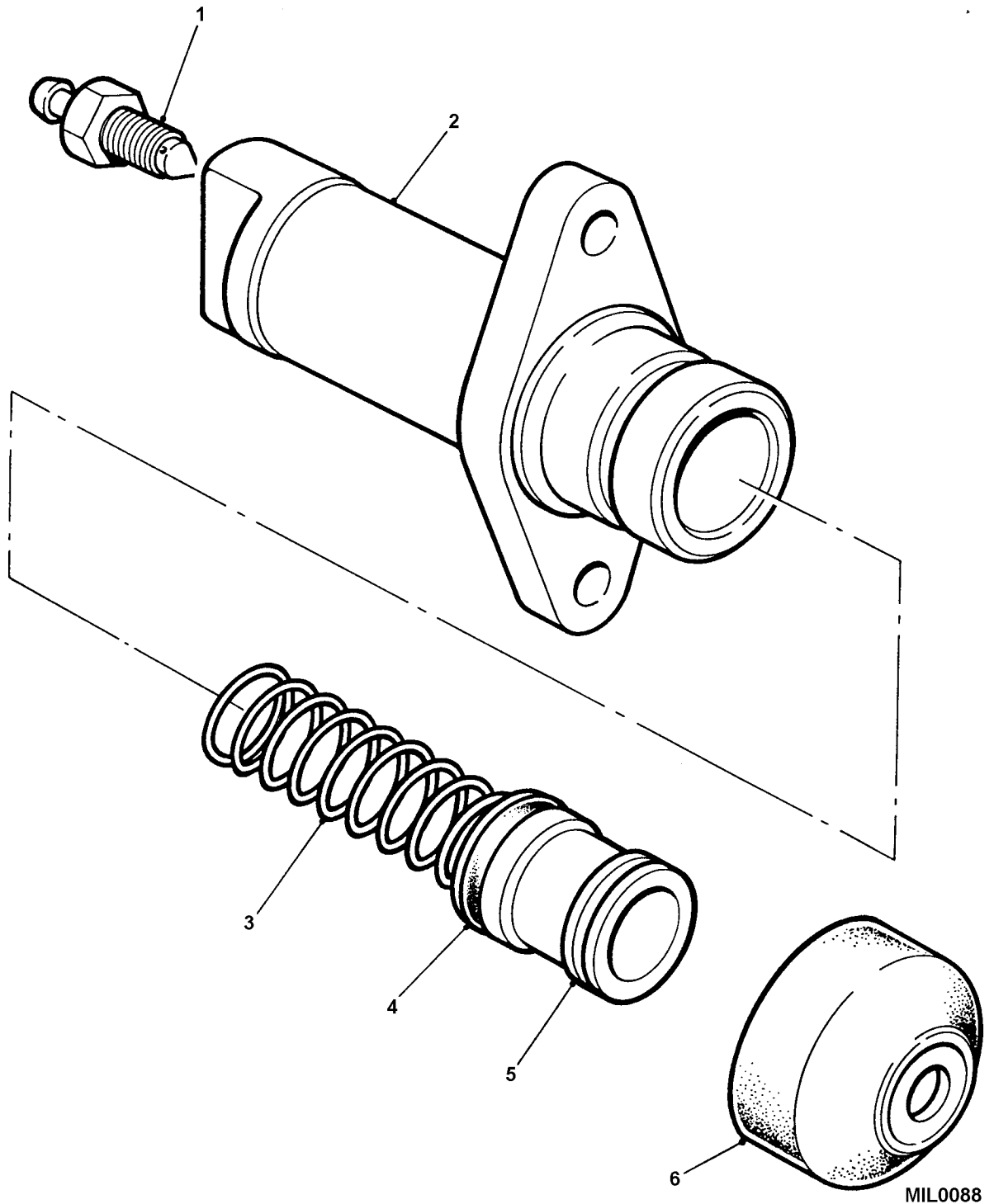
Fig 1 Slave cylinder removal/installation

REASSEMBLY**CAUTION**

CONTAMINATION. Cleanliness is essential whilst assembling the slave cylinder, ensure that hands are free from grease or dirt.

8 Reassemble the slave cylinder as follows:

- 8.1 Fit the bleed valve (1); to the cylinder body (2) do not over-tighten.
- 8.2 Lubricate the seals, piston and bore using new hydraulic fluid.
- 8.3 Fit the seal into the piston groove with the lip of the seal towards the fluid inlet end of the cylinder.
- 8.4 Locate the spring (3) over the front end of the piston (5).
- 8.5 Fit the assembly, spring first, into the cylinder ensuring that the seal lip does not fold back.
- 8.6 Fill the dust cover (6) with silicon grease (refer to Table 1 Serial 2) and fit to the cylinder body.



1 Bleed valve
2 Cylinder body
3 Spring

4 Seal
5 Piston
6 Dust cover

Fig 2 Exploded view of slave cylinder

REFITTING

9 Refit the slave cylinder as follows:

9.1 Coat both sides of the backing plate (Fig 1 (3)) with waterproof jointing compound (refer to Table 1 Serial 3).

9.2 Locate the backing plate on the cylinder, engage the push-rod through the centre of the dust cover and secure the cylinder to the bell housing, with the bleed screw uppermost.

9.3 Reconnect the fluid pipe.

9.4 Replenish and bleed the hydraulic system (refer to Para 17).

9.5 Check for fluid leaks with the pedal depressed and also with the system at rest.

MASTER CYLINDER**REMOVAL**

10 To remove the master cylinder carry out the following:

10.1 Drain the hydraulic fluid from the system.

10.2 Disconnect the fluid pipe (Fig 3 (3)) at the master cylinder (4). Blank off the fluid port and the end of the pipe to prevent the ingress of foreign matter.

10.3 Unclip the air cleaner, disconnect the bottom hose and move the assembly aside.

10.4 From inside the vehicle remove the fibre board closing panel above the pedals.

10.5 Remove the six bolts (9) securing pedal bracket (5) to the bulkhead.

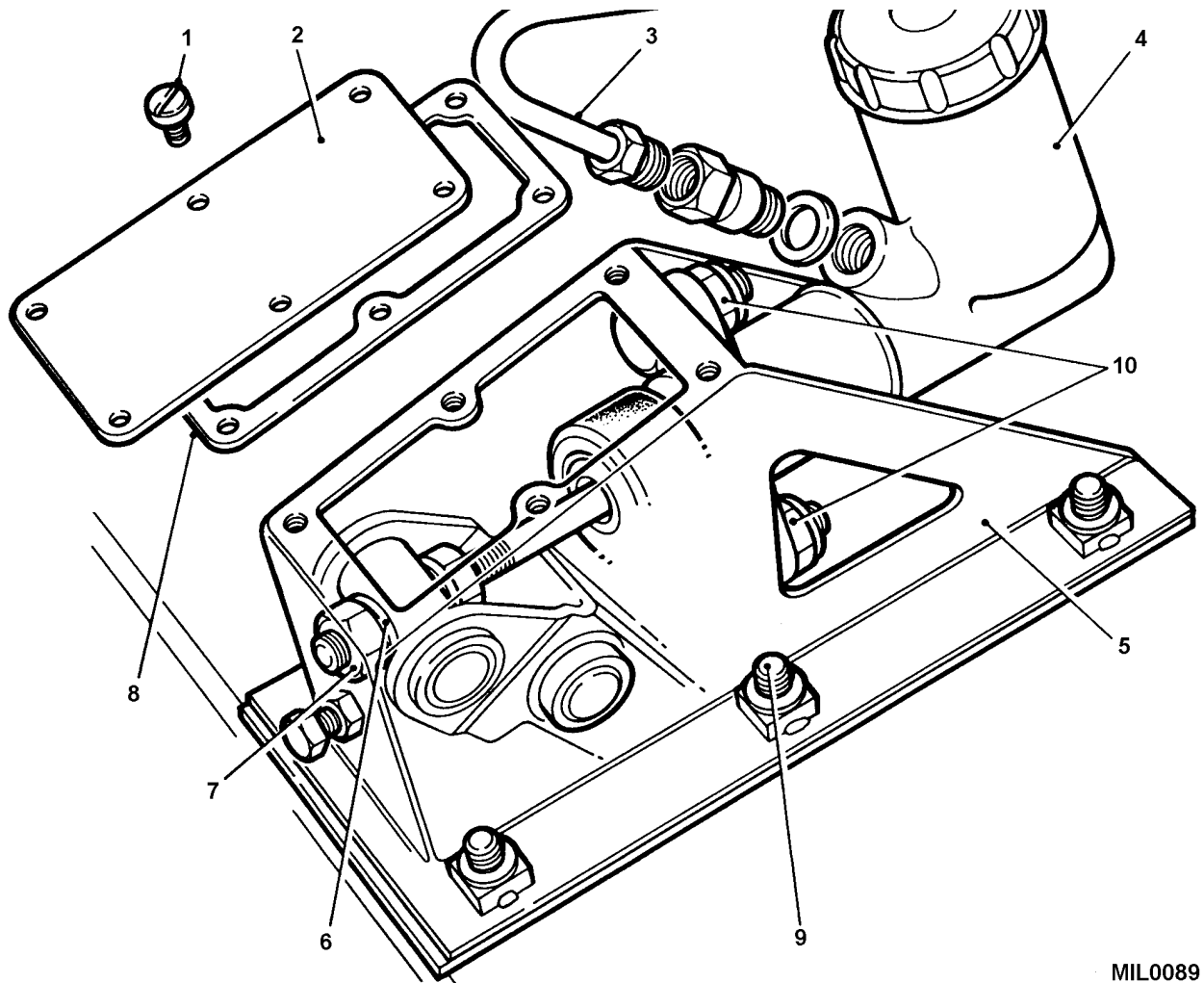
10.6 From inside the engine compartment remove the screw securing the speedometer cable to the top of the pedal bracket.

10.7 Move pipework and cables aside and lift out the pedal bracket complete, turn through 90° to ensure pedal clears hole in bulkhead.

10.8 With the assembly on a workbench, remove the six screws (1) securing the top cover (2) and gasket (8).

10.9 Remove the nut (7) and washer (6) from the end of the master cylinder push rod.

10.10 Remove the nuts and bolts (10) securing the master cylinder to the pedal bracket and remove the master cylinder.



MIL0089

- | | |
|-------------------|-------------------------|
| 1 Screw | 6 Plain washer |
| 2 Top cover | 7 Nut |
| 3 Fluid pipe | 8 Gasket |
| 4 Master cylinder | 9 Bolt |
| 5 Bracket | 10 Nut, bolt and washer |

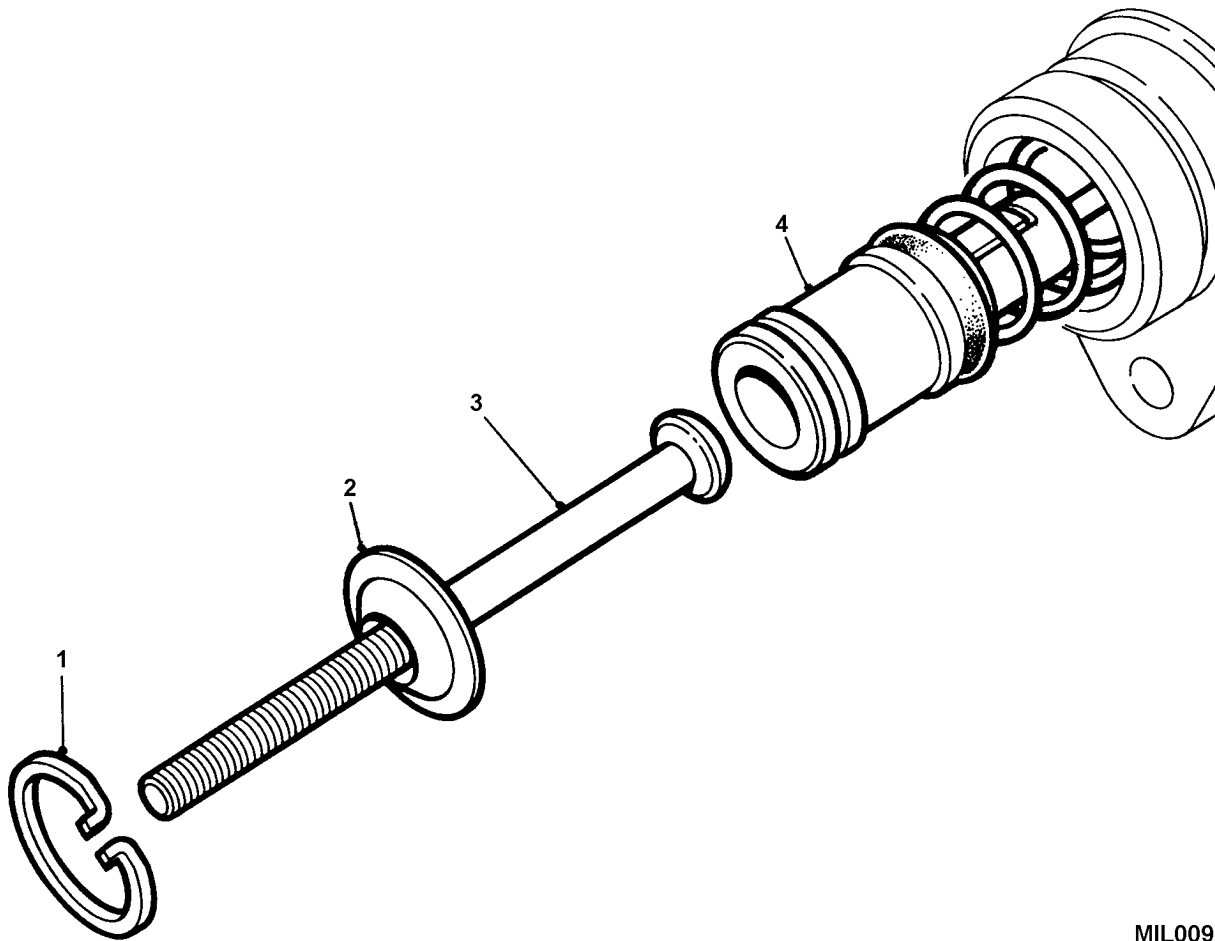
Fig 3 Master cylinder removal

DISMANTLING

11 Dismantle the master cylinder as follows:

- 11.1 Remove the circlip (Fig 4 (1)) and withdraw the push-rod (3) and retaining washer (2).
- 11.2 Withdraw the piston assembly (4). If necessary, apply a low air pressure to the fluid outlet port to expel the piston.
- 11.3 Prise the locking prong of the spring retainer clear of the piston shoulder and withdraw the piston (Fig 5).
- 11.4 Remove the seal from the piston.
- 11.5 Compress the spring (Fig 6 (2)) and position the valve stem (5) to align with the larger hole in the spring retainer (1).

- 11.6 Withdraw the spring and retainer.
- 11.7 Withdraw the valve spacer (3) and bowed washer (4) from the valve stem.
- 11.8 Remove the valve seal (6) from the stem.



MIL0090

1 Circlip
2 Retaining

washer

3 Push-rod

4 Piston assembly

Fig 4 Push-rod and piston assembly

CLEANING

12 Thoroughly clean all of the components using new hydraulic fluid (refer to Table 1 Serial 1) and dry using a lint free cloth.

EXAMINATION

13 Examine the cylinder bore and piston, ensuring that they are free from corrosion, score marks or ridges. If there is any doubt, then renew.

REPAIRS AND REPLACEMENT

14 The seals should be replaced with new seals from a master cylinder repair kit.

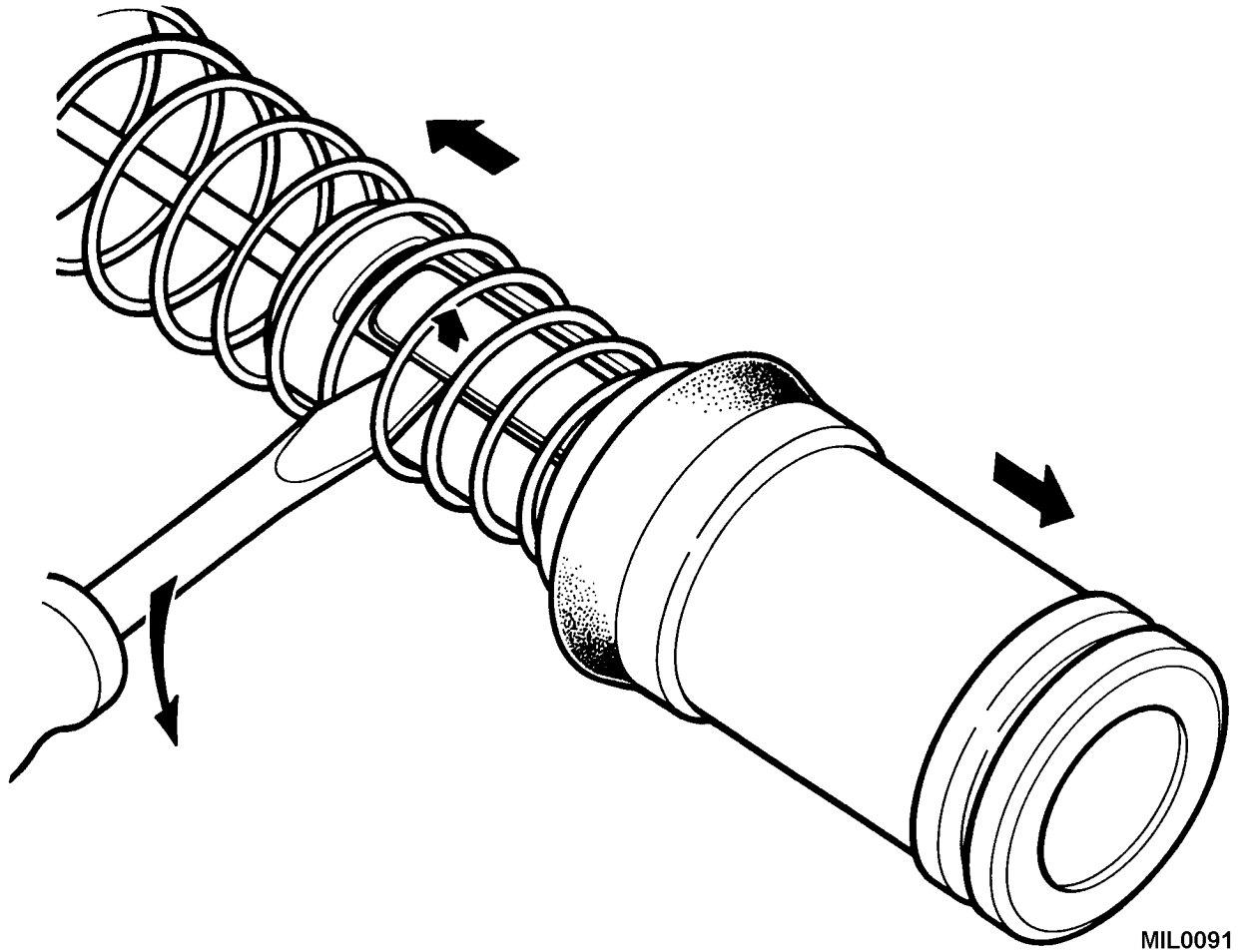
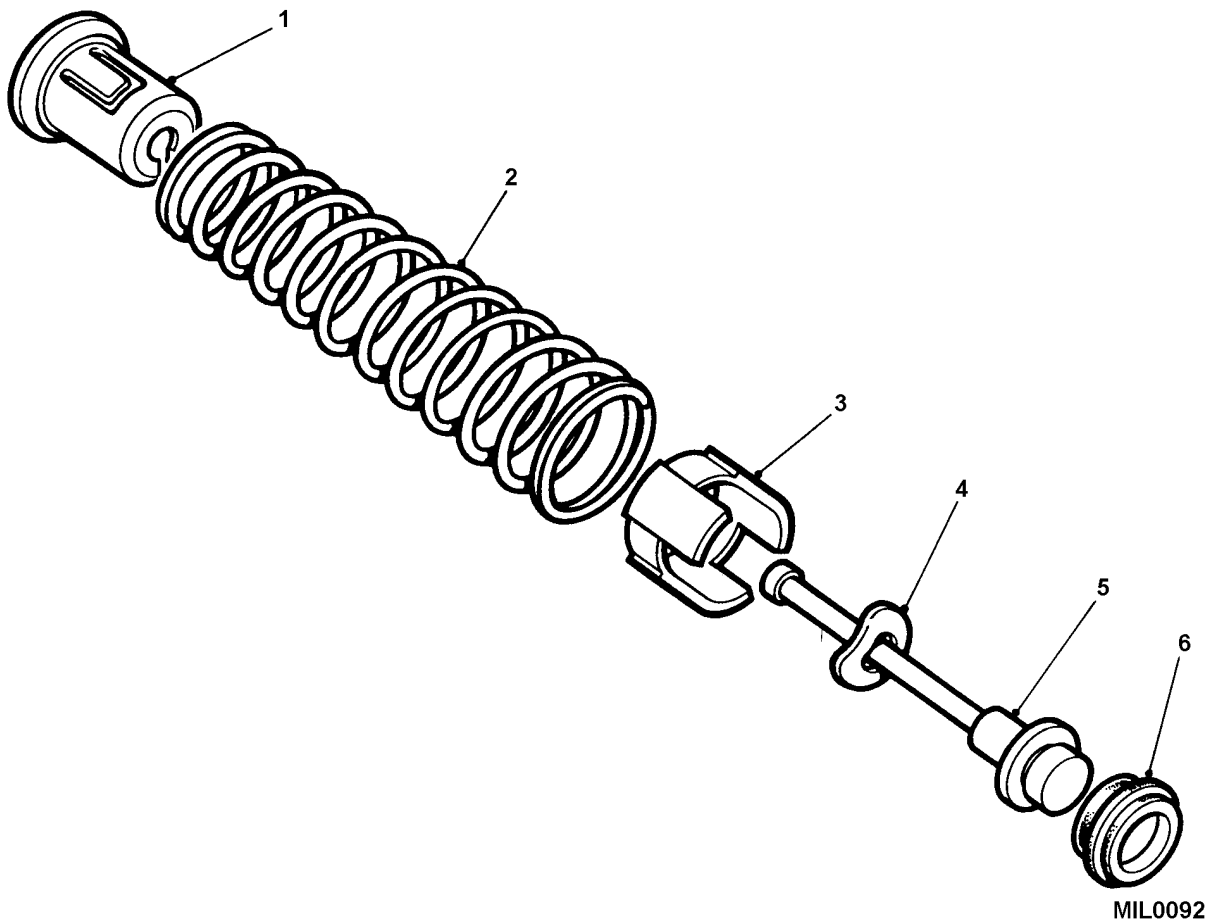


Fig 5 Removing piston from spring



1 Spring	retainer	4 Bowed	washer
2 Spring		5 Valve	stem
3 Valve	spacer	6 Valve	seal

Fig 6 Spring and valve assembly

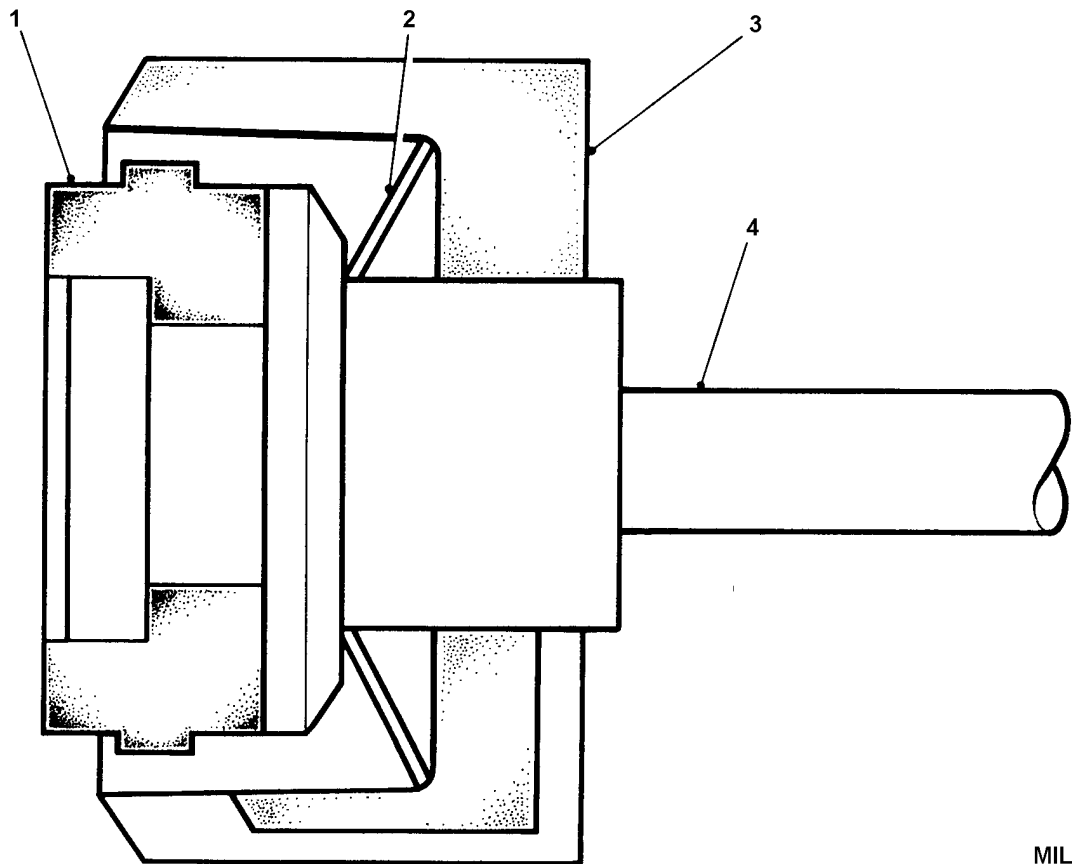
REASSEMBLY

15 To reassemble the master cylinder proceed as follows:

- 15.1 Smear the seals with silicon grease (refer to Table 1 Serial 2) and the remaining internal components with clean hydraulic fluid (refer to Table 1 Serial 1).
- 15.2 Fit the new valve seal (Fig 7 (1)), flat side first, on the end of the valve stem (4).
- 15.3 Place the bowed washer (2), domed side first, over the small end of the valve stem.
- 15.4 Fit the spacer (3) to the valve stem, legs first.
- 15.5 Insert the retainer (Fig 6 (1)) into the spring (2).
- 15.6 Compress the spring and engage the valve stem (5) in the key hole slot in the retainer.
- 15.7 Fit the new seal, large diameter last, to the piston (Fig 8 (3)).
- 15.8 Insert the piston (4) into the spring retainer (2) and engage the locking prong.

15.9 Smear the piston with a silicon grease (refer to Table 1 Serial 2) and insert the assembly, valve end first, into the cylinder.

15.10 Fit the push-rod (Fig 4 (3)), retaining washer (2) and circlip (1).



MIL0093

1 Valve seal
2 Bowed washer

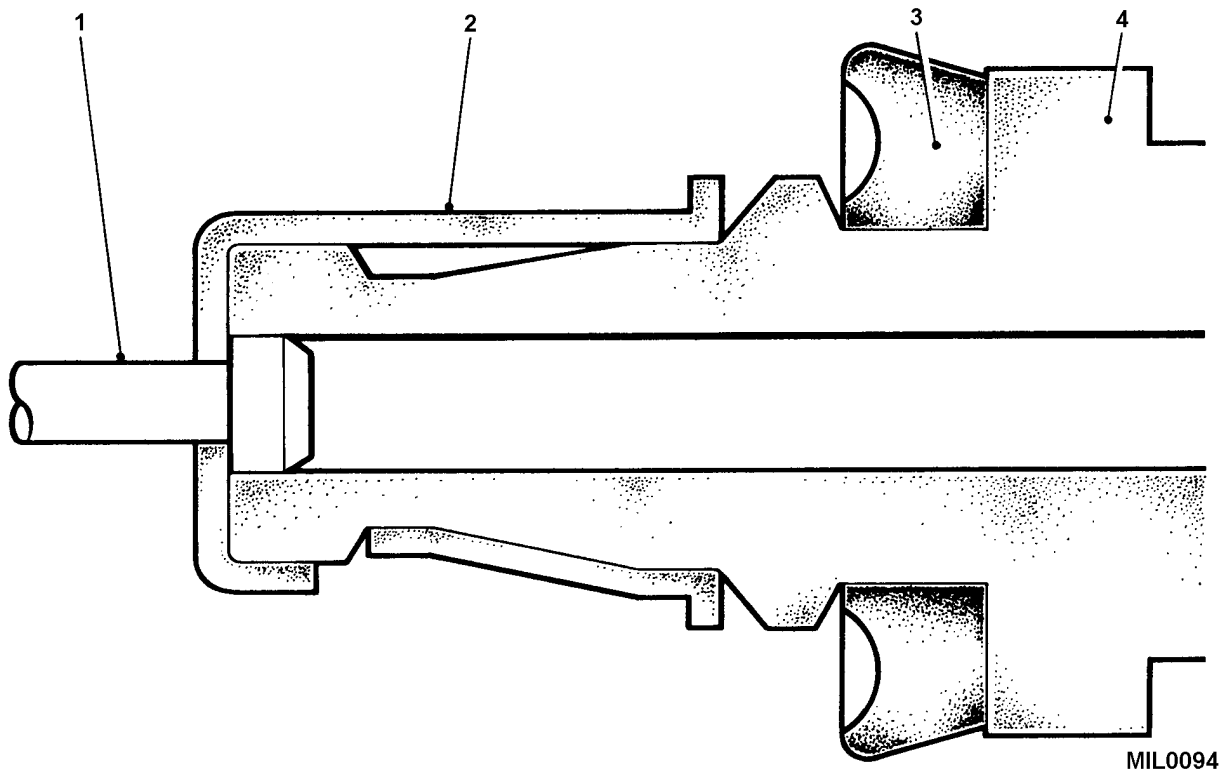
3 Valve spacer
4 Valve stem

Fig 7 Location of valve seal and bowed washer

REFITTING

16 Refit the master cylinder as follows:

- 16.1 Fit the master cylinder to the pedal bracket, engaging the cylinder push rod through the pedal trunnion.
- 16.2 Fit the plain washer and nut to the end of the push rod.
- 16.3 Fit the pedal bracket assembly onto the engine compartment bulkhead and secure.
- 16.4 Connect the fluid pipe to the master cylinder.
- 16.5 Bleed the clutch hydraulic system (refer to Para 17).
- 16.6 Carry out the clutch pedal and master cylinder setting procedure (refer to Para 18).
- 16.7 Fit the top cover and gasket to the to the pedal bracket and secure.



1 Valve stem	3 Piston seal
2 Spring retainer	4 Piston

Fig 8 Location of piston seal and spring retainer

16.8 Refit the air cleaner and hose and secure with the clips.

BLEEDING CLUTCH HYDRAULIC SYSTEM

CAUTION

HYDRAULIC FLUID. Use only the recommended hydraulic fluid (refer to Table 1 Serial 1).

NOTE

During the procedure, keep the fluid reservoir topped-up to avoid introducing air into the system.

17 To bleed the clutch hydraulic system proceed as follows:

17.1 Attach a length of suitable tubing to the slave cylinder bleed screw.

17.2 Place the free end of the tube in a glass jar containing clean clutch fluid.

17.3 Slacken the bleed screw.

17.4 Pump the clutch pedal, pausing at the end of each stroke, until the fluid issuing from the tubing is free of air with the free end below the surface of the fluid in the jar.

17.5 Whilst holding the clutch pedal down and with the free end of the tube below the fluid, tighten the bleed screw.

CLUTCH PEDAL AND MASTER CYLINDER SETTING

18 To set the clutch pedal and master cylinder carry out the following:

18.1 Slacken both locknuts on the master cylinder push rod.

18.2 Check the distance from the lower edge of the clutch pedal to the floor. The correct distance is 140 mm (5.500 in.) without a floor mat (Fig 9).

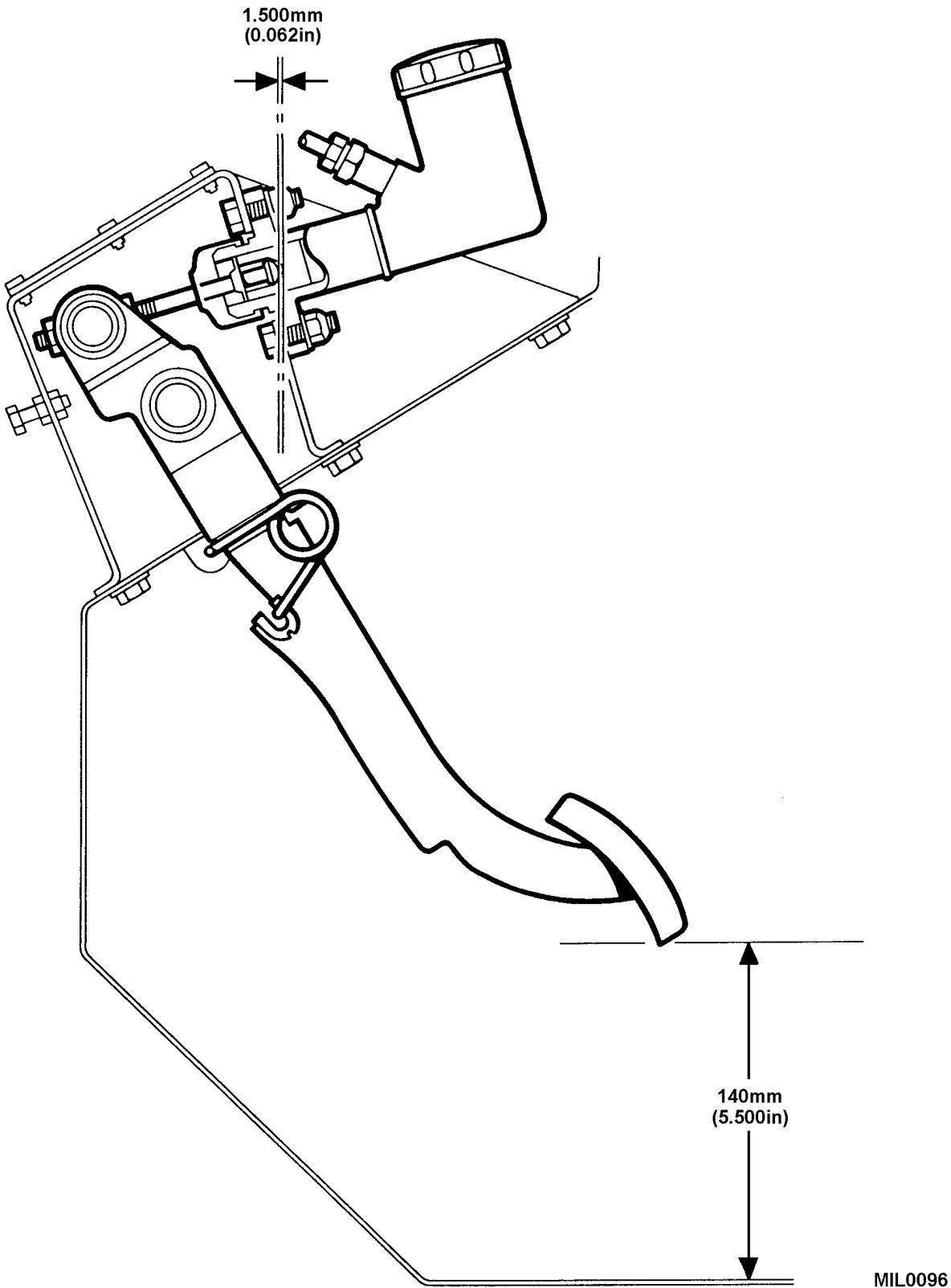
18.3 Adjust the pedal stop as necessary to obtain the correct distance.

18.4 Adjust the master cylinder push-rod until there is approximately 1.500 mm (0.062 in.) free play between the push rod and the master cylinder piston.

18.5 Tighten both locknuts.

18.6 Check the clutch pedal and ensure that there is a minimum of 6 mm (0.250 in.) free movement before pressure is felt. If necessary, readjust the master cylinder push rod.

18.7 Fit the gasket and top cover to the clutch pedal bracket.



MIL0096

Fig 9 Clutch pedal setting

CHAPTER 3

FIVE SPEED MANUAL GEARBOX

CONTENTS

Para

- 1 Introduction
Torque list
GEAR LEVER
 - 2 Removal
 - 3 Refitting
- GEARBOX MOUNTINGS
- 4 Removal
 - 5 Refitting

Fig

Page

- 1 Gearbox mountings..... 2

INTRODUCTION

1 This chapter details the Unit repairs for Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles fitted with the five speed manual gearbox and the 2.5 litre 300 Tdi direct injected turbocharged diesel engines.

TORQUE LIST

Gear selector lever to shaft 40-47Nm/29-35 lbf ft *

* New self locking nut must be used

GEAR LEVER

Removal

2 To remove the gear lever proceed as follows:

2.1 Remove the knobs from the transfer and differential lock lever and from the main gearchange lever.

2.2 Remove the gear lever cover.

2.3 Remove the 10 mm nyloc nut and washer securing the gearchange lever. Mark the gear lever spline setting and detach the lever and gaiter from the splined lower gear lever.

Refitting

3 To replace the gear lever proceed as follows:

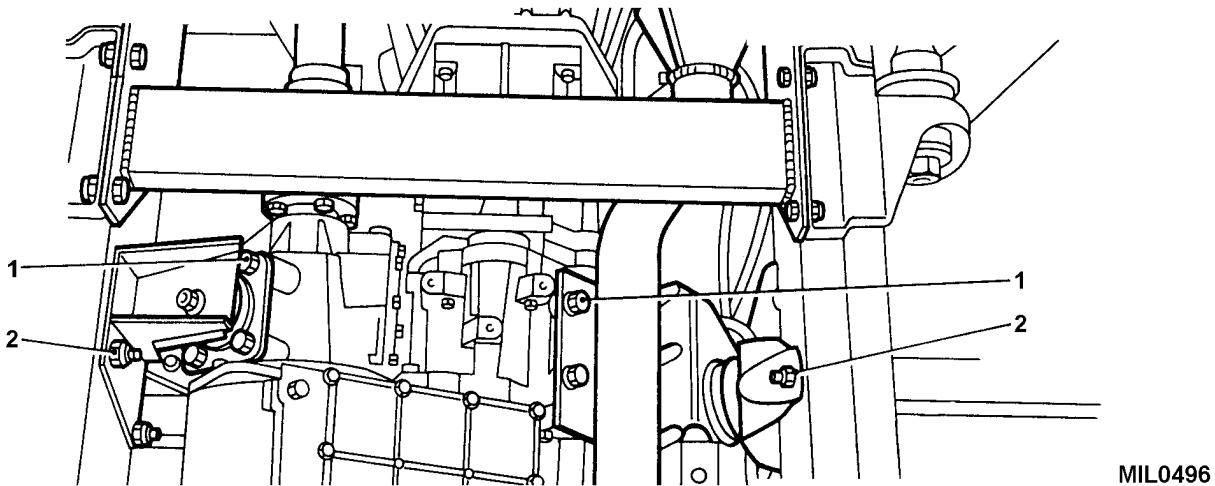
3.1 Fit the main gear lever gaiter and lever to the previously marked spline setting, and secure with a new 10 mm Nyloc nut and washer. Tighten to a torque of 40 to 47 Nm (29 to 35 lbf ft).

3.2 Fit the cover to both gear levers and fit the gear lever knobs.

GEARBOX MOUNTINGS

Removal

- 4 To remove the gearbox mountings proceed as follows:
 - 4.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
 - 4.2 Support the gearbox using suitable lifting equipment.
 - 4.3 From underneath the vehicle remove bolts (Fig 1 (1)) securing left and right hand mounting brackets to gearbox.
 - 4.4 Take the weight of the transmission.
 - 4.5 Remove the nuts and bolts (2) securing the left and right hand mounting brackets to the chassis.
 - 4.6 Remove the mounting brackets.



- 1 Gearbox/mounting bracket bolts 2 Mounting bracket/chassis nuts and bolts

Fig 1 Gearbox mountings

Refitting

- 5 To replace the gearbox mountings proceed as follows:
 - 5.1 Refitting of the mounting brackets is the reverse of the removal procedure.

CHAPTER 4

LT230T TRANSFER BOX AND PROPELLER SHAFTS

CONTENTS

Para

- 1 Introduction
PROPELLER SHAFTS
Torque list
- 2 Removal and refitting
- 3 Dismantling
- 4 Reassembly

Table

1	Sealants, adhesives and lubricants	1
---	--	---

Page

Fig

1	Propeller shaft alignment marks	2
2	Separating propeller shaft halves	3
3	Removing propeller shaft universal joint flange.....	4
4	Removing bearing cups	5
5	Fitting bearing cups.....	6

INTRODUCTION

1 This chapter details the Unit repair of the LT230T Transfer gearbox and Propeller shafts as fitted Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS and (TUM) Ambulance HS. However, there are no repairs applicable to the Transfer gearbox at this level of repair.

PROPELLER SHAFTS

TORQUE LIST

Propeller shaft flange bolts 41-52 Nm/30-38 lbf ft

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

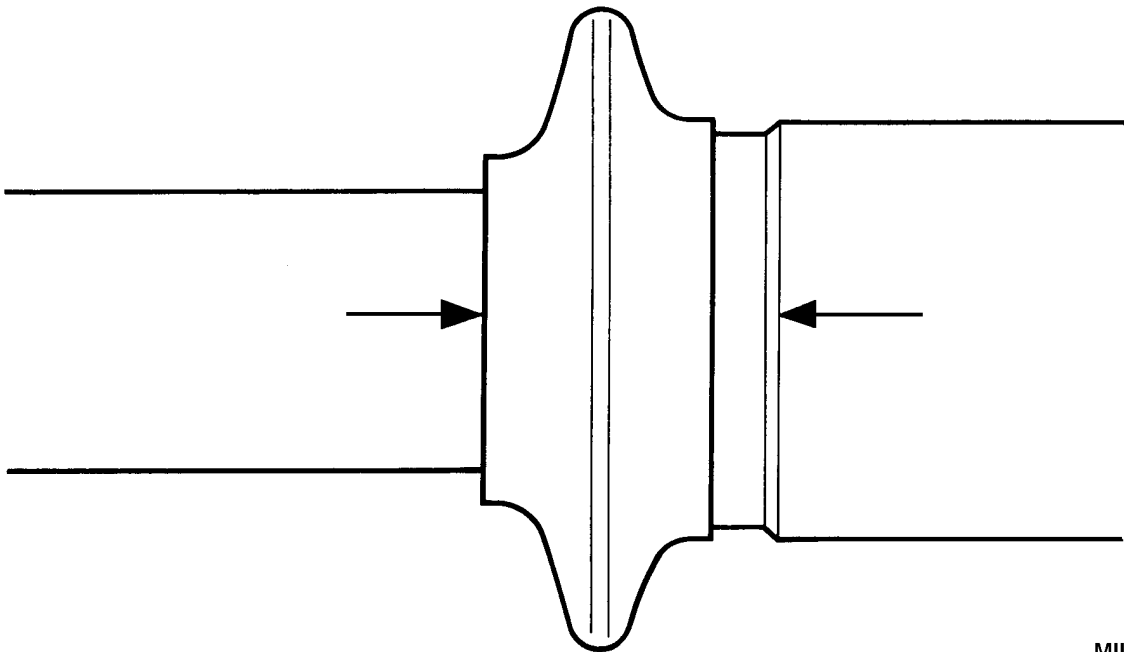
Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	XG 291	9150-99-918-3786	Grease

REMOVAL AND REFITTING

2 The removal and refitting of propeller shafts is self evident. When refitting tighten the flange bolts to a torque of 41 to 52 Nm (30 to 38 lbf ft).

NOTE

When fitted the splined sliding joint of the front propeller shaft should be adjacent to the front output housing of the transfer box and the rear shaft fitted with the sliding joint adjacent to the rear output housing of the transfer box.



MIL0193

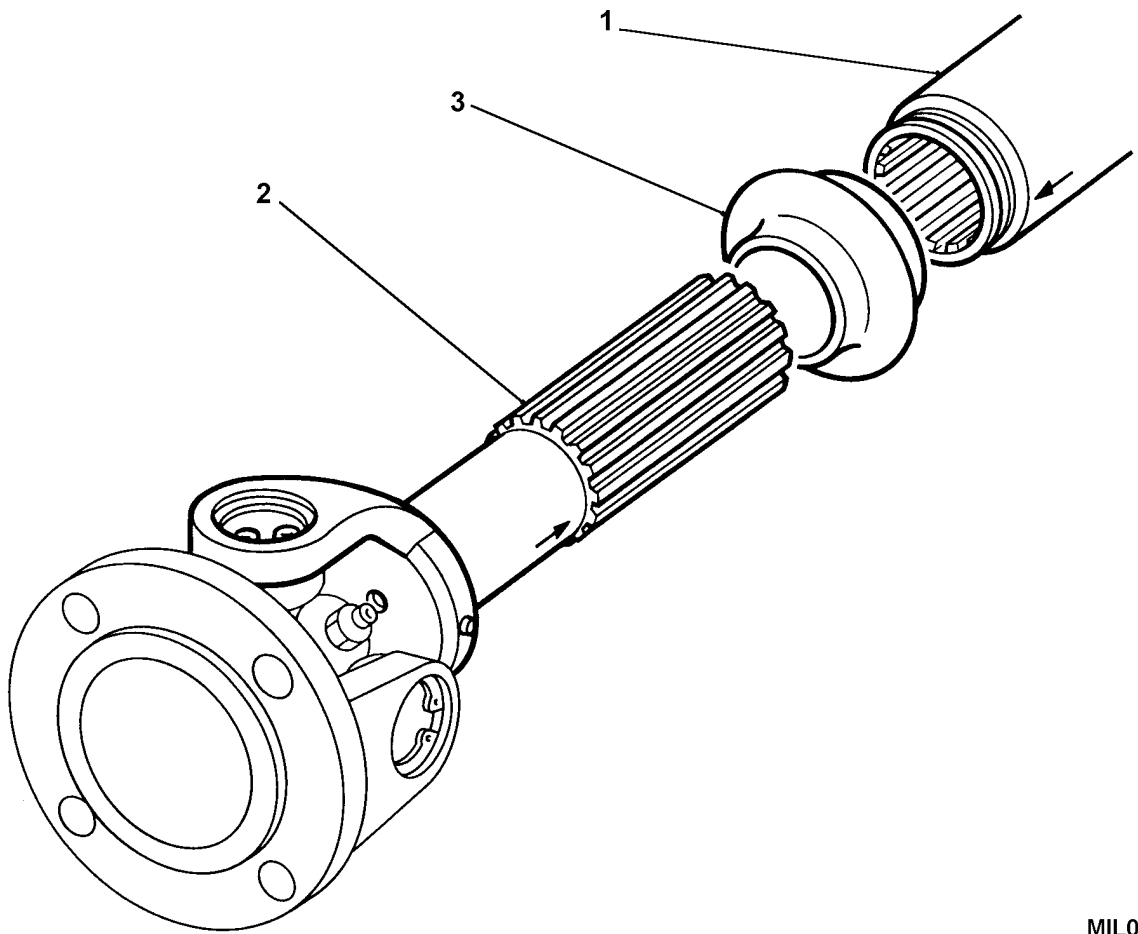
Fig 1 Propeller shaft alignment marks

DISMANTLING

- 3 To dismantle the propeller shafts carry out the following:
 - 3.1 Mark the propeller shaft and sliding member to assist reassembly (Fig 1).
 - 3.2 Carefully separate the shaft (Fig 2 (1)) and sliding member (2).
 - 3.3 Remove the rubber gaiter (dust cap) (3) from the propeller shaft.
 - 3.4 Clean and examine the splines for wear or damage. Renew the propeller shaft assembly if excessive spline wear is evident. Check the rubber gaiter for signs of perishing or splitting and renew, if necessary.
 - 3.5 Remove paint, rust etc. from the vicinity of the universal joint bearing cups and circlips.

NOTE

Before dismantling the universal joint, mark the position of the grease nipple relative to the journal yoke ears. On reassembly align the marks to reduce the possibility of imbalance.



MIL0194

2
1 Propeller shaft
Sliding member

3 Rubber gaiter

Fig 2 Separating propeller shaft halves

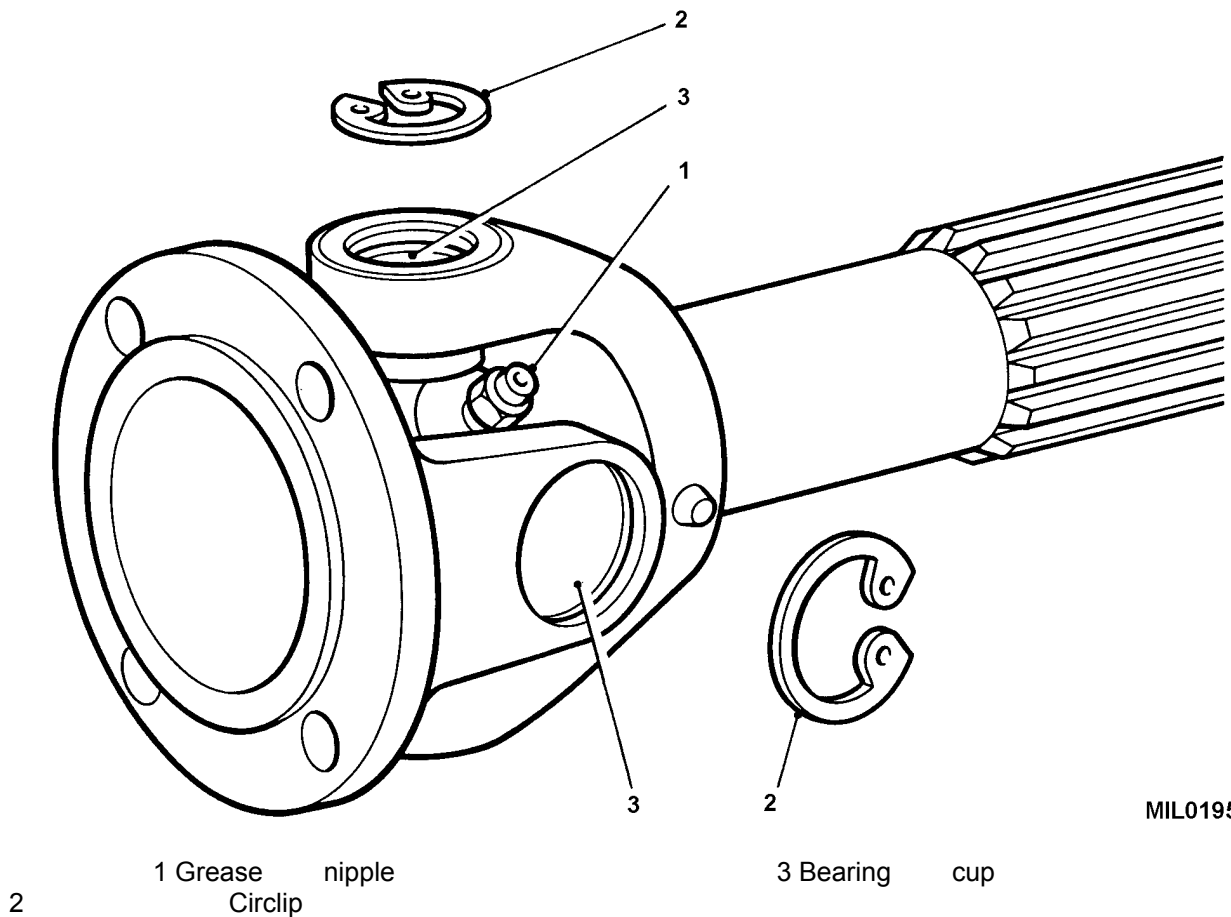
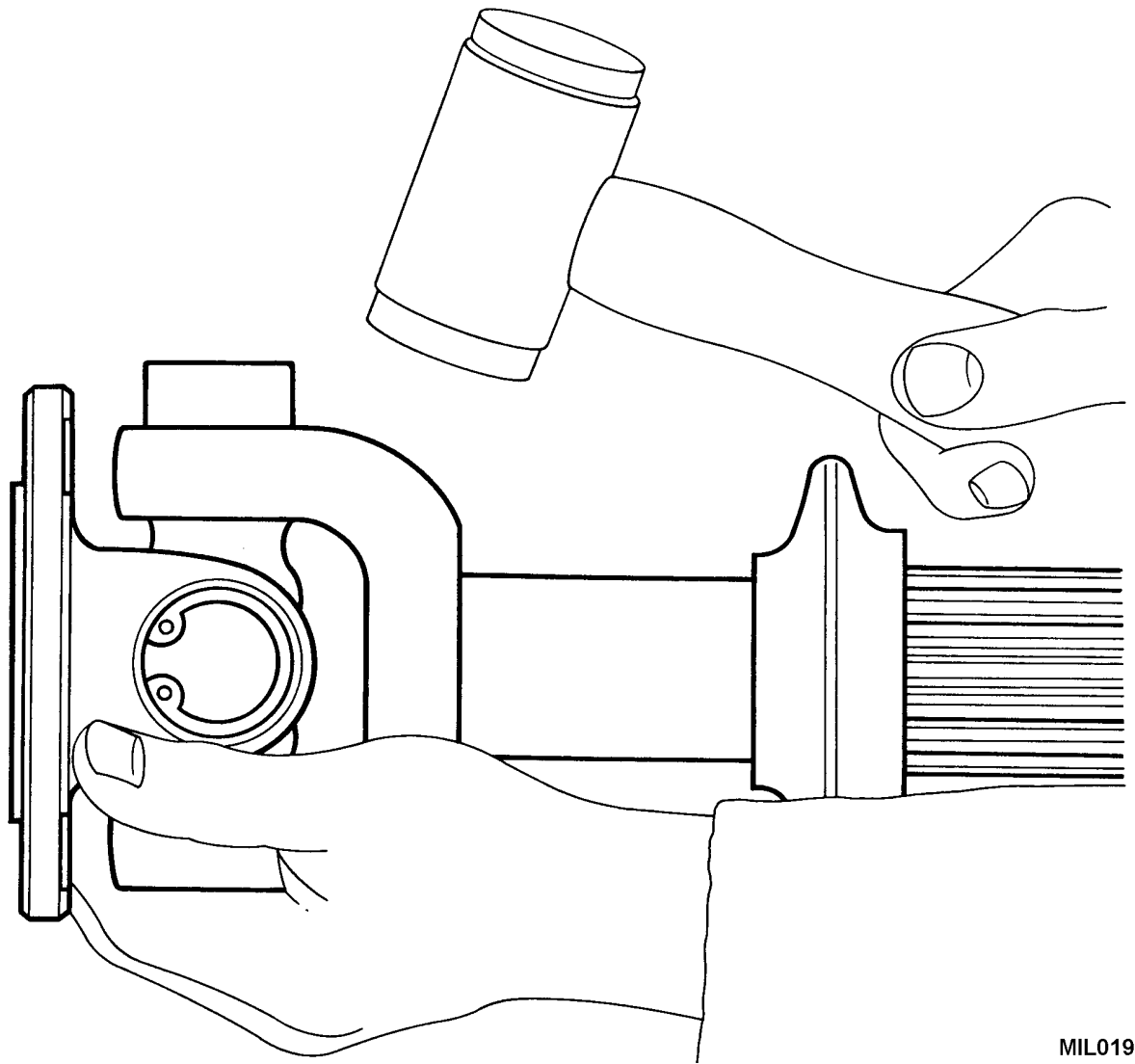


Fig 3 Removing propeller shaft universal joint flange

- 3.6 Remove the grease nipple (Fig 3 (1)) and circlips (2).
- 3.7 Tap the yokes (Fig 4) to eject the bearing cups (Fig 3 (3)).
- 3.8 Withdraw the bearing cups and spider and discard.
- 3.9 Repeat the previous operations to dismantle the universal joint at the other end of the propeller shaft.
- 3.10 Thoroughly clean the yokes and bearing cup locations.



MIL0196

Fig 4 Removing bearing cups

REASSEMBLY

- 4 To reassemble the propeller shaft proceed as follows:
 - 4.1 Remove the bearing cups from the new spider.
 - 4.2 Check that all needle rollers are present and are correctly positioned in the bearing cups.
 - 4.3 Ensure that the bearing cups are one third full of grease (refer to Table 1 Serial 1).
 - 4.4 With the grease nipple facing away from the flange, insert the new spider, complete with seals, into the yokes of the sliding member flange.
 - 4.5 Partially insert one bearing cup into a flange yoke and enter the spider trunnion into the bearing cup, taking care not to dislodge the needle rollers.

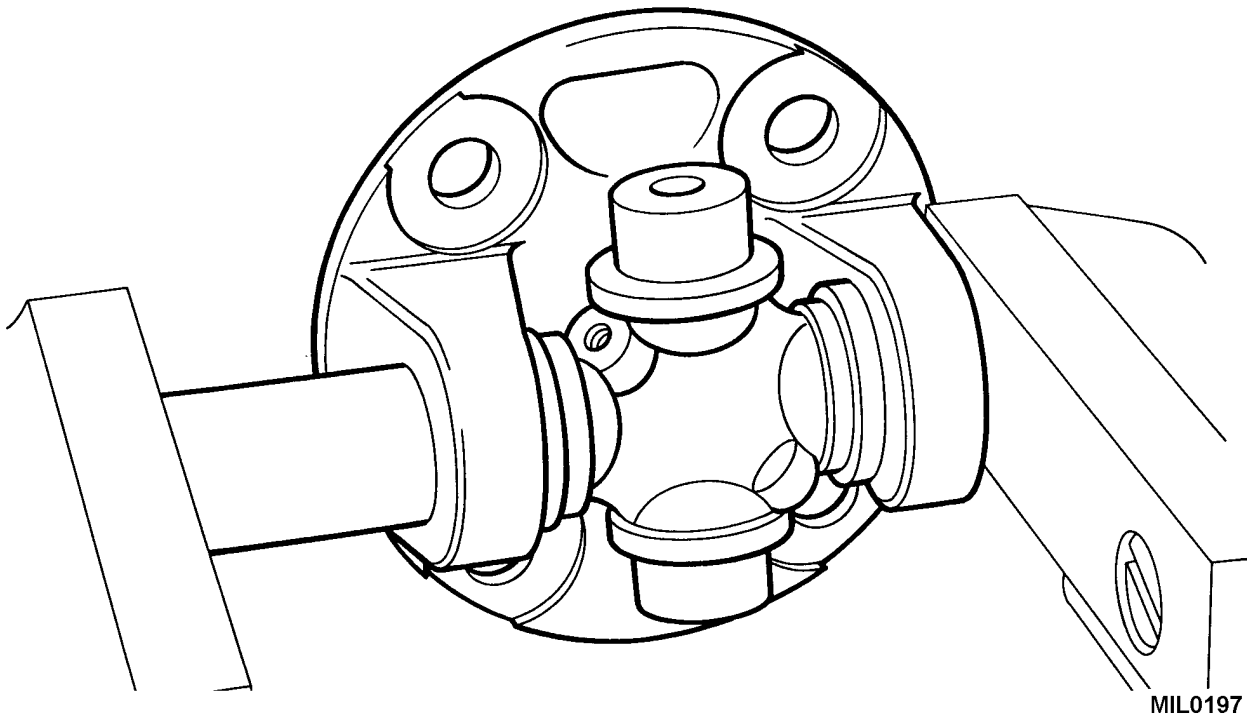


Fig 5 Fitting bearing cups

- 4.6 Insert a bearing cup into the opposite flange yoke. Using a vice (Fig 5), carefully press both cups into place, taking care to engage the spider trunnion without dislodging the needle rollers.
- 4.7 Remove the assembly from the vice.
- 4.8 Using a flat faced adaptor of a slightly smaller diameter than the bearing cups press each cup into its respective yoke until they reach the lower land of the circlip groove. Do not press the cups below this point or damage may be caused to the cups and seals.
- 4.9 Fit new circlips to retain the bearing cups.
- 4.10 Engage the spider in the yokes of the sliding member. Fit the bearing cups and circlips (refer to Para 4.5 to 4.9).
- 4.11 Repeat the complete procedure to fit the flange to the other end of the shaft.

NOTE

The universal joints on the front propeller shaft are, by design, not in-line with one another. The alignment marks on the sliding member and propeller shaft must coincide when reassembling.

- 4.12 Fit the rubber gaiter on the propeller shaft, ensuring the lip of the gaiter locates securely in the recess at the end of the propeller shaft.
- 4.13 Lubricate the splines of the sliding member with grease (refer to Table 1 Serial 1) and fit it to the propeller shaft.
- 4.14 Fit the grease nipples to the spiders and propeller shaft and lubricate with grease (refer to Table 1 Serial 1).

NOTE

Examine the grease nipples for damage before greasing. Ensure the grease gun locks onto the grease nipple, make sure grease is passed into the needle bearings of the prop shaft, evident when grease is expelled from the rubber seals. If grease fails to be expelled when grease gun is locked on the grease nipple should be examined for signs of damage and replaced as required.

4.15 Fit the propeller shaft to the vehicle (refer to Para 2).

CHAPTER 5

FRONT AXLE

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

This chapter covers the Unit repairs for Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles fitted with the Rover front axles. The repair instructions detailed are applicable to both left and right hand drive vehicles.

General

This chapter has been sub-chaptered to allow for the various types of vehicle axles/options as detailed below.

- 1.1 Chapter 5-1 Front Axle

CHAPTER 5-1

FRONT AXLE

CONTENTS

Para

1	Introduction FRONT AXLE ASSEMBLY Torque list
2	Removal (WARNING)
3	Refitting (WARNING) HUB ASSEMBLY
4	Removal
5	Dismantling
6	Reassembly STUB AXLE, AXLE SHAFT, CONSTANT VELOCITY JOINT AND SWIVEL ASSEMBLY Removal and dismantling
7	Stub axle
8	Axle shaft and constant velocity joint
9	Swivel assembly
10	Cleaning
11	Examination
12	Repairs and replacements
13	Reassembly
14	Swivel assembly
15	Constant velocity joint
16	Stub axle (CAUTION)
17	Refilling swivel assembly
18	Setting steering lock stop bolts DIFFERENTIAL ASSEMBLY
19	Removal
20	Refitting
21	Running in

Table

Page

1	Special tools.....	3
2	Sealants, adhesives and lubricants	3
3	Service kits.....	3
4	Hub shim spacers	12
5	Swivel pin housing shim spacers.....	19

Fig

1	Radius arm fixings at chassis member	4
2	Track rod protection bracket	4
3	Track rod to swivel housing ball joint	5
4	Radius arm to axle securing bolt.....	5
5	Panhard rod to axle.....	6
6	Drag link to swivel housing ball joint	6
7	Axle breather banjo bolt	7
8	Shock absorber lower securing nuts.....	8
9	Anti-roll bar links.....	9
10	Front hub assembly	11

(continued)

CONTENTS (continued)

Fig		Page
11	Checking drive shaft end play	1 3
12	Removing stub axle bearing and oil seal.....	14
13	Stub axle and swivel assembly.....	15
14	Removing constant velocity joint from axle shaft	16
15	Removing steel balls	17
16	Dismantling constant velocity joint	17
17	Checking swivel housing resistance.....	20
18	Fitting constant velocity joint to axle shaft	21
19	Removing the differential assembly	22

INTRODUCTION

1 This chapter covers the Unit repairs for Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles fitted with the Rover front axles. The repair instructions detailed are applicable to both left and right hand drive vehicles.

NOTEWheel bearings

After any examination or repair wheel bearings should be repacked with grease (refer to Para 6). Examination should take place at every major service period equivalent to 2 years.

FRONT AXLE ASSEMBLY**TORQUE LIST**

Propeller shaft flange bolts	41-52 Nm/30-38 lbf ft
Panhard rod axle bracket nuts	230 Nm/170 lbf ft
Radius arm to axle	190 Nm/140 lbf ft
Radius arm to chassis side member	190 Nm/140 lbf ft
Drag link to track rod end ball joints	40 Nm/30 lbf ft
Shock absorber lower securing nuts	75 Nm/55 lbf ft
Brake disc to hub	65-80 Nm/48-59 lbf ft
Hub lock nut (initial)	30 Nm/23 lbf ft *
Hub lock nut (final)	200-220 Nm/148-163 lbf ft *
Driving member to hub	65 Nm/48 lbf ft
Brake calliper 100	Nm/74 lbf ft
Wheel nuts	170 Nm/125 lbf ft
Bearing housing to axle	73 Nm/54 lbf ft
Lower swivel pin bolts	25 Nm/18 lbf ft
Top swivel pin bolts (initial)	65 Nm/48 lbf ft
Top swivel pin bolts (final)	78 Nm/57 lbf ft
Track rod ball joint	40 Nm/29 lbf ft
Stub axle to swivel pin	65 Nm/48 lbf ft
Differential to axle casing	36-46 Nm/27-34 lbf ft**

* New lock nut must be used

** New self locking nuts must be used

NOTE

The special tools listed in the following table will be referred to in the text, where used, by the serial number shown in the table.

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	LRT-37-004	6MT2/5120-99-725-6474	Front stub axle oil seal and bearing remover

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

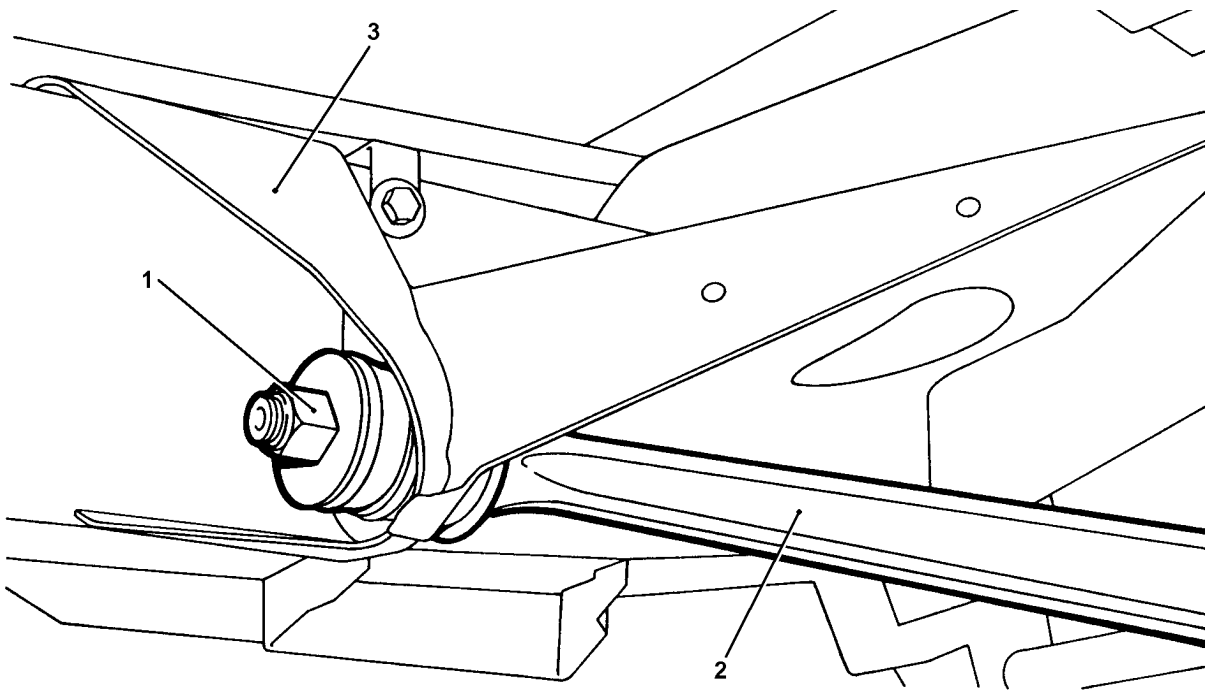
Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Loctite 270	8030-99-224-9318	Sealing compound
2	RTV	8030-99-224-6527	Silicone sealing compound
3	XG 291	9150-99-918-3786	Grease
4	OEP 220	9150-99-220-1477	Axle oil
5	Texaco Molytech EP00	9150-99-911-1798	Grease cartridge, one shot
6	Loctite 243	8030-01-475-2444	Thread lock

TABLE 3 SERVICE KITS

Serial (1)	NSN/Part Number where applicable (2)	Designation (3)
1	7XD 5306-99-808-7428	Patch loc bolt

REMOVAL

- 2 To remove the axle assembly from the vehicle carry out the following:
 - 2.1 Jack up the front of the vehicle and support the chassis frame with suitable stands.
 - 2.2 Remove the front road wheels.
 - 2.3 Support the axle weight with a suitable hydraulic jack.

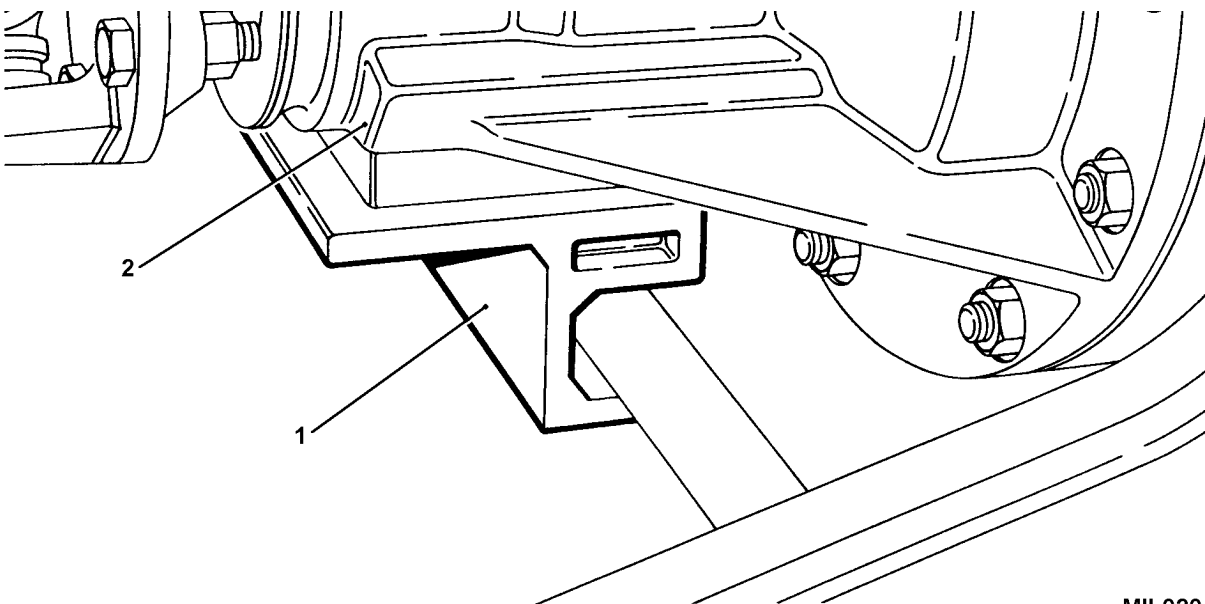


MIL0203

- 1 Nut and washer
- 2 Radius arm
- 3 Chassis side member

Fig 1 Radius arm fixings at chassis member

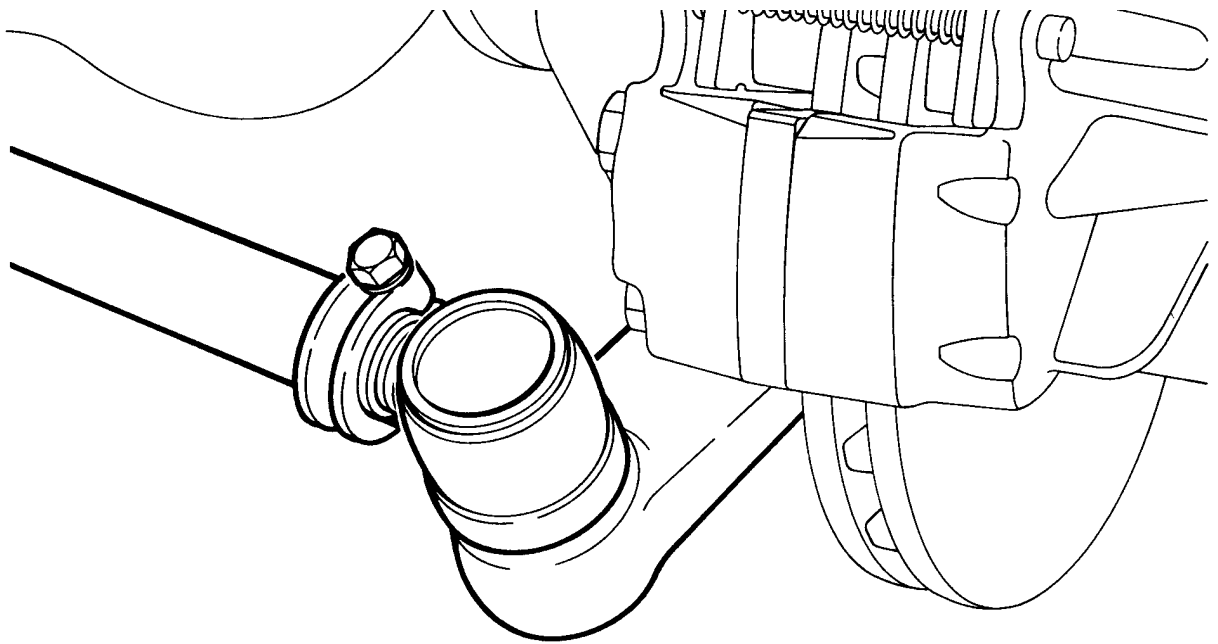
2.4 Remove the nuts and washers (Fig 1 (1)) securing the radius arms (2) to the chassis side members (3).



MIL0204

- 1 Track rod protection bracket
- 2 Differential assembly

Fig 2 Track rod protection bracket



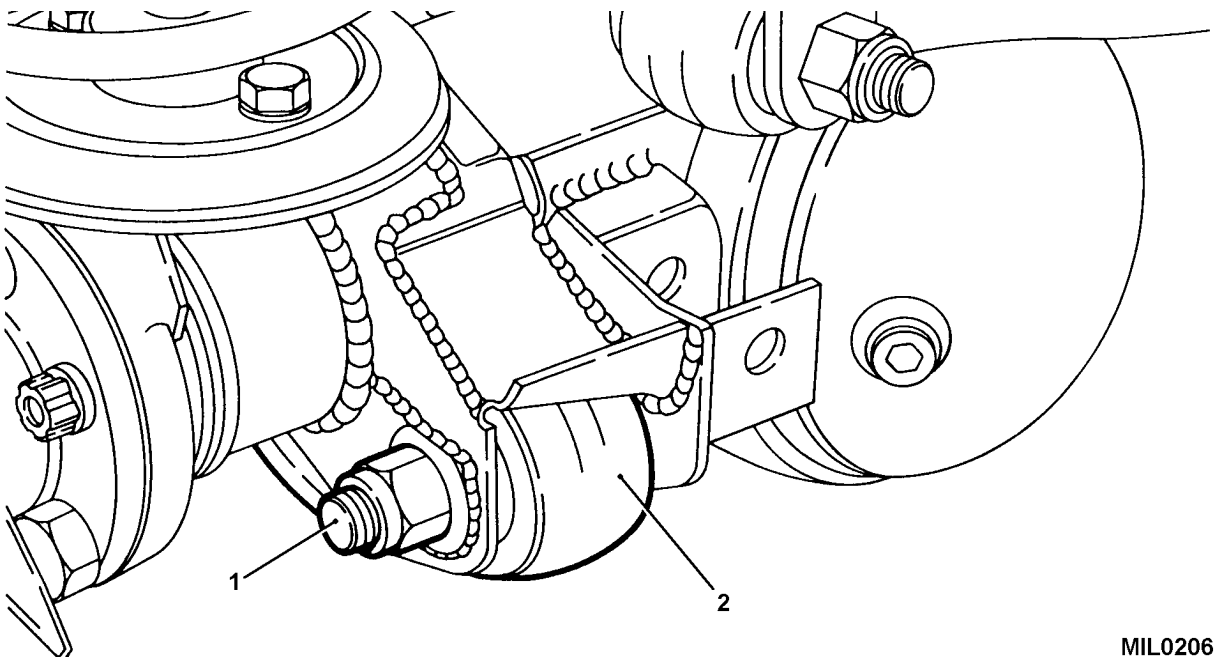
MIL0205

Fig 3 Track rod to swivel housing ball joint

2.5 Remove the track rod protection bracket (Fig 2 (1)) from the underside of the differential assembly (2).

2.6 Remove the nuts from the track rod ball joints and using a suitable extractor remove the track rod from the swivel housings (Fig 3).

2.7 Remove the nuts and bolts (Fig 4 (1)) securing the radius arms (2) to the axle brackets. Release the radius arms from the brackets and withdraw them from the chassis side members.

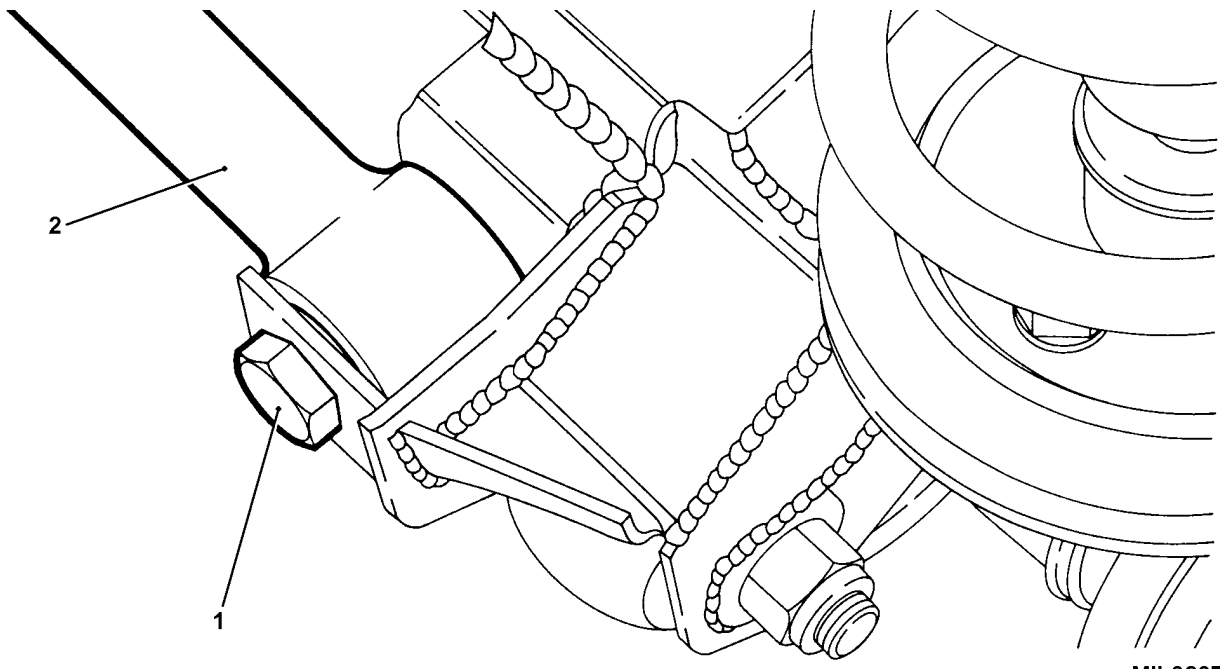


MIL0206

1 Nut and bolt

2 Radius arm

Fig 4 Radius arm to axle securing bolt



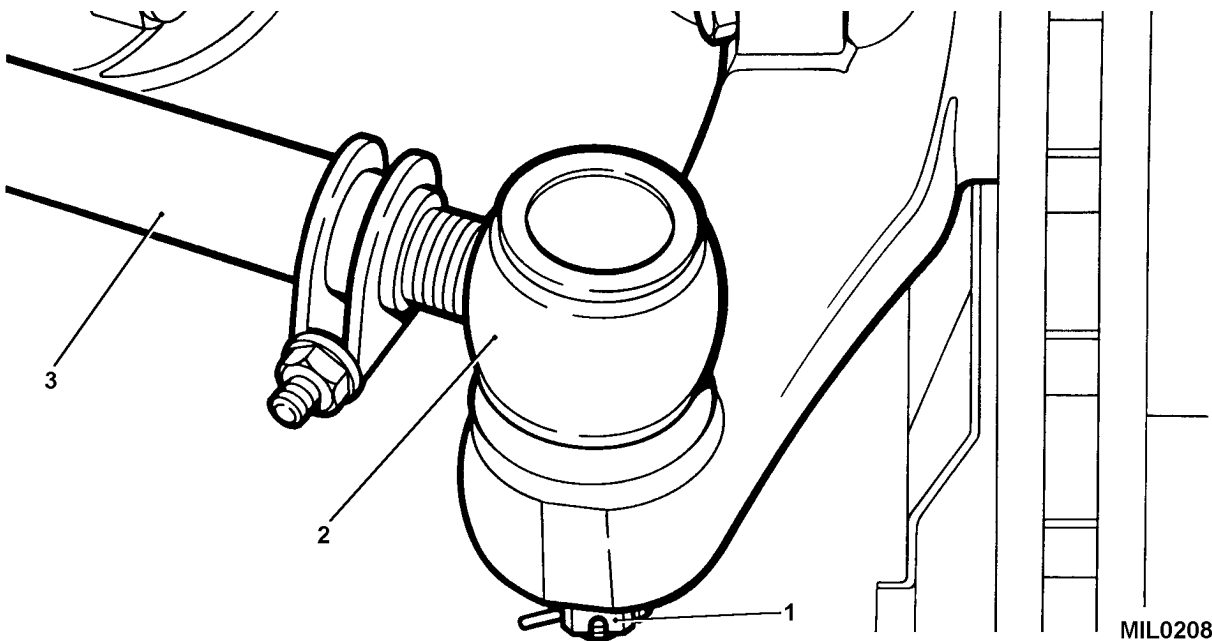
MIL0207

- 1 Nut and bolt
- 2 Panhard rod

Fig 5 Panhard rod to axle

2.8 Remove the nut and bolt (Fig 5 (1)) securing the panhard rod (2) to the axle, tie to chassis to keep clear of axle.

2.9 Remove the split pin nut and washer (Fig 6 (1)) from the drag link ball joint (2) at the swivel housing and using a suitable extractor disconnect the drag link (3) and tie to one side.



MIL0208

- 1 Nut, washer and split pin
- 2 Drag link ball joint
- 3 Drag link

Fig 6 Drag link to swivel housing ball joint

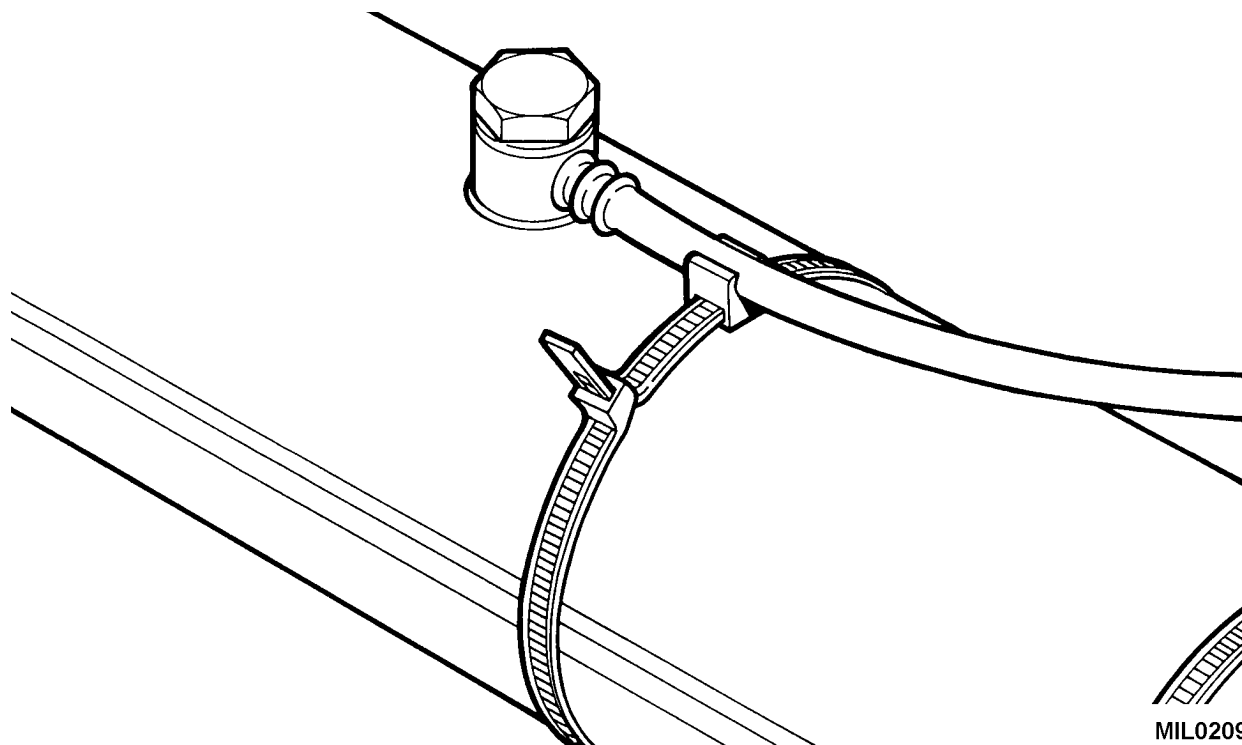


Fig 7 Axle breather banjo bolt

- 2.10 Undo the bolt and remove the axle breather banjo from the axle (Fig 7).
- 2.11 Remove the bolts securing brake hose brackets and refit the bolts to prevent oil leakage.
- 2.12 Remove the brake callipers and tie aside (refer to Chap 10).

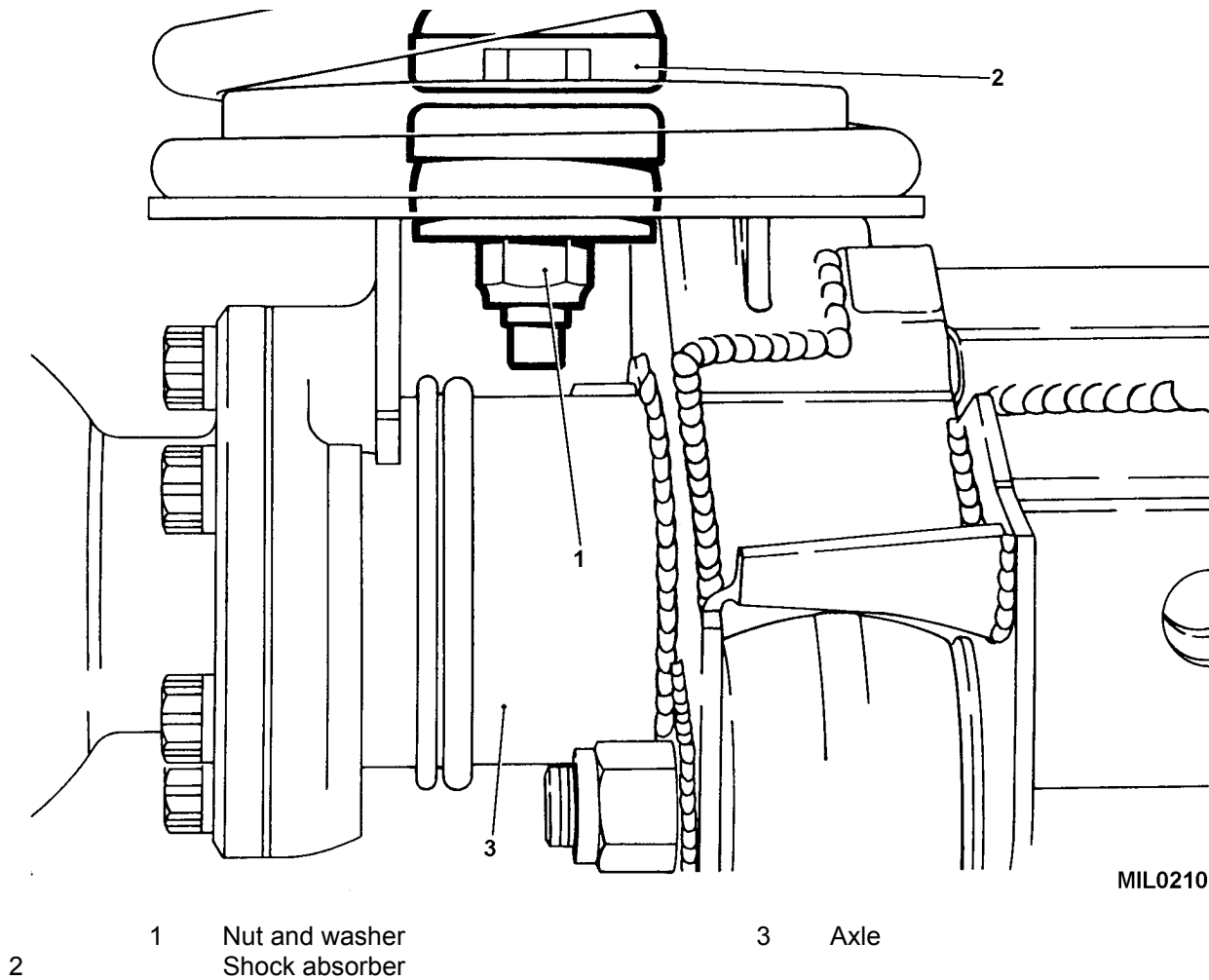


Fig 8 Shock absorber lower securing nuts

2.13 Remove the nuts and washers (Fig 8 (1)) securing the shock absorbers to the axle.

2.14 Mark the differential propeller shaft flanges with identification marks to aid re-assembly. Remove the four nuts and bolts, tie the propeller shaft to one side.

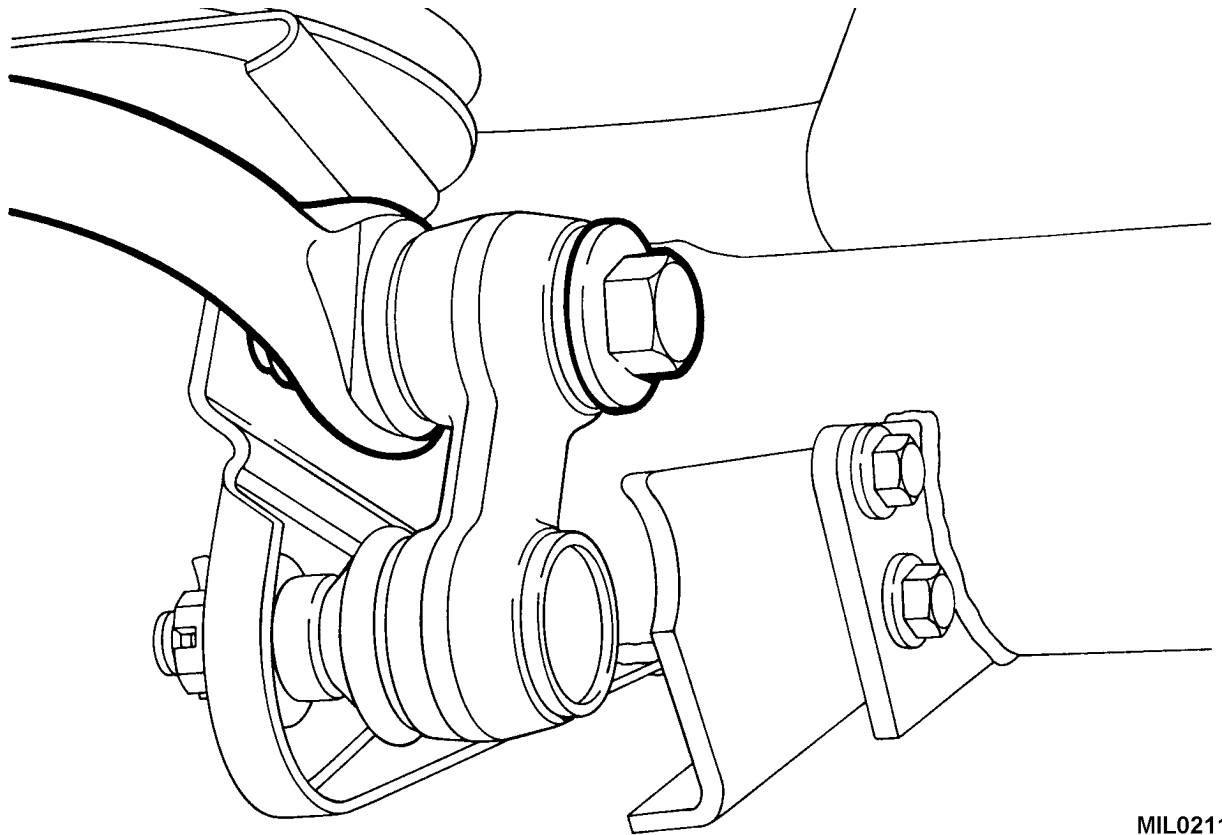
WARNING

AXLE REMOVAL. THE REMOVAL OF THE AXLE FROM THE VEHICLE WILL REQUIRE THE ASSISTANCE OF TWO FURTHER PERSONNEL TO STEADY THE AXLE WHEN LOWERING.

2.15 Carefully lower the axle assembly and remove the coil springs.

2.16 Disconnect the anti-roll bar link (Fig 9).

2.17 If the axle assembly is to be replaced remove the spring seats and track rod deflection plates and fit to the replacement axle.



MIL0211

Fig 9 Anti-roll bar links

REFITTING

WARNING

AXLE FITTING. THE FITTING OF THE AXLE TO THE VEHICLE WILL REQUIRE THE ASSISTANCE OF TWO FURTHER PERSONNEL TO STEADY THE AXLE WHEN OFFERING IT UP TO THE VEHICLE.

NOTE

The fixing bolts for all suspension bushes should be torqued when the vehicle is on the floor at its normal ride height (i.e. "loaded with its normal payload").

- 3 To refit the front axle assembly proceed as follows:
 - 3.1 Position the axle under the vehicle.
 - 3.2 Reverse the removal instructions.
 - 3.3 Tighten the propeller shaft to differential bolts to a torque of 41 to 52 Nm (30 to 38 lbf ft).
 - 3.4 Tighten the panhard rod to axle bracket nuts to a torque of 230 Nm (170 lbf ft).
 - 3.5 Tighten the radius arm to axle and radius arm to chassis side member bolts to a torque of 190 Nm (140 lbf ft).
 - 3.6 Tighten the drag link and track rod end ball joints to a torque of 40 Nm (30 lbf ft) and fit a new split pin.
 - 3.7 Tighten the shock absorber lower securing nuts to a torque of 75 Nm (55 lbf ft).

HUB ASSEMBLY

REMOVAL

- 4 To remove the front hub assembly:
 - 4.1 Slacken the road wheel nuts.
 - 4.2 Jack up the vehicle and lower onto suitable axle stands.
 - 4.3 Remove the road wheel.
 - 4.4 Remove the bolts securing the brake hose bracket and replace the bolts.
 - 4.5 Remove the brake calliper and secure to one side (refer to Chap 10).
 - 4.6 Lever off the dust cap (Fig 10 (1)).
 - 4.7 Remove the circlip (2) and withdraw the shim (3).
 - 4.8 Remove the securing bolts (6) and withdraw the hub driving member (4) complete with gasket (5).
 - 4.9 Remove the locknut and discard (7) and then remove the 'D' washer.
 - 4.10 Withdraw the hub and brake disc assembly complete with bearings and internal shim spacer (10).

DISMANTLING

- 5 To dismantle the brake disc and hub assembly proceed as follows:
 - 5.1 Remove the outer bearing (Fig 10 (9)) and shim spacer (10).
 - 5.2 If the existing hub is to be refitted, mark the relationship between the hub and brake disc to aid reassembly.
 - 5.3 Remove the bolts (15) then separate the hub (11) from the brake disc (14).
 - 5.4 Remove the grease seal (13) and the inner bearing (12) from the hub and discard the seal.
 - 5.5 If new bearings are to be fitted, remove the inner and outer bearing tracks from the hub.

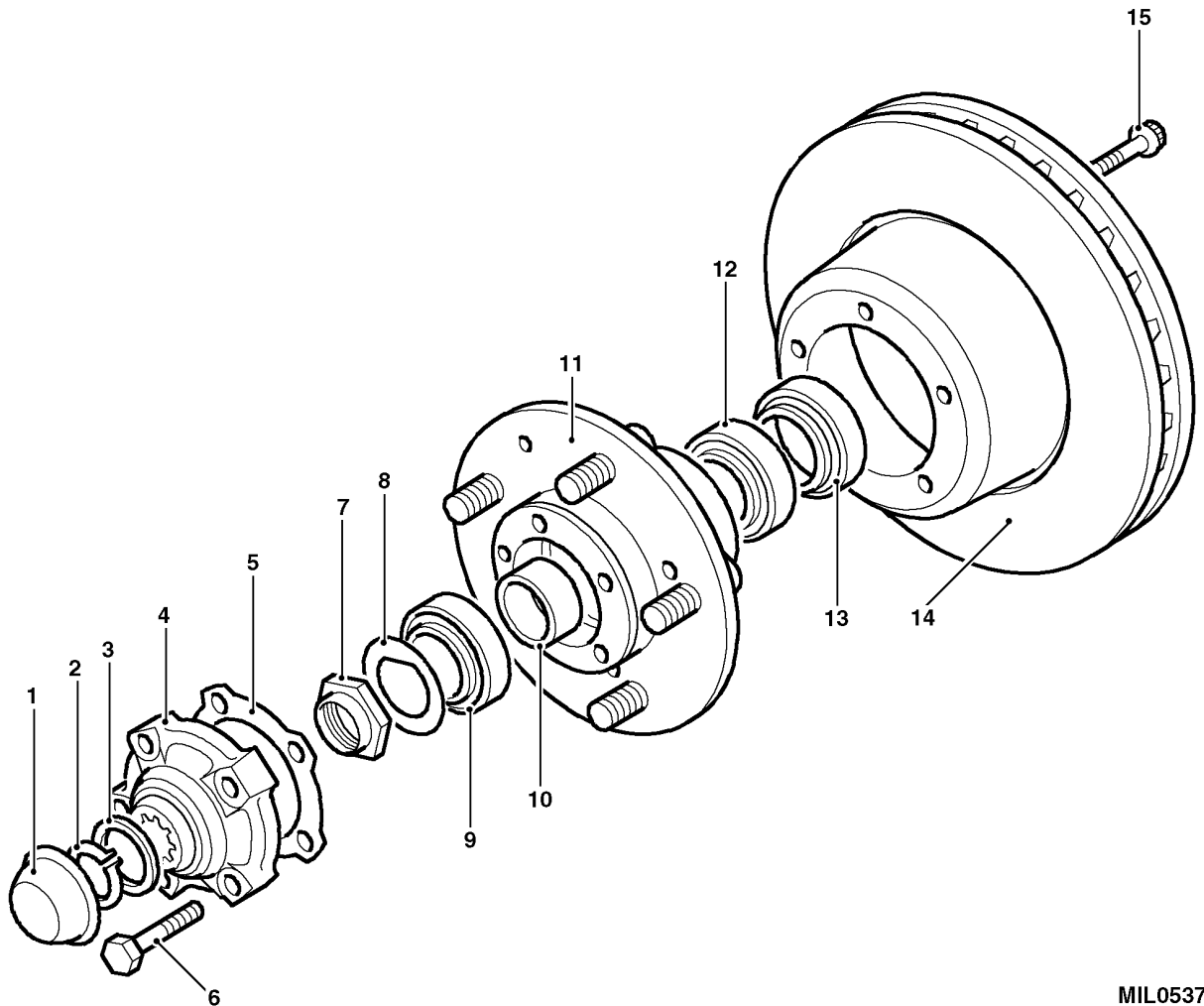
REASSEMBLY

- 6 Reassemble the hub as follows:

NOTE

New bearings come pre-greased. If original bearings are to be refitted, pack with a suitable amount of grease (refer to Table 2 Serial 3).

- 6.1 Clean and degrease the hub. If removed, fit the inner and outer bearing tracks.
- 6.2 Fit the bearing (Fig 10 (12)) to the hub.
- 6.3 Using a suitable tool fit a new grease seal (13) to the hub (noting the instruction inscribed on the seal). Drive in the seal so that it is recessed 4.0 mm (0.16 in) below the rear face of the hub.



MIL0537

1	Dust cap	9	Outer bearing
2	Circlip	10	Shim spacer
3	Shim	11	Hub
4	Hub driving member	12	Inner bearing
5	Gasket	13	Grease seal
6	Bolts	14	Brake disc
7	Locknut	15	Bolts
8	'D' washer		

Fig 10 Front hub assembly

6.4 Assemble the brake disc (14) to the hub (11) aligning the marks made during dismantling. Fit the retaining bolts (15) and tighten to 65 to 80 Nm (48 to 59 lbf ft).

6.5 Ensure that the stub axle and drive shaft are clean and fit the hub to the axle.

6.6 If fitting the original bearings fit the original shim spacer (10) (noting its colour code) and outer bearing (9).

NOTE

If fitting new bearings the shim spacer colour coded with a purple 'X' (refer Table 4 Serial 1) must be fitted at this stage.

6.7 Fit the 'D' washer (8) and new lock nut (7) and torque to 30 Nm (23 lbf ft).

- 6.8 Rotate and push/pull the hub to settle the bearings.
- 6.9 Torque nut to 200 to 220 Nm (148 to 163 lbf ft).
- 6.10 For new bearings, measure the end float using a plunger DTI firmly mounted to the hub taking the plunger reading from the hub nut face and by pushing and pulling the hub in the axial plane.
- 6.11 If no end float is evident, proceed to Para 6.18.
- 6.12 Should end float be present refer to Table 4 for the correct shim spacer for the end float measured. (rounding up to the nearest spacer detailed on the table).

TABLE 4 HUB SHIM SPACERS

Serial (1)	Part number (2)	Measured end float (3)	Shim spacer required (4)
1	TOF100000	0 mm	Shim spacer 15.5 (purple 'X')
2	TOF100010	0.025 mm to 0.075 mm	Shim spacer 15.4 (yellow)
3	TOF100020	0.100 mm to 0.150 mm	Shim spacer 15.3 (red)
4	TOF100030	0.175 mm to 0.225 mm	Shim spacer 15.2 (blue)
5	TOF100040	0.275 mm to 0.350 mm	Shim spacer 15.1 (green)
6	TOF100050	0.375 mm to 0.450 mm	Shim spacer 15.0 (black)
7	TOF100060	0.475 mm to 0.550 mm	Shim spacer 14.9 (white)

- 6.13 Remove locknut, 'D' washer, outer bearing and shim spacer.
- 6.14 Insert new selected shim spacer and replace the bearing, 'D' washer and locknut.
- 6.15 Torque locknut to 30 Nm (23 lbf ft).
- 6.16 Rotate and push/pull hub to settle the bearings.
- 6.17 Torque locknut to 200 to 220 Nm (148 to 163 lbf ft) and recheck that no end float is present.
- 6.18 Tap the locknut onto the flat of the stub axle.

NOTE

A round nose chisel must be used when undertaking this process and only use light force to knock the tab flat.

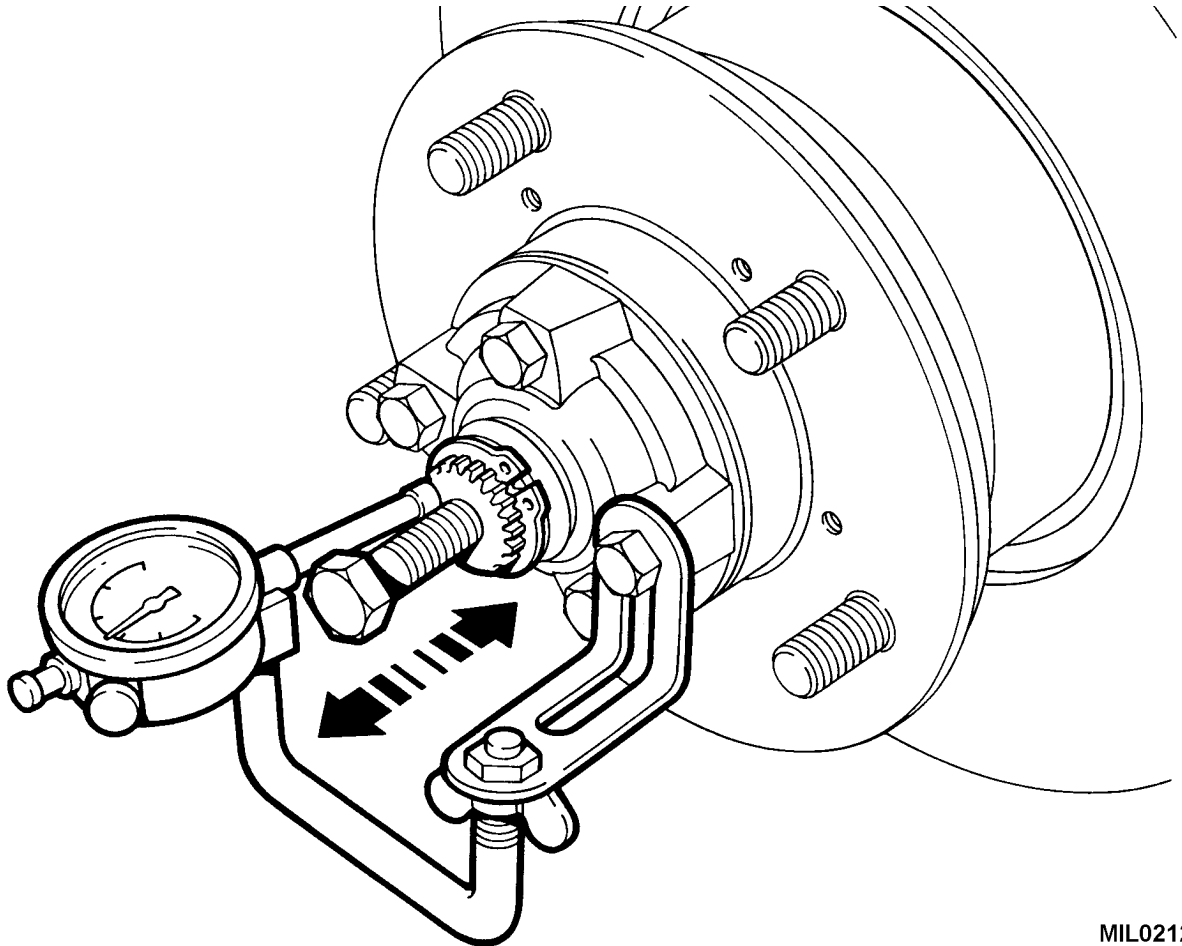
- 6.19 Fit the driving member (4) with a new gasket (5). Use new encapsulated Patch Loc bolts (refer Table 3 Serial 1) to secure the hub, evenly tighten the securing bolts (6) to a torque of 65 Nm (48 lbf ft).

NOTE

In out of territory locations it may be necessary to refit the existing bolts using Loctite 243. In this event, documents to be annotated with 'exchange bolts for the correct Encapsulated patch loc bolts when possible'.

- 6.20 Fit the original drive shaft shim (3) and secure with the circlip (2).
- 6.21 To check drive shaft endplay, mount a dial test gauge (Fig 11) and rest pin in a loaded condition on the end of the drive shaft.

- 6.22 Fit a suitable bolt to threaded end of drive shaft. Move drive shaft in and out noting dial gauge reading. End play should be between 0.08 to 0.25 mm (0.003 to 0.010 in.).
- 6.23 If endplay requires adjustment, remove circlip, measure shim thickness fit appropriate shim to give required endplay.
- 6.24 Remove bolt from drive shaft, fit circlip and dust cap.



MIL0212

Fig 11 Checking drive shaft end play

- 6.25 Fit brake calliper. Tighten to a torque of 100 Nm (74 lbf ft).
- 6.26 Locate the brake hose bracket to the top of the swivel pin housing.
- 6.27 If required, bleed brake system (refer to Chap 10-1).
- 6.28 Fit road wheel, remove axle stands and tighten road wheel nuts to 170 Nm (125 lbf ft).
- 6.29 Operate footbrake to locate brake pads before taking vehicle on road.

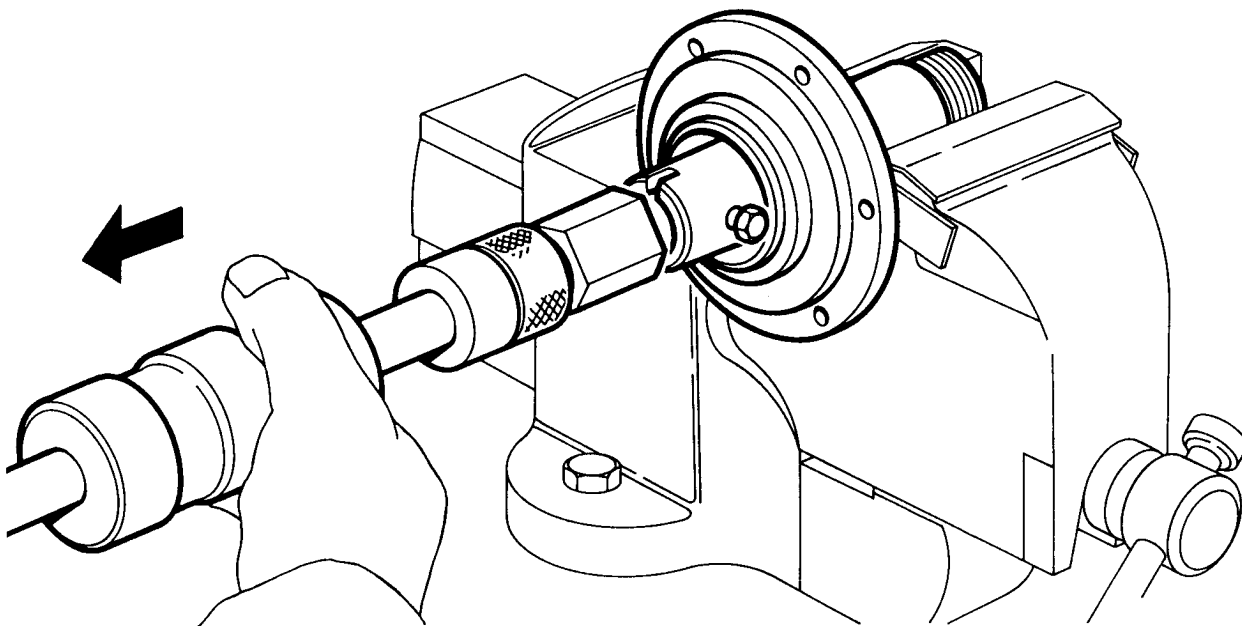
STUB AXLE, AXLE SHAFT, CONSTANT VELOCITY JOINT AND SWIVEL ASSEMBLY**REMOVAL AND DISMANTLING****Stub axle**

- 7 Remove the stub axle as follows:
 - 7.1 Remove the hub assembly (refer to Para 4).
 - 7.2 Place a suitable container under the swivel hub to catch the grease, which will escape from the assembly during the next step.
 - 7.3 Remove the six bolts (Fig 13 (26)) securing the stub axle (25) to the swivel housing (34), withdraw the stub axle and remove the mud shield (27) and gasket (28).
 - 7.4 Drill and chisel off thrust ring (31) taking care to avoid damaging stub axle.
 - 7.5 Remove bearing (30) and oil seal (29) using the special tool (refer to Table 1 Serial 1) (Fig 12).

NOTE

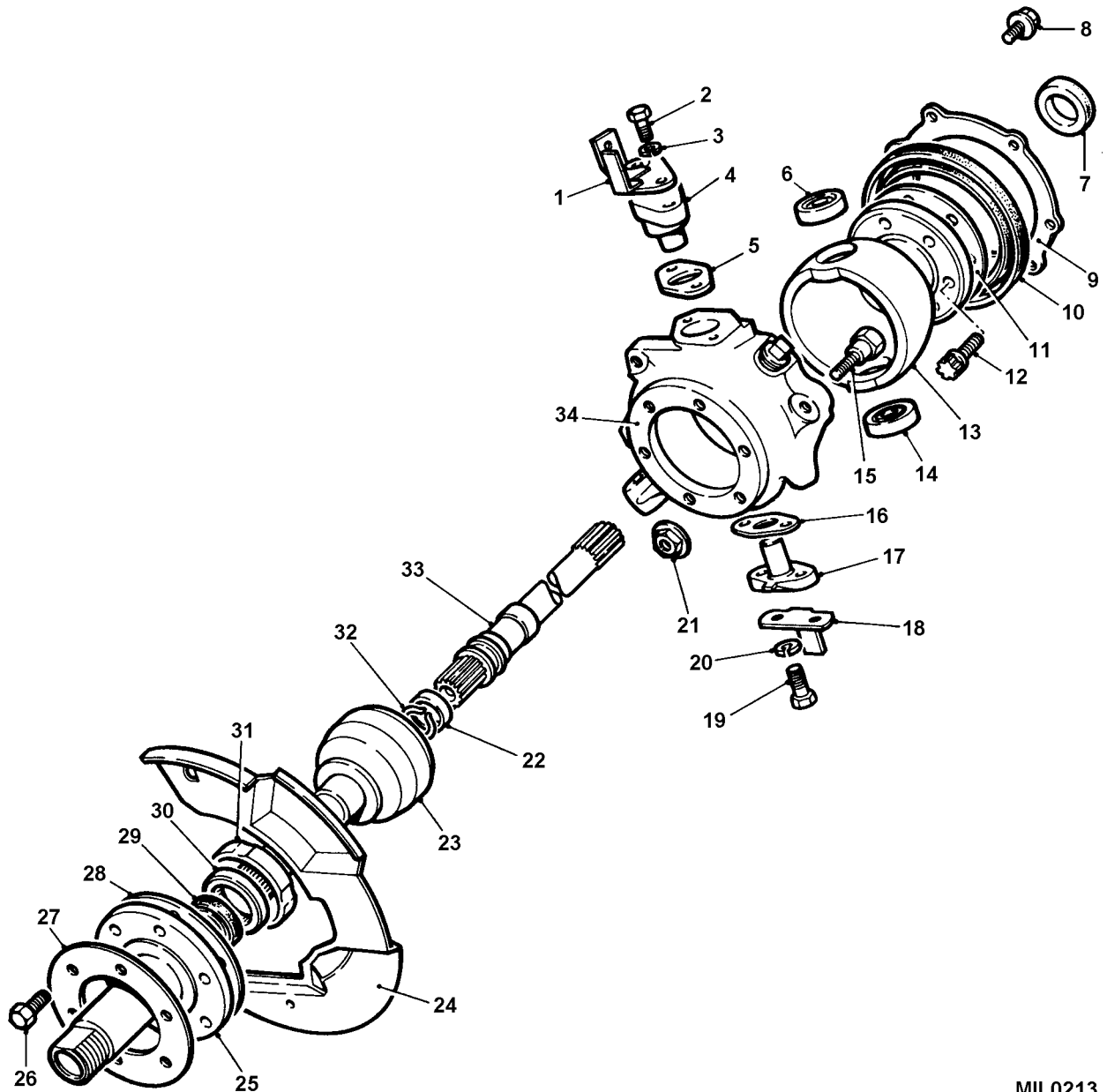
Ensure lip of tool locates behind bearing to drive it out.

- 7.6 Repeat instruction for removal of oil seal.



MIL0214

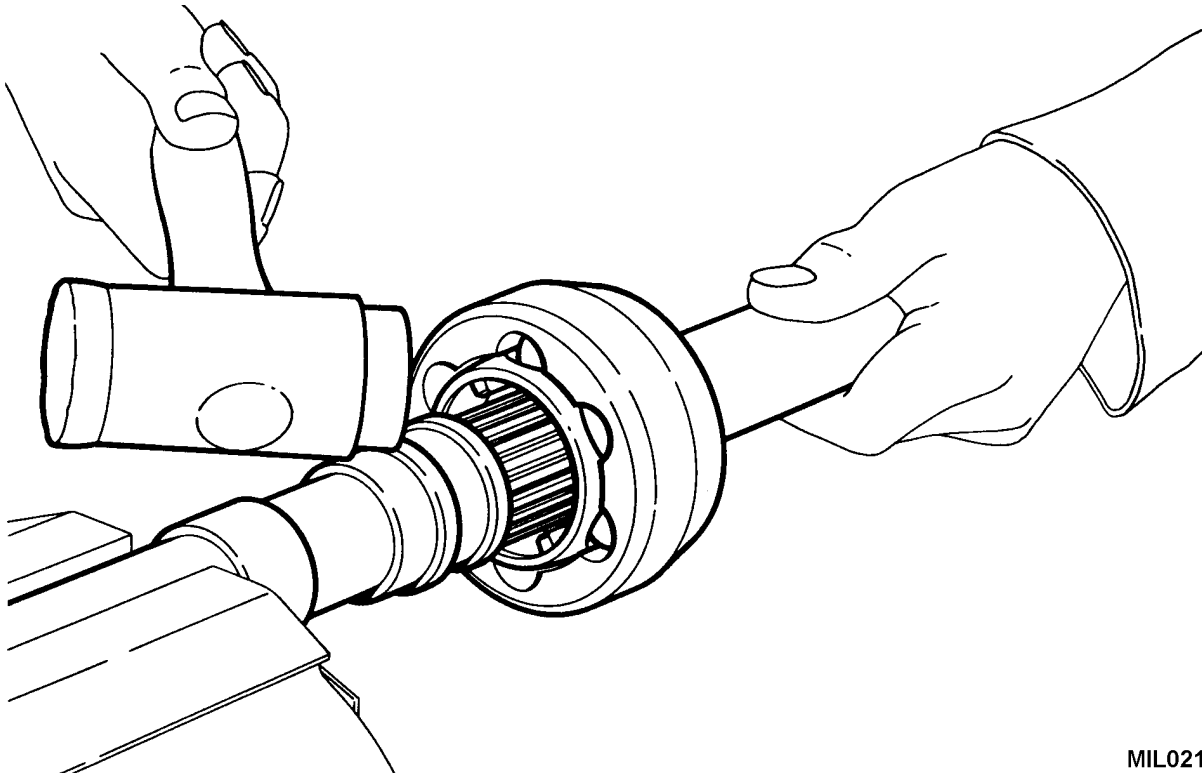
Fig 12 Removing stub axle bearing and oil seal



MIL0213

1	Brake hose bracket	13	Swivel bearing housing	24	Brake disc shield
2	Top swivel pin retaining bolt	14	Lower taper roller bearing	25	Stub axle
3	Spring washer	15	Steering lock stop bolt	26	Bolt
4	Upper swivel pin	16	Lower swivel pin gasket	27	Mud shield
5	Upper swivel pin shims	17	Lower swivel pin	28	Gasket
6	Upper taper roller bearing	18	Brake disc shield bracket	29	Oil seal
7	Inner oil seal	19	Lower swivel pin retaining bolt	30	Bearing
8	Oil seal retaining plate bolt	20	Spring washer	31	Thrust ring
9	Oil seal retaining plate	21	Steering lock stop nut	32	Circlip
10	Bearing housing oil seal	22	Bush	33	Axle shaft
11	Gasket	23	Constant velocity joint	34	Swivel housing
12	Swivel bearing housing bolt				

Fig 13 Stub axle and swivel assembly



MIL0215

Fig 14 Removing constant velocity joint from axle shaft

Axle shaft and constant velocity joint

8 To remove the axle shaft and constant velocity joint proceed as follows:

8.1 Pull out the axle shaft (Fig 13 (33)) and constant velocity joint (23) from the axle casing.

8.2 Constant velocity joint. To remove the constant velocity joint from the axle shaft and dismantle it carry out the following:

8.2.1 With the axle shaft firmly held in a soft jawed vice, and using a soft mallet,, drive the constant velocity joint from the shaft (Fig 14).

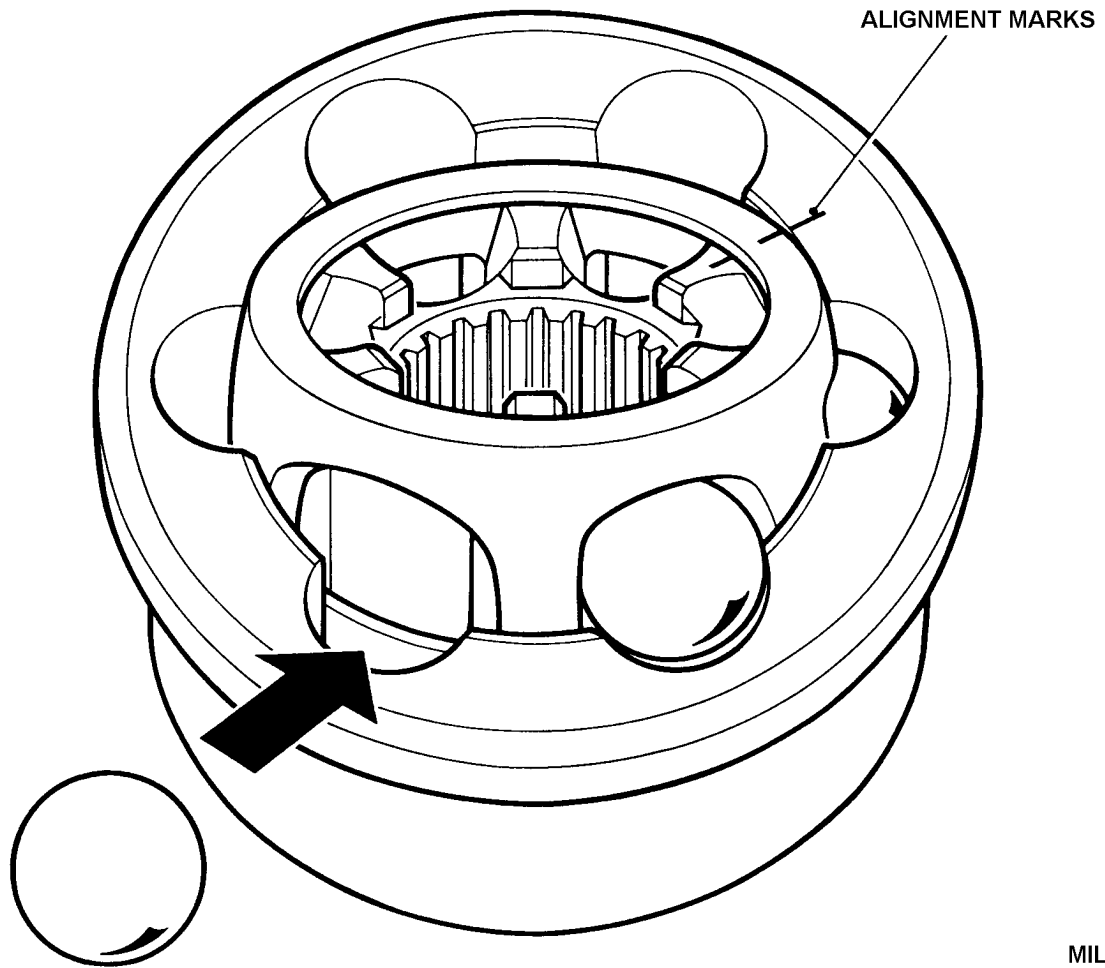
8.2.2 Mark the relative positions of the constant velocity joint inner and outer race and the cage to ensure correct reassembly (Fig 15).

8.2.3 Tilt and swivel the cage and inner race to remove the balls.

8.2.4 Swivel the cage into line with the axis of the joint until the two larger opposite apertures coincide with the two lands of the joint housing (Fig 16).

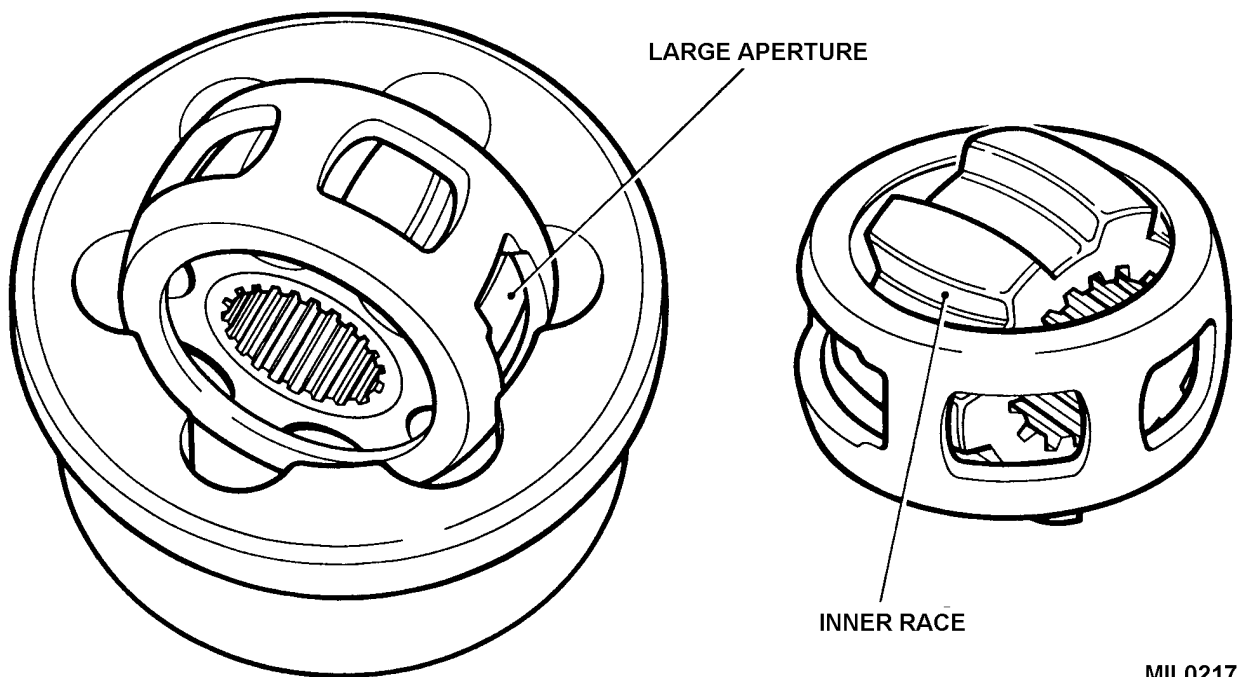
8.2.5 Withdraw the cage.

8.2.6 Turn the inner track at right angles to the cage with two of the lands opposite the cage openings, and withdraw the inner race (Fig 16).



MIL0216

Fig 15 Removing steel balls



MIL0217

Fig 16 Dismantling constant velocity joint

Swivel assembly

9 Remove the swivel assembly as follows:

9.1 Remove the brake disc shield (Fig 13 (24)), secured at the lower swivel pin and the steering lock stop bolt (15) and nut (21)

9.2 Disconnect the trackrod and if applicable the drag link ball joint from the swivel housing.

9.3 Remove bolts (8) securing oil seal retaining plate (9). Release assembly from swivel pin housing.

NOTE

Removal of oil seal (10) and retaining plate (9) is achieved when swivel bearing housing is removed.

9.4 Remove two bolts (19) and spring washers (20) complete with brake disc shield bracket (18) securing the lower swivel pin to the housing.

9.5 Withdraw lower swivel pin (17) and gasket (16) by tapping the small protruding lug.

9.6 Remove the top swivel pin retaining bolts (2) complete with brake hose bracket (1) (if not already removed).

9.7 Whilst supporting the swivel pin housing withdraw the top swivel pin (4) and shims (5). Remove the housing and retrieve the upper (6) and lower bearings (14).

9.8 Remove the lower bearing track from the swivel bearing housing.

9.9 Remove the seven bolts (12), securing the swivel pin bearing housing (13) to the axle casing and remove the housing and gasket (11).

9.10 Remove the inner oil seal (7) from the back of swivel bearing housing.

9.11 Remove top bearing track from swivel bearing housing.

CLEANING

10 Thoroughly clean and degrease all components.

EXAMINATION

11 Examine all components for general wear and condition paying particular attention to seal surfaces, balls, bearing tracks and splines.

REPAIRS AND REPLACEMENTS

12 Renew all seals, gaskets and components considered unfit for further use.

REASSEMBLY

13 To reassemble the stub axle, axle shaft, constant velocity joint and swivel assembly carry out the following:

Swivel assembly

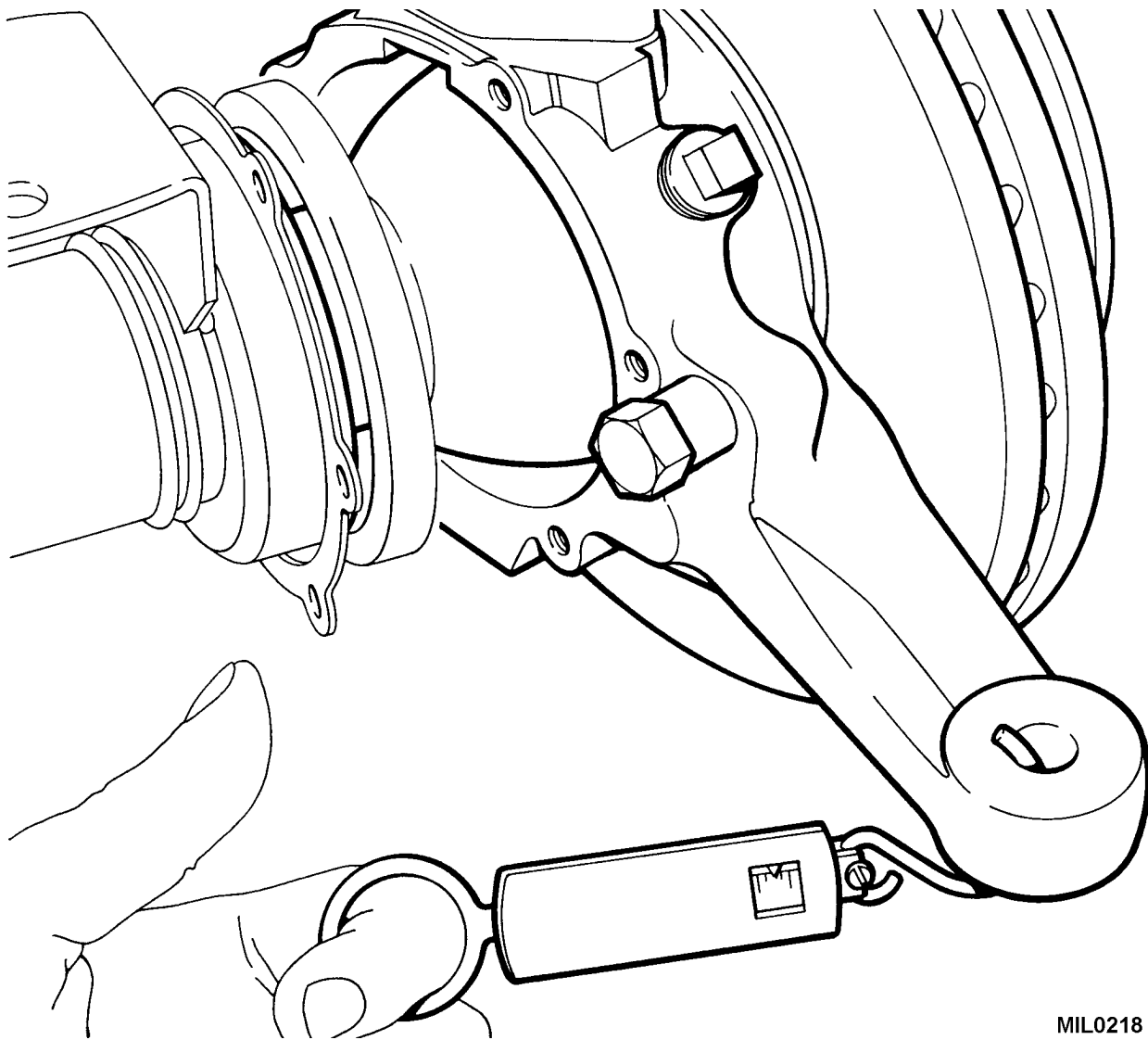
14 Reassemble the swivel assembly as follows:

14.1 Press in lower swivel pin bearing track to the swivel pin bearing housing (13).

- 14.2 Press in the upper swivel pin bearing track to the swivel pin bearing housing.
- 14.3 With the seal lips trailing, press the axle shaft oil seal (7) into the rear of the bearing housing. Grease seal lips.
- 14.4 Coat the swivel pin bearing housing to axle casing securing bolts (12) with a sealing compound (refer to Table 2 Serial 1).
- 14.5 Position a new gasket (11) on the swivel pin bearing housing to axle mating face.
- 14.6 Place bearing housing oil seal (10) and retaining plate (9) over axle flange ready for assembly.
- 14.7 Fit and secure the bearing housing to the axle with the seven bolts. Tighten to a torque of 73 Nm (54 lbf ft).
- 14.8 Grease (refer to Table 2 Serial 3) and fit upper (6) and lower (14) swivel pin taper roller bearings.
- 14.9 Position swivel pin housing (34) over swivel bearing housing (13).
- 14.10 Fit a new lower swivel pin gasket (16) and position on lower swivel pin (17).
- 14.11 Loosely fit brake shield bracket (18) and lower swivel pin (17) with lug outboard to swivel pin housing.
- 14.12 Loosely fit top swivel pin (4), existing shims (5) and brake hose bracket (1) to swivel pin housing.
- 14.13 Apply a sealing compound (refer to Table 2 Serial 1) to lower swivel pin bolts. Tighten to a torque of 25 Nm (18 lbf ft).

TABLE 5 SWIVEL PIN HOUSING SHIM SPACERS

Serial (1)	Part number (2)	NSN (3)	Shim spacer (4)
1	FRC 2883	7RU/2530-99-797-7039	Shim 0.075 mm
2	FRC 2884	7RU/2530-99-797-7040	Shim 0.130 mm
3	FRC 2885	7RU/2530-99-797-7041	Shim 0.250 mm
4	FRC 2886	7RU/5365-99-788-7773	Shim 0.750 mm



MIL0218

Fig 17 Checking swivel housing resistance

14.14 Tighten top swivel pin bolts to 65 Nm (48 lbf ft).

14.15 Check the top swivel pin pre-load by attaching a spring balance to the track rod ball joint bore, pull the spring balance to determine the effort required to turn the swivel housing (Fig 17).

14.16 The resistance, once initial inertia has been overcome should be 1.16 to 1.46 Kg (2.55 to 3.22 lb). If necessary, adjust by removing or adding shims to the top swivel pin as required (refer to Table 5).

NOTE

Swivel housing oil seal should not be fitted.

14.17 When setting is correct, remove top swivel pin bolts, coat threads with a sealing compound (refer to Table 2 Serial 1) and refit. Tighten to a torque of 78 Nm (57 lbf ft).

14.18 Apply grease (refer to Table 2 Serial 3) between lips of swivel oil seal.

14.19 Secure the oil seal (Fig 13 (10)) and retaining plate (9).

14.20 Fit the track rod link and if applicable the drag link. Tighten the ball joints to a torque of 40 Nm (29 lbf ft) and fit new split pins.

14.21 Fit brake disc shield (24) and loosely fit steering stop bolt (15) for later adjustment.

Constant velocity joint

15 Reassemble the constant velocity joint in reverse order of dismantling (refer to Para 8.2).

15.1 Check the end float of the assembled joint does not exceed 0.64 mm (0.025 in).

15.2 Fit the bush (22) to the axle shaft (33) and retain with the circlip (32), engage the constant velocity joint (23) on the axle shaft splines and using a soft mallet drive the joint home (Fig 18).

15.3 Taking care not to damage the axle shaft oil seals, insert the axle shaft through the swivel assembly into the axle casing, with differential splines engaged, push home.

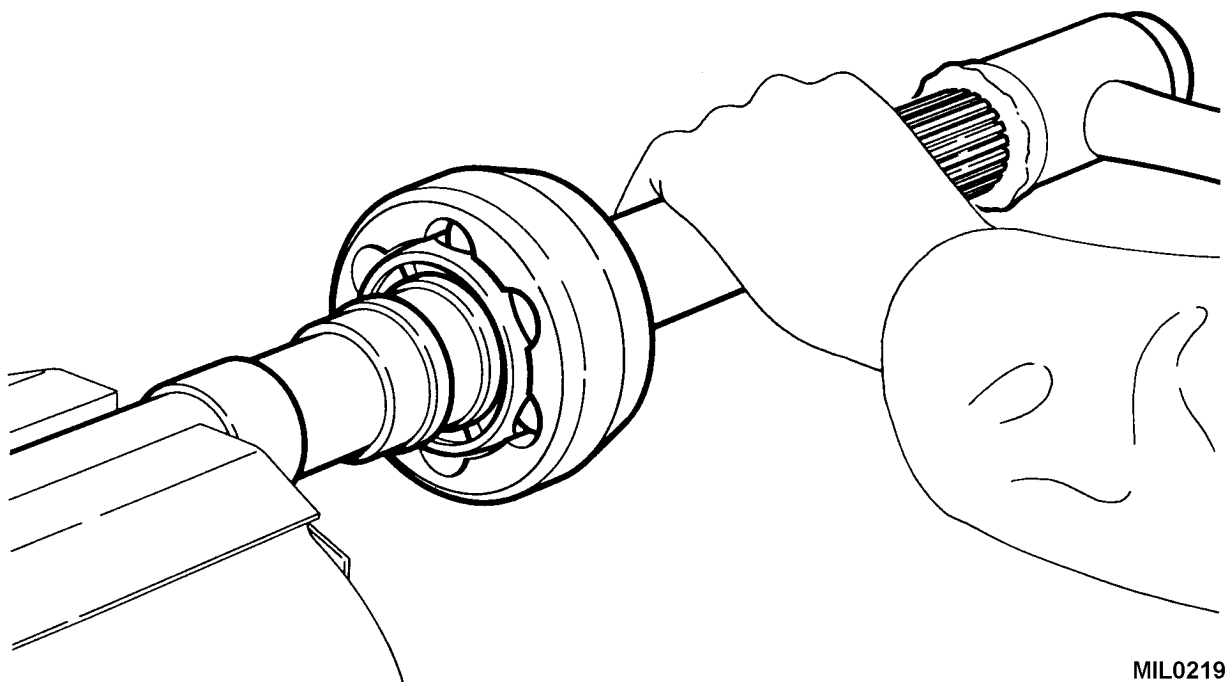


Fig 18 Fitting constant velocity joint to axle shaft

Stub axle

16 Fit the intermediate oil seal and bearing and refit the stub axle as follows:

16.1 Lubricate a new seal (refer to Fig 13 (29)) with oil (refer to Table 2 Serial 4), ensuring that lip is well lubricated, and with cavity side leading press the seal into the rear of the stub axle using a suitable tool.

16.2 Using a suitable tool fit the bearing (30) with its part number visible when fitted, and flush with the end face of the stub axle.

16.3 Press fit a new thrust ring (31) onto the stub axle.

16.4 Place a new gasket (28) in position on the swivel pin housing to stub axle mating face. Coat threads of stub axle bolts with sealing compound (refer to Table 2 Serial 1).

16.5 Fit stub axle with flat at 12 o'clock position.

CAUTION

CONSTANT VELOCITY JOINT. Ensure that constant velocity joint bearing journal is butted against thrust ring on stub axle before stub axle is secured.

16.6 Place mud shield (27) in position and secure stub axle (25) to swivel pin housing with six bolts (26) and tighten evenly to a torque of 65 Nm (48 lbf ft).

16.7 Fit brake flexible hoses to bracket (If disconnected).

16.8 Refit the hub assembly (refer to Para 6)

Refilling swivel assembly

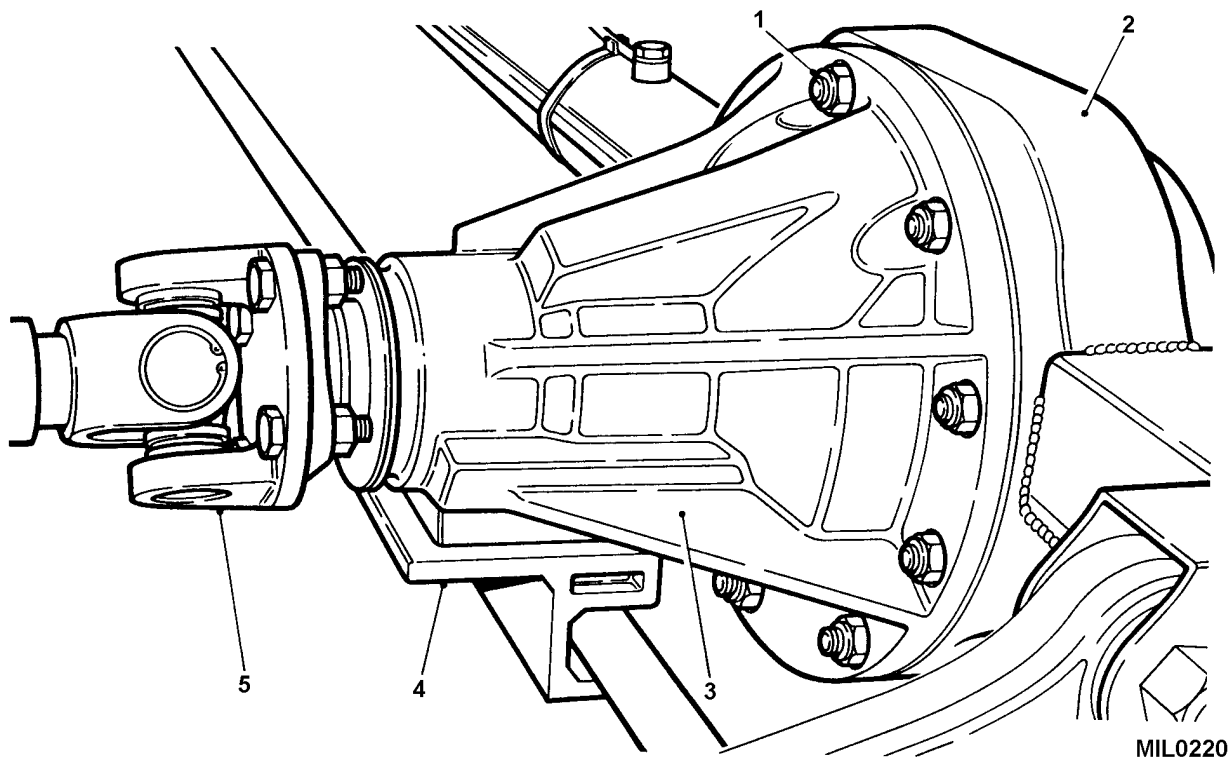
17 Fill the swivel assembly with grease as follows:

17.1 Remove the filler plug and inject grease (refer to Table 2 Serial 5) approximately 0.4 litre (0.70 pt).

17.2 Fit and tighten the plug and wipe away any surplus grease.

Setting steering lock stop bolts.

18 Set the steering lock stop bolts to provide a clearance of 20 mm (0.78 in.) (refer to Chap 7).



1 Self locking nuts

2 Axle casing

3 Differential assembly

4 Rod protection bracket

5 Propeller shaft

3

Fig 19 Removing the differential assembly

DIFFERENTIAL ASSEMBLY

Removal

NOTE

Removal of the differential assembly necessitates the removal of the road wheels, hub assemblies and stub axles to allow access to the axle shafts.

19 To remove the differential assembly carry out the following:

19.1 Using a suitable container drain the oil from the axle and refit the drain plug.

19.2 Mark the propeller shaft and differential flanges to aid reassembly, and disconnect the propeller shaft (Fig 19 (5)) from the differential flange and secure to one side.

19.3 Remove the track rod protection bracket (4) from the underside of the differential.

19.4 Withdraw the axle shafts sufficiently to disengage them from the differential unit (refer to Para 8).

19.5 Support the differential unit adequately whilst removing.

19.6 Remove the self locking nuts (1) securing the differential assembly (3) to the axle casing (2) and withdraw the unit from the vehicle.

Refitting

20 Refit the differential assembly to the axle casing as follows:

20.1 Coat mating faces with a sealing compound (refer to Table 2 Serial 2).

20.2 Support the differential assembly and position it on the axle casing.

20.3 Secure with new self locking nuts and tighten to a torque of 36 to 46 Nm (27 to 34 lbf ft).

20.4 Fit the track rod protection bracket to the underside of the differential unit.

20.5 Re-engage the axle shafts and refit the stub axles (refer to Para 16).

20.6 Refit the hubs and road wheels (refer to Para 6).

20.7 Refill the swivel assemblies (refer to Para 17).

20.8 Fill the axle with the approved oil (refer to Table 2 Serial 4).

20.9 After the initial axle run, check the oil level and replenish as necessary.

20.10 Where major running parts have been replaced, it is recommended practice to allow the axle assembly to 'run in' by avoiding, where possible heavy loads and high speeds during the initial running (refer to Para 21).

RUNNING IN

21 When running in the axles after repair the vehicle should be run for approximately 30 Km (18 miles) avoiding heavy loads and high speeds.

CHAPTER 6

REAR AXLES

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

1 This chapter gives the Unit repair for the rear axle systems as fitted to Truck Utility Light (TUL) HS, and Truck Utility Medium (TUM) HS and (TUL) Ambulance HS vehicles. The repair instructions detailed are applicable to both left and right hand drive vehicles.

General

2 This chapter has been sub-chaptered to allow for the various types of vehicle axles as detailed below.

- 2.1 Chapter 6-1 Heavy duty rear axle.
- 2.2 Chapter 6-2 Standard rear axle.

CHAPTER 6-1

HEAVY DUTY REAR AXLE

CONTENTS

Para

- 1 Introduction
REAR AXLE ASSEMBLY
Torque list
- 2 Removal (WARNING)
- 3 Installation (WARNING)
HALF SHAFTS
- 4 Removal
- 5 Cleaning
- 6 Examination
- 7 Installation
HUB ASSEMBLY
- 8 Removal
- 9 Dismantling
- 10 Reassembly
STUB AXLE
- 11 Removal and dismantling
- 12 Reassembly
DIFFERENTIAL ASSEMBLY
- 13 Removal
- 14 Installation
- 15 Checking rear axle backlash
- 16 Running in

Table

1	Special tools.....	2
2	Sealants, adhesives and lubricants	3
3	Service kits.....	3
4	Hub shim spacers	8

Page

Fig

1	Rear axle removal and installation.....	4
2	Rear hub assembly	7
3	Fitting oil seal	10
4	Removing the differential assembly	11
5	Checking rear axle backlash.....	13

INTRODUCTION

1 This sub-chapter covers the Unit repairs for Truck Utility Medium (TUL) HS and (TUM) Ambulance HS vehicles fitted with the heavy duty rear axles. The repair instructions detailed are applicable to both left and right hand drive vehicles.

NOTE

Wheel bearings

After any examination or repair wheel bearings should be repacked with grease (refer to Para 10). Examination should take place at every major service period equivalent to 2 years.

REAR AXLE ASSEMBLY

TORQUE LIST

Lower link to axle	260 Nm/192 lbf ft
Lower link to chassis mounting flange	63 Nm/46 lbf ft
Axle to pivot ball joint	176 Nm/130 lbf ft
Shock absorber to axle	75 Nm/55 lbf ft
Propeller shaft to axle	47 Nm /35 lbf ft
Driving member to hub	65 Nm /48 lbf ft
Brake disc to hub	65 – 80 Nm /48 - 59 lbf ft
Hub lock nut (initial)	30 Nm/23 lbf ft *
Hub lock nut (final)	200-220 Nm/148-163 lbf ft *
Brake calliper to axle	100 Nm /74 lbf ft
Wheel nuts	170 Nm /125 lbf ft
Stub axle to axle	65 Nm /48 lbf ft
Differential to axle casing	40 Nm/30 lbf ft**

* New lock nut must be used
** New self locking nuts must be used

NOTE

The special tools listed in the following table will be referred to in the text, where used, by the serial number shown in the table.

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	LRT-54-002	6MT2/5120-99-828-0406	Hub nut spanner

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	OEP 220	9150-99-220-1477	Axle oil
2	XG 291	9150-99-918-3786	Grease
3	RTV	8030-99-224-6527	Silicon sealing compound
4	Loctite 243	8030-01-475-2444	Thread lock

TABLE 3 SERVICE KITS

Serial (1)	NSN/Part Number where applicable (2)	Designation (3)
1	7XD 5306-99-808-7428	Patch loc bolt

REMOVAL

- 2 To remove the axle assembly from the vehicle carry out the following:
 - 2.1 Jack up the rear of the vehicle and support the chassis frame with suitable stands.
 - 2.2 Remove the rear road wheels.
 - 2.3 Support the axle weight with a suitable hydraulic jack.
 - 2.4 Disconnect the shock absorbers at the lower fixings (Fig 1 (1)) and remove the rubbers and washers.
 - 2.5 Disconnect the flexible brake hose at the three-way connection (2). Blank off the connections to prevent loss of brake fluid and ingress of foreign matter.
 - 2.6 Disconnect the breather hose at the banjo connection (6) on the axle casing. Remove the plastic tie straps securing breather hose to axle casing.
 - 2.7 Disconnect the lower links (5) at the axle.
 - 2.8 Mark the differential and propeller shaft flanges to aid reassembly. Remove the four nuts and bolts, lower the propshaft (7) and tie to one side.

2.9 Disconnect the pivot bracket ball joint by removing the split pin, castellated nut and plain washer securing the joint to the axle mounted bracket (3).

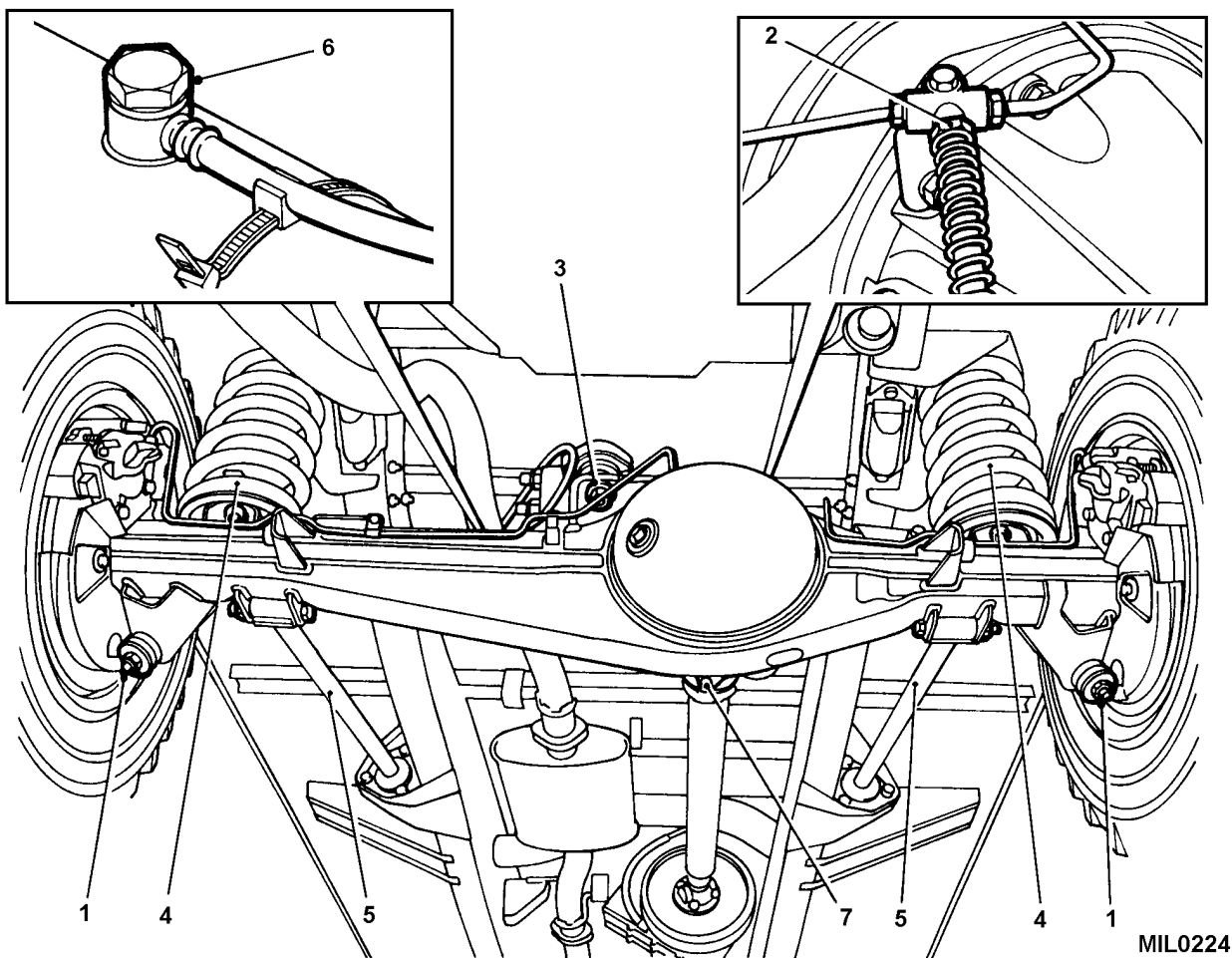
WARNING

HEAVY LOAD. THE REMOVAL OF THE AXLE ASSEMBLY WILL REQUIRE THE ASSISTANCE OF TWO ADDITIONAL PERSONNEL TO STEADY THE AXLE WHEN LOWERING.

2.10 Lower the axle, release the bolts securing coil spring retaining plates and remove the springs (4).

2.11 If a new or replacement axle assembly is to be fitted, remove the brake pipes from the existing axle assembly, clean and examine them. If they are satisfactory for further use fit to the replacement axle.

2.12 Remove the road spring seating plates and fit them to the replacement axle assembly.



- | | |
|------------------------|-------------------|
| 1 Shock absorbers | 5 Lower link |
| 2 Three-way connector | 6 Axle breather |
| 3 Axle mounted bracket | 7 Propeller shaft |
| 4 Coil springs | |

Fig 1 Rear axle removal and installation

INSTALLATION

3 To install the axle assembly on the vehicle proceed as follows:

WARNING

HEAVY LOAD. THE REFITTING OF THE AXLE TO THE VEHICLE WILL REQUIRE THE ASSISTANCE OF TWO FURTHER PERSONNEL TO STEADY THE AXLE WHEN LIFTING.

NOTE

The fixing bolts for all suspension bushes should be torqued when the vehicle is on the floor at its normal ride height (i.e. "loaded with its normal payload").

3.1 Fit the coil springs (4) to the axle and secure with the retaining plates and bolts.

3.2 Raise the axle with the jack and locate the lower links (5). Secure with the bolts and nuts, and tighten to a torque of 260 Nm (192 lbf ft).

3.3 Connect the pivot ball joint to the axle mounted bracket (3) and secure with the castellated nut, plain washer and split pin. Tighten to a torque of 176 Nm (130 lbf ft).

3.4 Connect the shock absorbers (1) to the attachment plate on the axle and tighten the securing nuts to a torque of 75 Nm (55 lbf ft).

3.5 Connect the propeller shaft (7), aligning the marks made when dismantling, and tighten the securing bolts to a torque of 47 Nm (35 lbf ft).

3.6 Reconnect flexible brake hose at the three-way connector (2).

3.7 Connect the breather hose banjo connection (6) to the top of the axle casing.

3.8 Fit the road wheels and remove the vehicle from the stands.

3.9 Fill the axle with the approved oil (refer to Table 2 Serial 1).

3.10 Bleed the brakes and top up the fluid (refer to Chap 10-1).

3.11 After the initial axle run (refer to Para 15), check the oil level and replenish as necessary.

NOTE

Where major running parts have been replaced during overhaul, it is recommended practice to allow the axle assembly to 'run in' by avoiding, where possible, heavy loads and high speeds during initial running (refer to Para 15).

HALF SHAFTS

REMOVAL

4 To remove the half shafts proceed as follows:

4.1 Prise off the dust cap (Fig 2 (1)), and remove the five securing bolts (5) from the driving member (3). Withdraw the driving member complete with the half shaft (16).

4.2 Remove the gasket (4).

4.3 If necessary repeat Para 4.1 to remove the other half shaft.

4.4 Remove the circlip (2) and withdraw the driving member.

CLEANING

5 Thoroughly clean the half shaft and driving member.

EXAMINATION

6 Examine the splines on the half shaft and driving member for damage and wear.

INSTALLATION

7 To refit the half shafts reverse the removal procedure using a new gasket (4) between the mating faces of the hub (11) and driving member (3) and tighten the bolts to a torque of 65 Nm (48 lbf ft).

HUB ASSEMBLY

REMOVAL

8 To remove the rear hub assemblies carry out the following:

8.1 Slacken the road wheel nuts.

8.2 Jack up the rear of the vehicle and lower onto suitable axle stands.

8.3 Remove the road wheel.

8.4 Disconnect the rear brake hose from the calliper and seal off end.

8.5 Remove the brake calliper.

8.6 Lever off the dust cap (Fig 2 (1)).

8.7 Remove the circlip (2).

8.8 Remove the securing bolts (5) and withdraw the hub driving member (3) complete with gasket (4).

NOTE

Do not remove drive shafts unless it is necessary.

8.9 Remove the locknut and discard (6), and then remove the 'D' washer (7).

8.10 Withdraw the hub and brake disc assembly complete with bearings and internal shim spacer (8).

DISMANTLING

9 To dismantle the brake disc and hub assembly proceed as follows:

9.1 Remove the outer bearing (9).

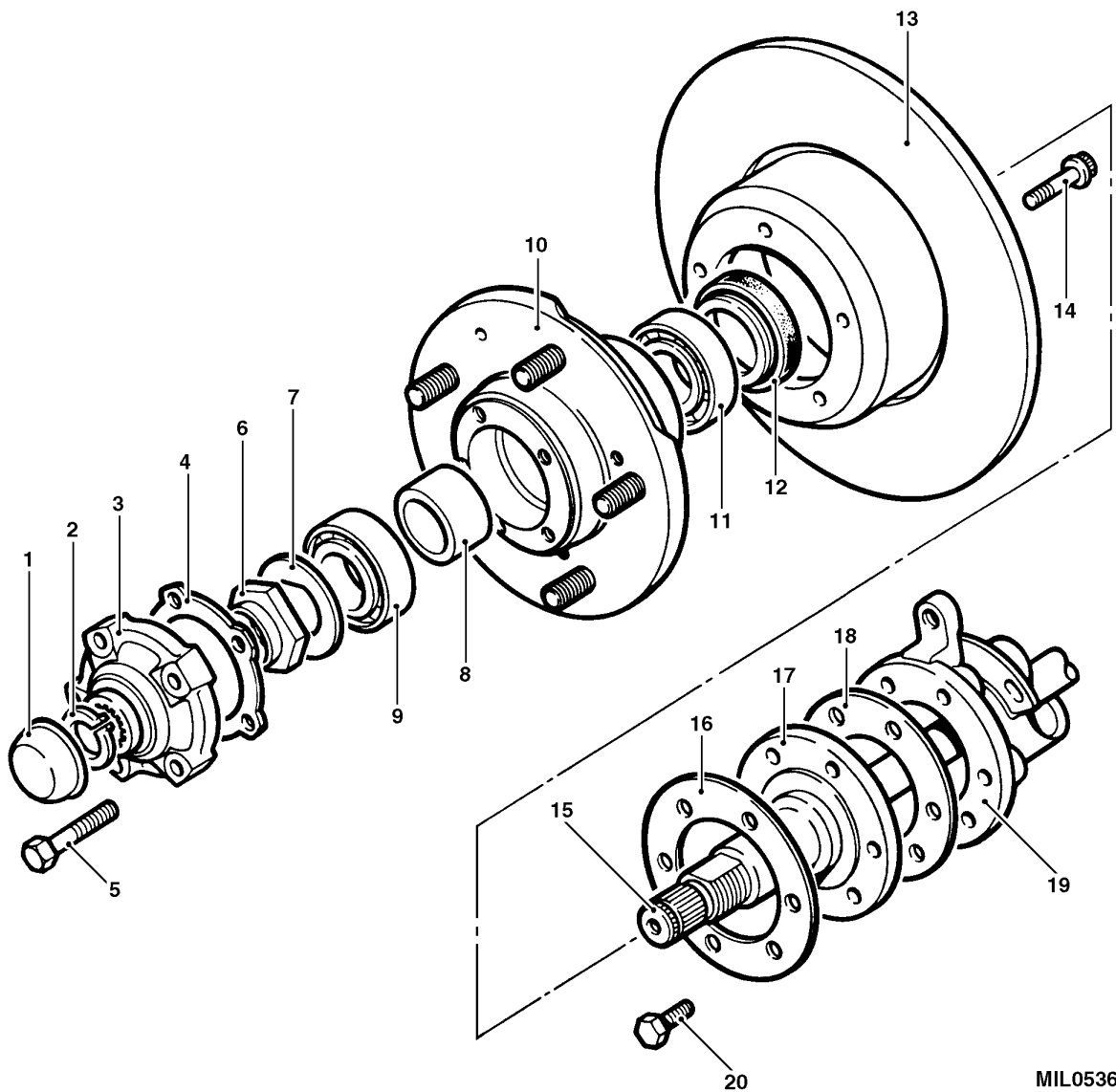
NOTE

If the existing hub is to be refitted, mark the relationship between the hub and brake disc to aid reassembly.

9.2 Remove the bolts (14) then separate the hub (10) from the brake disc (13).

9.3 Remove the grease seal (12) and the inner bearing (11) from the hub and discard the seal.

9.4 If new bearings are to be fitted, remove the inner and outer bearing tracks from the hub.



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- | | | | |
|----|----------------|----|---------------|
| 1 | Dust cap | 11 | Inner bearing |
| 2 | Circlip | 12 | Grease seal |
| 3 | Driving member | 13 | Brake disc |
| 4 | Gasket | 14 | Bolt |
| 5 | Bolt | 15 | Half shaft |
| 6 | Lock nut | 16 | Mudshield |
| 7 | "D" washer | 17 | Stub axle |
| 8 | Shim spacer | 18 | Gasket |
| 9 | Outer bearing | 19 | Axle casing |
| 10 | Hub | 20 | Bolt |

Fig 2 Rear hub assembly

REASSEMBLY

10 Reassemble the hub as follows:

10.1 Clean and degrease the hub. If removed, fit the inner and outer bearing tracks.

NOTE

New bearings come pre-greased. If original bearings are to be refitted, pack with a suitable amount of grease (refer to Table 2 Serial 2).

10.2 Fit the inner bearing (11) to the hub.

10.3 Using a suitable tool fit a new grease seal (12) to the hub with the lip side leading. Drive in the seal so that it is flush with the rear face of the hub. Apply grease liberally to the seal lips.

10.4 Assemble the brake disc (13) to the hub (10) aligning the marks made during dismantling. Fit the retaining bolts (14) and tighten to 65 to 80 Nm (48 to 59 lbf ft).

10.5 Ensure that the stub axle and drive shaft are clean and fit the hub to the axle.

10.6 If fitting the original bearings fit the original shim spacer (8) (noting its colour code) and outer bearing (9).

NOTE

If fitting new bearings the shim spacer colour coded with a purple 'X' (refer to Table 4 Serial 1) must be fitted at this stage.

10.7 Fit the 'D' washer and the new locknut and torque to 30 Nm (23 lbf ft).

10.8 Rotate and push/pull the hub to settle the bearings.

10.9 Torque lock nut to 200 to 220 Nm (148 to 163 lbf ft).

10.10 For new bearings, measure the end float using a plunger DTI firmly mounted on the hub, taking the plunger reading from the hub nut face and by pushing and pulling the hub in the axial plane.

10.11 If no end float is evident, proceed to Para 10.18

10.12 Should end float be present refer to Table 4 for the correct shim spacer for the end float measured (rounding up to the nearest spacer detailed on the table).

TABLE 4 HUB SHIM SPACERS

Serial (1)	Part number (2)	Measured end float (3)	Shim spacer required (4)
1	TOF100000	0 mm	Shim spacer 15.5 (purple 'X')
2	TOF100010	0.025 mm to 0.075 mm	Shim spacer 15.4 (yellow)
3	TOF100020	0.100 mm to 0.150 mm	Shim spacer 15.3 (red)
4	TOF100030	0.175 mm to 0.225 mm	Shim spacer 15.2 (blue)
5	TOF100040	0.275 mm to 0.350 mm	Shim spacer 15.1 (green)
6	TOF100050	0.375 mm to 0.450 mm	Shim spacer 15.0 (black)
7	TOF100060	0.475 mm to 0.550 mm	Shim spacer 14.9 (white)

- 10.13 Remove locknut, 'D' washer, outer bearing and shim spacer.
- 10.14 Insert new selected shim spacer and replace the bearing, 'D' washer and locknut.
- 10.15 Torque locknut to 30 Nm (23 lbf ft).
- 10.16 Rotate and push/pull hub to settle bearings.
- 10.17 Torque locknut to 200 to 220 Nm (148 to 163 lbf ft) and recheck that no end float is present.
- 10.18 Tap the lock nut onto the flat of the stub axle.

NOTE

A round nose chisel must be used when undertaking this process and only use light force to knock the tab flat.

- 10.19 Fit the driving member (3) with a new gasket (4). Use new encapsulated Patch Loc bolts (refer Table 3 Serial 1) to secure the hub, evenly tighten the securing bolts (5) to a torque of 65 Nm (48 lbf ft).

NOTE

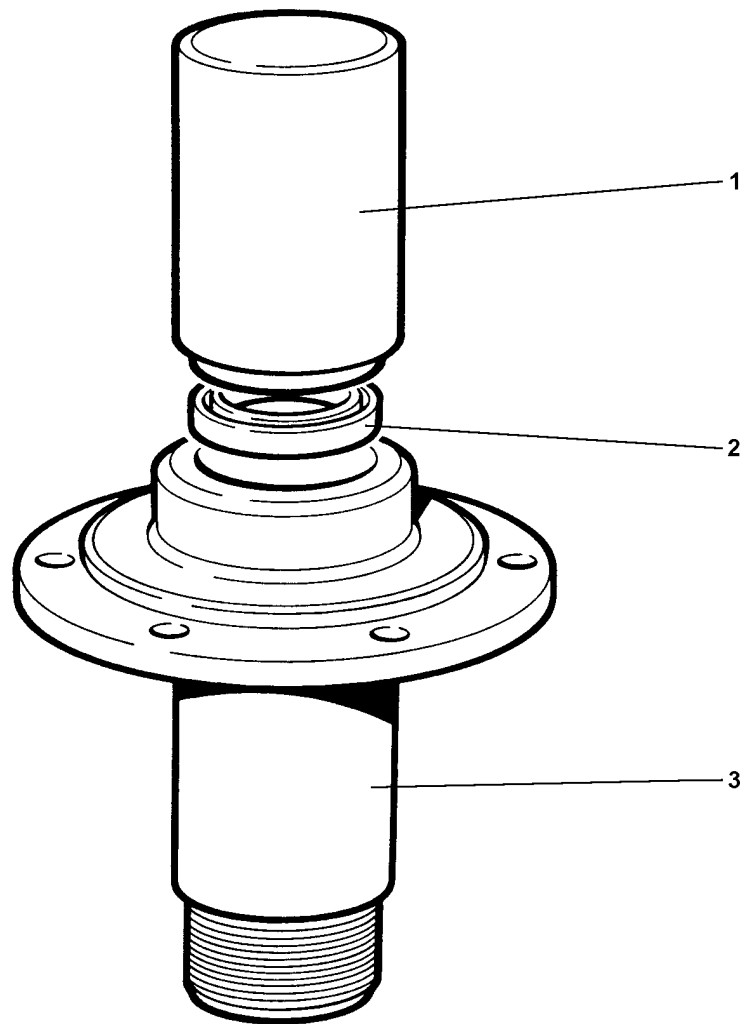
In out of territory locations it may be necessary to refit the existing bolts using Loctite 243. In this event, documents to be annotated with 'exchange bolts for the correct Encapsulated patch loc bolts when possible'.

- 10.20 Fit circlip (2) to drive shaft.
- 10.21 Fit brake calliper. Tighten to a torque of 100 Nm (74 lbf ft).
- 10.22 Connect the brake pipe.
- 10.23 Bleed brake system (refer to Chap 10-1).
- 10.24 Fit road wheel, remove axle stands and tighten the nuts to 170 Nm (125 lbf ft).
- 10.25 Operate footbrake to locate brake pads before taking vehicle on road.

STUB AXLE

REMOVAL AND DISMANTLING

- 11 To remove and dismantle the rear stub axle carry out the following:
 - 11.1 Remove the hub assembly (refer to Para 8).
 - 11.2 Remove the six bolts (Fig 2 (20)) securing the stub axle (17) to the axle casing (19).
 - 11.3 Remove the mudshield (16).
 - 11.4 Remove stub axle and gasket (18).
 - 11.5 Remove rear half shaft (15) from axle casing (19).
 - 11.6 Remove and discard stub axle grease seal.



MIL0227

- | | | | | |
|---|---|---|---|-----------|
| 2 | 1 | Rear stub axle oil seal replacer
Grease seal | 3 | Stub axle |
|---|---|---|---|-----------|

Fig 3 Fitting oil seal

REASSEMBLY

12 To reassemble the stub axle proceed as follows:

- 12.1 Lubricate a new seal (Fig 3 (2)) with oil (refer to Table 2 Serial 1) and using a suitable tool fit the new oil seal, lipside trailing, so that the seal is flush with the rear face of the stub axle (3).
- 12.2 Fit a new gasket and position the stub axle and mudshield, locate the six bolts and tighten to a torque of 65 Nm (48 lbf ft).
- 12.3 Fit the rear axle half shaft taking care not to damage the stub axle seal.
- 12.4 Refit the rear hub assembly (refer to Para 10).

DIFFERENTIAL ASSEMBLY

REMOVAL

13 To remove the differential assembly carry out the following:

- 13.1 Using a suitable container drain the oil from the axle and refit the drain plug.
- 13.2 Disconnect the propeller shaft (Fig 4 (4)) from the differential flange and secure to one side.
- 13.3 Remove the hub driving member fixings and withdraw the axle half shafts sufficiently to disengage them from the differential unit (refer to Para 4).
- 13.4 Remove the self locking nuts (1) securing the differential assembly (3) to the axle casing (2) and withdraw the unit from the vehicle. Suitably support the differential unit whilst removing.

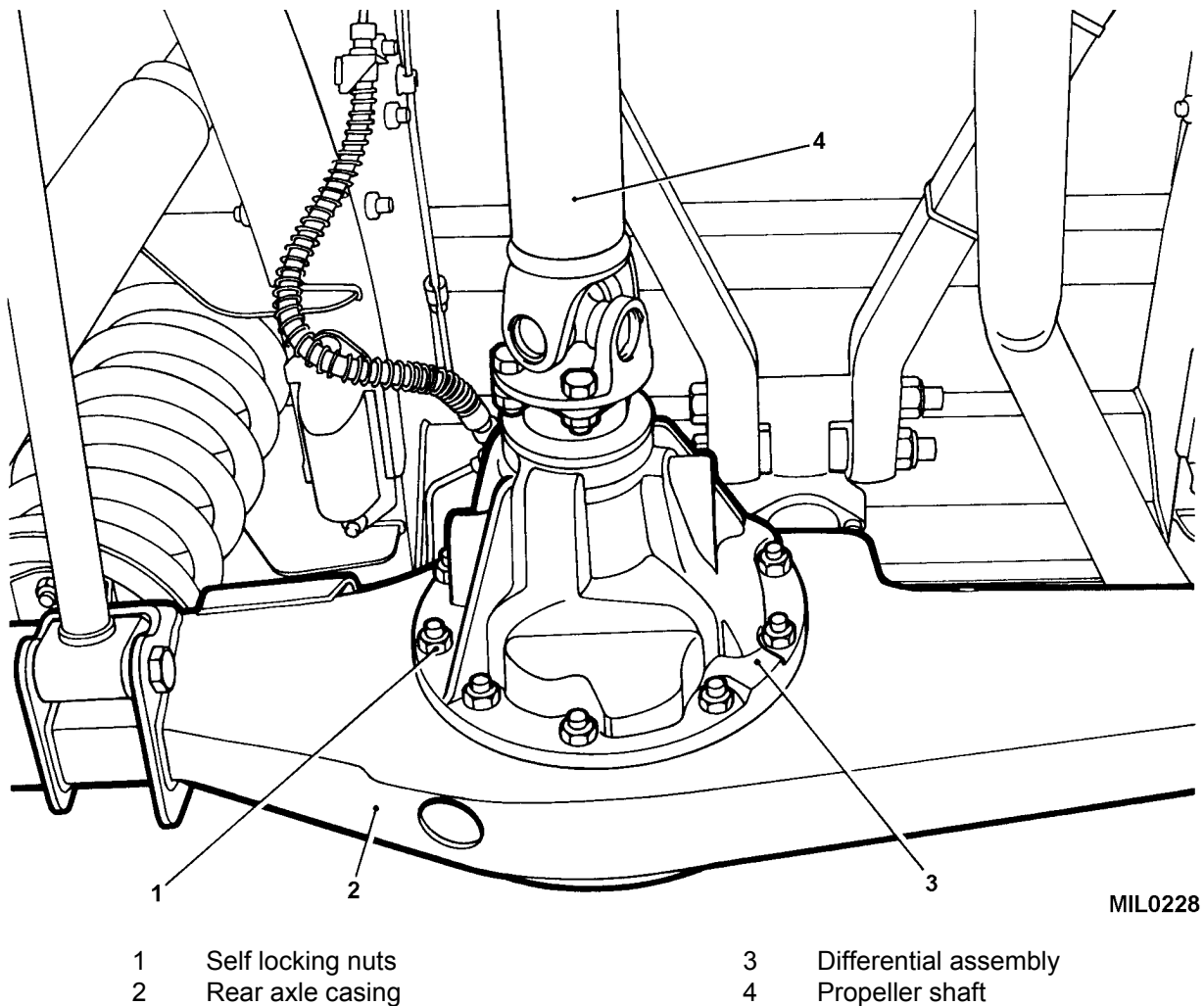


Fig 4 Removing the differential assembly

INSTALLATION

14 Refit the assembly to the axle as follows:

- 14.1 Ensure mating faces are clean and apply a bead of sealant (refer to Table 2 Serial 3) to axle case.
- 14.2 Suitably support the differential assembly and position on the axle casing.
- 14.3 Secure with self locking nuts and tighten to a torque of 40 Nm (30 lbf ft).
- 14.4 Position propeller shaft. Align markings made previously and tighten bolts to a torque of 48 Nm (35 lbf ft).
- 14.5 Refit hubs and half shafts.
- 14.6 Replenish axle with oil (refer to Table 2 Serial 1).
- 14.7 After initial axle run, check oil level and replenish if necessary.
- 14.8 Where major running parts have been replaced during overhaul, it is recommended practice to allow the axle assembly to be 'run in' (refer to Para 15).

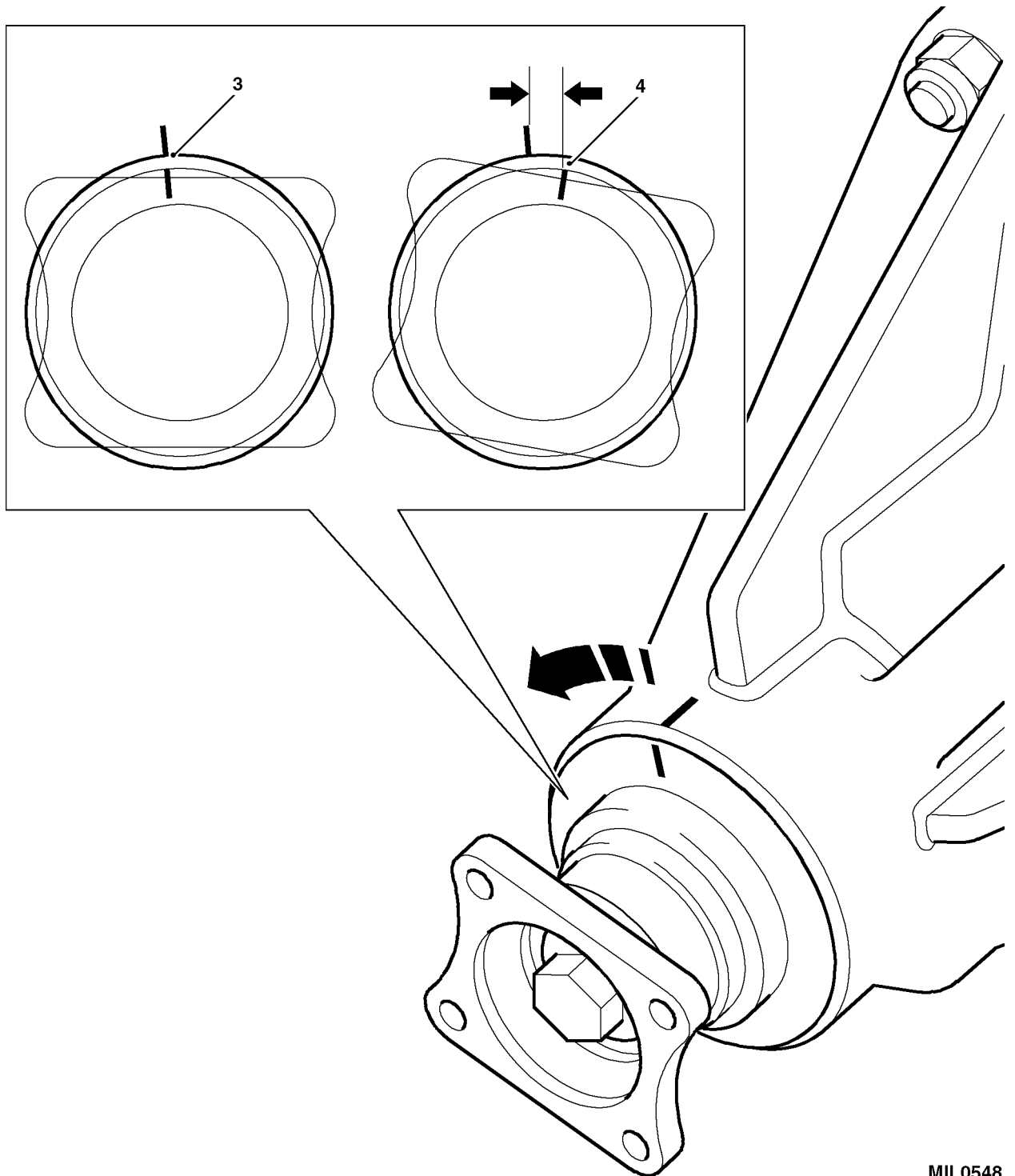
CHECKING REAR AXLE BACKLASH

15 To check the rear axle backlash, carry out the following:

- 15.1 Place the vehicle on a ramp and chock the rear wheels.
- 15.2 Mark the flanges for reassembly and disconnect the propshaft from the rear final drive coupling.
- 15.3 Rotate the final drive coupling flange fully anti-clockwise and scribe a line on the edge of the flange mudshield (Fig 5).
- 15.4 Scribe a second line on the pinion housing casting to coincide with the first.
- 15.5 Rotate the final drive coupling flange fully clockwise and measure the distance between the two marks.
- 15.6 If this distance exceeds 10 mm (0.4 in) the final drive unit should be renewed.

RUNNING IN

16 When running in the axles after repair the vehicle should be run for approximately 30 Km (18 miles) avoiding heavy loads and high speeds.



MIL0548

Fig 5 Checking rear axle backlash

CHAPTER 6-2

STANDARD REAR AXLE

CONTENTS

Para

- 1 Introduction
REAR AXLE ASSEMBLY
Torque list
- 2 Removal
- 3 Installation
HALF SHAFTS
- 4 Removal
- 5 Cleaning
- 6 Examination
- 7 Installation
HUB ASSEMBLY
- 8 Removal
- 9 Dismantling
- 10 Reassembly
STUB AXLE
- 11 Removal and dismantling
- 12 Reassembly
DIFFERENTIAL ASSEMBLY
- 13 Removal
- 14 Installation
- 15 Checking rear axle backlash
- 16 Running in

Table

1	Special tools.....	2
2	Sealants, adhesives and lubricants	2
3	Service kits.....	2
4	Hub shim spacers	8

Page

Fig

1	Rear axle removal and installation.....	5
2	Rear hub assembly	7
3	Fitting oil seal	10
4	Removing the differential assembly	11
5	Checking rear axle backlash.....	13

INTRODUCTION

1 This sub-chapter covers the Unit repairs for Truck Utility Light (TUL) HS, vehicles fitted with the standard rear axles. The repair instructions detailed are applicable to both left and right hand drive vehicles.

NOTEWheel bearings

After any examination or repair wheel bearings should be repacked with grease (refer to Para 10). Examination should take place at every major service period equivalent to 2 years.

REAR AXLE ASSEMBLY**TORQUE LIST**

Hub lock nut (initial)
Hub lock nut (final)

30 Nm/23 lbf ft *
200-220 Nm/148-163 lbf ft *

* New lock nut must be used

NOTE

The special tools listed in the following table will be referred to in the text, where used, by the serial number shown in the table.

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	LRT-54-002	6MT2/5120-99-828-0406	Hub nut spanner

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	OEP 220	9150-99-220-1477	Axle oil
2	XG 291	9150-99-918-3786	Grease
3	RTV	8030-99-224-6527	Silicone sealing compound
4	Loctite 243	8030-01-475-2444	Thread lock

TABLE 3 SERVICE KITS

Serial (1)	NSN/Part Number where applicable (2)	Designation (3)
1	7XD 5306-99-808-7428	Patch loc bolt

REMOVAL

- 2 To remove the axle assembly from the vehicle carry out the following:
 - 2.1 Jack up the rear of the vehicle and support the chassis frame.
 - 2.2 Remove the rear road wheels.
 - 2.3 Support the axle weight with a suitable hydraulic jack.
 - 2.4 Disconnect the shock absorbers at the lower fixings (Fig 1 (1)) and remove the rubbers and washers.
 - 2.5 Disconnect the flexible brake hose at the three-way connection (2). Blank off the connections to prevent loss of brake fluid and ingress of foreign matter.
 - 2.6 Disconnect the breather hose at the banjo connection (6) on the axle casing. Remove the plastic tie straps securing breather hose to axle casing.
 - 2.7 Disconnect the lower links (5) at the axle.
 - 2.8 Mark the differential and propeller shaft flanges to aid reassembly. Remove the four nuts and bolts, lower the propshaft (7) and tie to one side.
 - 2.9 Disconnect the pivot bracket ball joint by removing the split pin, castellated nut and plain washer securing the joint to the axle mounted bracket (3).

NOTE

The removal and the refitting of the axle assembly will require the assistance of two additional personnel to steady the axle when lowering.

- 2.10 Lower the axle, release the bolts securing coil spring retaining plates and remove the springs (4).
- 2.11 If a new or replacement axle assembly is to be fitted, remove the brake pipes from the existing axle assembly, clean and examine them, if they are satisfactory for further use fit to the replacement axle.
- 2.12 Remove the road spring seating plates and fit them to the replacement axle assembly.

INSTALLATION

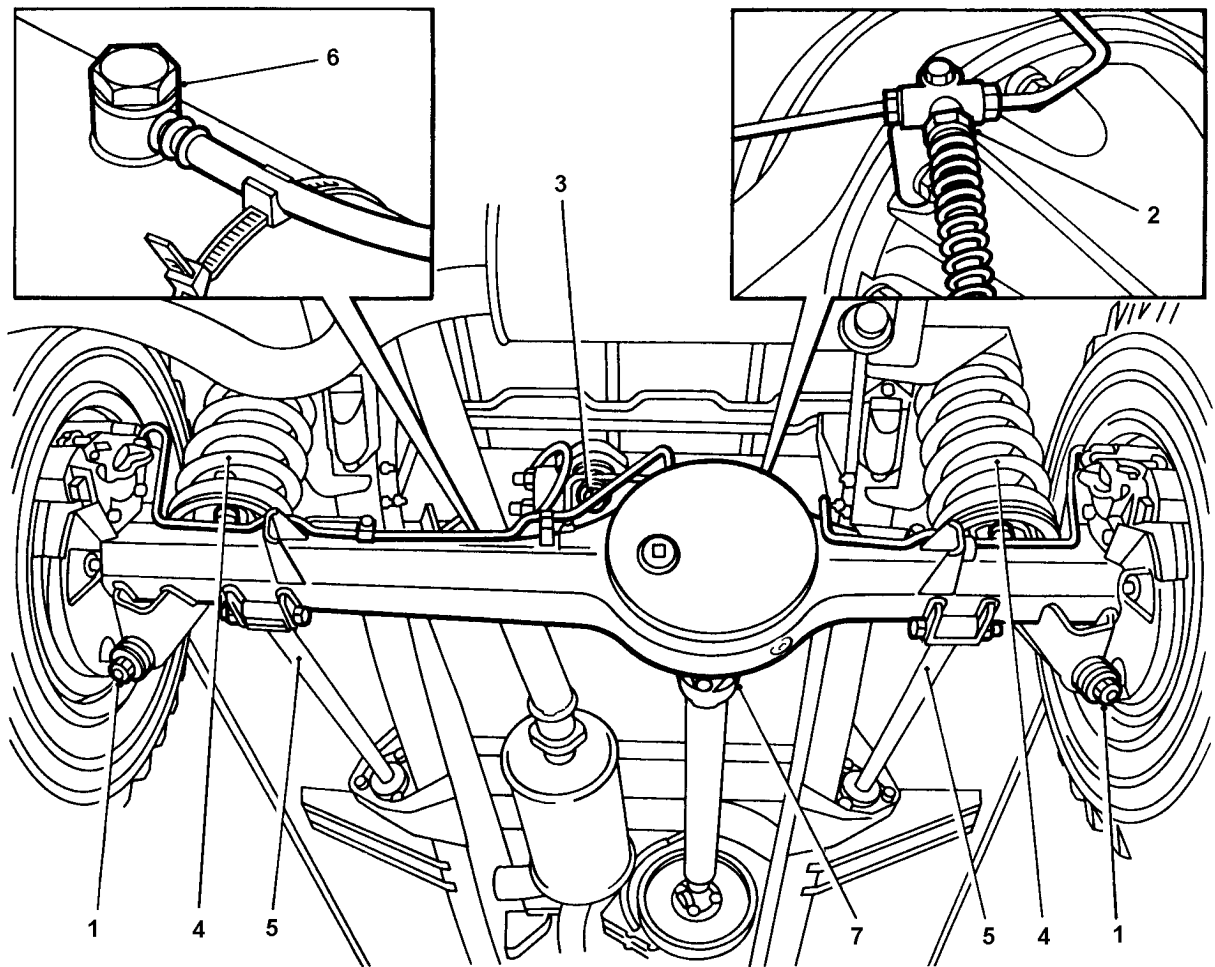
- 3 To install the axle assembly on the vehicle proceed as follows:

NOTE

The fixing bolts for all suspension bushes should be torqued when the vehicle is on the floor at its normal ride height (i.e. "loaded with its normal payload").

- 3.1 Fit the coil springs (4) to the axle and secure with the retaining plates and bolts.
- 3.2 Raise the axle with the jack and locate the lower links (5). Secure with the bolts and nuts, and tighten to a torque of 64 Nm (47 lbf ft).
- 3.3 Connect the pivot ball joint to the axle mounted bracket (3) and secure with the castellated nut, plain washer and split pin. Tighten to a torque of 176 Nm (130 lbf ft).

- 3.4 Connect the shock absorbers (1) to the attachment plate on the axle and tighten the securing nuts to a torque of 75 Nm (55 lbf ft).
- 3.5 Connect the propeller shaft (7), aligning the marks made when dismantling, and tighten the securing bolts to a torque of 47 Nm (35 lbf ft).
- 3.6 Reconnect flexible brake hose at the three-way connector (2).
- 3.7 Connect the breather hose banjo connections (6) to the top of the axle casing.
- 3.8 Fit the road wheels and remove the vehicle from the stands.
- 3.9 Fill the axle with the approved oil (refer to Table 2 Serial 1).
- 3.10 Bleed the brakes and top up the fluid (refer to Chap 10-1).
- 3.11 After the initial axle run (refer to Para 15), check the oil level and replenish as necessary.
- 3.12 Where major running parts have been replaced during overhaul, it is recommended practice to allow the axle assembly to 'run in' by avoiding, where possible, heavy loads and high speeds during initial running (refer to Para 15).



MIL0231

- | | |
|------------------------|-------------------|
| 1 Shock absorbers | 5 Lower link |
| 2 Three-way connector | 6 Axle breather |
| 3 Axle mounted bracket | 7 Propeller shaft |
| 4 Coil springs | |

4

Fig 1 Rear axle removal and installation

HALF SHAFTS

REMOVAL

4 To remove the half shafts proceed as follows:

- 4.1 Remove the five axle half shaft retaining bolts (Fig 2 (3)), and withdraw the half shaft (1).
- 4.2 Remove the gasket (2) and discard.
- 4.3 If necessary repeat Para 4.1 to remove the other half shaft.

CLEANING

- 5 Thoroughly clean the half shaft.

EXAMINATION

- 6 Examine the splines on the half shaft for damage and wear.

INSTALLATION

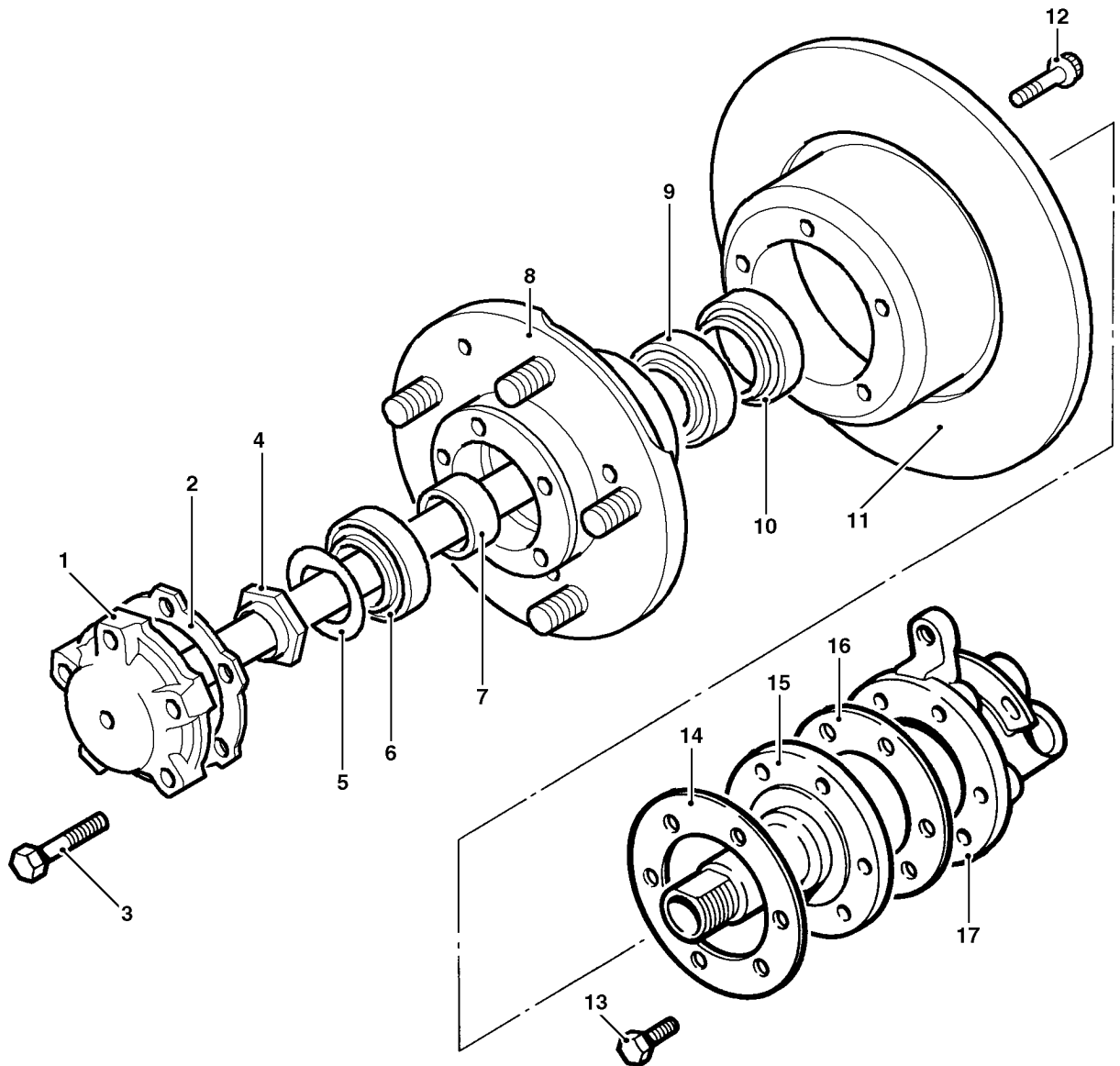
- 7 To refit the half shafts reverse the removal procedure using a new gasket (2) between the mating faces of the hub (9) and half shaft. Tighten the bolts to a torque of 65 Nm (48 lbf ft).

HUB ASSEMBLY**REMOVAL**

- 8 To remove the rear hub assemblies carry out the following:
 - 8.1 Slacken the road wheel nuts.
 - 8.2 Jack up the rear of the vehicle and lower onto suitable axle stands.
 - 8.3 Remove the road wheel.
 - 8.4 Disconnect the rear brake hose from the calliper and seal off end.
 - 8.5 Remove the brake calliper.
 - 8.6 Remove the five bolts (3) and withdraw the axle shaft (1).
 - 8.7 Remove the gasket (2).
 - 8.8 Remove the locknut (4) and 'D' washer (5).
 - 8.9 Withdraw the hub and brake disc assembly complete with bearings and internal shim spacer (7).

DISMANTLING

- 9 To dismantle the brake disc and hub assembly proceed as follows:
 - 9.1 Remove the outer bearing (6) and withdraw shim spacer (7).
 - 9.2 If the existing hub is to be refitted, mark the relationship between the hub and brake disc to aid reassembly.
 - 9.3 Remove the bolts (12) then separate the hub (8) from the brake disc (11).
 - 9.4 Remove the grease seal (10) and the inner bearing (9) from the hub and discard the seal.
 - 9.5 If new bearings are to be fitted, remove the inner and outer bearing tracks from the hub.



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	1	Axle half shaft	10	Grease seal
2		Gasket	11	Brake disc
3		Bolt	12	Bolt
4		Lock nut	13	Bolt
5		'D' washer	14	Mudshield
	6	Outer bearing	15	Stub axle
7		Shim spacer	16	Gasket
8		Hub	17	Axle casing
9		Inner bearing		

Fig 2 Rear hub assembly

REASSEMBLY

10 Reassemble the hub as follows:

10.1 Clean and degrease the hub. If removed fit the inner and outer bearing tracks.

NOTE

New bearings come pre-greased. If original bearings are to be refitted, pack with a suitable amount of grease (refer to Table 2 Serial 2).

10.2 Fit the inner bearing (9) to the hub.

10.3 Using a suitable tool fit a new grease seal (10) to the hub with the lip side leading. Drive in the seal so that it is flush with the rear face of the hub. Apply grease liberally to the seal lips.

10.4 Assemble the brake disc (11) to the hub (8) aligning the marks made during dismantling. Fit the retaining bolts (12) and tighten to 73 Nm (54 lbf ft).

10.5 If fitting the original bearings fit the original shim spacer (7) (noting its colour code) and outer bearing (6).

NOTE

If fitting new bearings the shim spacer colour coded with a purple 'X' (refer to Table 4 Serial 1) must be fitted at this stage.

10.6 Ensure that the stub axle and drive shaft are clean and fit the hub assembly to the axle.

10.7 Fit the 'D' washer and the new locknut and torque to 30 Nm (23 lbf ft).

10.8 Rotate and push/pull the hub to settle the bearings.

10.9 Torque lock nut to 200 to 220 Nm (148 to 163 lbf ft).

10.10 For new bearings, measure the end float using a plunger DTI firmly mounted on the hub, taking the plunger reading from the hub nut face and by pushing and pulling the hub in the axial plane.

10.11 If no end float is evident, proceed to Para 10.18

10.12 Should end float be present refer to Table 4 for the correct shim spacer for the end float measured (rounding up to the nearest spacer detailed on the table).

TABLE 4 HUB SHIM SPACERS

Serial (1)	Part number (2)	Measured end float (3)	Shim spacer required (4)
1	TOF100000	0 mm	Shim spacer 15.5 (purple 'X')
2	TOF100010	0.025 mm to 0.075 mm	Shim spacer 15.4 (yellow)
3	TOF100020	0.100 mm to 0.150 mm	Shim spacer 15.3 (red)
4	TOF100030	0.175 mm to 0.225 mm	Shim spacer 15.2 (blue)
5	TOF100040	0.275 mm to 0.350 mm	Shim spacer 15.1 (green)
6	TOF100050	0.375 mm to 0.450 mm	Shim spacer 15.0 (black)
7	TOF100060	0.475 mm to 0.550 mm	Shim spacer 14.9 (white)

10.13 Remove locknut, 'D' washer, outer bearing and shim spacer.

10.14 Insert new selected shim spacer and replace the bearing, 'D' washer and locknut.

10.15 Torque locknut to 30 Nm (23 lbf ft).

10.16 Rotate and push/pull hub to settle bearings.

- 10.17 Torque locknut to 200 to 220 Nm (148 to 163 lbf ft) and recheck that no end float is present.
- 10.18 Tap the lock nut onto the flat of the stub axle.

NOTE

A round nose chisel must be used when undertaking this process and only use light force to knock the tab flat.

- 10.19 Fit a new gasket (2) and fit the axle shaft (1) to hub (8). Use new encapsulated Patch Loc bolts (refer Table 3 Serial 1) to secure the hub, evenly tighten the securing bolts (3) to a torque of 65 Nm (48 lbf ft).

NOTE

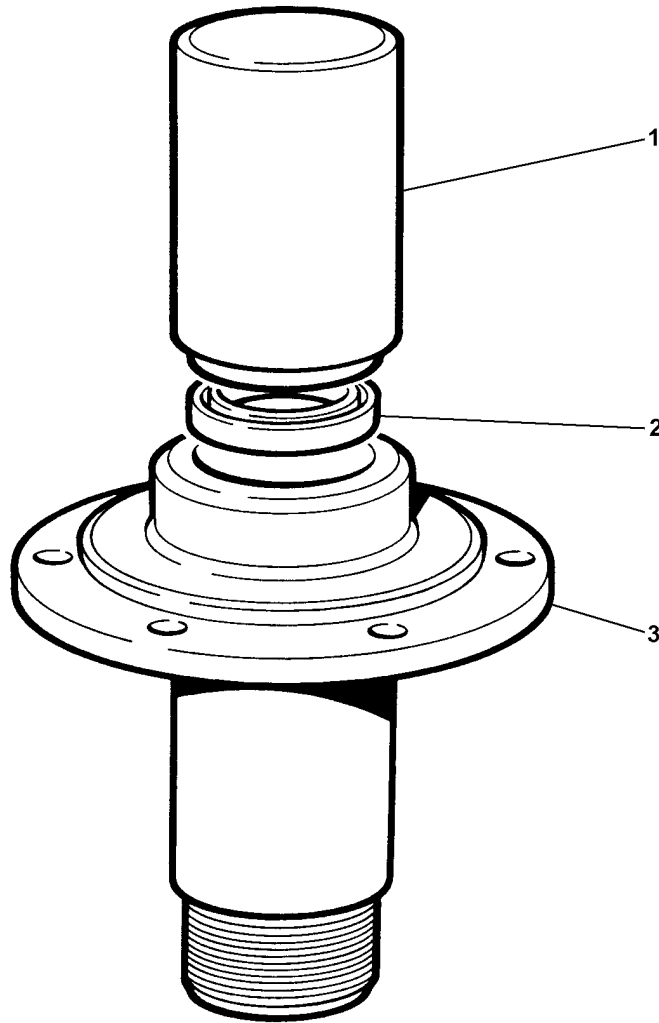
In out of territory locations it may be necessary to refit the existing bolts using Loctite 243. In this event, documents to be annotated with 'exchange bolts for the correct Encapsulated patch loc bolts when possible'.

- 10.20 Fit brake calliper. Tighten to a torque of 100 Nm (74 lbf ft).
- 10.21 Connect the brake pipe.
- 10.22 Bleed brake system (refer to Chap 10-1).
- 10.23 Fit road wheel, remove axle stands and tighten the nuts to 170 Nm (125 lbf ft).
- 10.24 Operate footbrake to locate brake pads before taking vehicle on road.

STUB AXLE

REMOVAL AND DISMANTLING

- 11 To remove and dismantle the rear stub axle carry out the following:
 - 11.1 Remove the hub assembly (refer to Para 8).
 - 11.2 Remove the six bolts (Fig 2 (13)) securing the stub axle to the casing.
 - 11.3 Remove the mudshield (14).
 - 11.4 Remove stub axle (15) and gasket (16).
 - 11.5 Remove and discard stub axle oil seal.



MIL0227

- | | | | | |
|---|---|---|---|-----------|
| 2 | 1 | Rear stub axle oil seal replacer
Grease seal | 3 | Stub axle |
|---|---|---|---|-----------|

Fig 3 Fitting oil seal

REASSEMBLY

12 To reassemble the stub axle proceed as follows:

12.1 Lubricate a new grease seal (Fig 3 (2)) with oil (refer to Table 2 Serial 1) and using a suitable tool fit the new oil seal, lipside trailing so that the seal is flush with the rear face of the stub axle (3).

12.2 Fit a new gasket and position the stub axle and mudshield, locate the six bolts and tighten to a torque of 65 Nm (48 lbf ft).

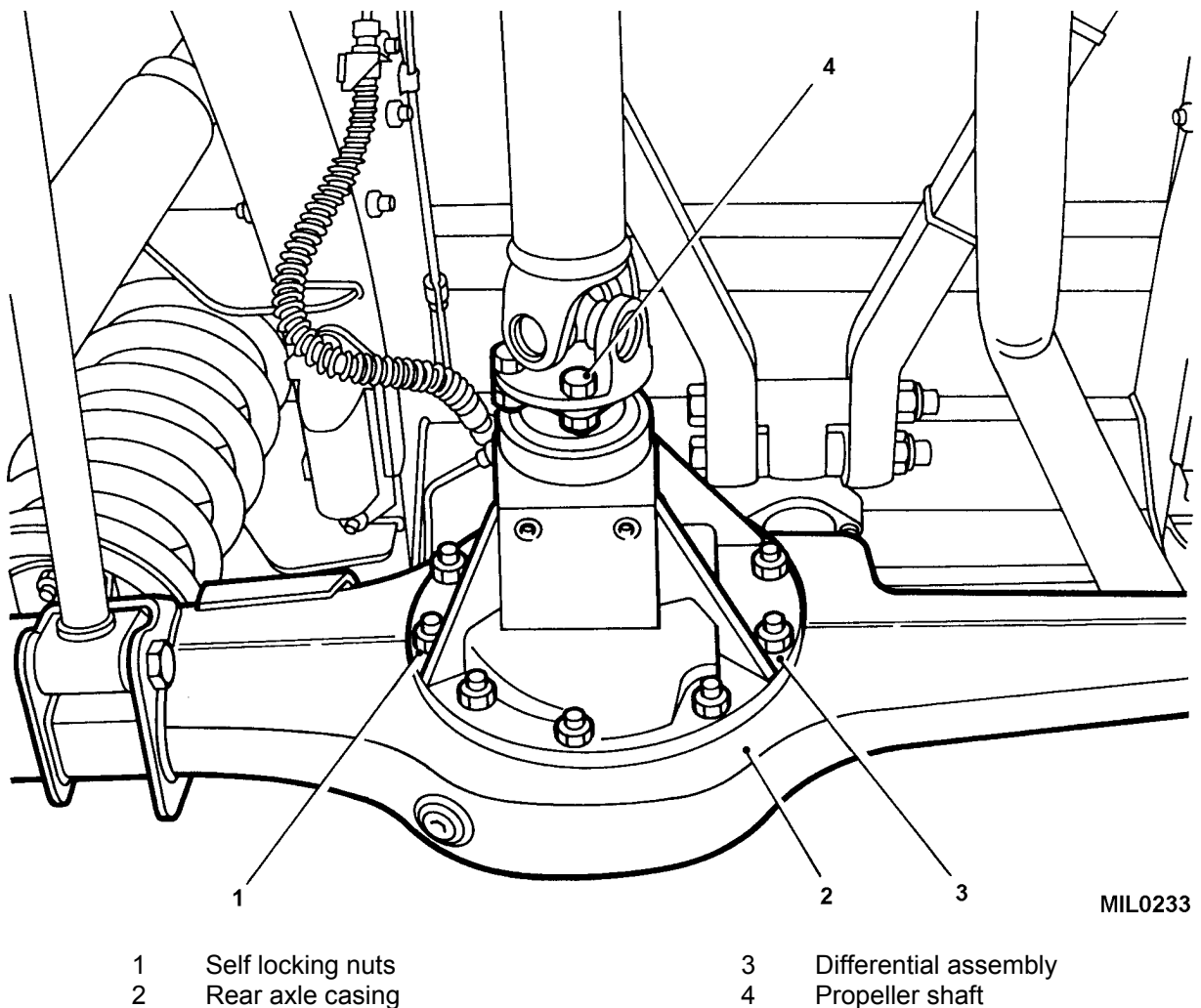
12.3 Refit the rear hub assembly (refer to Para 10).

DIFFERENTIAL ASSEMBLY

REMOVAL

13 To remove the differential assembly carry out the following:

- 13.1 Using a suitable container drain the oil from the axle and refit the drain plug.
- 13.2 Disconnect the propeller shaft (Fig 4 (4)) from the differential flange and secure to one side.
- 13.3 Remove the hub driving member fixings and withdraw the axle half shafts sufficiently to disengage them from the differential unit (refer to Para 4).
- 13.4 Suitably support the differential unit whilst removing.
- 13.5 Remove the self locking nuts (1) securing the differential assembly (3) to the axle casing (2) and withdraw the unit from the vehicle.



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Fig 4 Removing the differential assembly

INSTALLATION

14 Refit the assembly to the axle as follows:

- 14.1 Ensure mating faces are clean and apply a bead of sealant (refer to Table 2 Serial 3) to axle case.
- 14.2 Suitably support the differential assembly and position on the axle casing.
- 14.3 Secure with self locking nuts and tighten to a torque of 40 Nm (30 lbf ft).
- 14.4 Position propeller shaft. Align markings and tighten bolts to a torque of 48 Nm (35 lbf ft).
- 14.5 Refit Hubs and half shafts.
- 14.6 Replenish axle with oil (refer to Table 2 Serial 1).
- 14.7 After initial axle run (refer to Para 15), check oil level and replenish if necessary.
- 14.8 Where major running parts have been replaced during overhaul, it is recommended practice to allow the axle assembly to be 'run in' (refer to Para 15).

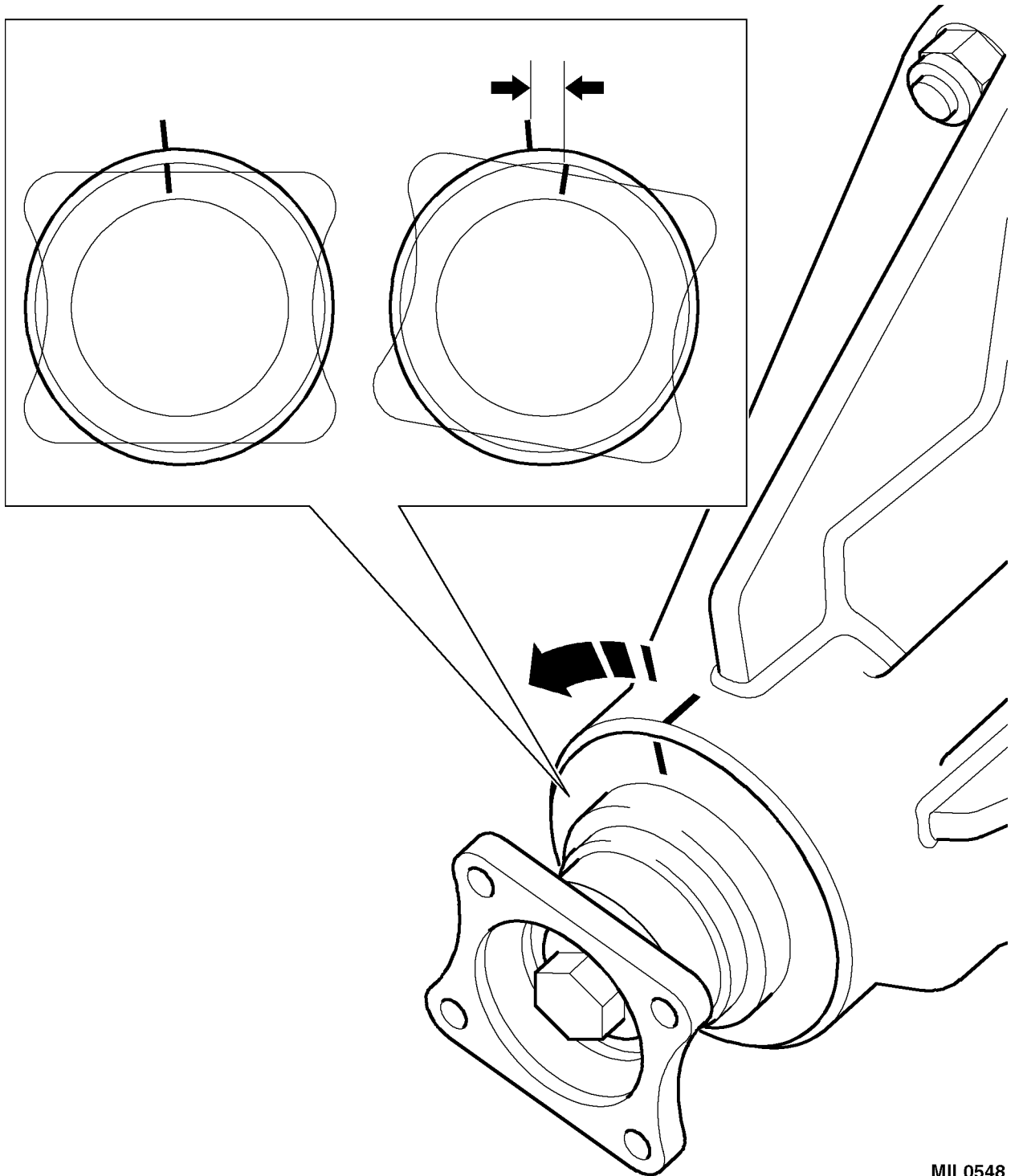
CHECKING REAR AXLE BACKLASH

15 To check the rear axle backlash, carry out the following:

- 15.1 Place the vehicle on a ramp and chock the rear wheels.
- 15.2 Mark the flanges for reassembly and disconnect the propshaft from the rear final drive coupling.
- 15.3 Rotate the final drive coupling flange fully anti-clockwise and scribe a line on the edge of the flange mudshield (Fig 5).
- 15.4 Scribe a second line on the pinion housing casting to coincide with the first.
- 15.5 Rotate the final drive coupling flange fully clockwise and measure the distance between the two marks.
- 15.6 If this distance exceeds 10 mm (0.4 in) the final drive unit should be renewed.

RUNNING IN

16 When running in the axles after repair the vehicle should be run for approximately 30 Km (18 miles) avoiding heavy loads and high speeds.



MIL0548

Fig 5 Checking rear axle backlash

CHAPTER 7

POWER ASSISTED STEERING SYSTEM

CONTENTS

Para	
1	Introduction TORQUE LIST STEERING WHEEL ASSEMBLY Collapsible shaft
2	Removal Steering wheel
3	Removal Instrument panel
4	Removal Steering column switches
5	Removal Steering column heater/start switch
6	Removal Brake pedal box
7	Removal Steering column
8	Removal
9	Refitting Brake pedal box
10	Refitting Steering column heater/start switch
11	Refitting Steering column switches
12	Refitting Instrument panel and nacelle
13	Refitting Steering wheel
14	Refitting Collapsible shaft
15	Refitting STEERING BOX
16	Removal (CAUTIONS)
17	Draining the fluid
21	Centralise the steering
25	Refitting
26	Refilling the system (WARNING)(CAUTION)
27	Bleeding (CAUTIONS)
28	Testing the system (CAUTIONS)
29	Adjustment (WARNING)
	STEERING PUMP
30	Removal (CAUTIONS)
31	Refitting
32	Drive belt adjustment
	DROP ARM BALL JOINT
33	Removal/dismantling (WARNING)
34	Repairs and replacement
35	Reassembly

(continued)

CONTENTS (CONTINUED)

STEERING DAMPER

36 Removal

37 Refitting

Track rod and linkage

38 Track rod removal

39 Linkage removal

40 Refitting linkage

41 Refitting track rod (CAUTION)

42 Drag link and drag link ends

43 Removing drag link ends

44 Refitting drag link ends

45 Refit drag link (CAUTION)

FRONT WHEEL ALIGNMENT

46 Alignment

47 Adjustment

48 Steering lock stops

49 Adjustment

Table	Page
1 Special tools	3
2 Sealants, adhesives and lubricants.....	3

Fig	Page
1 Collapsible shaft	4
2 Instrument panel.....	5
3 Underside of nacelle showing securing screws	6
4 Steering switch multi-plugs.....	7
5 Steering column heater/start switch removal	8
6 Steering column tie-bar	9
7 Steering column securing bolts	10
8 Steering column heater/start switch installation	11
9 Steering box assembly	14
10 Adjustment screw and bleed nipple.....	16
11 Test equipment.....	18
12 Steering pump	21
13 Drop arm ball joint	22
14 Fitting drop arm tab washer.....	24
15 Removing steering damper	25
16 Removing track rod linkage.....	26
17 Removing drag link.....	27
18 Setting steering stop locks	30

INTRODUCTION

1 This chapter covers the Unit repairs for Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles fitted with the power assisted steering system. The repair instructions detailed are applicable to both left and right hand drive vehicles.

TORQUE LIST

Steering column support brackets nuts and bolts		29-35 Nm/22-26 lbf ft
Steering wheel to shaft		25 Nm/18 lbf ft
Universal joint pinch bolt collapsible shaft assembly		34 Nm/25 lbf ft
Steering box to chassis side member		81 Nm/60 lbf ft
Universal joint pinch bolt on power steering box		25 Nm/18 lbf ft
Tie bar to arm mounting		81 Nm/60 lbf ft
Tie bar to steering box		81 Nm/60 lbf ft
Drag link to drop arm		40 Nm/30 lbf ft
Panhard rod	230	Nm/170 lbf ft
Steering box feed and return pipes		
16mm	thread	20 Nm/15 lbf ft
14mm	thread	15 Nm/11 lbf ft
Hose clip	3	Nm/2 lbf ft
High pressure union connection		20 Nm/15 lbf ft
Drop arm to steering box		176 Nm/130 lbf ft
Cross rod to drop arm		41 Nm/30 lbf ft
Track rod ball joint nuts		40 Nm/30 lbf ft
Drag link clamp bolts		14 Nm/10 lbf ft

STEERING WHEEL ASSEMBLY

NOTE

The special tools listed in the following table will be referred to in the text, where used, by the serial number shown in the table.

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	LRT-57-030	6MT2/4910-99-535-4941	PAS pressure test tube c/w adaptor
2	LRT-57-005	6MT2/6685-99-747-4771	Power steering test set
3	LRT-57-001	6MT2/5130-99-767-3076	Power steering test adapter
4	LRT-57-036		Ball joint separator
5			3 leg puller
6			Adaptor

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	OX 75	9150-99-869-4114	Power steering oil
2	XG279	9150-99-250-7742	Grease
3	Celloseal	8030-99-225-0232	Anti-seize grease

COLLAPSIBLE SHAFT**Removal**

2 To remove the collapsible shaft carry out the following:

2.1 Remove the vehicle bonnet.

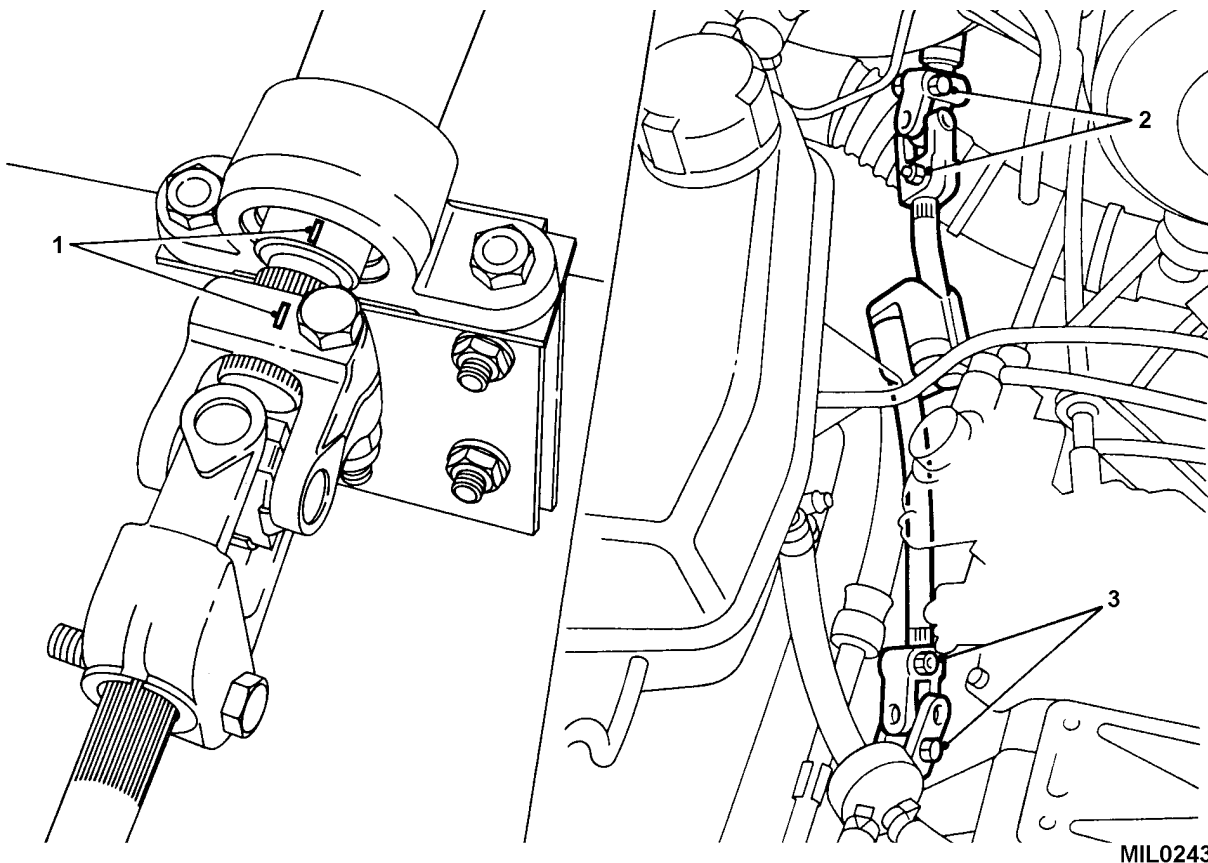
2.2 Set the road wheels and steering wheels in the straight ahead position.

2.3 Mark the relationship (Fig 1 (1)) of the steering column inner shaft to the top universal joint.

NOTE

The collapsible shaft can be disconnected from the steering column only, if required, by removing the bolts from the top universal joint and slackening the top bolt of the lower universal joint.

2.4 Remove the two bolts (2) from the top universal joint and the lower bolt (3) of the bottom universal joint. Slacken the upper bolt of the bottom universal joint and withdraw the shaft.



1 Alignment marks
2 Top universal bolts

3 Bottom universal bolts

Fig 1 Collapsible shaft

STEERING WHEEL

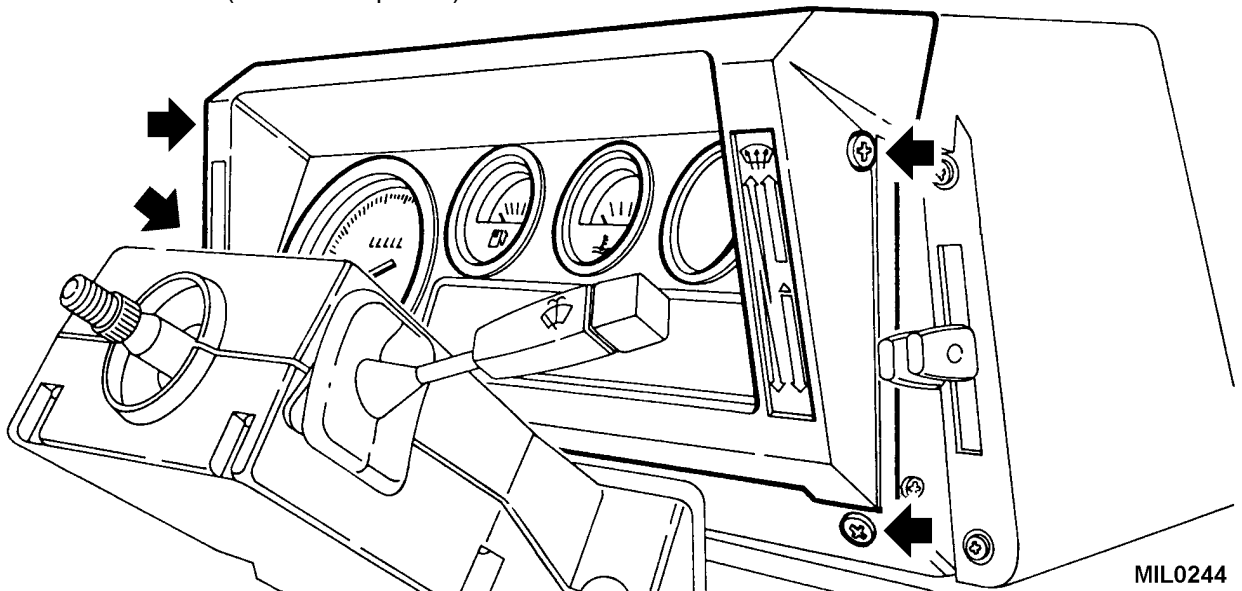
Removal

- 3 To remove the steering wheel carry out the following:
 - 3.1 Ensure that the front wheels are in the straight ahead position.
 - 3.2 Prise the finisher from the centre of the steering wheel.
 - 3.3 Remove the steering wheel retaining nut, make suitable alignment marks on the column and wheel, and remove the steering wheel.

INSTRUMENT PANEL

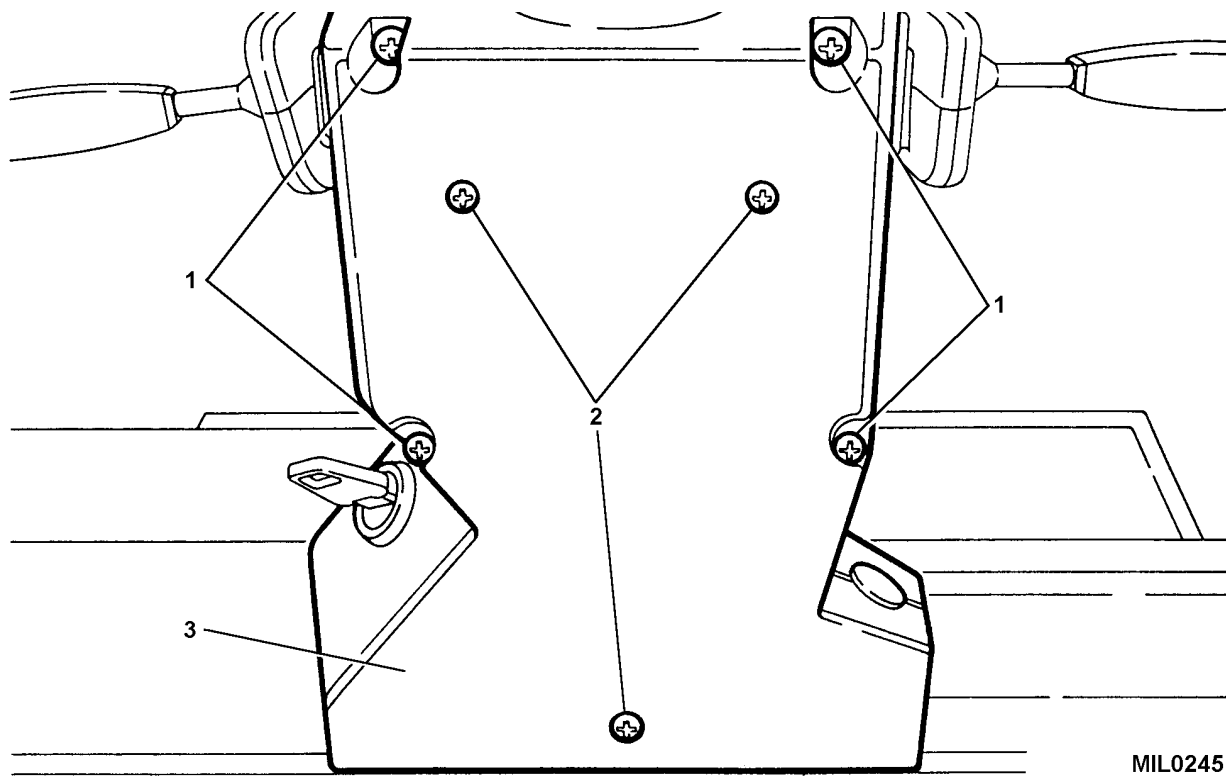
Removal

- 4 Remove the instrument panel as follows:
 - 4.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).



MIL0244

Fig 2 Instrument panel



- | | | | |
|---|---------------------|---|------------------------|
| 1 | Screws | 3 | Bottom half of nacelle |
| 2 | Self tapping screws | | |

Fig 3 Underside of nacelle showing securing screws

4.2 Remove the four screws (Fig 2) securing the instrument panel, ease the panel away from the fascia and disconnect the speedometer cable.

4.3 Disconnect the two block connectors, one multi-plug connector and one white wire then withdraw the panel complete with instruments.

STEERING COLUMN SWITCHES

Removal

5 Remove the steering column switches as follows:

5.1 Remove the four screws (Fig 3 (1)) and three self tapping screws (2) to remove the top half of the nacelle.

5.2 Ease the bottom half of the nacelle (3) from the switch grommets and remove.

5.3 Disconnect the multi-plugs (Fig 4 (1) and (2)).

5.4 Loosen the clamp screw (3) at the top of the switch cluster and remove the switches.

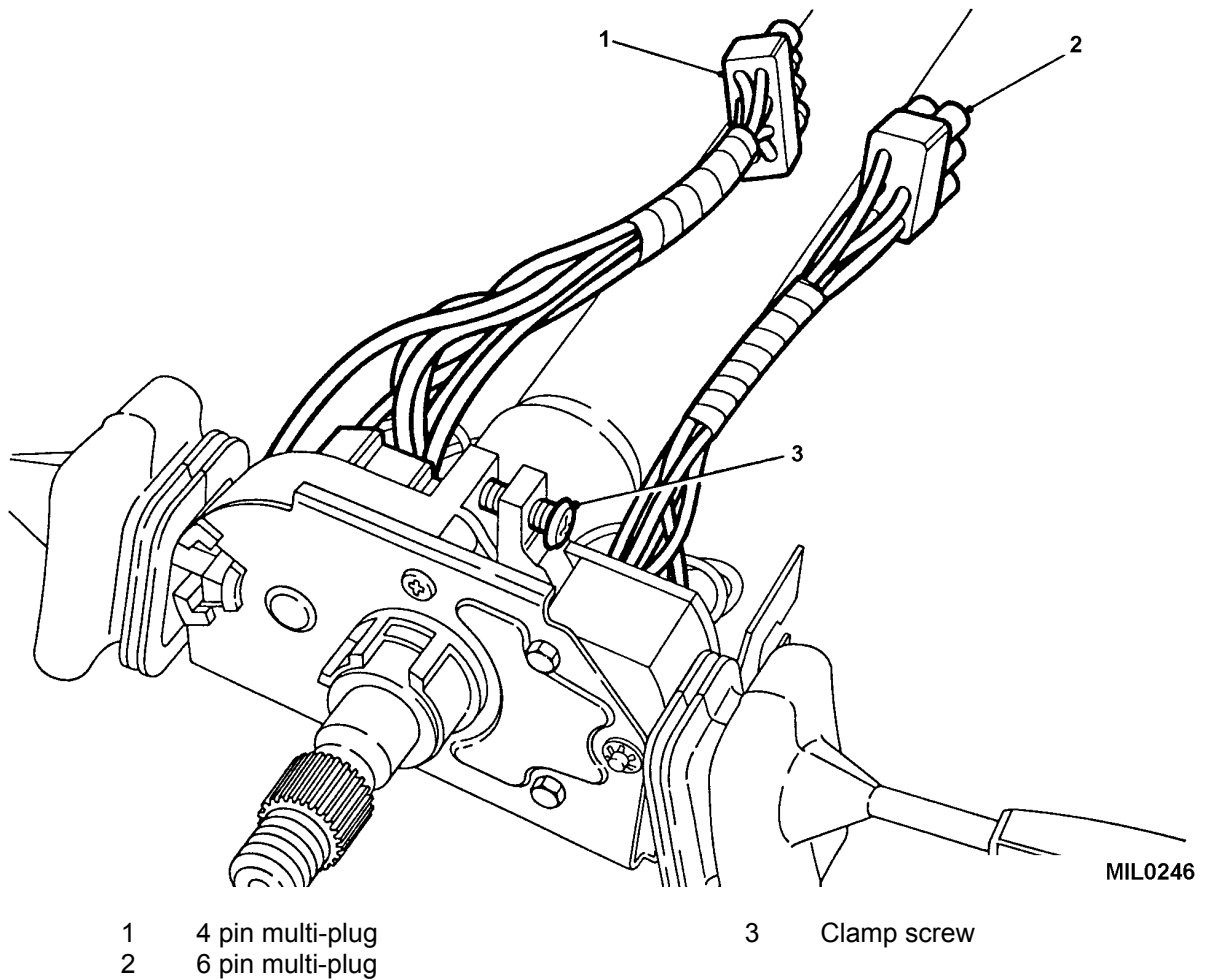


Fig 4 Steering switch multi-plugs

STEERING COLUMN HEATER/START SWITCH

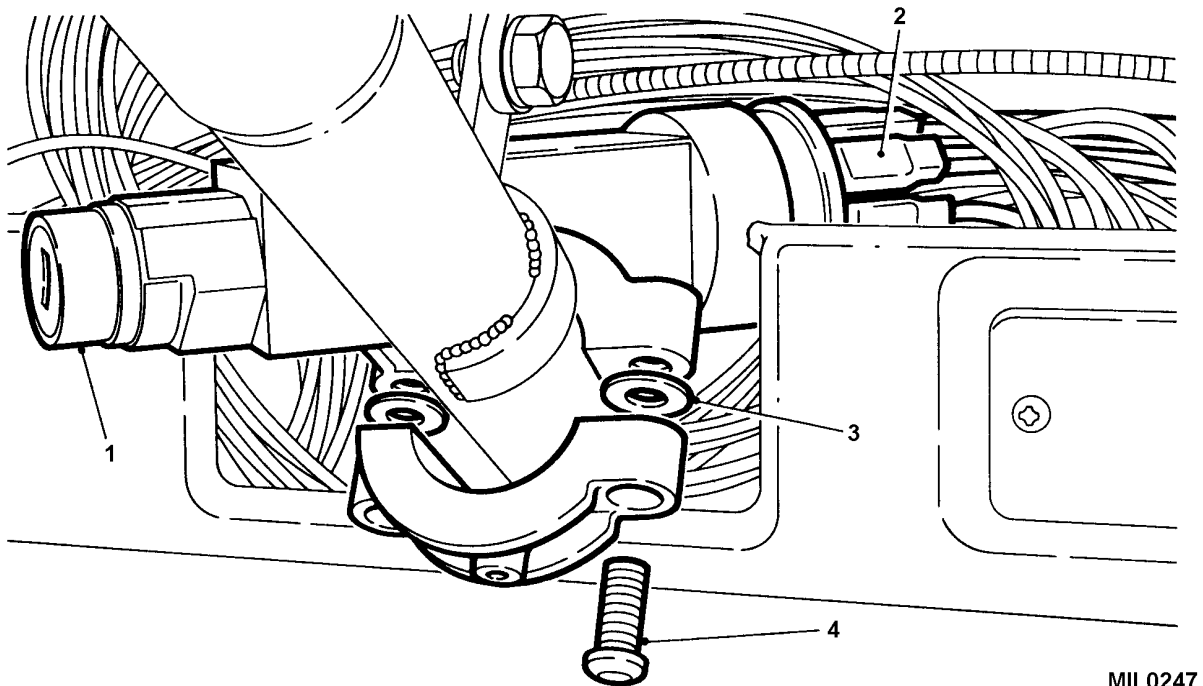
Removal

6 Remove the steering column heater start/switch as follows:

6.1 Note the position of the cables on the back of the switch then disconnect the lucar connectors (Fig 5 (2)).

6.2 Using a suitable punch or stud extractor remove the two shear bolts (4) securing the switch to the steering column.

6.3 Remove the switch (1) and collect the two plain washers (3) from between the switch and clamp.



1 Switch
2 Lucar connectors

3 Washer
4 Shear bolt

Fig 5 Steering column heater/start switch removal

BRAKE PEDAL BOX

Removal

7 To remove the brake pedal box (refer to Chap 10-1).

STEERING COLUMN

Removal

8 Remove the steering column as follows:

8.1 Remove the bolt (Fig 6) securing the tie-bar to the steering column.

8.2 Remove the two bolts (Fig 7 (5)) securing the lower end of the steering column (4) and discard.

8.3 Remove the two bolts (3) securing the two halves of the top clamp and the two bolts (2) that secure the top half of the clamp to the bulkhead and remove the clamp (7) and rubber packing (8).

8.4 Remove the two bolts (1) securing the column main support bracket to the bulkhead and withdraw the steering column and main support bracket from over the inner shaft (6). Note that one of the bolts has a harness securing bracket located under the head.

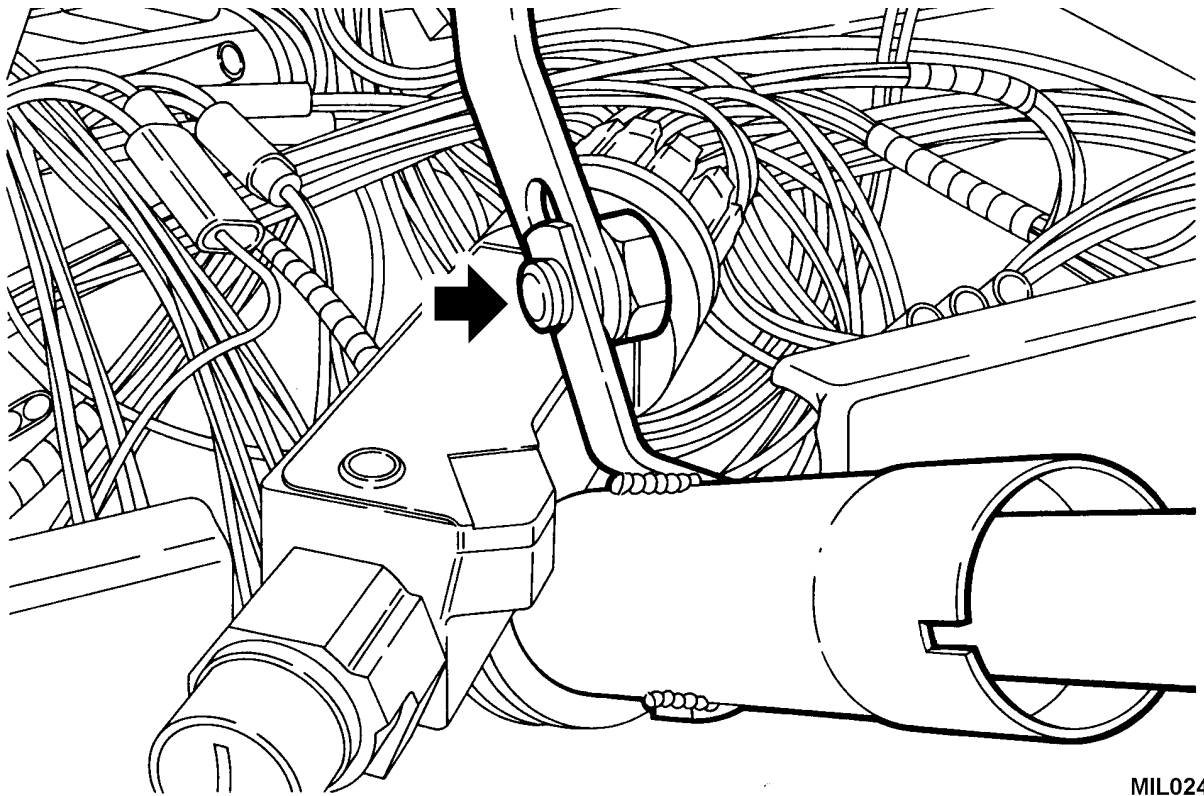


Fig 6 Steering column tie-bar

Refitting

NOTE

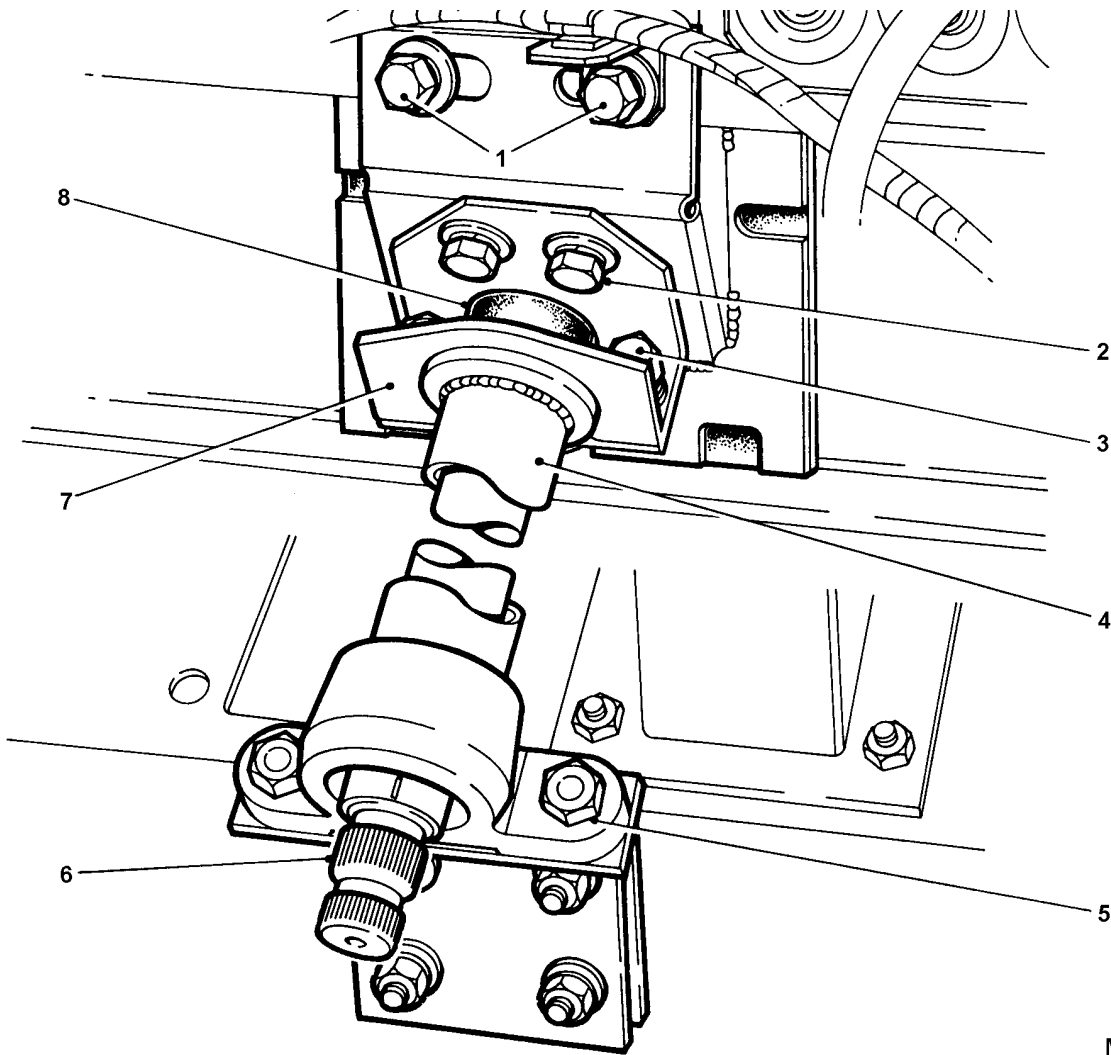
The steering column is a non-serviceable item and can only be serviced as a complete assembly.

9 Refit the steering column as follows:

9.1 Fit the main support bracket and packing to the steering column and manoeuvre the column (4) into position over the inner shaft (6).

9.2 Loosely secure the main support bracket and harness bracket to the bulkhead with two-bolt (1).

9.3 Loosely fit the clamp (7) and rubber packing strip (8) to the column and retain with two bolts (3).



MIL0249

- | | | |
|-------------------|--|------------------------|
| 1 Bolt | | 5 Support bracket nuts |
| 2 Bulkhead bolt | | 6 Inner shaft |
| 3 Clamp bolt | | 7 Clamp |
| 4 Steering column | | 8 Rubber packing |

Fig 7 Steering column securing bolts

9.4 Loosely secure the lower end of the column to the lower support bracket with two nuts and bolts (5).

9.5 Loosely secure the clamp bracket to the main support bracket with two bolts (2).

9.6 Working inside the vehicle cab, fit the tie-bar to the column bracket and secure with the single bolt (Fig 6).

9.7 Finally tighten the main support bracket bolts, clamp bracket bolts, upper clamp bolts and the lower support bracket nuts and bolts to 29-35 Nm (22-26 lbf ft).

BRAKE PEDAL BOX

Refitting

10 To refit the brake pedal box (refer to Chap 10-1).

STEERING COLUMN HEATER/START SWITCH

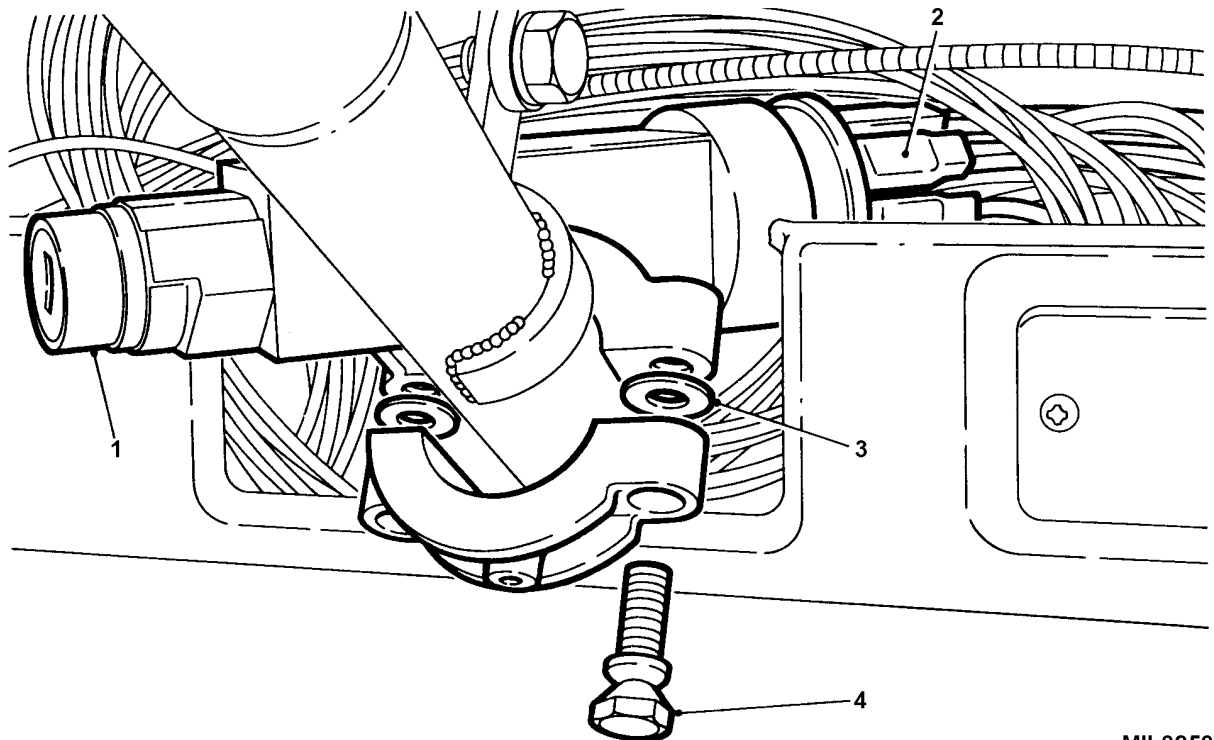
Refitting

11 Refit the steering column heater/start switch as follows:

11.1 Place the heater/start switch (Fig 8 (1)) in position on the steering column and secure with the clamp and shear bolts (4), inserting two plain washers (3) between the switch and clamp.

11.2 Evenly tighten the bolts to secure the switch, then complete the tightening until the heads of the bolts shear.

11.3 Connect the electrical leads (2) to the rear of the switch, in the order noted at removal (refer to Para 6.10).



MIL0250

1 Switch
2 Lucar connectors

3 Washer
4 Shear bolt

Fig 8 Steering column heater/start switch installation

STEERING COLUMN SWITCHES

Refitting

12 Fit the steering column switches assembly, secure with the single screw (Fig 4 (3)) and connect the multi-plugs (1), and (2).

INSTRUMENT PANEL AND NACELLE**Refitting**

13 Refit the instrument panel and nacelle as follows:

13.1 Offer up the instrument panel and connect the speedometer cable, two block connectors, one multi-plug and single white lead to their respective locations at the back of the panel. Locate the panel and secure with the four screws.

13.2 Locate the bottom half of the nacelle in position and fit to the switch grommets, fit the top half and secure with the screws.

STEERING WHEEL**Refitting**

14 Refit the steering wheel as follows:

14.1 Turn the indicator cancelling ring so that the slots are vertical and the lug with the arrow points to the left, in the direction of the indicator switch.

14.2 Ensure that the front wheels of the vehicle are in the straight ahead position.

14.3 Fit the steering wheel with the finisher attachment lug at the bottom, ensuring that the indicator cancelling forks locate in the cancelling ring slots and aligning the marks made during removal.

14.4 Secure the wheel with the nut and a new shake-proof washer and tighten to a torque of 25 Nm (18 lbf ft).

14.5 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

COLLAPSIBLE SHAFT**Refitting**

15 Refit the collapsible shaft as follows:

15.1 If necessary fit new universal joints to the support. Note that the long joint is fitted to the short length of shaft and the short joint to the long end. The joints can only be fitted one way to the shaft.

15.2 With the steering lock engaged and the road wheels in the straight ahead position, line-up the marks made during dismantling (refer to Para 2.3) and fit the collapsible shaft assembly with the long leg of the shaft to the steering box. Fit the pinch bolts and nuts and tighten to a torque of 34 Nm (25 lbf ft).

STEERING BOX

REMOVAL

CAUTIONS

- (1) **CONTAMINATION.** In order to prevent the power steering system from contamination, it is essential to protect all disconnected hoses and their respective interfaces from the ingress of foreign matter, both during dismantle and until reassembly commences.
 - (2) **PAINTWORK DAMAGE.** Power steering fluid is harmful to paintwork. Should any fluid be spilt on to body, chassis or any other components immediately wipe clean.
 - (3) **USED FLUID.** It is most important that fluid drained from the system is not re-used.
 - (4) **PUMP DAMAGE.** Do not start engine until reservoir is full as pump will be damaged.
 - (5) **PIPE FITTINGS.** Metric pipe fittings are used with 'O' ring pipe ends on fittings to steering box. Replace all 'O' rings whenever pipes are disconnected.
- 16 Remove the steering box from the vehicle as follows:
- 16.1 Park vehicle on level surface.
 - 16.2 Chock rear wheels, raise vehicle and locate axle stands.
 - 16.3 Remove the road wheel nearest to the steering box.
 - 16.4 Disconnect the ends of the panhard rod and drop the rod clear of the chassis.
 - 16.5 Disconnect the drag link (Fig 9 (3)) from the drop arm (4) using a suitable extractor.
 - 16.6 Slacken but do not remove nut securing tie bar (5) to mounting.
 - 16.7 Remove the tie bar to box mounting bolts (8) and move the tie bar to the side.

Draining the fluid

- 17 Remove the filler cap from the power steering fluid reservoir.
- 18 Place suitable drain can under steering box (9) to contain fluid.
- 19 Disconnect feed and return pipes from steering box, drain and discard fluid.
- 20 Plug open pipes and steering box ports to prevent ingress of dirt.

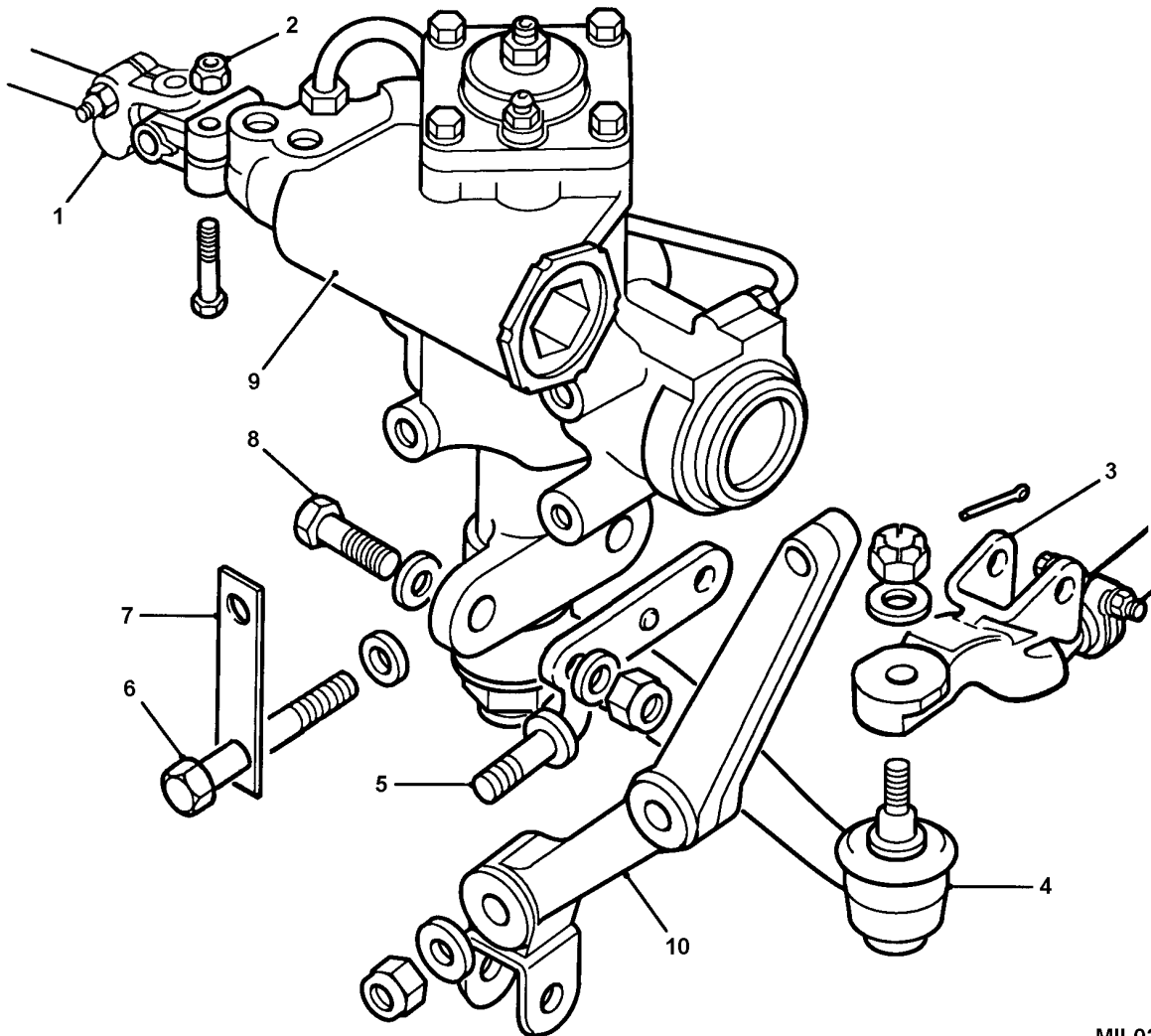
Centralise the steering

NOTE

To centralise the steering box, insert a suitable peg into the hole in steering box casing above the rear of the drop arm and line up with the indent in the drop arm.

- 21 Remove the pinch bolt and nut (2) securing lower shaft universal joint (1) to power steering box.
- 22 Remove the bolts (6) securing the steering box to chassis side member, and remove the spacer plate (7).
- 23 Withdraw power steering box.

24 Clean all mounting faces, unions etc. prior to refitting.



MIL0251

- | | | | |
|---|--------------------|----|--------------------|
| 1 | Universal joint | 6 | Steering box bolts |
| 2 | Pinch bolt and nut | 7 | Spacer plate |
| 3 | Drag link | 8 | Bolts and nuts |
| 4 | Drop arm | 9 | Steering box |
| 5 | Tie bar | 10 | Arm mounting |

Fig 9 Steering box assembly

REFITTING

25 To refit the steering box to the vehicle proceed as follows:

25.1 Position the steering box (9) to chassis side member, ensuring locating peg is engaged. Fit spacer plate (7) and tighten bolts (6) to 81 Nm (60 lbf ft).

25.2 Fit pinch bolt and nut (2) securing universal joint (1) to power steering box. Tighten to 25 Nm (19 lbf ft).

25.3 Secure the tie bar (5), to steering box and also to the arm mounting (10). Tighten bolts and nuts to 81 Nm (60 lbf ft), starting with tie bar to arm mounting, then tie bar to steering box then slacken nut and bolts by one complete turn.

- 25.4 Check steering box, adjust if necessary (refer to the NOTE above Para 21).
- 25.5 Refit drag link (3) to drop arm (4) and tighten nut to 40 Nm (30 lbf ft).
- 25.6 Refit panhard rod and tighten to 230 Nm (170 lbf ft).
- 25.7 Remove sealing plugs, locate and secure feed and return pipes to steering box. Tighten 16 mm thread to 20 Nm (15 lbf ft), and 14 mm thread to 15 Nm (11 lbf ft).

Refilling the system

26 To refill the system proceed as follows:

- 26.1 Remove filler cap. Fill power steering reservoir to oil level mark on dipstick (refer to Table 2 Serial 1).
- 26.2 Bleed power steering system (refer to Para 27).
- 26.3 With engine running, test steering system for leaks by holding the steering hard on full lock in both directions.

CAUTION

FLUID PRESSURE. Do not maintain this pressure for more than 30 seconds in any one minute, otherwise the oil may overheat, resulting in damage to the seals.

- 26.4 Test drive vehicle using both full lock directions, to settle steering components. If possible, drive vehicle over speed bumps and include harsh braking.

WARNING

TESTING THE VEHICLE. DO NOT TEST DRIVE VEHICLE ON PUBLIC HIGHWAY.

- 26.5 Drive vehicle in a straight line on level ground and stop.
- 26.6 Tighten tie bar to arm mounting bolts and nuts to 110 Nm (81 lbf ft).
- 26.7 Tighten nuts and bolts securing tie bar to Steering box to 81 Nm (60 lbf ft).
- 26.8 Check steering wheel is aligned correctly with wheels in straight ahead position.
- 26.9 If necessary reposition steering wheel.
- 26.10 Road test vehicle.

Bleeding

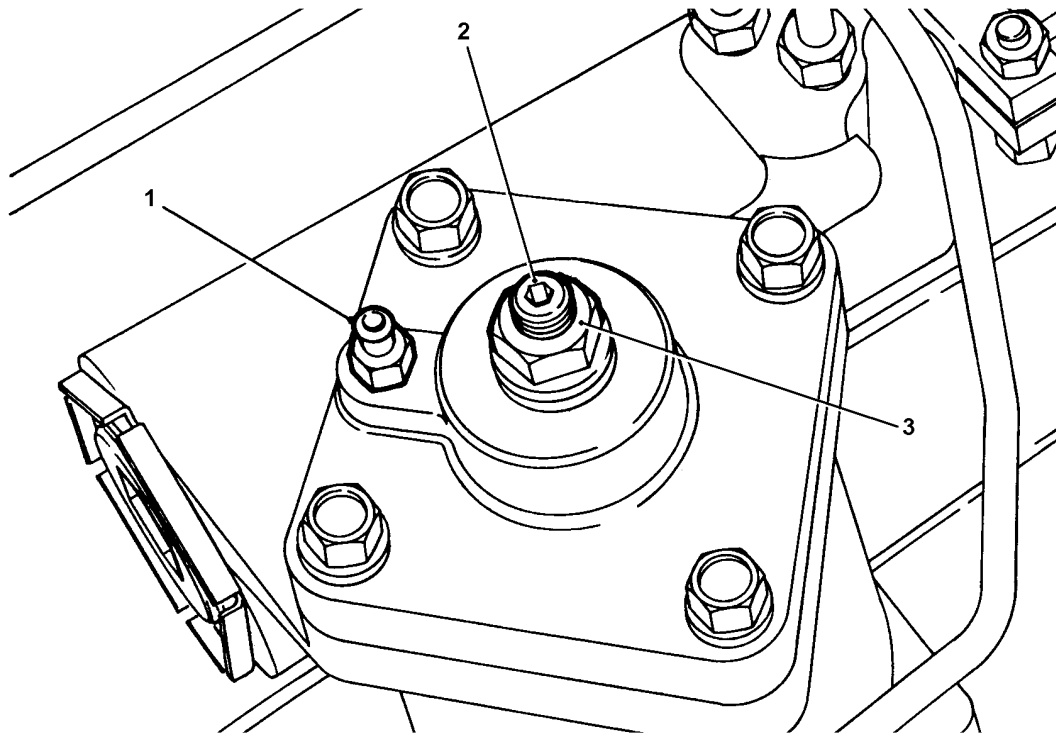
27 To bleed the system of air proceed as follows:

CAUTIONS

(1) PAINTWORK DAMAGE. Power steering fluid is harmful to paintwork. Should any fluid seep on to body, chassis or any other components immediately wipe clean.

(2) USED FLUID. It is most important that fluid drained from the system is not reused.

- 27.1 Fill the steering fluid reservoir to the mark on the side of the reservoir with power steering fluid (refer to Table 2 Serial 1).



MIL0252

1 Bleed nipple
Adjuster screw

3 Locknut

2

Fig 10 Adjustment screw and bleed nipple

27.2 Run the engine until it reaches normal operating temperature.

27.3 Check the reservoir fluid level, replenish if necessary.

NOTE

For the following operation (Para 27.4 to 27.6) ensure that the steering reservoir is kept full. Do not increase the engine speed or move the steering wheel.

27.4 With the engine at idle speed, slacken the bleed screw (Fig 10 (1)). When fluid seepage past the bleed screw is observed, re-tighten the screw.

NOTE

Ensure that all fluid released during bleeding is wiped clean from the surrounding areas.

27.5 Recheck the fluid level, replenish if necessary.

27.6 Check hose joints, pump and steering box for any fluid leaks under pressure by holding the steering hard on full lock in both directions.

CAUTION

FLUID PRESSURE. Do not maintain this pressure for more than 30 seconds in any one minute, otherwise the oil may overheat, resulting in damage to the seals.

27.7 If necessary, take the appropriate remedial action to rectify any leaks.

27.8 With the vehicle stationary the steering should be smooth lock-to-lock in both directions, that is, no heavy or light spots when changing direction.

27.9 Check for correct steering characteristics by road testing the vehicle.

Testing the system

CAUTION

FAULT CONDITIONS. Under certain hydraulic pump fault conditions it is possible to obtain pressures of up to 103 bar (1500 lbf/in²). Therefore, it is important to realise that the pressure upon the gauge is in direct proportion to the pressure being exerted upon the steering wheel. When testing, apply pressure to the steering wheel very gradually while carefully observing the pressure gauge.

28 To test the power steering system proceed as follows:

NOTE

If there is a lack of power assistance for the steering the pressure of the hydraulic pump should be checked first. Refer to the fault diagnosis chart (Cat 512 Chap 7) to assist in tracing faults in the power steering.

28.1 The hydraulic pressure test kit (Fig 11) is used for testing the power steering system.

NOTE

The gauge is calibrated to read up to 137 bar (2000 lbf/in²). The normal pressure, which may be expected in the power steering system, is 76 bar (1100 lbf/in²).

28.2 Check the steering fluid level reservoir, replenish if necessary.

28.3 Examine the power steering units and connections for leaks.

NOTE

All leaks must be rectified before attempting to test the system.

28.4 Check the serpentine belt for condition.

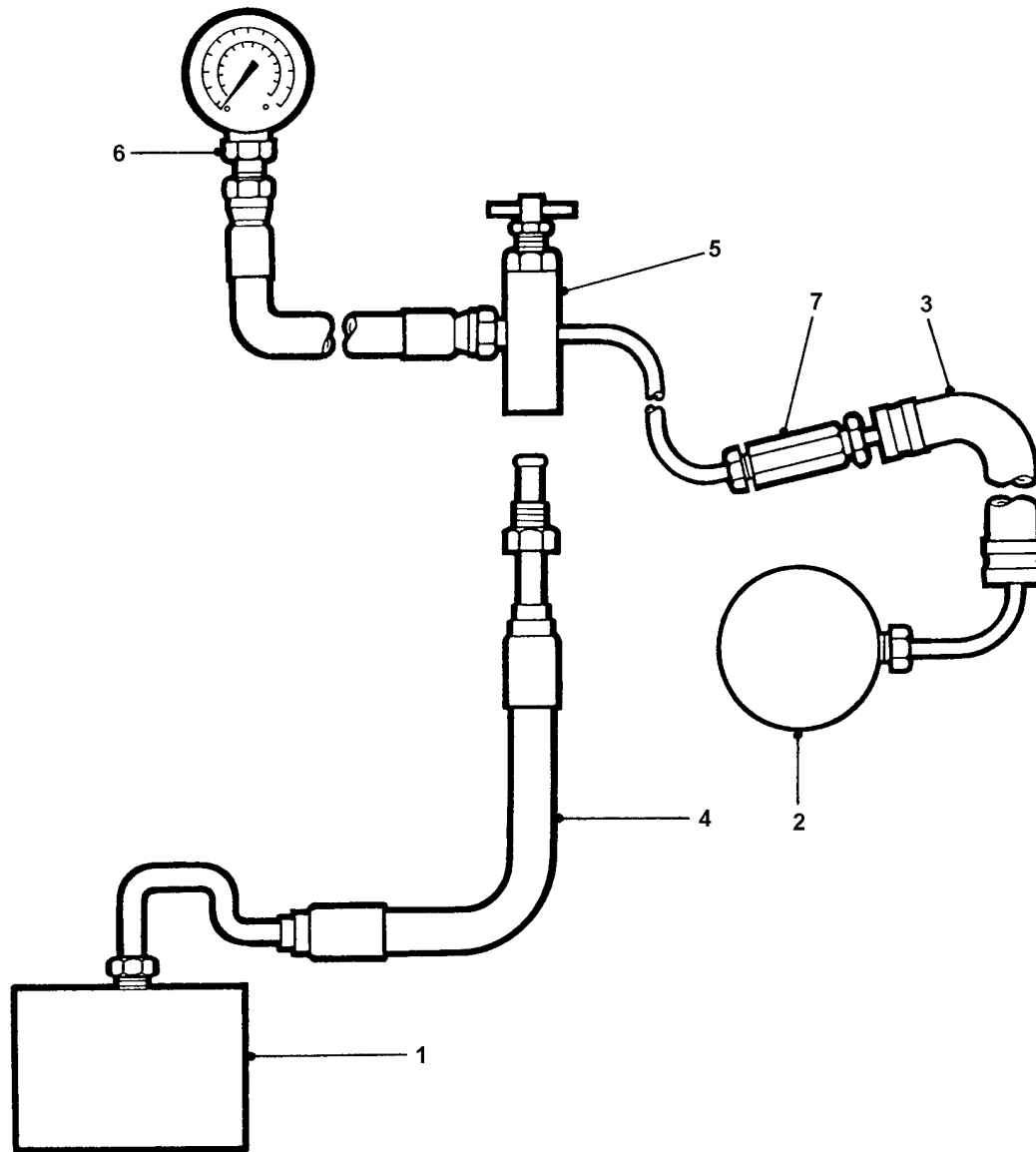
28.5 Assemble the test equipment and fit to the vehicle (Fig 11).

28.6 Open the tap in the adapter (5).

28.7 Bleed the system but exercise extreme care when carrying out this operation so as not to overload the pressure gauge (6).

CAUTION

STEERING WHEEL LOCK. Under no circumstances must the steering wheel be held on full lock for more than 30 seconds in any one minute, as the oil can overheat and possible damage to the seals may occur.



MIL0253

- | | | | |
|---|--|---|--|
| 1 | Steering box | 5 | Test adapter (refer to Table 1 Serial 3) |
| 2 | Steering pump | 6 | Pressure gauge (refer to Table 1 Serial 2) |
| 3 | Hose from steering box to pump | 7 | Adapter (refer to Table 1 Serial 1) |
| 4 | Pressure test tube (refer to Table 1 Serial 1) | | |

Fig 11 Test equipment

28.8 With the system in good condition, momentarily apply lock in one direction until a reading is obtained at idle speed, repeat at 1000 rev/min. The pressures should be as follows:

28.8.1 Steering wheel held hard on full lock and engine running at 1000 rev/min, the pressure should be 68 to 75 bar (1000 to 1100 lbf/in²).

28.8.2 With the engine idling and the steering wheel held hard on full lock, the pressure should be 27 bar (400 lbf/in²) minimum.

28.9 Repeat checks for other lock.

28.10 Release the steering wheel and allow the engine to idle. The pressure should be below 7 bar (100 lbf/in²).

28.11 If the pressures recorded previously (refer to Para 28.8.1 to 28.8.2) are outside the specified range, or pressure imbalance is recorded, a fault exists in the system. To determine if the fault is in the steering box or the pump proceed as follows:

28.11.1 Close the adapter tap (5) for a period not exceeding five seconds.

28.11.2 If the gauge (1) fails to register the specified pressures, the pump is inefficient and a new pump should be fitted.

28.11.3 If pump delivery is satisfactory and low pressure or marked imbalance exists, the fault must be in the steering box valve and worm assembly.

Adjustment

29 To check minimum backlash proceed as follows:

29.1 Jack up the front of the vehicle until the wheels are clear of the ground.

WARNING

VEHICLE SAFETY. ENSURE WHEELS ARE CHOCKED AND AXLE SUPPORTS ARE SECURELY SUPPORTING THE VEHICLE PRIOR TO CARRYING OUT THIS PROCEDURE.

29.2 Disconnect drag link at steering box end (Fig 9 (3)).

29.3 Centralise steering box by inserting a suitable peg into the hole in the steering box casing above the drop arm and line up with the indent in the rear of the drop arm.

29.4 The adjustment is obtained by rocking the drop arm about centre whilst an assistant slowly tightens the steering box adjuster screw (Fig 10 (2)).

29.5 Tighten the locknut (3) when all backlash has been removed.

29.6 Repeat the check for backlash. If backlash still exists, loosen locknut and repeat adjustment procedure.

29.7 Turn the steering wheel from lock to lock and check that no excessive tightness exists at any point.

29.8 Ensure front wheels are aligned and in straight ahead position.

29.9 Adjust drag link 924 mm (36.4 in) between ball joint centres.

29.10 Connect drag link and tighten to torque of 40 Nm (30 lbf ft).

29.11 Lower the vehicle to ground level and remove the wheel chocks.

29.12 Road test the vehicle.

STEERING PUMP**REMOVAL**

30 To remove the pump proceed as follows:

CAUTIONS

(1) CONTAMINATION. In order to prevent the power steering system from contamination, it is essential to protect all disconnected hoses and their respective interfaces from the ingress of foreign matter, both during dismantle and until reassembly commences.

(2) PAINTWORK DAMAGE. Power steering fluid is harmful to paintwork. Should any fluid be spilt on to body, chassis or any other components immediately wipe clean.

(3) USED FLUID. It is most important that fluid drained from the system is not re-used.

30.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

30.2 Remove fan and viscous coupling (refer to Chap 12-1)

30.3 Restrain steering pump pulley, loosen but do not remove three bolts securing the drive pulley.

30.4 Using a hexagonal socket and tommy bar on the pulley nut, tension the auto-tensioning device and remove the drive belt.

30.5 Remove the three bolts and withdraw the pump pulley.

30.6 From underneath the vehicle disconnect the pump to steering box hose (Fig 12 (1)) and reservoir to pump hose (2) connections and allow the steering fluid to drain into a suitable container. Seal the hose apertures.

30.7 Remove bolts securing the pump to engine block mounting and manoeuvre pump from the mounting complete with pump bracket.

30.8 Remove the bracket fixings and release the bracket from the pump.

REFITTING

31 To refit the power assisted steering pump proceed as follows:

31.1 Refitting the pump is a reversal of removal procedure.

31.2 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

NOTE

The feed hose clip should be tightened to 3 Nm (2 lbf ft) and the high pressure union connection to 20 Nm (15 lbf ft).

31.3 Top up and bleed the system (refer to Para 27).

31.4 Check hose joints and pump for any fluid leaks under pressure by holding the steering hard on full lock in both directions.

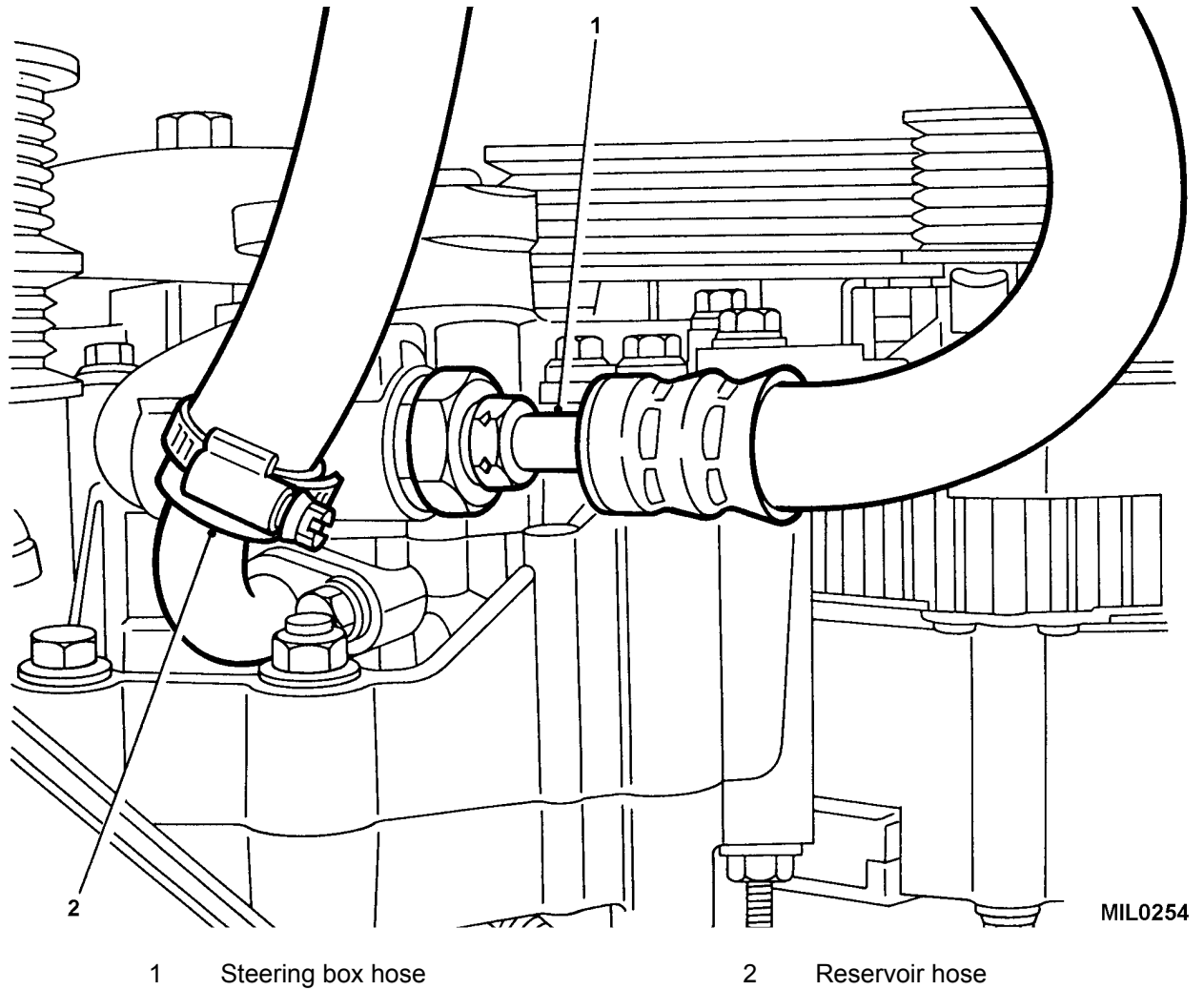
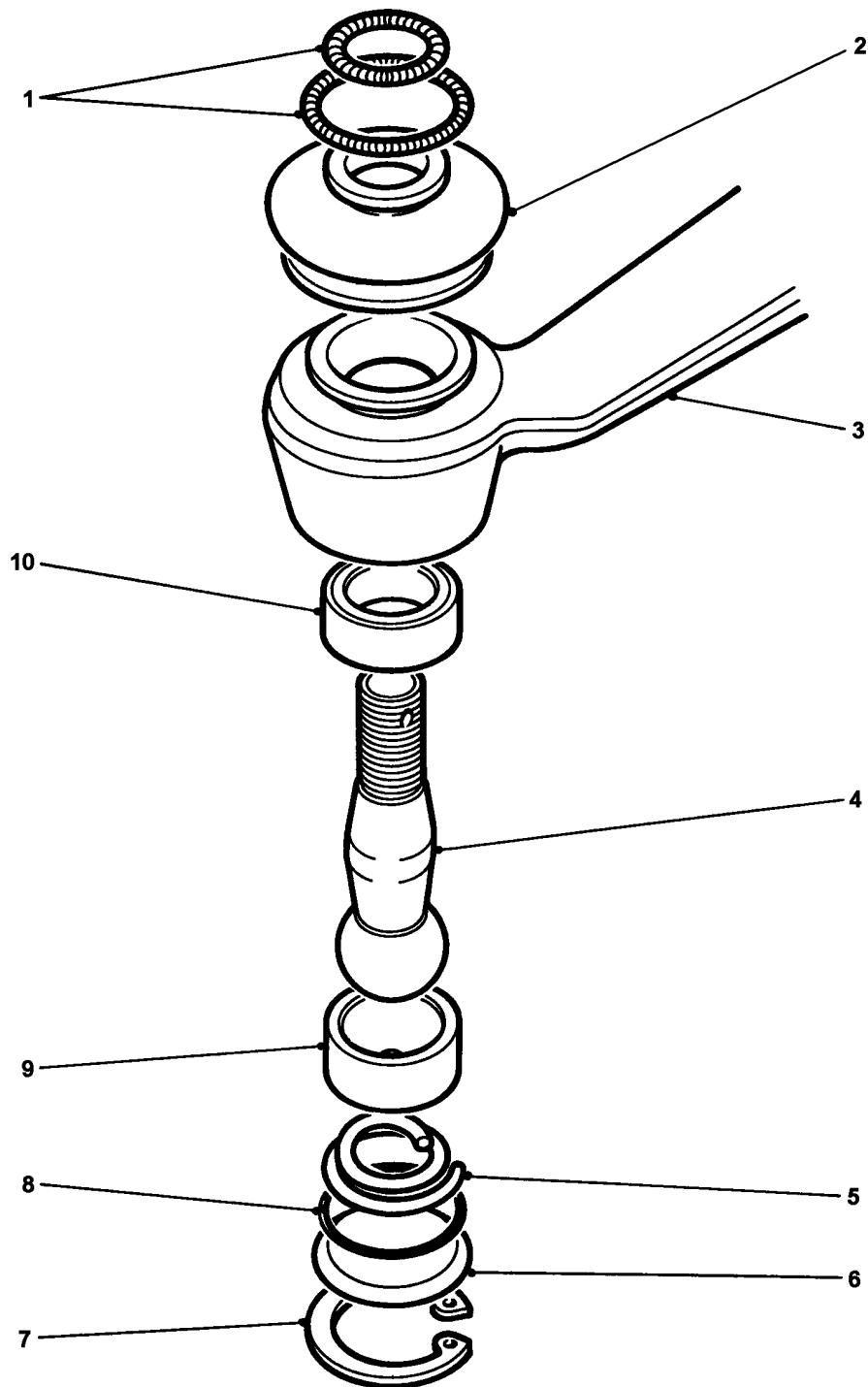


Fig 12 Steering Pump

Drive belt adjustment

32 The serpentine belt fitted to the engine has a self tensioning device incorporated in the belt run. No adjustment is required to the belt once the belt has been refitted.



MIL0255

- 1 Spring rings
- 2 Dust cover
- 3 Drop arm
- 4 Ball pin
- 5 Spring

- 6 Cover plate
- 7 Circlip
- 8 'O' ring
- 9 Lower ball joint
- 10 Upper ball pin socket

Fig 13 Drop arm ball joint

DROP ARM BALL JOINT

Removal/dismantling

- 33 To dismantle and overhaul the drop arm ball joint carry out the following:
- 33.1 Position the vehicle on a lift.
 - 33.2 Raise the vehicle to working height.
 - 33.3 Remove and discard the split pin from the nut securing the drop arm joint.
 - 33.4 Remove the nut securing the drop arm joint to the drag link.
 - 33.5 Using special tool (refer to Table 1 Serial 4), break the taper joint and release the drag link assembly.
 - 33.6 Tie the drag link aside.
 - 33.7 Release the spring rings (Fig 13 (1)) securing the dust cover (2), remove and discard the dust cover and spring rings.
 - 33.8 Remove and discard the circlip (7) securing the cover plate (6).
 - 33.9 Remove the cover plate and discard the spring (5) and 'O' ring (8), if fitted.

WARNING

SUITABLE EYE PROTECTION MUST BE WORN.

- 33.10 Remove and discard the lower ball joint (9) and ball pin (4) from the drop arm.
- 33.11 Clean the drop arm joint housing (3).
- 33.12 Using special tool (refer to Table 1 Serial 5), and adaptor (refer to Table 1 Serial 6) withdraw and discard the upper ball pin socket (10).
- 33.13 Remove the puller and adaptor.
- 33.14 Clean the drop arm joint housing.

Repairs and replacement

- 34 A repair kit is available for use when overhauling the drop arm ball joint.

REASSEMBLY

- 35 To reassemble and refit the drop arm ball joint proceed as follows:
- 35.1 Press the upper socket (Fig 13 (10)) into the drop arm (3) up to the shoulder in the housing.
 - 35.2 Dip the ball in Grease (refer to Table 2 Serial 2), fit to the housing and pack with grease.
 - 35.3 Fit the lower ball joint (9) followed by the spring (5) with the small diameter towards the ball.
 - 35.4 Fit the 'O' ring seal (8) and locate the cover plate (6) on the spring. Compress the spring in the manner used for dismantling (refer to Para 33.3) and fit the circlip (7).
 - 35.5 Fit the dust cover (2) and retain with the two spring rings (1).

35.6 Fit the drop arm (Fig 14 (1)) to the steering box using a new tab washer (3) under the securing nut (2). Tighten the nut to a torque of 176 Nm (130 lbf ft).

35.7 Bend the tab washer against the recess (5) in the end of the drop arm and against a flat (4) on the securing nut

35.8 Fit the cross rod to the drop arm ball joint, tighten the nut to a torque of 41 Nm (30 lbf ft) and secure with a new split pin.

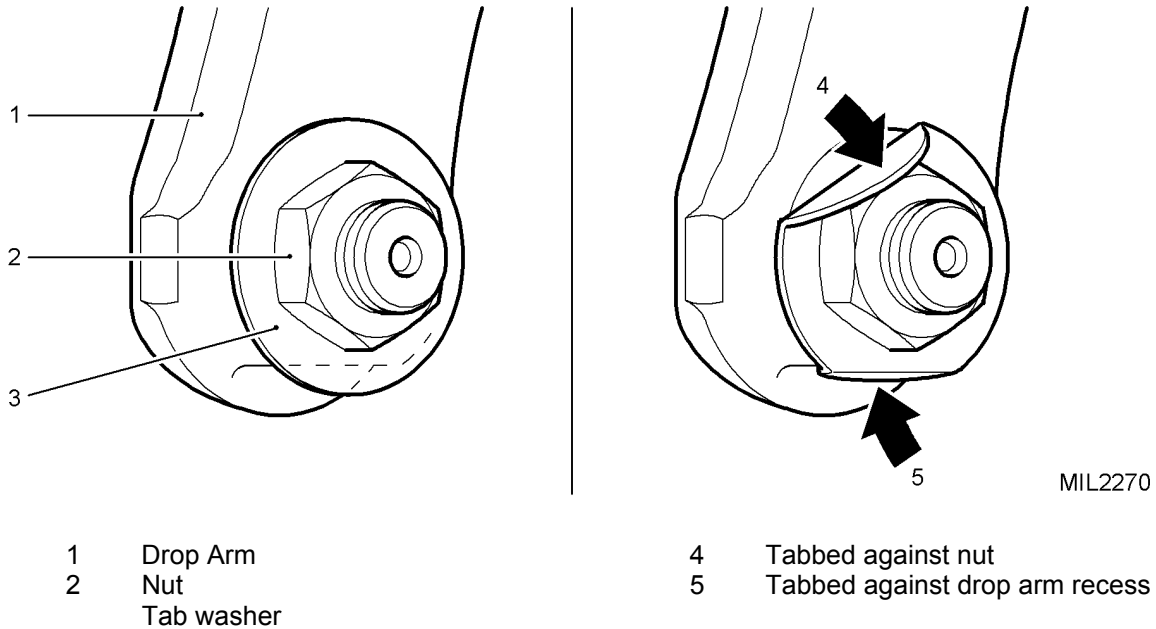


Fig 14 Fitting drop arm tab washer

STEERING DAMPER

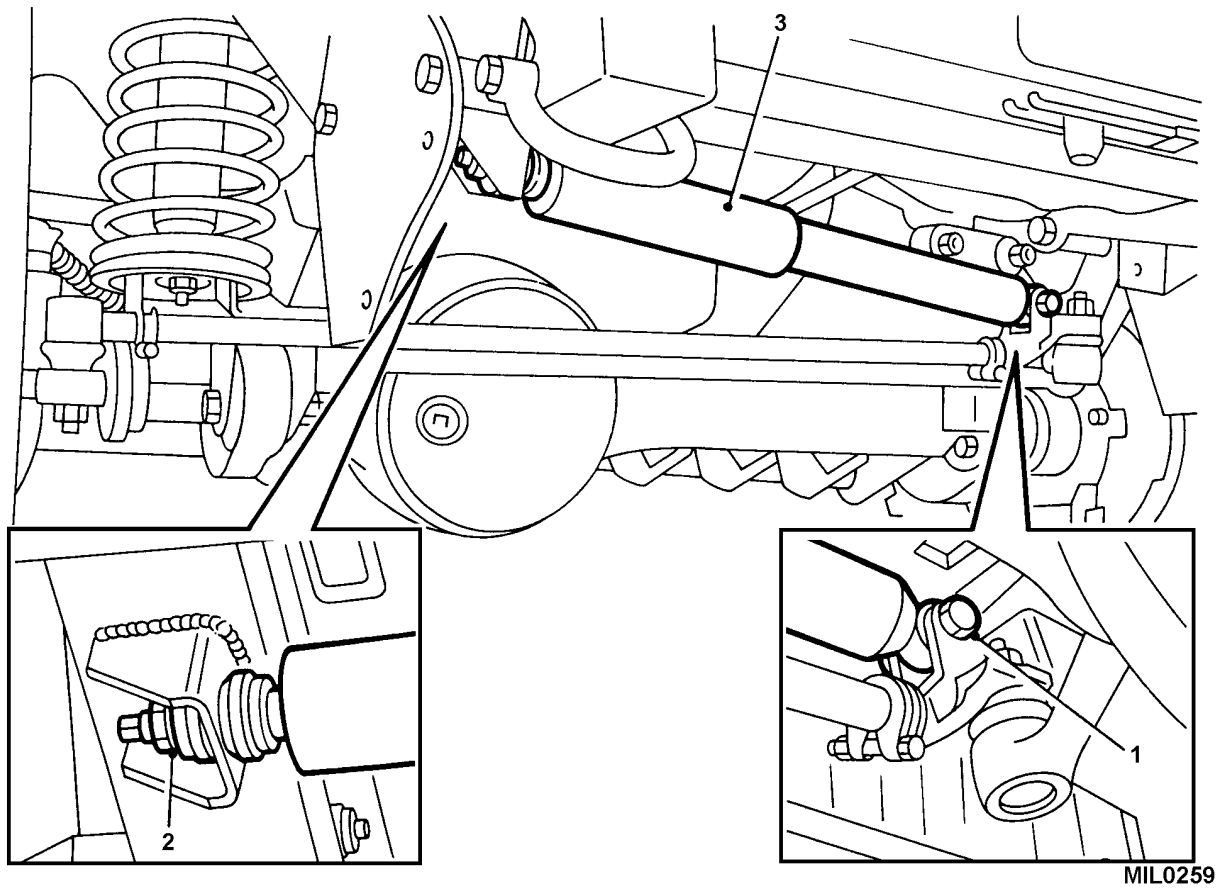
REMOVAL

36 To remove the steering damper proceed as follows:

- 36.1 Place the vehicle on a ramp, or support the front axle on axle stands.
- 36.2 Remove fixings at drag link bracket (Fig 15 (1)).
- 36.3 Remove fixings at chassis bracket (2).
- 36.4 Remove steering damper (3).

REFITTING

37 To refit the steering damper reverse the removal procedure.



- 1 Drag link bracket fixings
- 2 Chassis bracket fixings

- 3 Steering damper

Fig 15 Removing steering damper

TRACK ROD AND LINKAGE

Track rod removal

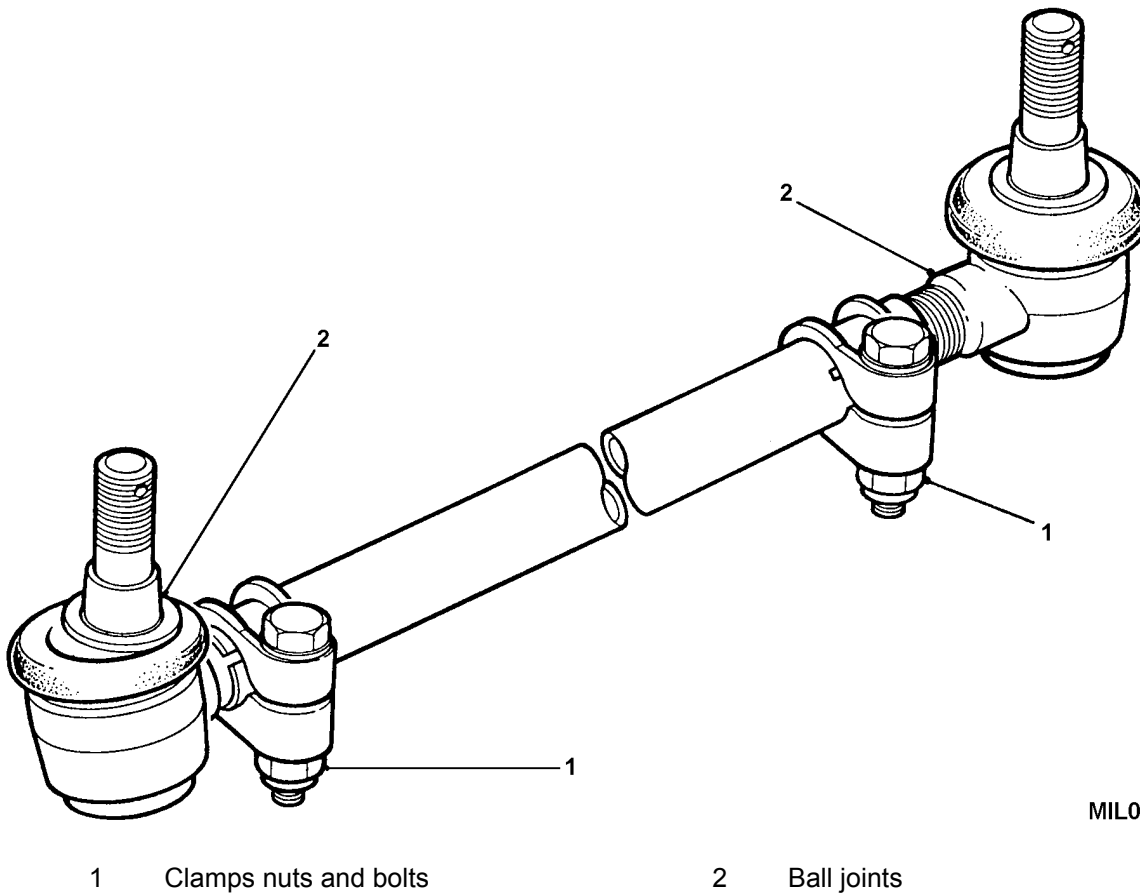
38 To remove the track rod proceed as follows:

- 38.1 Place the vehicle on a ramp, or support the front axle on axle stands.
- 38.2 Centralise steering and disconnect track rod ball joints using a ball joint splitter.
- 38.3 Remove track rod.

Linkage removal

39 To remove the linkage proceed as follows:

- 39.1 Loosen clamp nuts and bolts (Fig 16 (1)).
- 39.2 Unscrew ball joints (2).



MIL0260

Fig 16 Removing track rod linkage

Refitting linkage

40 To refit the linkage proceed as follows:

40.1 Lightly lubricate ball joint threads in anti-seize grease (refer to Table 2 Serial 3) then fit ball joints (renew if necessary). Loosely fit clamp pinch bolts.

40.2 Screw in ball joints to full extent of threads.

Refitting track rod**CAUTION**

TRACK ROD DAMAGE. A track rod that is damaged or bent must be renewed. No attempt should be made to repair or straighten it.

41 Refit the track rod as follows:

41.1 Fit track rod and tighten ball joint nuts to 40 Nm (30 lbf ft).

41.2 Check front wheel alignment (refer to Para 46).

41.3 Remove vehicle from ramp or axle stands.

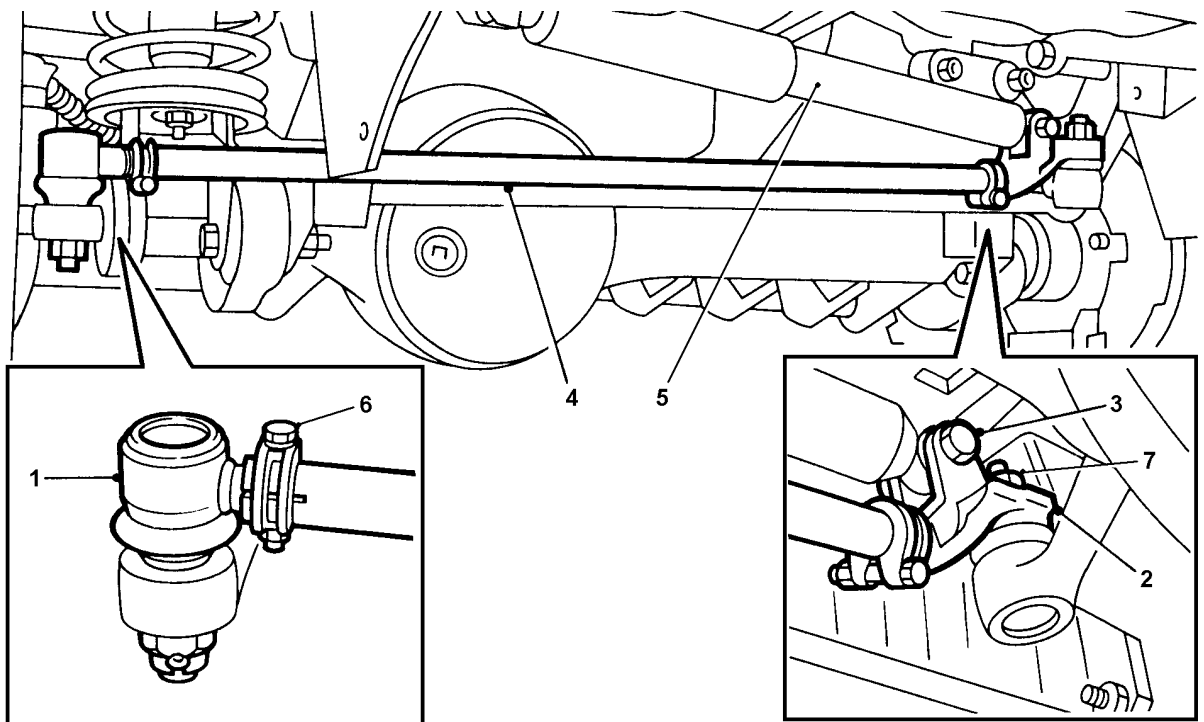
DRAG LINKS AND DRAG LINK ENDS

42 Remove the drag link as follows:

NOTE

Ensure wheels are positioned straight ahead during the following procedure.

- 42.1 Place the vehicle on a ramp, or support front axle on axle stands.
- 42.2 Remove front road wheel nearest to the steering box.
- 42.3 Disconnect drag link ball joint at swivel housing arm (Fig 17 (1)) using a ball joint splitter.
- 42.4 Disconnect drag link ball joint at drop arm (7) using a ball joint splitter.
- 42.5 Undo nut and bolt (3) and remove the steering damper (5) from drag link bracket (2).



MIL0261

- | | | | |
|---|-------------------------|---|-----------------|
| 1 | Ball joint | 5 | Steering damper |
| 2 | Drag link bracket | 6 | Clamp bolt |
| 3 | Steering damper fixings | 7 | Drop arm |
| 4 | Drag link | | |

Fig 17 Removing drag link

Removing drag link ends

43 Remove the drag link ends as follows:

- 43.1 Loosen clamp bolts (6).
- 43.2 Unscrew ball joint (1) and drag link bracket (2).
- 43.3 Clean internal threads in drag link (4).

Refitting drag link ends

44 Refit the drag link ends as follows:

- 44.1 Lightly lubricate threads in anti-seize grease (refer to Table 2 Serial 3) then fit drag link ends (renew if necessary). Loosely fit clamp pinch bolts.
- 44.2 Set ball joints to drag link distance to 28.5 mm (1.12 in).
- 44.3 Adjust ball pin centres to nominal length of 924 mm (36.4 in), this length is adjusted during refit.
- 44.4 Centralise steering box (refer to Para 21).
- 44.5 Align steering wheel if necessary.

Refit drag link

45 Refit the drag link as follows:

CAUTION

NEW DRAG LINK. Fit new drag link if existing drag link is damaged or bent. No attempt should be made to repair it.

- 45.1 Fit drag link. Tighten ball joint nuts to 40 Nm (30 lbf ft).
- 45.2 Check steering stop locks. (refer to Para 39)
- 45.3 Ensure full steering travel is obtained between lock stops. Adjust drag link length to suit.
- 45.4 Tap ball joints so that both pins are in the same angular plane.
- 45.5 Tighten clamp bolts to 14 Nm (10 lbf ft).
- 45.6 Refit road wheel and remove vehicle from ramp.
- 45.7 Road test vehicle.
- 45.8 If driving straight ahead and steering wheel is offset by up to $\pm 5^\circ$ in either direction, remedy by adjusting drag link length.

NOTE

To correct steering wheel deviations greater than $\pm 5^\circ$ remove and reposition steering wheel.

FRONT WHEEL ALIGNMENT**ALIGNMENT****NOTE**

Approved front wheel alignment and tracking equipment should be used to perform this operation. Only the use of basic equipment is described below. No adjustment is provided for caster, camber or swivel pin inclinations.

46 Align the front wheels as follows:

- 46.1 Set vehicle on level ground with road wheels positioned straight ahead.

46.2 Push vehicle backwards and forwards to settle linkage.

46.3 Set up the equipment to manufacturers instructions and check alignment as advised by the equipment supplier.

46.4 Check tightness of clamp bolt fixings. Tighten to 14 Nm (10 lbf ft).

Adjustment

47 To adjust steering alignment proceed as follows:

47.1 Loosen the clamps at both ends of the track rod.

47.2 Turn the track rod to increase or decrease its effective length until the toe-out is correct (refer to Cat 532 serial 5).

47.3 Push vehicle rearwards turning the steering wheel from side to side to settle the ball joints. With road wheels set in straight ahead position, push vehicle forward a short distance.

47.4 Recheck the track and if required, adjust as necessary.

47.5 When the alignment is correct, tap the ball joints to the maximum of their travel to ensure full unrestricted movement of the track rod. Return the joints to a central position and in line.

47.6 Finally, tighten clamp bolts to a torque of 14 Nm (10 lbf ft).

STEERING LOCK STOPS

48 To check the steering lock stops carry out the following:

48.1 Measure stop bolt protrusion (Fig 18 (x)). This must be 45 mm (1.8 in).

Adjustment

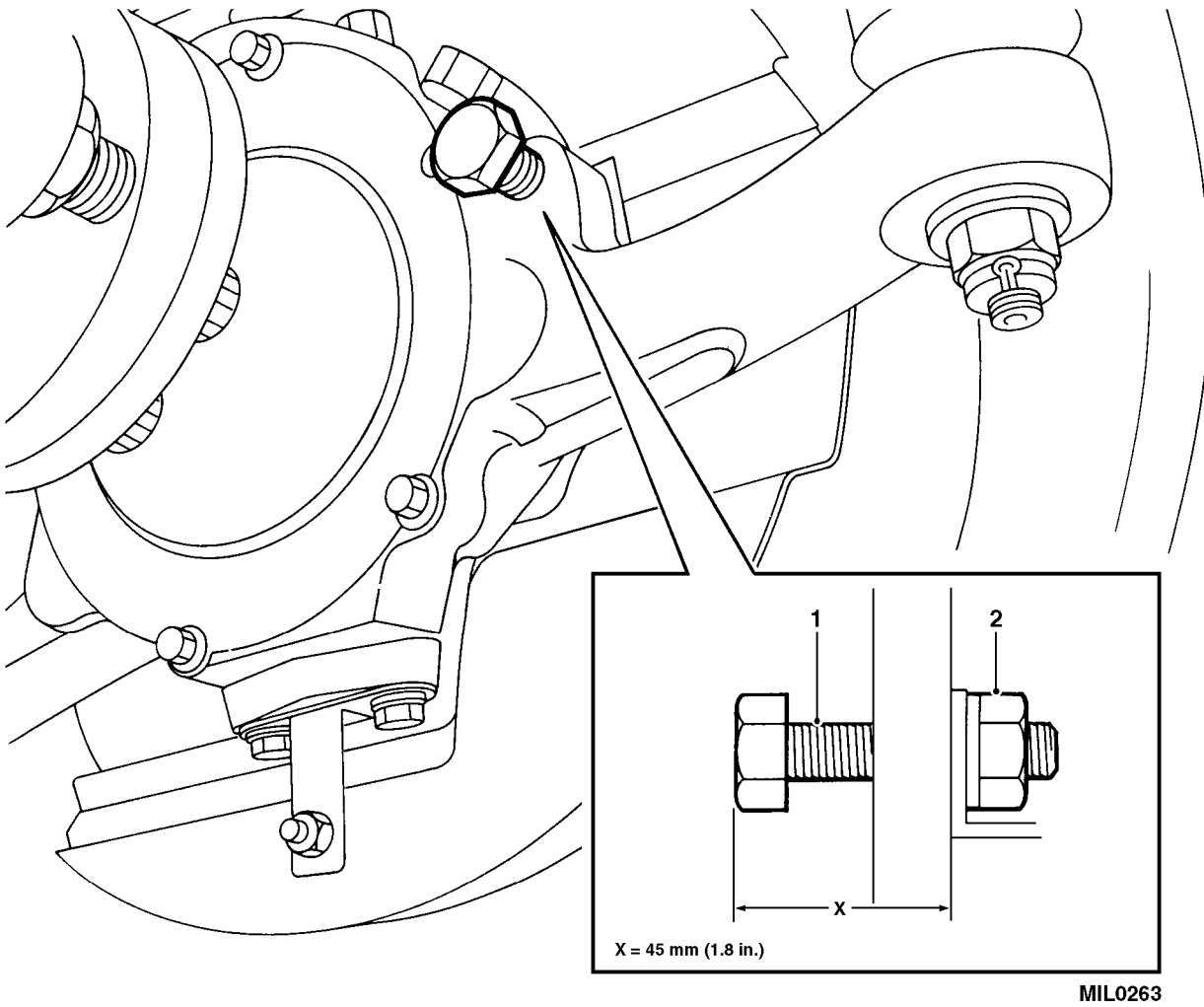
49 Adjust the lock stops as follows:

49.1 Loosen stop bolt locknut (Fig 18 (2)).

49.2 Turn stop bolt (1) as required.

49.3 Tighten locknut.

49.4 Check wheel position at full lock for fouling on suspension, axle, body, chassis, etc. This should be at least 20 mm with the wheel at full lock.



1 Stop bolt

2 Stop bolt locknut

Fig 18 Setting steering lock stops

CHAPTER 8

SUSPENSION SYSTEM

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

This chapter gives the Unit repair for the rear axle suspension systems as fitted to Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS (GS), Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles.

General

This chapter has been sub-chaptered to allow for the various types of vehicle axles as detailed below.

- 1.1 Chapter 8-1 (TUL) HS (all vehicles) and (TUM) HS (GS only) suspension system.
- 1.2 Chapter 8-2 (TUM) HS (FFR only vehicles) and (TUM) Ambulance HS suspension system.

CHAPTER 8-1

(TUL) HS (ALL VEHICLES) AND (TUM) HS (GS ONLY) SUSPENSION SYSTEM

CONTENTS

Para	
1	Introduction Torque list FRONT SUSPENSION Panhard rod
2	Removal
3	Cleaning/examination
4	Repairs and replacement
5	Refitting Radius arm
6	Removal
7	Cleaning/examination
8	Repairs and replacement
9	Refitting Front shock absorbers
10	Removal
11	Cleaning
12	Examination
13	Refitting Front road spring
14	Removal (CAUTION)
15	Refitting FRONT ANTI-ROLL BAR (TUM)
16	Removal
17	Reassembly REAR SUSPENSION Rear road springs
18	Removal
19	Refitting Shock absorbers
20	Removal
21	Cleaning
22	Examination
23	Refitting Lower link
24	Removal
25	Cleaning/examination
26	Repairs and replacement
27	Refitting Upper links, pivot bracket and ball joint
28	Removal
29	Cleaning/examination
30	Repairs and replacement
31	Refitting

(continued)

CONTENTS (continued)

Fig		Page
1	Panhard rod removal/installation.....	4
2	Radius arm chassis mounting removal/installation	5
3	Track rod protection bracket.....	6
4	Track rod to swivel housing ball joint.....	6
5	Radius arm axle mounting removal/installation.....	7
6	Front shock absorber lower fixings.....	8
7	Front shock absorber upper fixings.....	10
8	Front road spring upper location	12
9	Front anti-roll bar link assembly	14
10	Rear road spring and shock absorber lower fixings.....	16
11	Lower link fixings	18
12	Upper link mounting bracket.....	19
13	Upper link to pivot bracket.....	20
14	Pivot bracket and ball joint.....	21

INTRODUCTION

1 This chapter covers the Unit repairs for Truck Utility Light (HS) (all vehicles) and Truck Utility Medium (HS) (GS only) vehicles suspension systems. The repair instructions detailed are applicable to both left and right hand drive vehicles.

TORQUE LIST

Panhard rod	230	Nm/170 lbf ft
Radius arm nuts and bolts		190 Nm/140 lbf ft
Track rod ball joints		40 Nm/30 lbf ft
Shock absorber nuts		75 Nm/55 lbf ft
Wheel nuts	170	Nm/125 lbf ft
Front anti roll bar to chassis		30 Nm/22 lbf ft
Anti roll bar link to axle		40 Nm/29 lbf ft
Anti roll bar to anti roll bar link		68 Nm/50 lbf ft
Flexible link bolts to chassis		63 Nm/46 lbf ft*
Lower link to axle		260 Nm/192 lbf ft*
Flexible mounting nut to chassis		176 Nm/130 lbf ft
Pivot bracket and ball joint to rear axle		176 Nm/130 lbf ft
Upper link arms to chassis		260 Nm/192 lbf ft
Upper link arms to pivot bracket		190 Nm/140 lbf ft

* New lock nut must be used

FRONT SUSPENSION

WARNING

WHERE APPLICABLE, SUSPENSION BUSHES SHOULD ALWAYS BE REPLACED AS MATCHED PAIRS.

NOTE

Where suspension components are secured with self locking nuts and they are removed for repair or overhaul purposes, new self locking nuts must be used when refitting the components.

PANHARD ROD

Removal

2 To remove the panhard rod carry out the following:

2.1 Working underneath the vehicle remove the nut (Fig 1 (2)) and bolt (1) securing the panhard rod (4) to the mounting arm (3).

2.2 Remove the nut and bolt (5) securing the panhard rod to the axle and withdraw the rod.

Cleaning/examination

3 Thoroughly clean the rod and examine for bends, cracks or any damage that would render it unfit for further service.

Repairs and replacement

4 The rubber mounted bushes may be renewed by carrying out the following:

4.1 Using a suitable hydraulic or bench press and a length of metal tubing, slightly smaller in diameter than the outside of the bush, press out the rubber mounted bushes. Ensure that the tubing locates on the outer edge of the bush and not on the rubber inner.

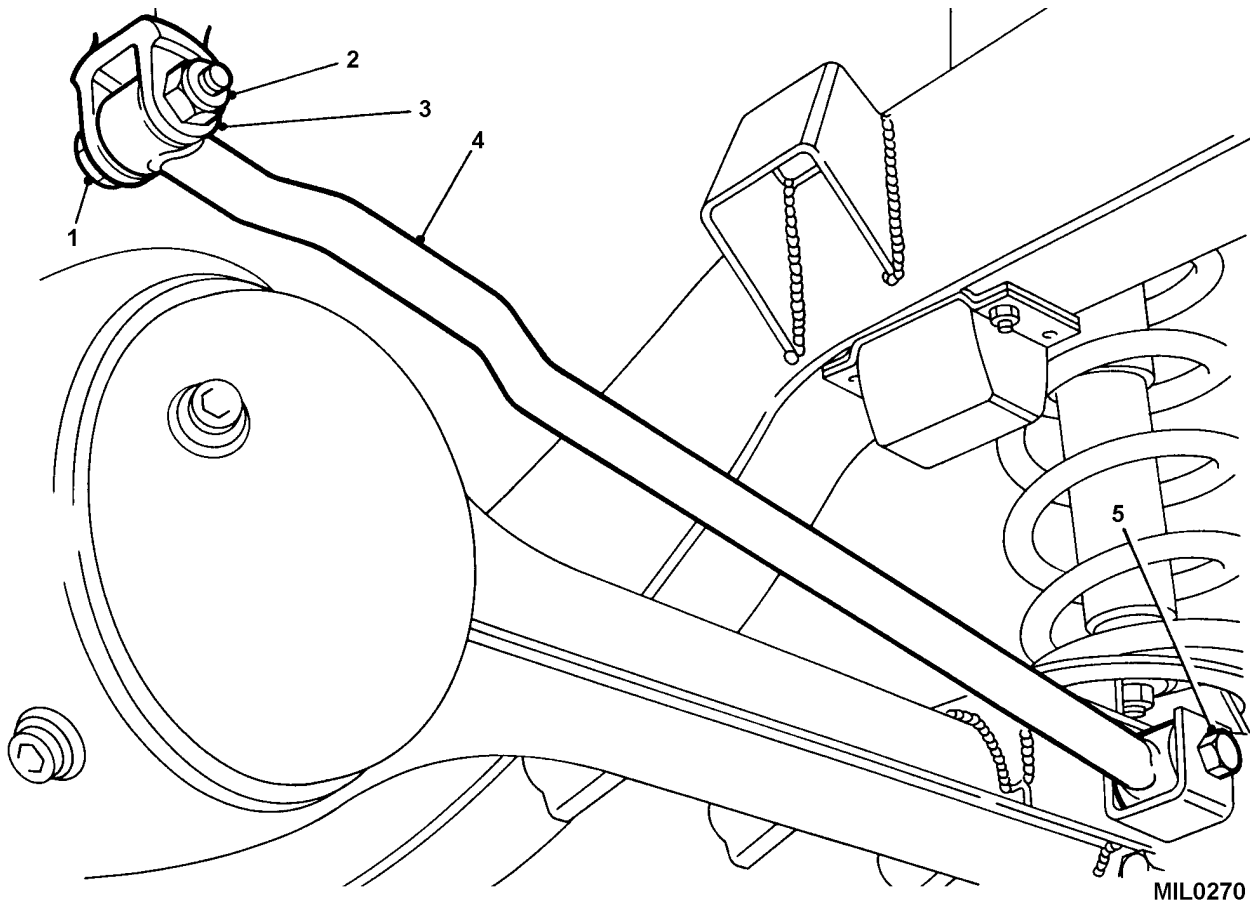
4.2 Fit new bushes centrally to their locations in the rod, ensuring that pressure is applied to the outer edge of the bush only.

Refitting

5 Refit the panhard rod in reverse order of removal, with the front suspension at the normal ride height, not jacked up. Tighten the securing nuts and bolts to a torque of 230 Nm (170 lbf ft).

NOTE

The fixing bolts for all suspension bushes should be torqued when the vehicle is on the floor at its normal ride height (i.e. "loaded with its normal payload").



1 Bolt
2 Nut
3 Mounting arm

4 Panhard rod
5 Nut and bolt

Fig 1 Panhard rod removal/installation

RADIUS ARM

Removal

- 6 To remove the radius arms carry out the following:
 - 6.1 Slacken the road wheel retaining nuts.
 - 6.2 Raise the vehicle, support the chassis on suitable axle stands and remove the front road wheels (remove both wheels only if removing both radius arms).
 - 6.3 Support the front axle weight using a suitable hydraulic jack.
 - 6.4 Remove the lock nut (Fig 2 (1)) and washer (2) securing the radius arm (5) to the chassis side member.

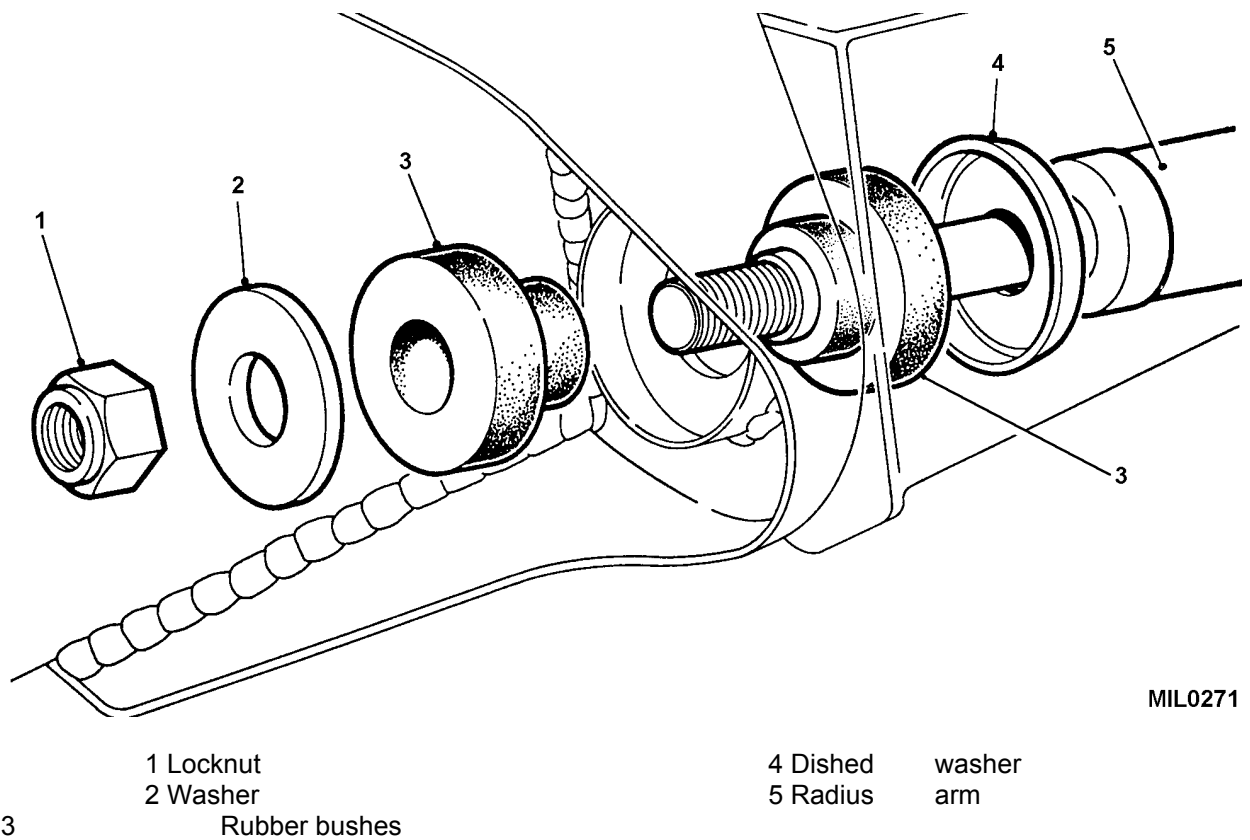
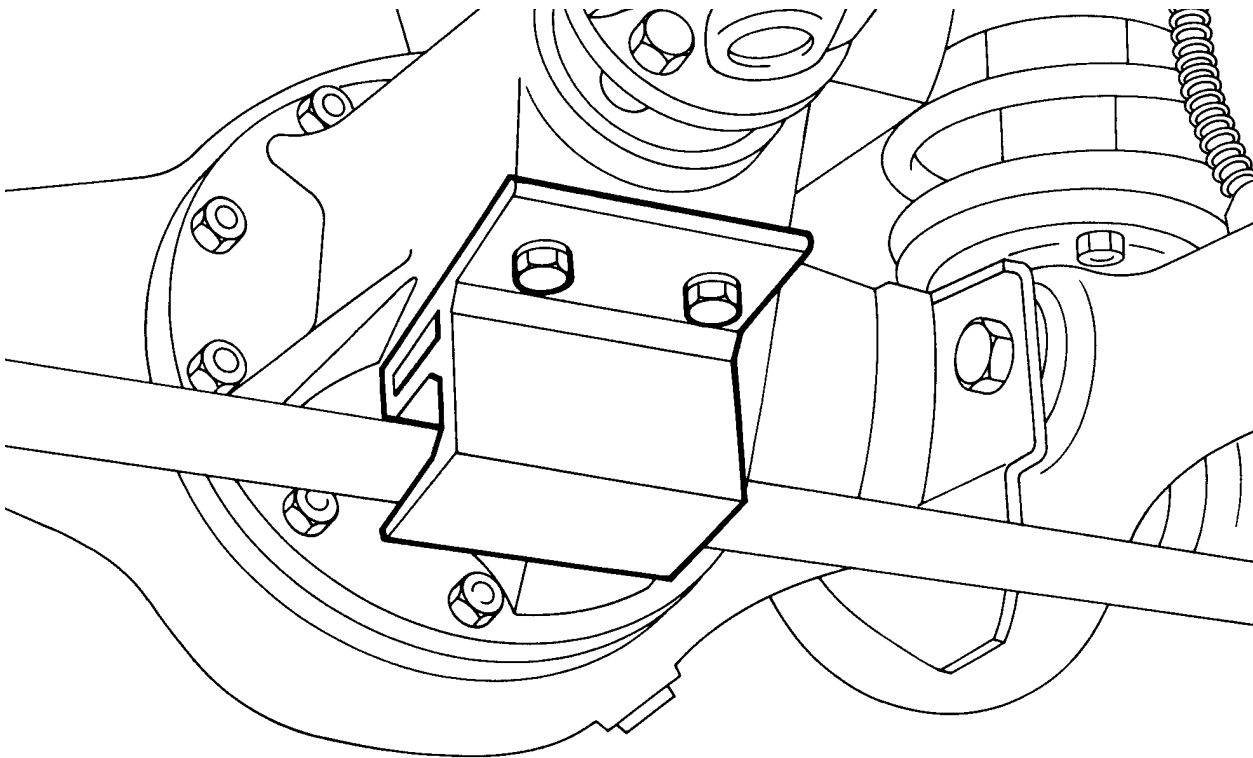
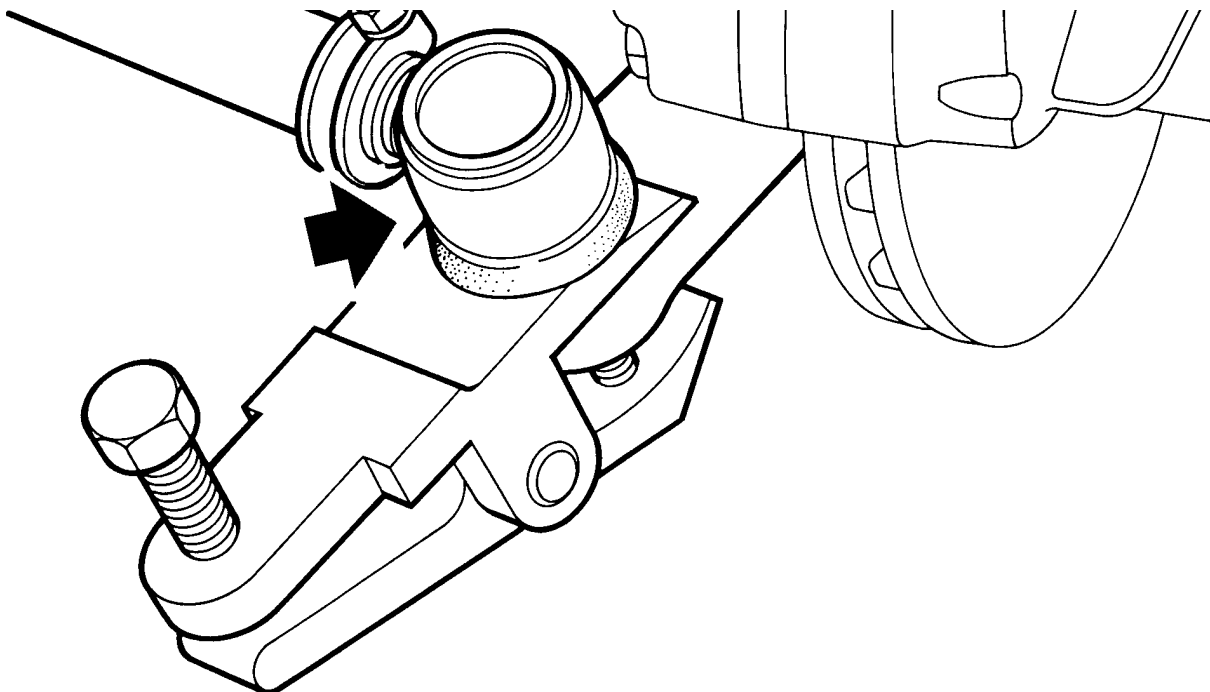


Fig 2 Radius arm chasis mounting removal/installation



MIL0272

Fig 3 Track rod protection bracket



MIL0273

Fig 4 Track rod to swivel housing ball joint

- 6.5 Remove the track rod protection bracket (Fig 3) from the underside of the differential assembly.
- 6.6 Remove the nuts from the track rod ball joints and using a suitable ball joint splitter (Fig 4) remove the track rod from the swivel housing.
- 6.7 Remove the nuts (Fig 5 (2)) and bolts (1) securing the radius arm (3) to the axle bracket. Release the radius arm from the bracket and withdraw from the chassis side member. Remove the rubber bushes (Fig 2 (3)) and dished washer (4) from the chassis mounting. Discard rubber bushes.

Cleaning/examination

- 7 Thoroughly clean the radius arms and examine for bends, cracks or any damage that would render them unfit for further service.

Repairs and replacement

- 8 The rubber mounted bushes may be renewed by carrying out the following:
- 8.1 Using a suitable hydraulic or bench press and a length of metal tubing, slightly smaller in diameter than the outside diameter of the bush, press out the rubber mounted bushes. Ensure that the tubing locates on the outer edge of the bush and not on the rubber inner.
- 8.2 Fit new bushes centrally to their locations in the radius arm ensuring that pressure is applied to the outer edge of the bush only.

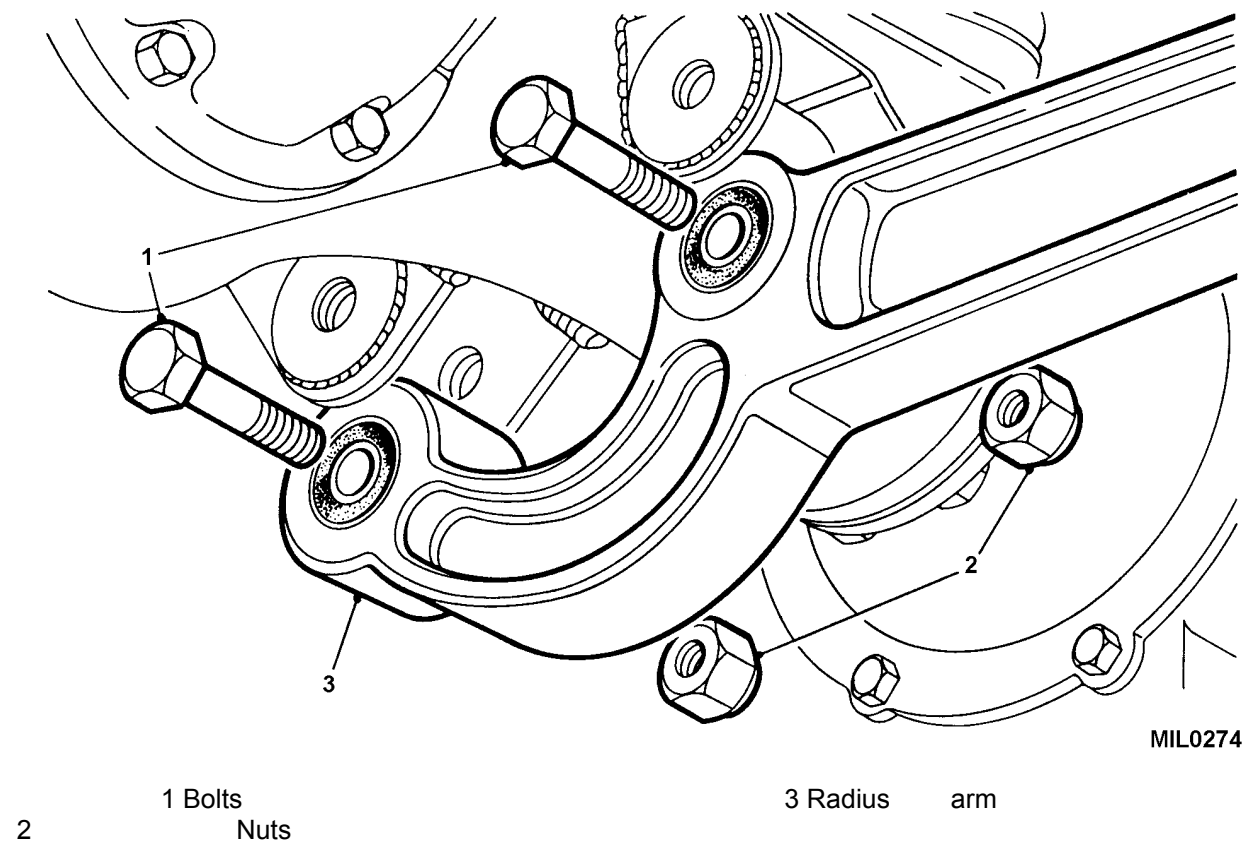


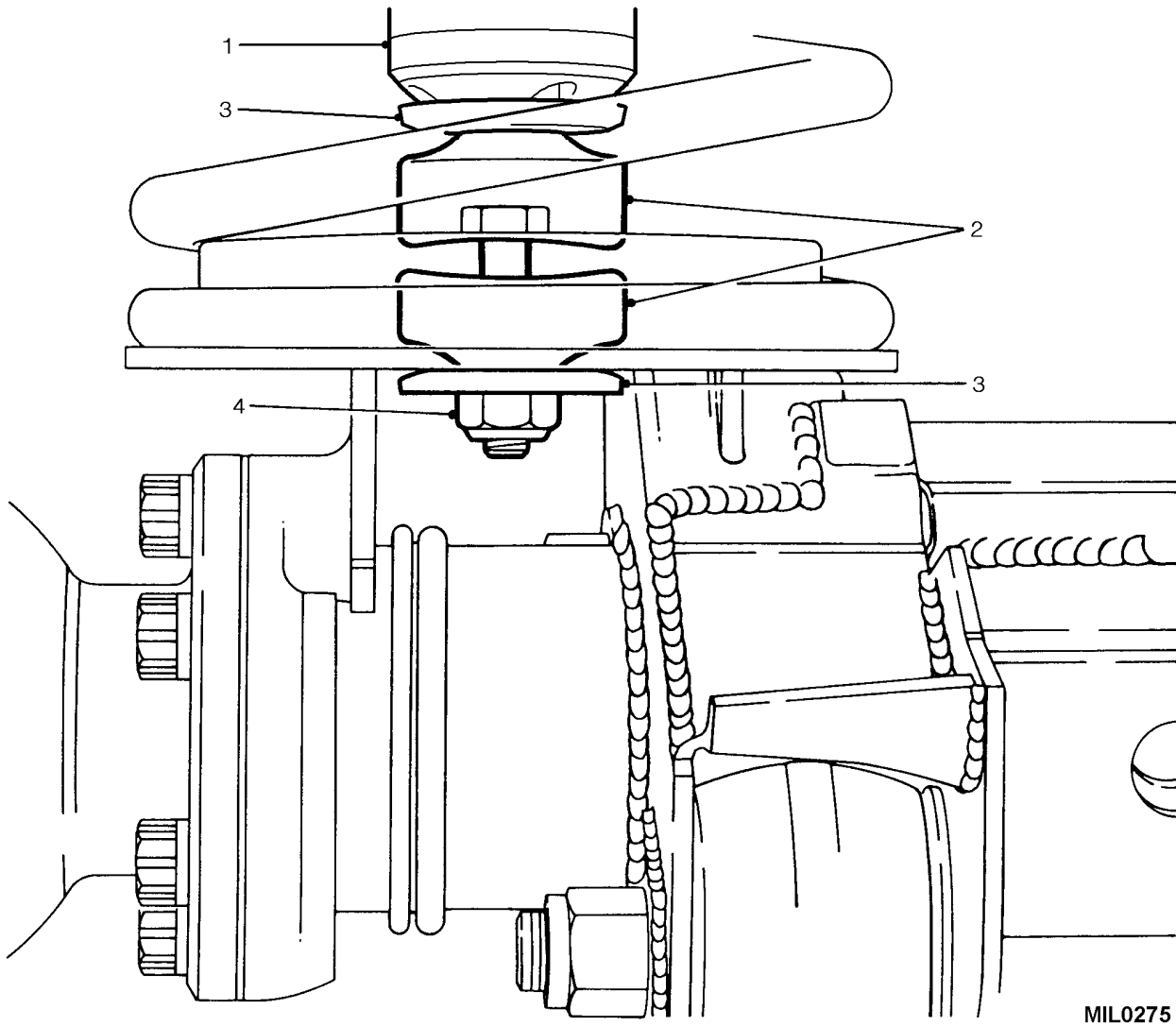
Fig 5 Radius arm axle mounting removal/installation

Refitting

9 Refit the radius arms in reverse order of removal fitting new bushes at the chassis side member locations. Tighten the radius arm securing nuts and bolts to a torque of 190 Nm (140 lbf ft) and the track rod ball joint securing nuts to a torque of 40 Nm (30 lbf ft).

NOTE

The fixing bolts for all suspension bushes should be torqued when the vehicle is on the floor at its normal ride height (i.e. "loaded with its normal payload").



- | | | | |
|----------|----------|-------------|--------|
| 1 Shock | absorber | 3 Retaining | washer |
| 2 Rubber | cushion | 4 Locknut | |

Fig 6 Front shock absorber lower fixings

FRONT SHOCK ABSORBERS

Removal

10 To remove the front shock absorbers carry out the following:

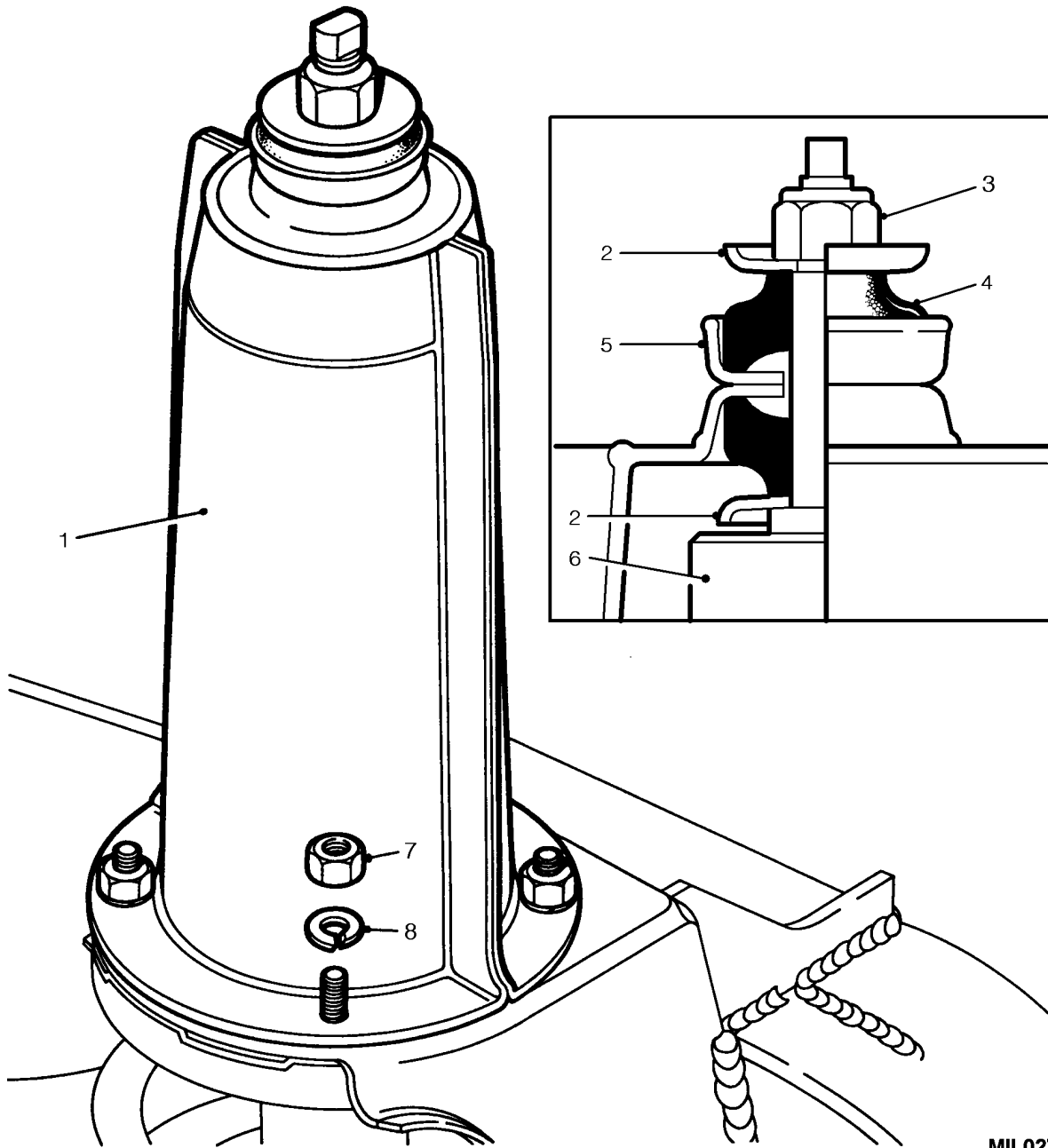
10.1 Slacken the relevant road wheel nuts.

10.2 Raise the front of the vehicle using a suitable hydraulic jack. Support the chassis on suitable stands and remove the road wheel. Remove both front wheels only if removing both shock absorbers.

10.3 Support the axle weight using the hydraulic jack.

10.4 Remove the locknut (Fig 6 (4)) and retaining washer (3) securing the shock absorber (1) to the axle and withdraw the rubber cushion (2).

10.5 Remove the four nuts (Fig 7 (7)) and spring washers (8) securing the shock absorber mounting bracket (1).



MIL0276

- | | |
|--------------------|------------------|
| 1 Mounting bracket | 5 Guide washer |
| 2 Retaining washer | 6 Shock absorber |
| 3 Locknut | 7 Nut |
| 4 Rubber cushion | 8 Spring washers |

Fig 7 Front shock absorber upper fixings

- 10.6 Withdraw the bracket complete with shock absorber (6).
- 10.7 Remove the lower rubber cushion (Fig 6 (2)) from the shock absorber (1) and retaining washer (3).

10.8 Remove the locknut (Fig 7 (3)) securing the shock absorber (6) to the bracket (1), remove the retaining washer (2), rubber cushion (4) and guide washer (5) and withdraw the bracket from the top of the shock absorber.

10.9 Remove the rubber cushion (4) and retaining washer (2) from the shock absorber.

Cleaning

11 Thoroughly clean the exterior of the shock absorber.

Examination

12 Examine the shock absorber as follows:

12.1 Check the exterior for corrosion and oil leaks.

12.2 Check the operation by extending and compressing the shock absorber, resistance should be uniform throughout the length of each stroke. If resistance is erratic or weak renew the shock absorber. When checking resistance a new shock absorber may be used for comparison. To ensure that the new shock absorber is primed, fully extend and compress the unit several times before testing begins. During the tests and when priming, the damper must be kept in the upright position.

Refitting

NOTE

The rubber cushion and retaining washer layout shown in Fig 7 is applicable to all stem damper mountings

13 Refit the shock absorbers in reverse order of removal fitting new rubber cushions and locknuts as applicable. Tighten the shock absorber securing nuts to a torque of 75 Nm (55 lbf ft) and the road wheel nuts to a torque of 170 Nm (125 lbf ft).

FRONT ROAD SPRING

Removal

CAUTION

BRAKE HOSES. During the following procedure avoid over stretching the brake hoses. If necessary, slacken the locknuts attaching the hose connector to the bracket on the swivel housing, to allow the hoses to follow the axle.

14 To remove the front road springs carry out the following:

14.1 Remove the front shock absorber (refer to Para 10).

14.2 Lower the axle sufficiently to free the road spring.

14.3 Withdraw the road spring.

14.4 Withdraw the shock absorber bracket securing ring.

Refitting

15 Refit the front road spring as follows:

NOTE

When fitting new road springs ensure that the correct type is being fitted.

15.1 Fit the shock absorber retaining ring (Fig 8 (3)) and temporarily secure with one of the nuts (1).

15.2 Position the road spring (4) on the axle seating.

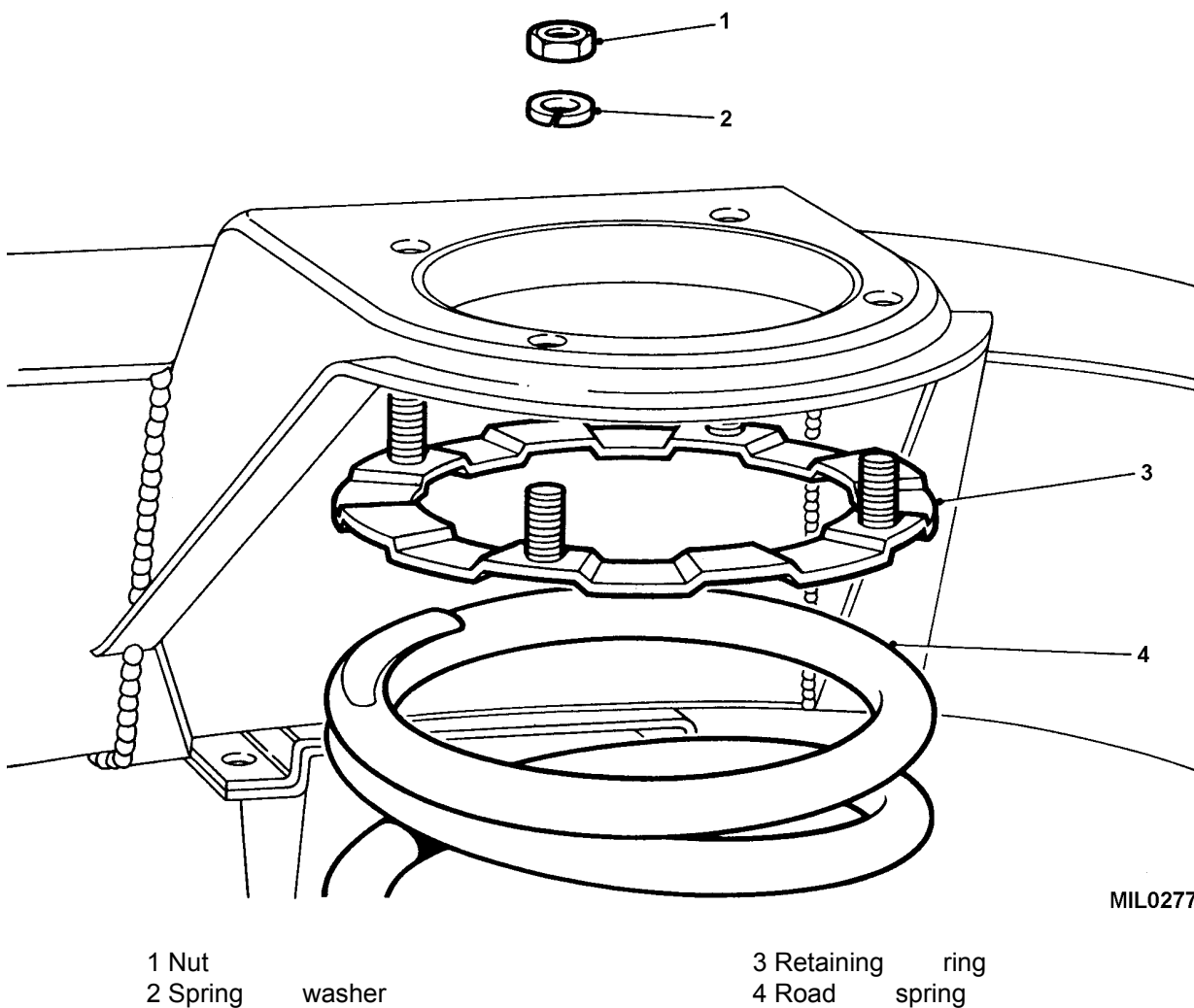
NOTE

The close coiled end of the road spring must be fitted uppermost.

15.3 Raise the axle and ensure that the road spring locates correctly in the upper seating.

15.4 Remove the nut temporarily securing the retaining ring.

15.5 Refit the shock absorber (refer to Para 13).



MIL0277

Fig 8 Front road spring upper location

FRONT ANTI-ROLL BAR (TUM AND AMBULANCE ONLY)

Removal

16 For removal of the front anti-roll bar proceed as follows:

16.1 Remove the two nuts (Fig 9 (4)) washers (2) and bolts (1) securing the anti-roll bar (5) to the axle link (6).

16.2 Remove the four nuts and bolts (two each side), retaining the two anti-roll bar straps and rubber bushes to the chassis rails and remove the bar from vehicle.

16.3 Remove the split pin (8) and castellated nut (7) and remove the ball joint and link from the axle location.

Reassembly

17 To reassemble the front anti-roll bar proceed as follows:

NOTE

If the ball joint requires replacement the complete link must be renewed.

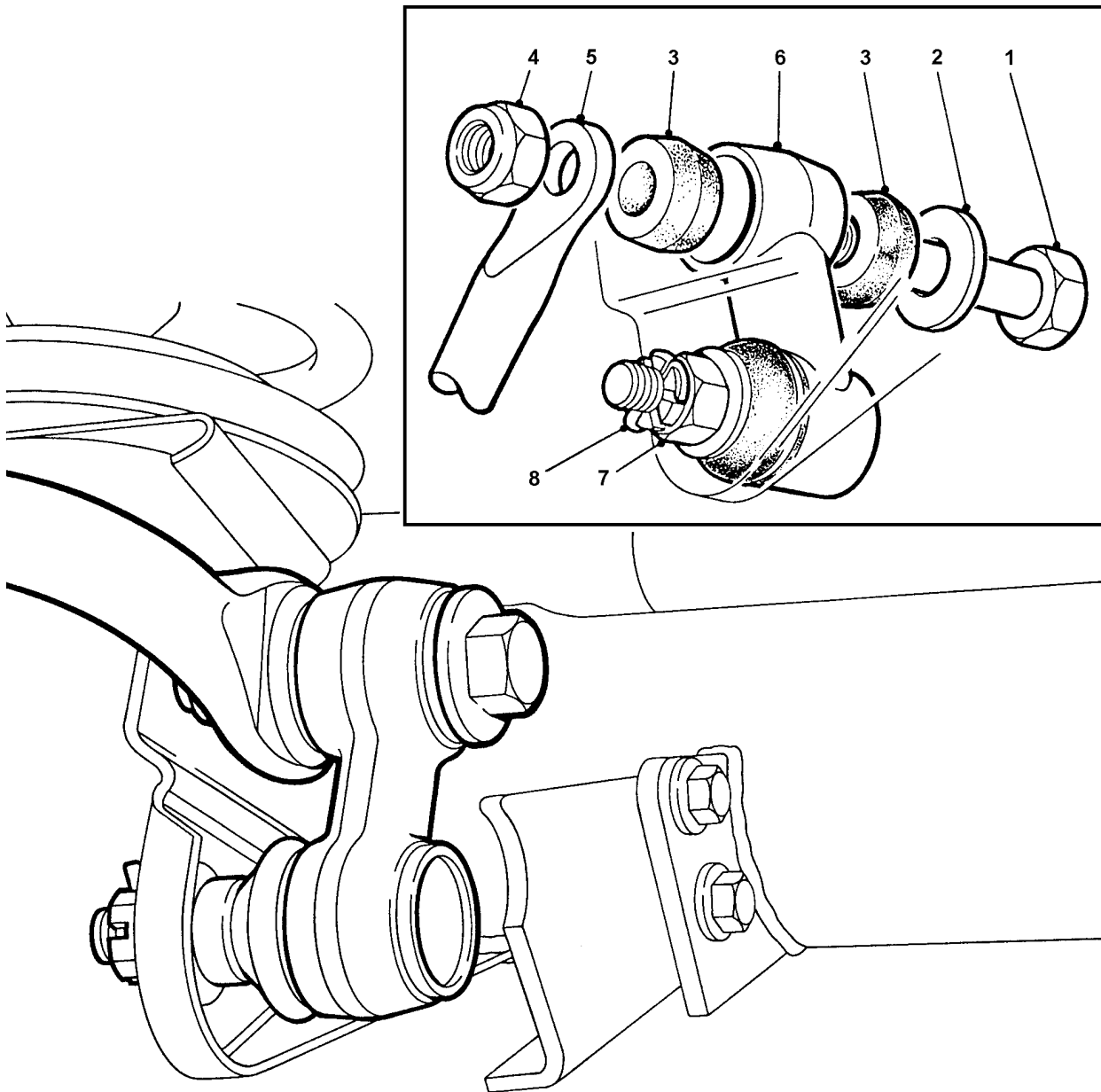
17.1 Fit the anti-roll bar (5) to the chassis. Secure the straps and bushes with the four nuts and bolts, tightening to 30 Nm (22 lbf ft).

17.2 Fit the ball joint and link (6) to the axle location. Tighten the castellated nut (7) to 40 Nm (29 lbf ft) and fit a new split pin (8).

17.3 Fit new bushes (3) in the sequence illustrated and fit the anti-roll bar (5) to the ball joint link. Tighten the nuts and bolts to 68 Nm (50 lbf ft).

NOTE

The fixing bolts for all suspension bushes should be torqued when the vehicle is on the floor at its normal ride height (i.e. "loaded with its normal payload").



MIL0283

- | | |
|-----------------|-------------------|
| 1 Bolt | 5 Anti-roll bar |
| 2 Washer | 6 Axle link |
| 3 Rubber bushes | 7 Castellated nut |
| 4 Nut | 8 Split pin |

Fig 9 Front anti-roll bar link assembly

REAR SUSPENSION

WARNING

WHERE APPLICABLE, SUSPENSION BUSHES SHOULD ALWAYS BE REPLACED AS MATCHED PAIRS.

NOTE

Where suspension components are secured with self locking nuts and they are removed for repair or overhaul purposes, new self locking nuts must be used when refitting the components.

REAR ROAD SPRINGS

Removal

18 Remove the rear road springs as follows:

- 18.1 Slacken the rear road wheel nuts, raise the rear of the vehicle, lower onto axle stands and remove the road wheels.
- 18.2 Using a suitable hydraulic jack support the axle weight.
- 18.3 Disconnect the shock absorber (Fig 10 (2)) at the lower end.
- 18.4 Remove the road spring retaining plate (3).
- 18.5 Lower the axle sufficiently to withdraw the road spring (1) complete with rubber isolator, taking care not to stretch the flexible brake hose by lowering the axle too far.

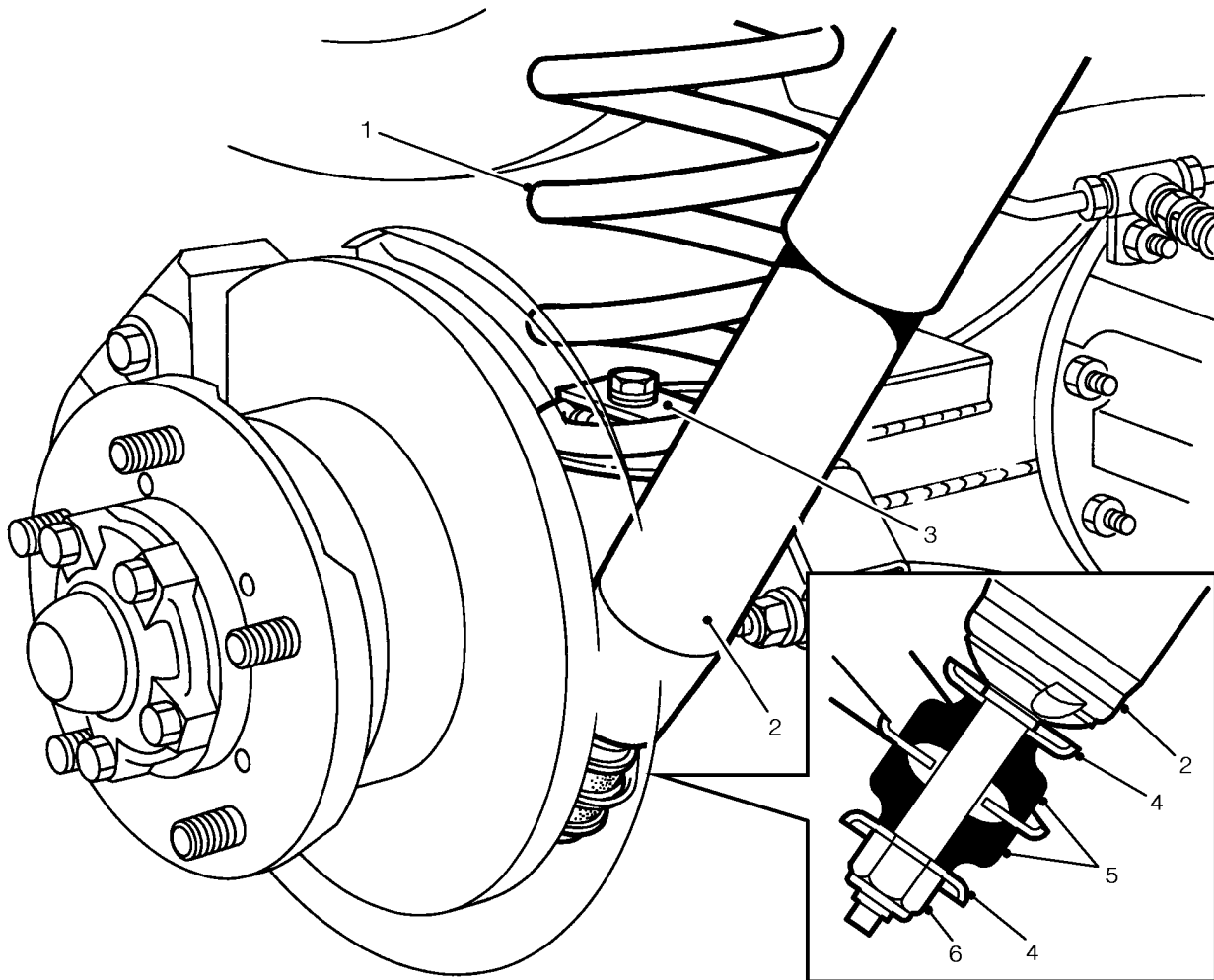
Refitting

NOTES

- (1) When fitting new road springs ensure that the correct type are being fitted.
- (2) On TUL vehicles the close coiled end of the road spring must be fitted uppermost.

19 Refit the rear road springs as follows:

- 19.1 Fit the spring to the lower spring seat and secure with the retaining plate.
- 19.2 Fit a new rubber isolator to the top of the spring.
- 19.3 Raise the axle sufficiently enough to allow correct location of the spring in the upper seat.
- 19.4 Secure the shock absorber with the rubber bushes correctly located, using a new locknut tightened to a torque of 75 Nm (55 lbf ft).
- 19.5 Remove the hydraulic jack supporting the axle, fit the road wheels and lower the vehicle to the ground.
- 19.6 Finally tighten the road wheel nuts to a torque of 170 Nm (125 lbf ft).



MIL0278

- 1 Road spring
- 2 Shock absorber
- 3 Retaining plate

- 4 Retaining washer
- 5 Rubber cushion
- 6 Locknut

Fig 10 Rear road spring and shock absorber lower fixings

SHOCK ABSORBERS

Removal

- 20 To remove the rear shock absorbers carry out the following:
 - 20.1 Slacken the rear road wheel nuts. Raise the rear of the vehicle, lower onto axle stands and remove the road wheels.
 - 20.2 Using a suitable hydraulic jack support the axle weight.
 - 20.3 Remove the shock absorber upper and lower retaining nuts, washers and rubber bushes.
 - 20.4 Remove the shock absorber from the top locating shaft and withdraw it from the vehicle.

Cleaning

- 21 Thoroughly clean the exterior of the shock absorber.

Examination

- 22 Examine the shock absorber as follows:
 - 22.1 Check the exterior for corrosion and oil leaks.
 - 22.2 Check the operation by extending and compressing the shock absorber, resistance should be uniform throughout the length of each stroke. If resistance is erratic or weak renew the shock absorber. When checking resistance a new shock absorber may be used for comparison. To ensure that the new shock absorber is primed, fully extend and compress the unit several times before testing begins. During the tests and when priming, the damper must be kept in the upright position.

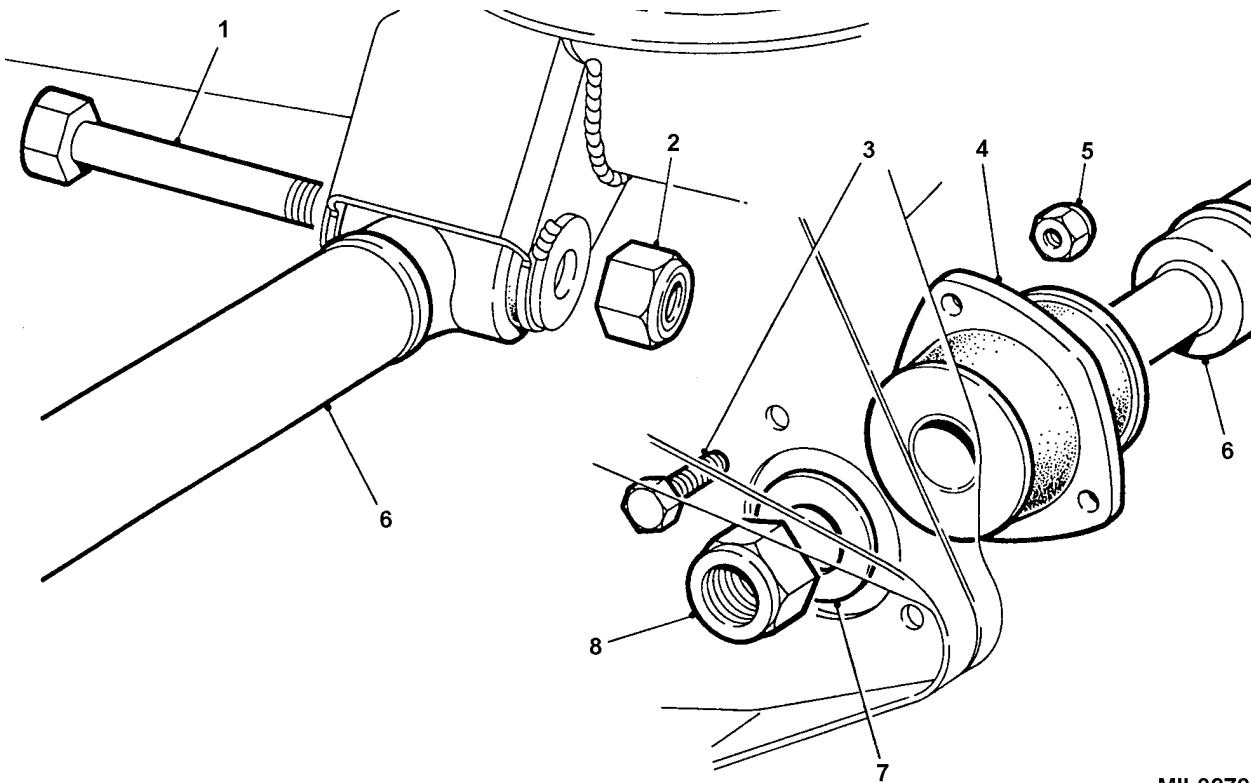
Refitting

- 23 Refit the shock absorbers in reverse order of removal fitting new rubber bushes and locknuts as applicable and tightening nuts to a torque of 75 Nm (55 lbf ft). Tighten the road wheel nuts to a torque of 170 Nm (125 lbf ft).

LOWER LINK

Removal

- 24 To remove the lower link carry out the following:
 - 24.1 Raise the rear of the vehicle using a suitable hydraulic jack and support the vehicle using stands placed under the axle.
 - 24.2 Remove the locknut (Fig 11 (2)) and bolt (1) securing the lower link (6) to the axle.
 - 24.3 Remove the three locknuts (5) and bolts (3) securing the flexible mounting rubber (4) to the chassis mounted bracket and withdraw the lower link (6) from the vehicle.
 - 24.4 Remove the locknut (8) and withdraw the washer and flexible mounting rubber from the lower link.



MIL0279

- | | | | |
|---|------------------------|---|----------------------------|
| 1 | Bolt | 5 | Flexible mounting lock nut |
| 2 | Locknut | 6 | Lower link |
| 3 | Flexible mounting bolt | 7 | Washer |
| 4 | Flexible mounting | 8 | Lower link locknut |

Fig 11 Lower link fixings

Cleaning/examination

25 Thoroughly clean the link arm and examine for damage and distortion likely to render it unfit for further service. Examine the bush at the axle end of the link and renew as necessary. Examine the flexible mounting rubber for suitability for further service.

Repairs and replacement

26 The rubber mounted bushes at the axle end of the link arm may be renewed by carrying out the following:

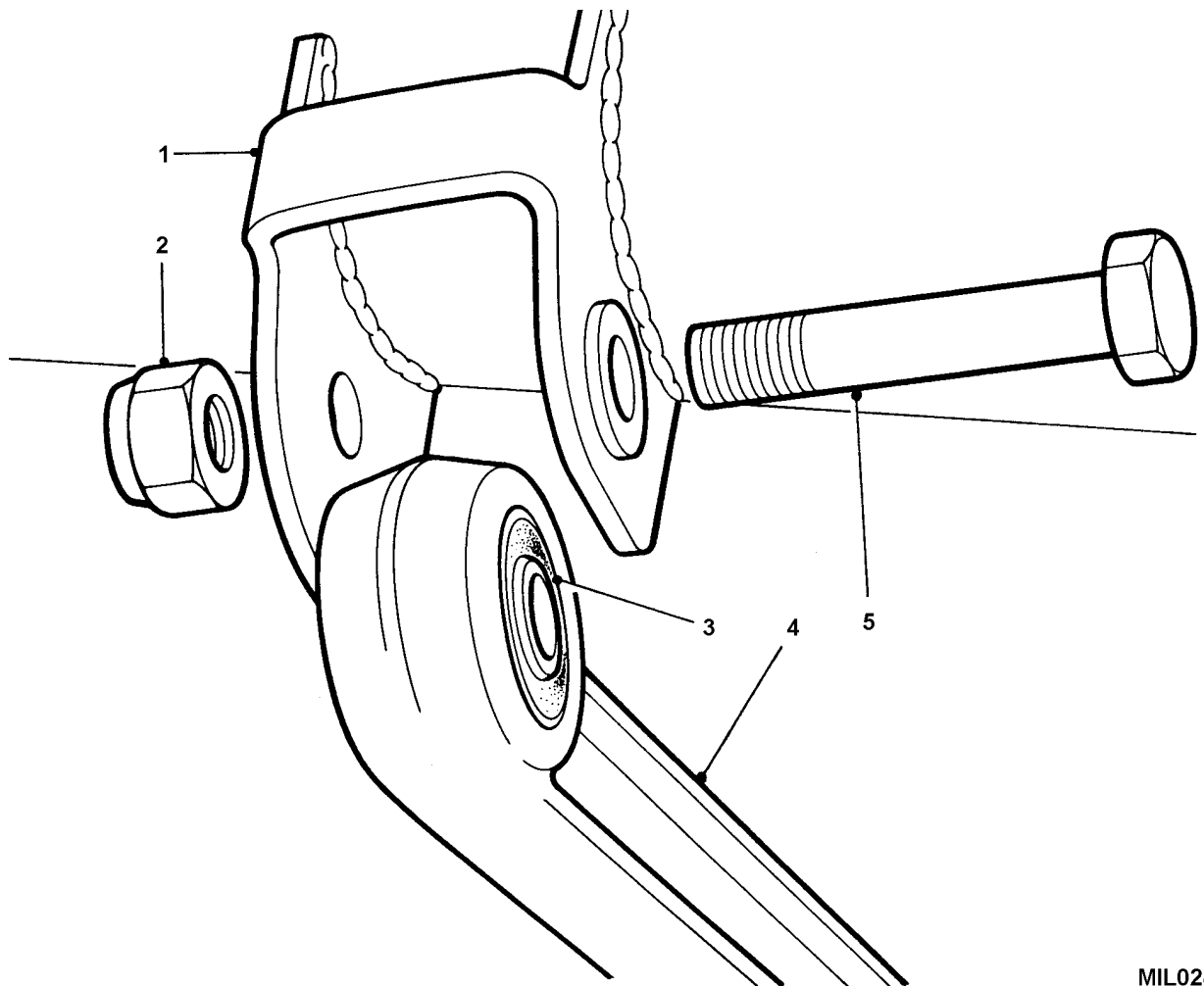
26.1 Using a suitable hydraulic or bench press and a length of metal tubing, slightly smaller in diameter than the outside of the bush, press out the rubber mounted bushes. Ensure that the tubing locates on the outer edge of the bush and not on the rubber inner.

26.2 Fit a new bush centrally to the location in the lower link ensuring that pressure is applied to the outer edge of the bush only.

Refitting

27 Refit the lower link as follows:

27.1 Fit the flexible mounting (Fig 11 (4)) and washer (7), to the lower link (6). Retain with a new locknut (8) but do not fully tighten the nut at this stage.



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- | | | | |
|---|--------------------------|---|------------|
| 1 | Chassis mounting bracket | 4 | Upper link |
| 2 | Locknuts | 5 | Bolt |
| 3 | Bush | | |

Fig 12 Upper link mounting bracket

27.2 Locate the flexible mounting in the chassis mounted bracket and secure with the bolts (3) and new locknuts (5), torque to 63Nm (46 lbf ft).

27.3 Locate the bushed end of the lower link in the bracket on the axle and secure with the bolt (1) and a new locknut (2). Tighten the locknut to a torque of 260 Nm (192 lbf ft).

27.4 Lower the vehicle, remove the jack and allow the axle to take up its static laden position.

27.5 Tighten the locknut (8), at the flexible mounting, to a torque of 176 Nm (130 lbf ft).

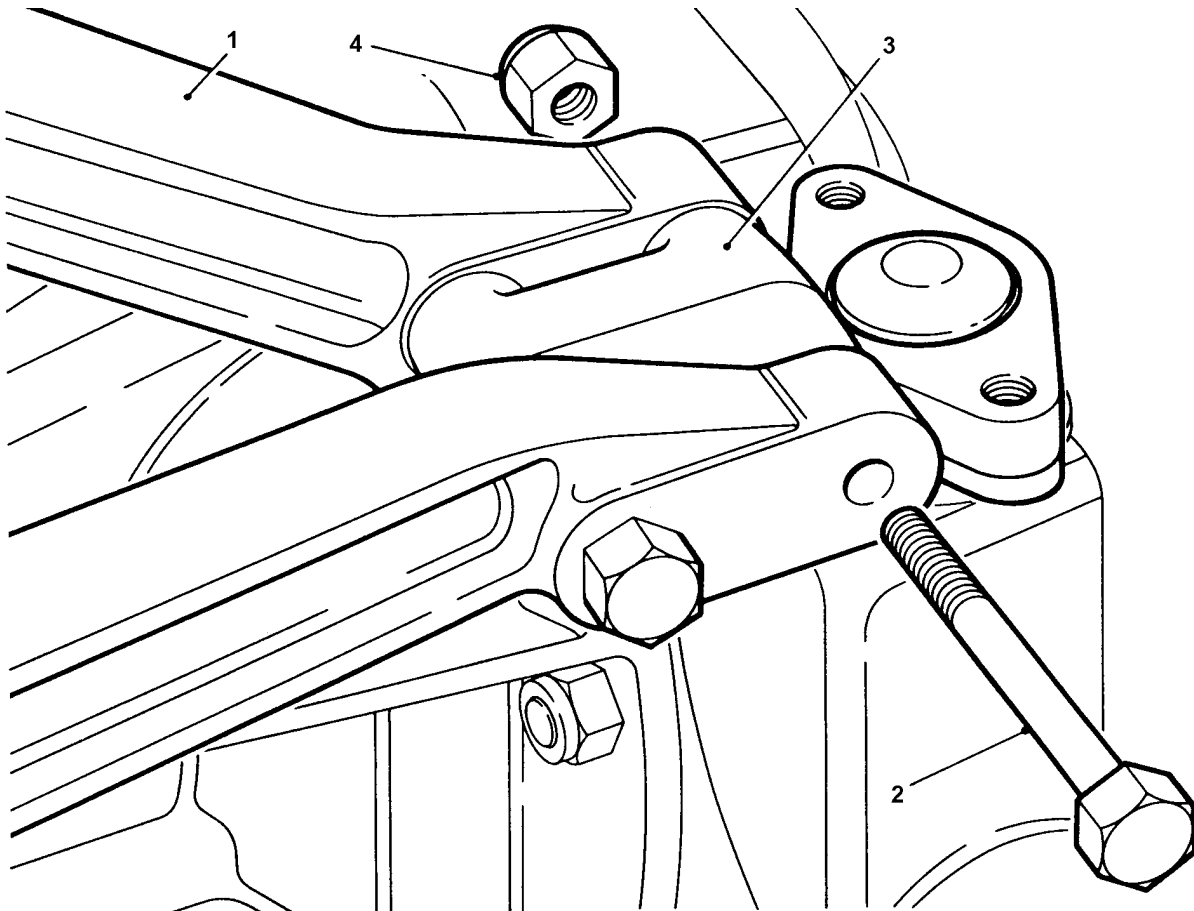
NOTE

The fixing bolts for all suspension bushes should be torqued when the vehicle is on the floor at its normal ride height (i.e. "loaded with its normal payload").

UPPER LINKS, PIVOT BRACKET AND BALL JOINT**Removal**

28 To remove the upper links, pivot bracket and ball joint carry out the following:

28.1 Raise the rear of the vehicle using a suitable hydraulic jack. Support the rear of the chassis on stands allowing the axle to be freely suspended.



MIL0281

1 Upper link
2 Bolt

3 Pivot bracket
4 Locknut

Fig 13 Upper link to pivot bracket

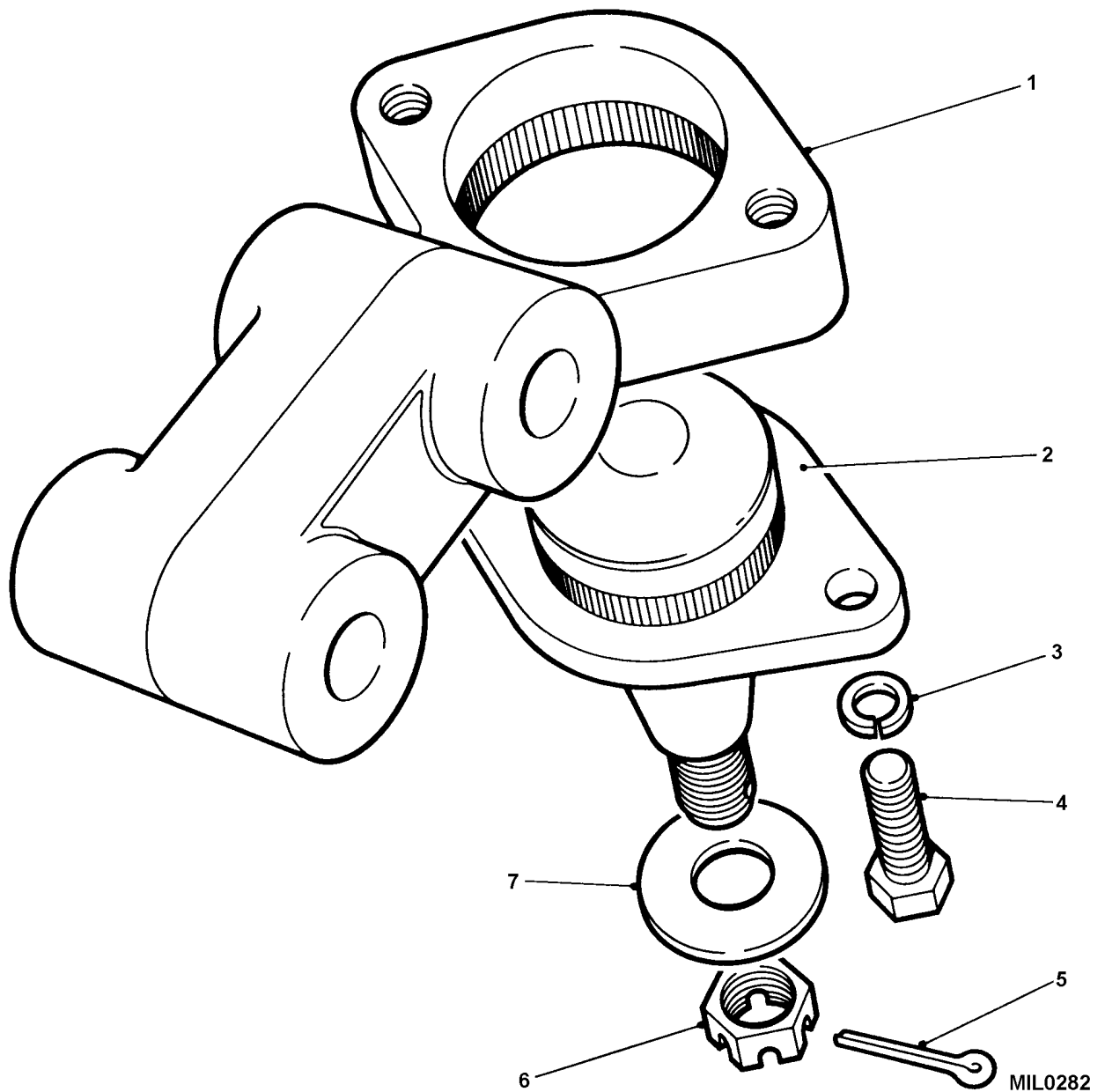
28.2 Remove the axle breather retaining straps from the left upper link.

28.3 Remove the locknuts (Fig 12 (2)) and bolts (5) securing the upper links (4) to the chassis mounting brackets (1).

28.4 Remove the two locknuts (Fig 13 (4)) and bolts (2) securing the upper links (1) to the pivot bracket (3) and withdraw the upper links.

28.5 Remove the split pin (Fig 14 (5)) and the castellated nut (6) and washer (7) securing the ball joint (2) at the axle bracket.

28.6 Using a suitable fork type ball joint extractor remove the ball pin from the axle bracket.



1 Pivot bracket
2 Ball joint
3 Spring washer
4 Bolt

5 Split pin
6 Castellated nut
7 Washer

4

Fig 14 Pivot bracket and ball joint

28.7 Withdraw the pivot bracket complete with ball joint.

NOTE

The ball joint is supplied prepacked with grease, as a complete assembly, therefore it must not be dismantled.

28.8 If the ball joint is satisfactory for continued service no further dismantling is necessary. If the ball joint assembly requires replacing remove the two bolts (4) and spring washers (3) and withdraw it from the pivot bracket (1).

Cleaning/examination

29 Thoroughly clean the upper links and brackets, and examine for damage or distortion likely to render them unfit for further service. Examine the bushes at the chassis end of the links and the pivot bracket ball joint. Renew as necessary.

Repairs and replacement

30 The rubber mounted bushes at the mounting bracket end of the link arms may be renewed by carrying out the following:

30.1 Using a suitable hydraulic or bench press and a length of metal tubing, slightly smaller in diameter than the outside of the bush, press out the rubber mounted bushes. Ensure that the tubing locates on the outer edge of the bush and not on the rubber inner.

30.2 Fit a new bush centrally to the location in the upper link ensuring that pressure is applied to the outer edge of the bush only.

Refitting

31 Refit the upper links, pivot bracket and ball joint as follows:

31.1 If a new ball joint is being fitted press the ball joint (Fig 14 (2)) into the pivot bracket (1), ensuring that the flanges align, secure with the two bolts (4) and spring washers (3).

31.2 Fit the assembled pivot bracket and ball joint to the rear axle. Secure with the large plain washer (7) and castellated nut (6). Tighten the nut to a torque of 176 Nm (130 lbf ft) and lock with a new split pin.

31.3 Fit the link arms to the pivot bracket, and chassis-mounting bracket. Secure with the bolts and new locknuts but do not fully tighten at this stage.

NOTE

The fixing bolts for all suspension bushes should be torqued when the vehicle is on the floor at its normal ride height (i.e. "loaded with its normal payload").

31.4 Evenly tighten all locknuts to the following torque figures:

31.4.1 Upper link arms to chassis bracket nuts 260 Nm (192 lbf ft).

31.4.2 Upper link arms to pivot bracket nuts 190 Nm (140 lbf ft).

CHAPTER 8-2

(TUM) HS (FFR ONLY VEHICLES) AND (TUM) AMBULANCE HS SUSPENSION SYSTEM

CONTENTS

Para

- 1 Introduction
- Rear anti-roll bar
- 3 Removal
- 4 Reassembly

Fig

Page

- 1 Rear anti-roll bar link assembly 2

INTRODUCTION

1 This chapter covers the Unit repairs for the (TUM) HS (FFR only vehicles) and (TUM) Ambulance HS vehicles suspension systems. The repair instructions detailed are applicable to both left and right hand drive vehicles.

2 The (TUM) Ambulance HS front and rear suspension system is the same as the TUM front and rear suspension system except for the anti-roll bar configuration, (refer to Chap 8-1).

WARNING

WHERE APPLICABLE, SUSPENSION BUSHES SHOULD ALWAYS BE REPLACED AS MATCHED PAIRS.

REAR ANTI-ROLL BAR

Removal

- 3 For removal of the rear anti-roll bar proceed as follows:
 - 3.1 Remove the two nuts (Fig 2 (2)) washers (3) and bolts (9) securing the anti-roll bar (4) to the axle link (6).
 - 3.2 Remove the eight nuts and bolts (1) (four each side) retaining the two anti-roll bar straps and rubber bushes to the chassis rails and remove the bar from vehicle.
 - 3.3 Remove the split pin (8) and castellated nut (7) and remove the ball joint and link from the axle location.

Reassembly

- 4 To reassemble the anti-roll bar proceed as follows:

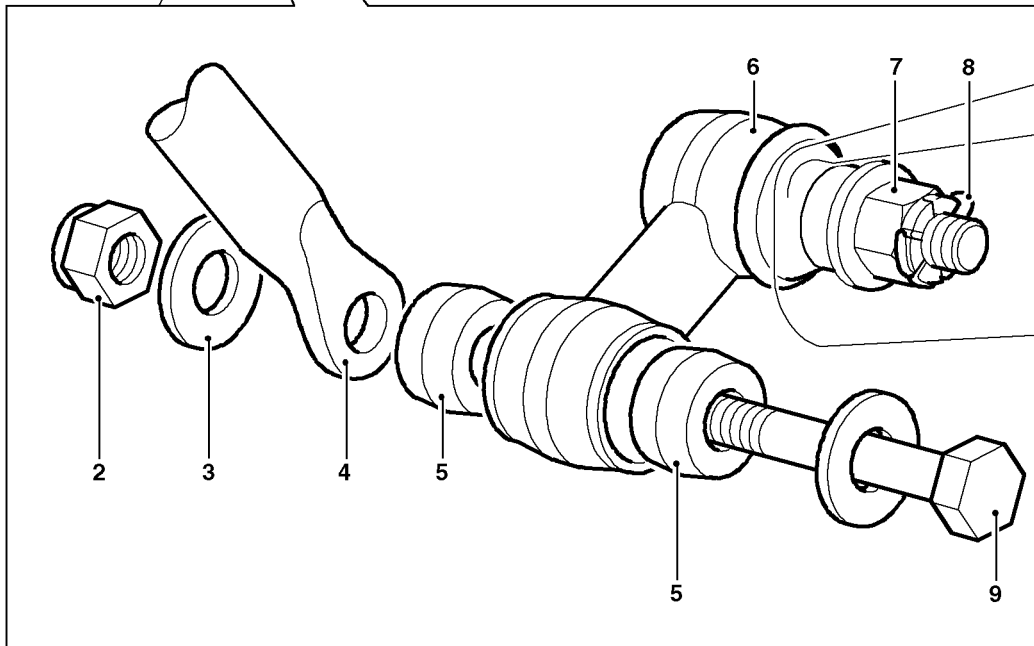
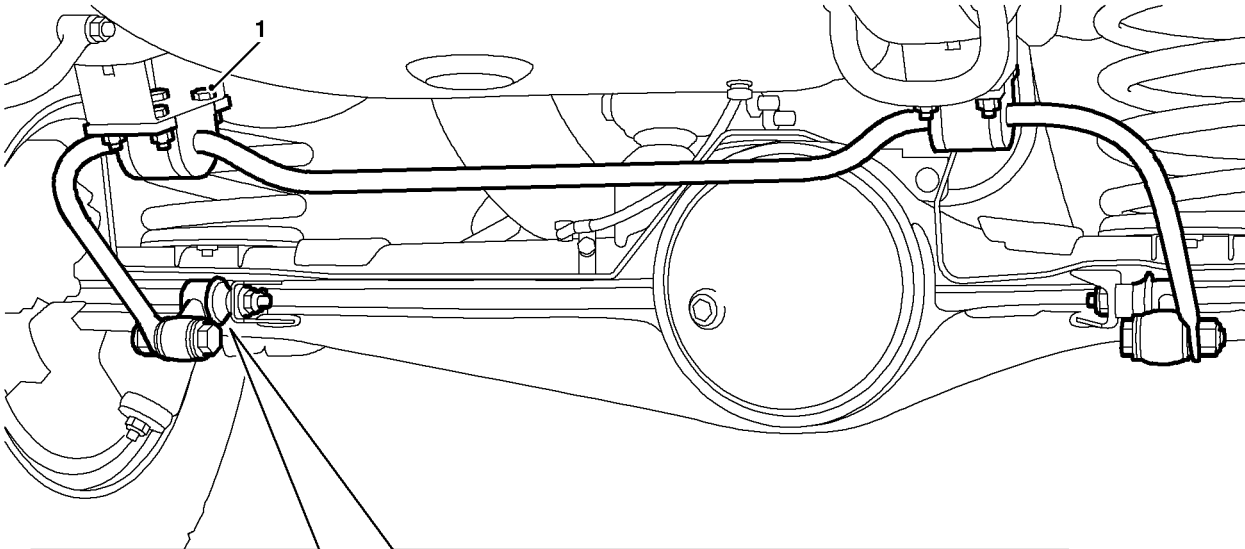
NOTE

If the ball joint requires replacement the complete link must be renewed.

- 4.1 Fit the anti-roll bar (4) to the chassis. Secure the straps and bushes with the eight bolts and nuts, tightening to 30 Nm (22 lbf ft).

4.2 Fit the ball joint and link (6) to the axle location. Tighten the castellated nut (7) to 40 Nm (29 lbf ft) and fit a new split pin (8).

4.3 Fit new rubber bushes in the sequence illustrated and fit the anti-roll bar (4) to the ball joint link (6). Tighten the nuts and bolts to 68 Nm (50 lbf ft).



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- | | | | |
|---|----------------|---|-----------------|
| 1 | Nuts and bolts | 6 | Axle link |
| 2 | Nut | 7 | Castellated nut |
| 3 | Washer | 8 | Split pin |
| 4 | Anti-roll bar | 9 | Bolt |
| 5 | Rubber bushes | | |

Fig 1 Rear anti-roll bar link assembly

CHAPTER 9

WHEELS AND TYRES

CONTENTS

Para

- 1 Introduction
- 2 General
- 3 Tyre wear
- 4 Tyre pressures (CAUTION)
- 6 Tyre treads
- 7 Tyre repair
- 8 Tyre changing
- 9 Wheel balancing
- 10 Wheels

INTRODUCTION

1 This chapter details the repair of wheels and tyres as fitted to Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles.

General

2 This chapter has been sub-chaptered as detailed below.

2.1 Chapter 9-1 Wheel Changing.

TYRE WEAR

3 The most important factors, among many which have an adverse effect on tyre life are:

- 3.1 Incorrect tyre pressure.
- 3.2 High average speeds.
- 3.3 Harsh acceleration.
- 3.4 Frequent hard braking.
- 3.5 Warm dry climatic conditions.
- 3.6 Poor road surfaces.
- 3.7 Impact fractures caused by striking a kerb or brick, etc.
- 3.8 Wear in suspension and steering components.
- 3.9 Incorrect wheel alignment.

TYRE PRESSURES

4 To ensure maximum tyre life and performance are obtained careful attention must be given to ensure that correct tyre pressures are maintained. Emergency soft pressures should only be used in extreme conditions where extra flotation is required. Maximum speed should be restricted to 40 Km/h (25 Mph). Return the pressures to normal immediately firm ground is gained.

5 Pressures should be checked and adjusted in accordance with the Maintenance Schedule (refer to AESP 2320-D-128-601), paying particular attention to the following points:

5.1 Whenever possible the tyres should be checked cold, as the pressure is approximately 0.21 bar (3.0 lbf/in²) higher at running temperature.

5.2 Valve caps should always be fitted as they form a positive seal on the valves, and prevent the ingress of dirt and water.

5.3 Any unusual pressure loss in excess of 0.05 to 0.21 bar (1 to 3 lbf/in²) should be investigated and corrected.

5.4 The spare wheel should always be checked, so that it is ready for use at any time.

5.5 When carrying out the tyre pressure checks, also inspect the tyres for cuts, abrasions, bulges and for objects embedded in the tread. More frequent inspections are recommended when the vehicle is regularly used in off road conditions. Clean off any oil or grease using a dry cloth.

CAUTION

TYRE DEGRADATION. Do not use any form of petrol or solvent to clean tyres, as they have a softening and decomposing effect on the rubber.

TYRE TREADS

6 The tread form of the tyres is designed for both on and off road usage, the pattern ensures maximum grip and efficient tread cleaning when operating on soft ground. For information on acceptable tread depth and wear, refer to AESP 2610-A-409-531.

TYRE REPAIR

7 Details on tyre repair can be found in AESP 2610-A-409-521 Chap 2.

TYRE CHANGING

8 Details on tyre changing can be found in AESP 2610-A-409-521 Chap 1.

WHEEL BALANCING

9 Details on tyre and wheel balancing can be found in AESP 2610-A-409-521 Chap 3.

WHEELS

10 For details on wheel changing refer to Cat 522 Chapter 9-1.

CHAPTER 9-1

WHEELS

CONTENTS

Para			
		Torque list	
		Wheels (WARNING)	
1		Removal	
2		Refitting	
Fig			Page
1		Tightening sequence for wheel nuts	2

TORQUE LIST

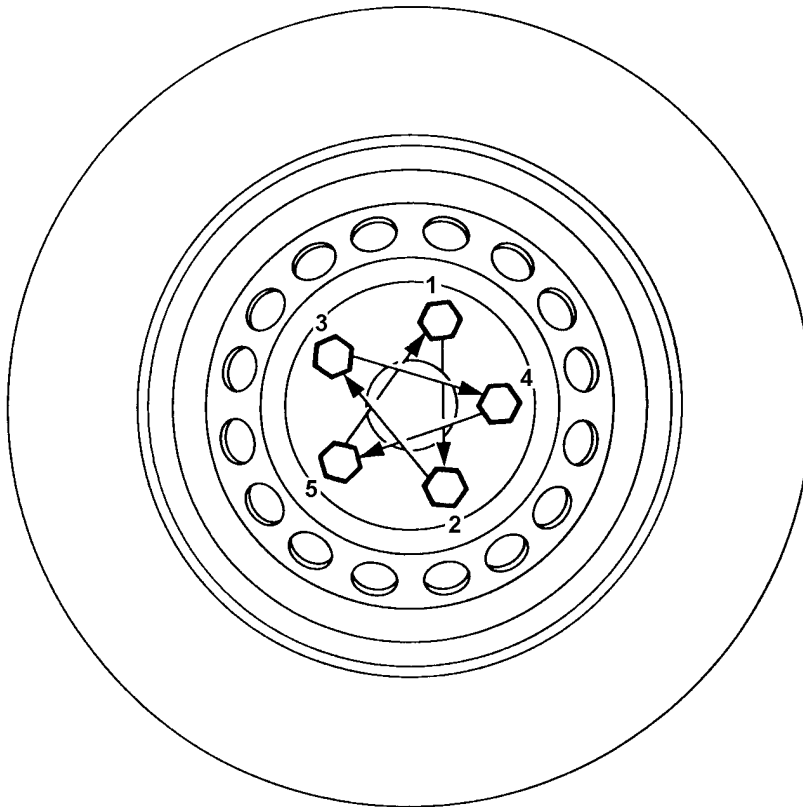
Wheel nuts	Steel wheels	170 Nm/125 lbf ft
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WARNING

VEHICLE STABILITY. THE HAND BRAKE ACTS ON THE TRANSMISSION, NOT THE REAR WHEELS, AND MAY NOT HOLD THE VEHICLE WHEN JACKING. IT IS ESSENTIAL WHEN JACKING THE VEHICLE TO CHOCK THE REMAINING ROAD WHEELS TO PREVENT THE VEHICLE FROM ROLLING.

Removal

- 1 To remove the road wheels carry out the following:
 - 1.1 With the ignition switched on engage the differential lock. Check that the warning light is illuminated.
 - 1.2 Select low gear in the transfer box and any gear in the main gearbox.
 - 1.3 Chock the road wheels that are not going to be removed.
 - 1.4 Slacken the wheel nuts on the wheel to be removed.
 - 1.5 Using a suitable jack raise the vehicle and support with an axle stand.
 - 1.6 Remove the wheel nuts and carefully withdraw the wheel over the studs.



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Fig 1 Tightening sequence for wheel nuts

Refitting

- 2 To refit the road wheels carry out the following:
 - 2.1 Ensure that the retaining nuts and studs are clean and free from damage.
 - 2.2 Lightly coat the wheel mounting spigot face with a suitable anti-seize compound to minimise the possibility of adhesion between the wheel and spigot face.
 - 2.3 Apply a drop of lubricating oil to the wheel studs.
 - 2.4 Refit the wheel taking care not to damage the stud threads.
 - 2.5 Fit the wheel nuts by hand to ensure that they are not cross-threaded.
 - 2.6 Using a suitable wrench tighten the nuts until the wheel is secure, without over-tightening the nuts.
 - 2.7 Lower the vehicle and finally tighten the road wheel nuts in the correct sequence (Fig 1) to the correct torque (refer to Torque List).
 - 2.8 Re-torque the wheel nuts after 100km or 30 minutes.

CHAPTER 10

BRAKING SYSTEM

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

1 This chapter details the Unit repair of the brake system as fitted to Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles.

General

2 This chapter has been sub-chaptered to allow for the various types of vehicle engines as detailed below.

2.1 Chapter 10-1 Braking system.

2.2 Chapter 10-2 Winter/water.

CHAPTER 10-1

BRAKING SYSTEM

CONTENTS

Para

1	Introduction
	Torque list
	FRONT BRAKE CALLIPERS
2	Removal
3	Dismantling
4	Cleaning
5	Examination
6	Reassembly
7	Refitting
	REAR BRAKE CALLIPERS
8	Removal
9	Removing the brake pads and callipers (TUL)
11	Removing the brake pads and callipers (TUM and Field Ambulance)
13	Dismantling
14	Cleaning
15	Examination
16	Reassembly
18	Refitting
	Bleeding the brakes
19	Primed system
20	Unprimed system
	FRONT BRAKE DISCS
21	Removal
22	Examination
23	Refitting
	REAR BRAKE DISCS
24	Removal
25	Examination
26	Refitting
	MASTER CYLINDER (CAUTION)
27	Removal
28	Dismantling (WARNING)
29	Renewing secondary plunger seals
30	Reassembly (WARNING)(CAUTION)
31	Refitting (WARNING)
	SERVO ASSEMBLY
32	Removal
33	Refitting
34	Non-return valve renewal
	BRAKE PEDAL BOX
35	Removal
36	Dismantling
37	Examination
38	Repair and replacement
39	Reassembly
	TRANSMISSION BRAKE
40	Dismantling
41	Examination

(continued)

CONTENTS (continued)

Para

- 42 Reassembly
HAND BRAKE LEVER
- 43 Removal
- 44 Refitting
BRAKE VACUUM PUMP
- 45 Removal
- 46 Refitting

Table

Page

- 1 Special tools 3
- 2 Sealants, adhesives and lubricants 3
- 3 Service kits 3

Fig

- 1 Front brake calliper 5
- 2 Clamping pistons 6
- 3 Removing the rear brake pads (TUL) 8
- 4 Removing the rear brake pads (TUM and Field Ambulance) 9
- 5 Rear brake calliper piston removal 10
- 6 Rear brake calliper (TUL) 11
- 7 Checking brake disc run out 1 4
- 8 Master cylinder arrangement 16
- 9 Primary plunger assembly 17
- 10 Swirl tube 18
- 11 Secondary plunger assembly 19
- 12 Secondary plunger fitting 20
- 13 Brake pedal removal 22
- 14 Servo unit to pedal connections 23
- 15 Servo non-return valve replacement 24
- 16 Transmission brake assembly 27
- 17 Brake cable adjustment 29
- 18 Hand brake lever assembly 3 0
- 19 Brake vacuum pump removal 31/3 2

INTRODUCTION

1 This chapter details the Unit repairs for the braking systems fitted to Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles. The repair instructions detailed are applicable to both left and right hand drive vehicles.

TORQUE LIST

Calliper to axle		100 Nm/74 lbf ft
Wheel nuts	steel wheel	170 Nm/125 lbf ft
Brake pipe to calliper		12 Nm/9 lbf ft
Brake disc to hub		73 Nm/54 lbf ft
Master cylinder to servo		14 Nm/10 lbf ft
Brake pipes to master cylinder		13 Nm/10 lbf ft
Servo to pedal box		14 Nm/10 lbf ft
Drum back plate to transfer box		72 Nm/53 lbf ft
Transmission brake drum screw		25 Nm/18 lbf ft
Transmission brake drum adjuster bolt		25 Nm/18 lbf ft
Propeller shaft 46		Nm/34 lbf ft
Vacuum pump retaining bolts		25 Nm/18 lbf ft

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	LRT-70-500	6NT2/5120-99-737-3406	Brake piston compressor

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	OX8	9150-99-220-2348	Brake fluid
2	XG279	9150-99-250-7742	General purpose grease
3	Ardrox 6333	7930-99-225-3993	Brake cleaning fluid (2-5% solution in water)
4	Celloseal	8030-99-225-0232	Anti seize grease
5	Loctite 243	8030-01-475-2444	Thread lock

TABLE 3 SERVICE KITS

Serial (1)	NSN/Part Number where applicable (2)	Designation (3)
1	5306-99-567-0676	Patch loc bolt

FRONT BRAKE CALLIPERS**REMOVAL**

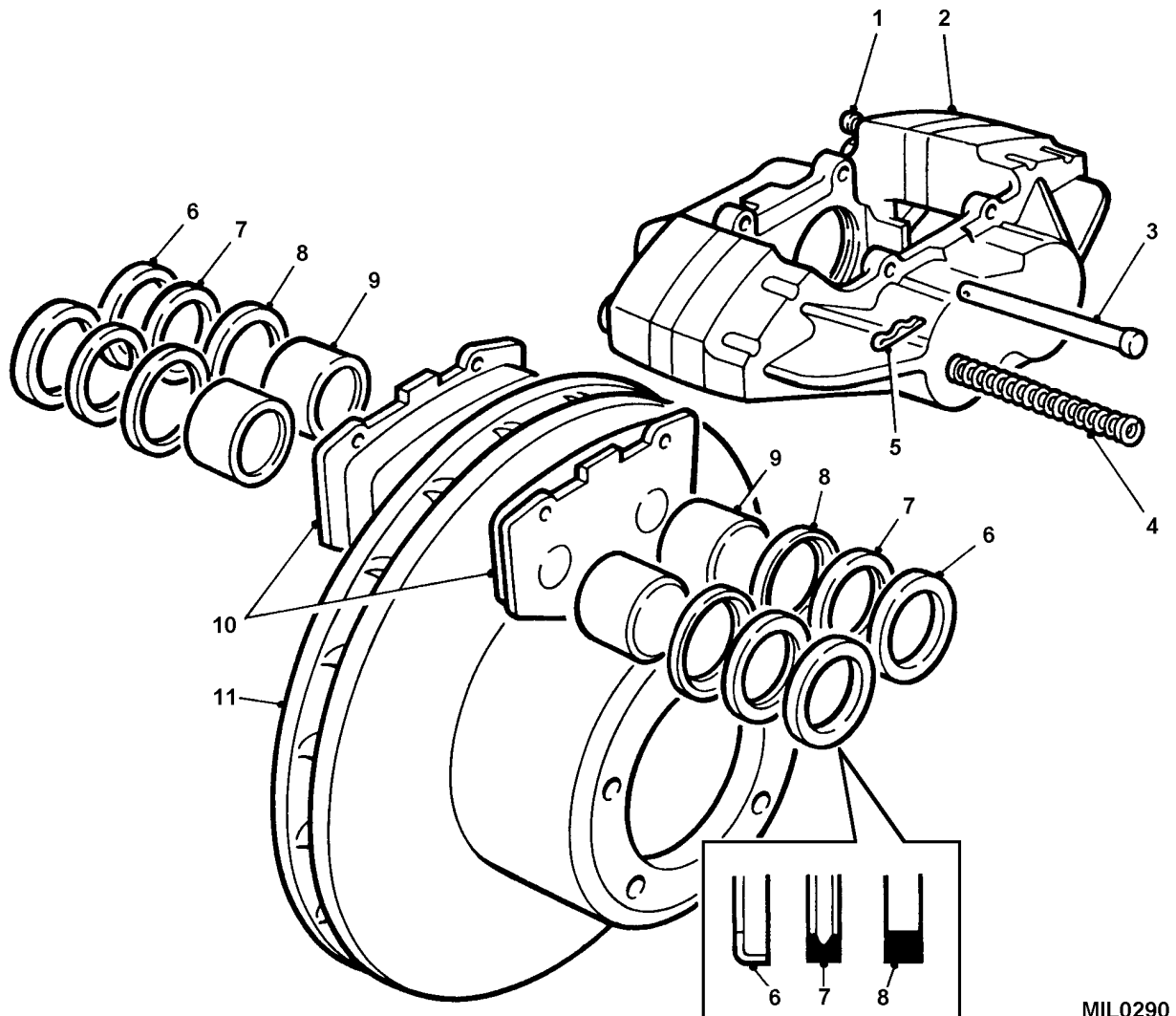
- 2 To remove the front brake callipers proceed as follows:
 - 2.1 Slacken the front wheel retaining nuts, jack- up the vehicle, lower onto suitable axle stands and remove the wheels.
 - 2.2 Expose the flexible brake hose by pulling back the coiled protective covering and using a recognised hose clamp, clamp the hose to prevent loss of brake fluid.
 - 2.3 Disconnect the rigid brake pipe from the flexible hose, seal the exposed pipe ends to prevent ingress of dirt. If necessary the rigid brake pipe to calliper can be disconnected when the calliper is removed.
 - 2.4 Remove the spring clips (Fig 1 (5)), withdraw the retaining pins (3) and the anti-rattle springs (4). Ease out the brake pads (10) and, if the same pads are to be refitted, identify them to the location from which they were removed.
 - 2.5 Remove the two securing bolts and withdraw the calliper (2) from the brake disc (11).

NOTE

If the calliper is to be cleaned, use brake cleaning fluid (refer to Table 2 Serial 3).

Dismantling

- 3 To dismantle the callipers carry out the following:
 - 3.1 Before commencing dismantling thoroughly clean the outer surfaces of the assembly with brake cleaning fluid (refer to Table 2 Serial 3).
 - 3.2 Using special tool (refer to Table 1 Serial 1), clamp the pistons in the mounting half of the calliper (Fig 2), keeping fingers well clear. With caution, apply air pressure to the fluid inlet port to expel the outer pistons. Since it is unlikely that both pistons will expel at the same time, regulate the rate with a suitable piece of timber between the appropriate piston and calliper.
 - 3.3 Remove the outer pistons (Fig 1(9)) keeping them identified with their respective bores.
 - 3.4 Repeat Paras 3.1 to 3.3 to remove the opposing pistons.



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- 1 Bleed screw
- 2 Calliper
- 3 Retaining pin
- 4 Anti-rattle spring
- 5 Spring clip
- 6 Fluid seal

- 7 Wiper seal
- 8 Wiper seal retainer
- 9 Piston
- 10 Brake pads
- 11 Brake disc

6

Fig 1 Front brake calliper

3.5 Remove the wiper seal retainers (8) by inserting a blunt screwdriver between the retainer and the seal and prise the retainer carefully from the mouth of the bore.

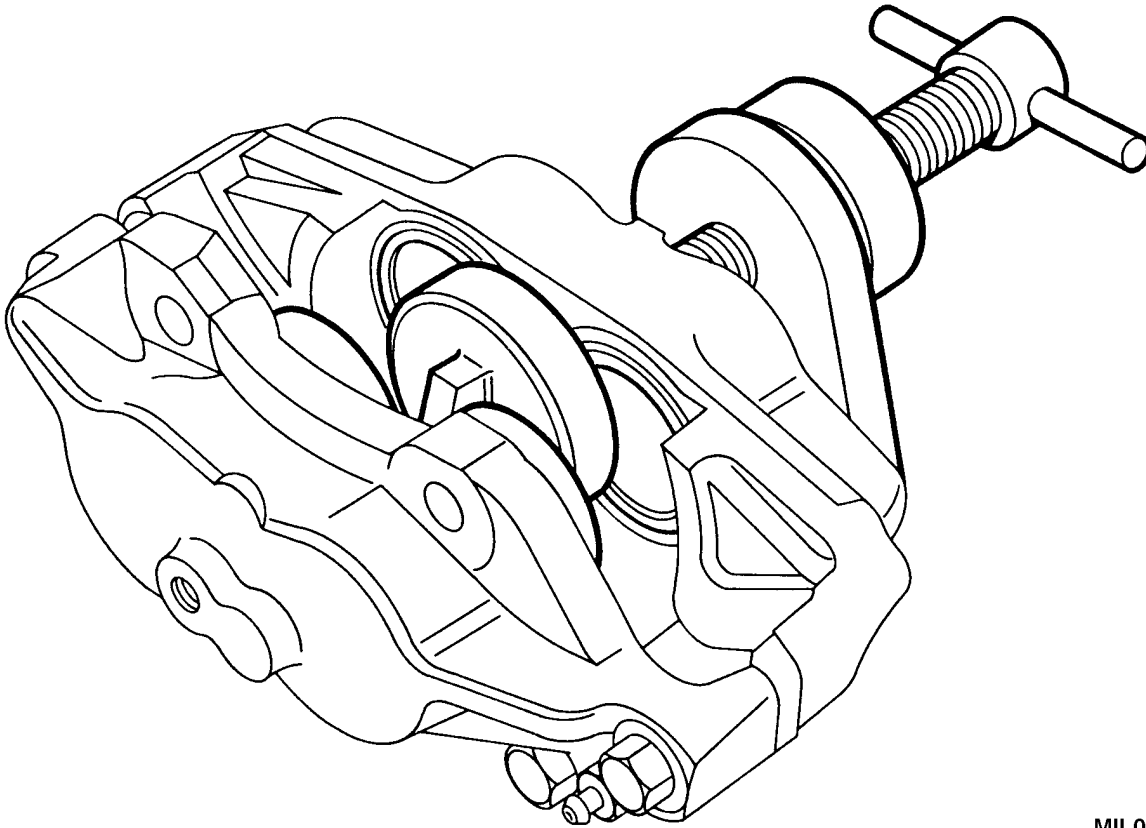
3.6 Taking care not to damage the seal grooves, extract the wiper seals (7) and the fluid seals (6).

NOTE

Do not separate the calliper halves.

Cleaning

4 Thoroughly clean bores, pistons and seal grooves with clean brake fluid (refer to Table 2 Serial 1).



MIL0291

Fig 2 Clamping pistons

Examination

5 Examine the components thoroughly, if the calliper bores or pistons are corroded or if their condition is not perfect a new calliper must be fitted.

Reassembly

6 Fitting the outer pistons first, reassemble the calliper as follows:

6.1 Coat a new fluid seal (Fig 1(6)) with brake fluid (refer to Table 2 Serial 1). Ease the seal into the groove in the bore using only the fingers and ensure that it is properly seated. The fluid seal and the groove are not the same in section that when the seal is seated it feels proud to touch at the edge furthest away from the mouth of the bore.

6.2 Smear the appropriate piston (9) with brake fluid (refer to Table 2 Serial 1) and insert it squarely into the bore by hand only. Do not tilt the piston during insertion, leave approximately 8 mm (0.315 in.) protruding from the bore.

6.3 Coat a new wiper seal (7) with brake fluid (refer to Table 2 Serial 1) and fit it to a new seal retainer (8). Slide the assembly, seal first, over the protruding piston and into the bore recess. Using the piston clamp special tool (refer to Table 1 Serial 1) press home the seal retainer and piston.

6.4 Fit the second piston to the outer side, clamp the pistons and repeat to fit the pistons to the inner bores.

REFITTING

7 Refit the callipers and pads to the vehicle as follows:

7.1 Fit the calliper to the axle and secure with two new encapsulated Patch Loc bolts, tightening evenly to a torque of 100 Nm (74 lbf ft).

NOTE

In out of territory locations it may be necessary to refit the existing bolts using Loctite 243. In this event, documents to be annotated with 'exchange bolts for the correct Encapsulated patch loc bolts when possible'.

7.2 Connect the brake flexible hose to the calliper rigid brake pipe and remove the hose clamp.

7.3 Lightly smear the back and edges of the pads with antisieze compound (refer to Table 2 Serial 4) carefully avoiding the friction material.

7.4 Fit the pads and secure using new pins, split pins and anti-rattle springs.

7.5 Bleed the brake circuit (refer to Para 19).

7.6 When the foregoing instructions have been completed on both callipers, depress the brake pedal firmly several times to locate the friction pads.

7.7 Fit the road wheels, jack-up the vehicle and remove the axle stands and finally tighten the wheel nuts to a torque of 170 Nm (125 lbf ft).

7.8 Check the fluid level in the reservoir and top-up as necessary.

7.9 Road test the vehicle, remembering that if new friction pads have been fitted, that they are not yet 'bedded in' and may take several hundred miles before the brakes are at maximum efficiency.

REAR BRAKE CALLIPERS

NOTE

The following procedure is applicable to the TUL, TUM and Field Ambulance vehicles. The brake callipers fitted to the TUL differ only in size and external pipe connections to the TUM/Field Ambulance vehicles due to the vehicles braking systems being to suit 2600 Kg, Gross Vehicle Weight (GVW) 3350 Kg and 3800 Kg GVW respectively.

REMOVAL

8 To remove the rear brake calliper proceed as follows:

8.1 Slacken the rear wheel retaining nuts, jack-up the vehicle then lower onto axle stands and remove the wheel.

8.2 Expose the flexible brake hose at the rear axle by pulling back the coiled protective covering and clamp the hose using a suitable hose clamp, to prevent fluid loss.

8.3 Remove the brake pipe from the rear brake calliper. Seal the ends of the pipe to prevent the ingress of dirt.

Removing the brake pads and callipers - (TUL)

- 9 Remove the split retaining pins (Fig 3 (2)) and anti-rattle springs (3) and withdraw the pads (1). If the same pads are to be refitted, identify them for assembly to their original locations.
- 10 Remove the two securing bolts and withdraw the calliper (4) from the vehicle.

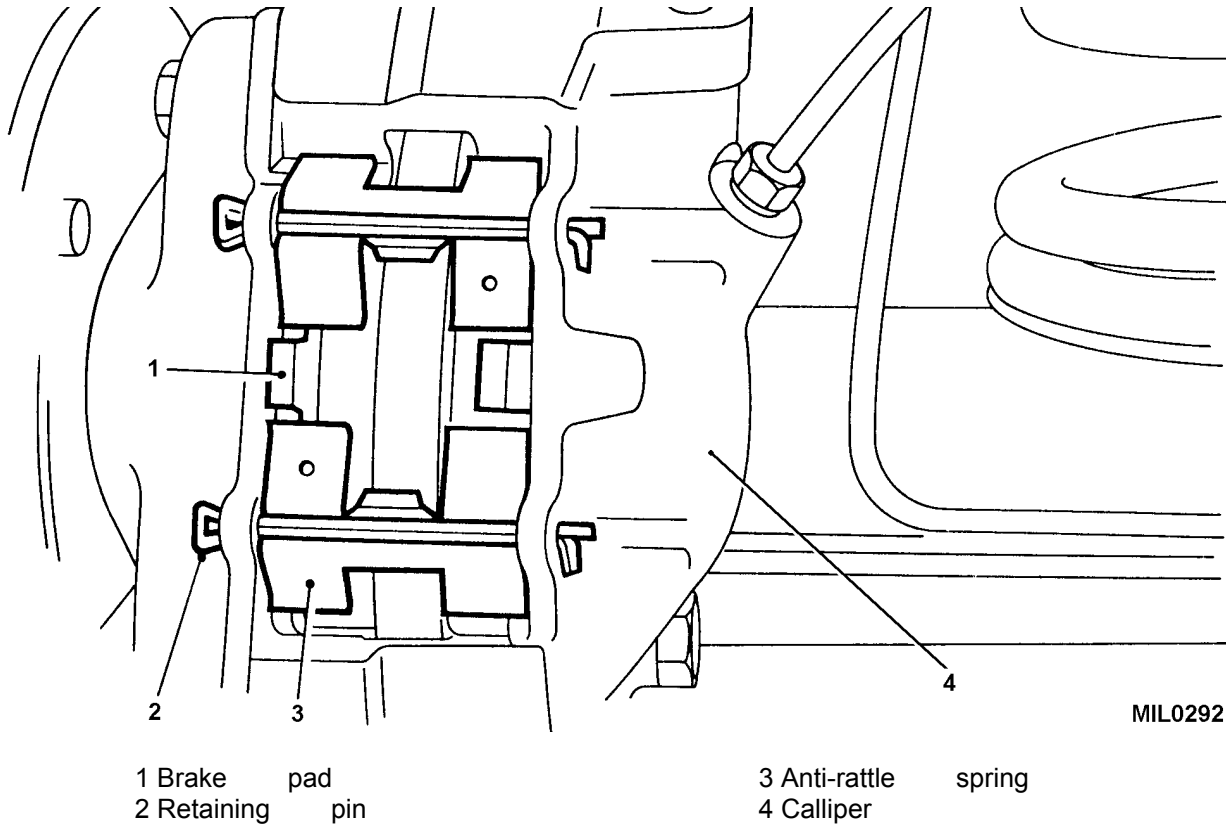


Fig 3 Removing the rear brake pads (TUL)

Removing the brake pads and callipers - (TUM and Field Ambulance)

- 11 Remove the split pins (Fig 4 (1)), withdraw the retaining pins (4) and the anti-rattle springs (2). Ease out the brake pads (3) and if the same pads are to be refitted, identify them to the location from which they were removed.
- 12 Remove the two securing bolts and withdraw the calliper (5) from the vehicle.

NOTE

If the calliper is to be cleaned, use only brake cleaning fluid (refer to Table 2 Serial 3).

Dismantling

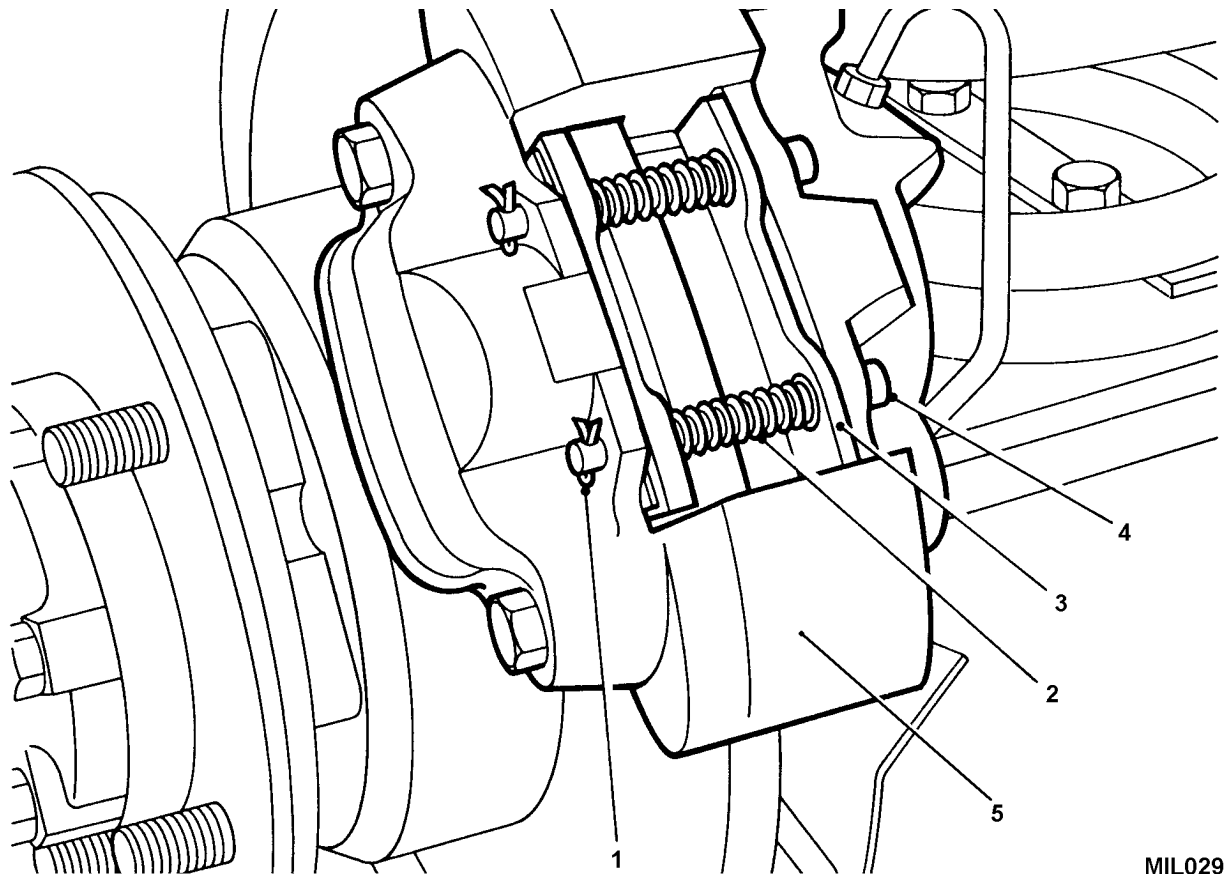
- 13 To dismantle the callipers carry out the following:

NOTE

Do not separate the calliper halves.

13.1 Before dismantling thoroughly clean the outer surfaces of the assembly with brake cleaning fluid (refer to Table 2 Serial 3).

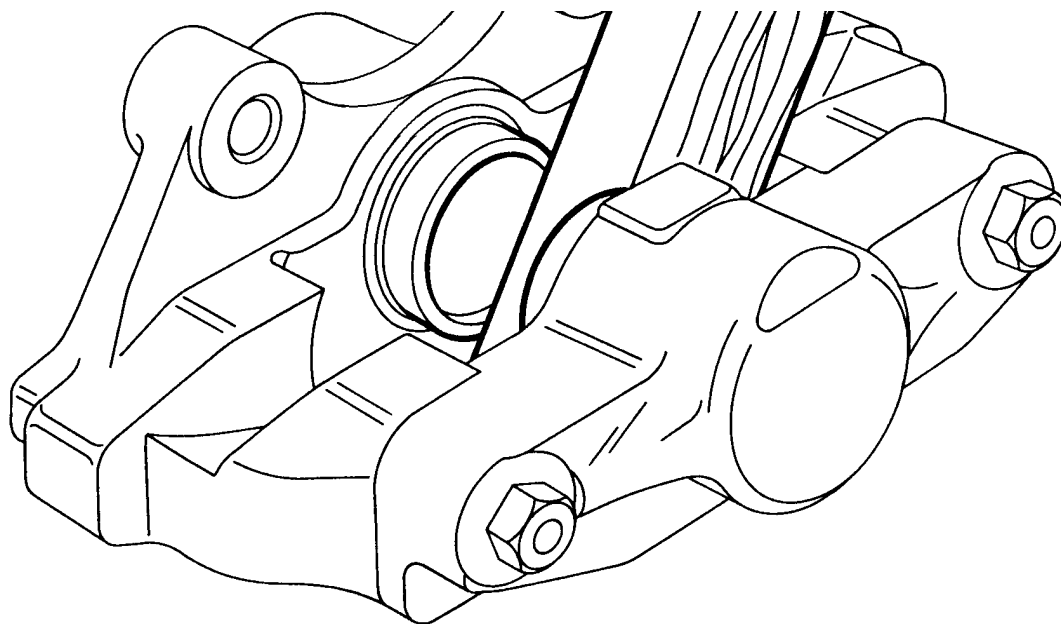
13.2 Keeping the fingers clear, and with caution, apply air pressure to the fluid inlet port to expel the outer piston. Use a suitable packing piece to restrain the piston that is not to be removed (Fig 5).



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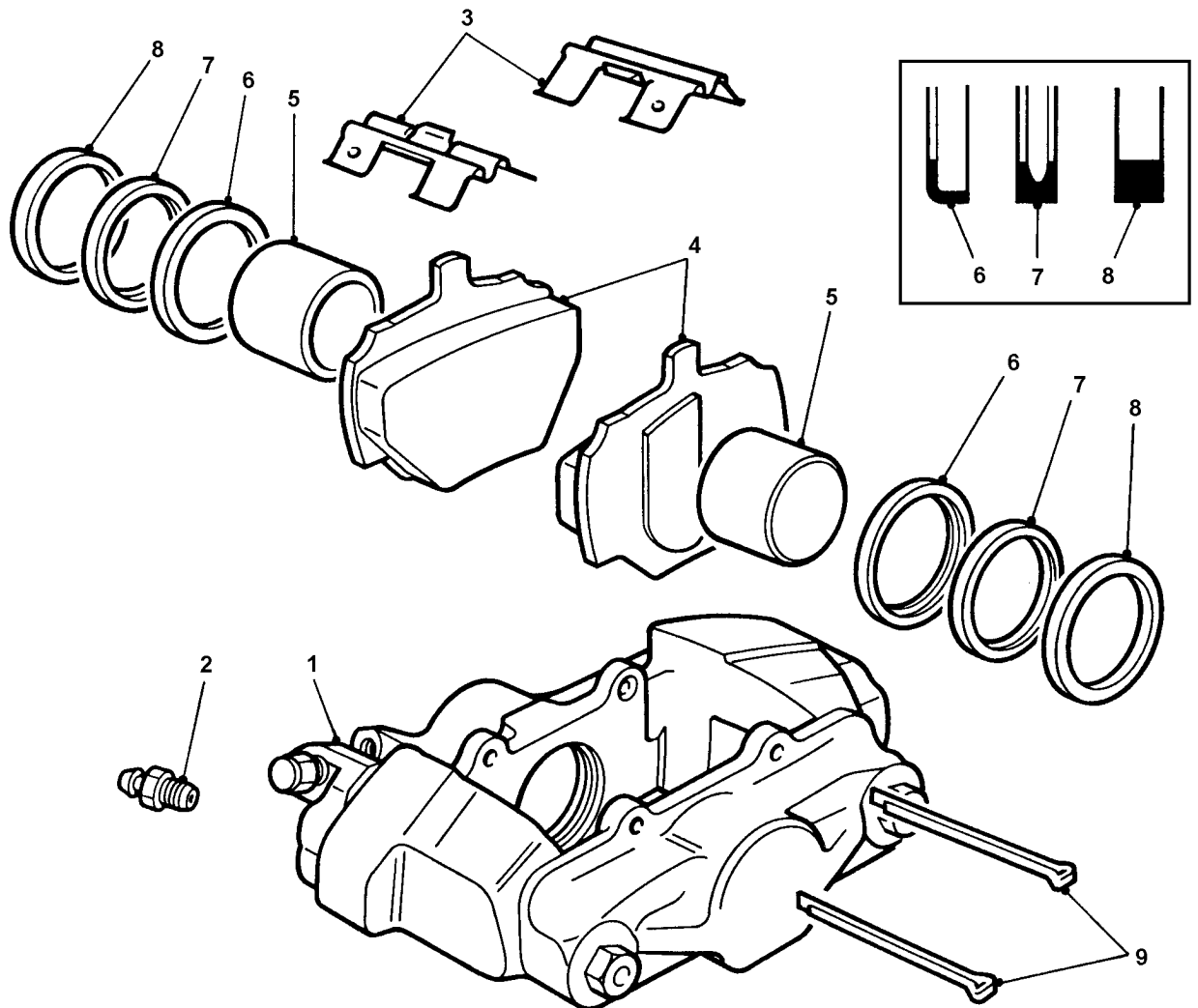
- | | | |
|---|----------------------|-----------------|
| 3 | 1 Split pin | 4 Retaining pin |
| | 2 Anti-rattle spring | 5 Calliper |
| | Brake pad | |

Fig 4 Removing the rear brake pads (TUM and Field Ambulance)



MIL0295

Fig 5 Rear brake calliper piston removal



MIL0294

- 1 Calliper
- 2 Bleed screw
- 3 Pad retaining springs
- 4 Brake pads
- 5 Piston

- 6 Wiper seal retainer
- 7 Wiper seal
- 8 Fluid seal
- 9 Retaining pins

5

Fig 6 Rear brake calliper (TUL)

13.3 Remove the piston (Fig 6 (5)).

13.4 Remove the wiper seal retainer (6) by inserting a blunt screw driver between the retainer and the seal and prise the retainer carefully from the mouth of the bore.

13.5 Extract the wiper seal (7) and the fluid seals (8) without damaging the seal grooves.

Cleaning

14 Thoroughly clean the bore, piston and particularly the seal grooves with clean brake fluid (refer to Table 2 Serial 1).

Examination

15 Examine the components thoroughly, if the calliper bore or piston are corroded or if their condition is not perfect a new calliper must be fitted.

Reassembly

16 Refit the outer piston and reassemble the calliper as follows:

16.1 Coat a new fluid seal (Fig 6 (8)) with brake fluid (refer to Table 2 Serial 1). Ease the seal into the bore using only the fingers and ensure that it is properly seated. The fluid seal and the groove are not the same in section that when the seal is seated it feels proud to touch at the edge furthest away from the mouth of the bore.

16.2 Smear the piston (5) with brake fluid (refer to Table 2 Serial 1) and insert it squarely into the bore by hand only. Do not tilt the piston during insertion and leave approximately 8 mm (0.315 in.) of the piston protruding from the bore.

16.3 Coat a new wiper seal (7) with brake fluid (refer to Table 2 Serial 1) and fit it to a new seal retainer (6). Slide the assembly, seal first, over the protruding piston and into the bore recess. Using the piston clamp special tool (refer to Table 1 Serial 1) press home the seal retainer and piston.

17 Dismantle, clean, examine and reassemble the piston in the inner side of the calliper (refer to Para 13 to 16).

REFITTING

18 Refit the calliper to the vehicle as follows:

18.1 Fit the calliper to the axle and secure with two new encapsulated Patch Loc bolts, tighten evenly to a torque of 100 Nm (74 lbf ft).

NOTE

In out of territory locations it may be necessary to refit the existing bolts using Loctite 243. In this event, documents to be annotated with 'exchange bolts for the correct Encapsulated patch loc bolts when possible'.

18.2 Connect the brake pipe to the calliper and tighten the pipe fixing to a torque of 12 Nm (9 lbf ft) and remove the clamp from the flexible brake hose.

18.3 Lightly smear the back and edges of the brake pads (4) with antiseize compound (refer to Table 2 Serial 4), carefully avoiding the friction material. Fit the pads and secure using new retaining pins (9), split pins (where applicable) and pad retaining springs (3).

18.4 Bleed the brake circuit (refer to Para 19).

18.5 When the refitting instructions have been completed on both callipers, depress the brake pedal firmly several times to locate the friction pads.

18.6 Fit the road wheels, jack-up the vehicle, remove the axle stands and finally tighten the wheel nuts to a torque of 170 Nm (125 lbf ft).

18.7 Check the fluid level in the reservoir and top-up as necessary.

18.8 Road test the vehicle, remembering that if new friction pads have been fitted, that they are not yet 'bedded-in' and may take several hundred miles before the brakes are at maximum efficiency.

BLEEDING THE BRAKES

Primed system

19 To bleed the brakes on a primed system carry out the following:

19.1 Attach a length of clear plastic or rubber hose to the bleed screw (Fig 6 (2)), first starting at the rear of the vehicle on the bleed screw furthest away from the master cylinder. Immerse the other end of the tube in a glass jar containing a quantity of clean new brake fluid.

19.2 Check that the fluid reservoir is full to the maximum mark and keep the reservoir topped up during the bleeding operations.

19.3 Unscrew the bleed screw approximately one half of a turn, enough to allow fluid to be pumped out. Opening the bleed screw too far will allow air to be drawn back into the system around the threads.

19.4 Depress the brake pedal fully, pause and then allow the pedal to fully return.

NOTE

Allow at least five seconds to elapse with the foot off the pedal to ensure that the pistons fully return before operating the pedal again.

19.5 Repeat para 19.4 until fluid free from air bubbles appears in the glass jar. Close the bleed screw immediately after the last down stroke, whilst the pedal is depressed.

19.6 Remove the bleed hose and replace the dust cap on the bleed screw.

19.7 Repeat Para 19.1 to 19.6 on the opposite rear brake calliper.

19.8 Bleed the front brakes commencing with the calliper furthest away from the master cylinder as detailed in Para 19.1 to 19.6.

Unprimed system

20 To bleed a replacement master cylinder or a fully drained system carry out the following:

20.1 Top up the fluid reservoir to the maximum mark.

20.2 Open a bleed screw in both circuits and allow fluid to prime both circuits of the master cylinder by gravity for a approximately five minutes, then bleed the system as for a primed system (refer to Para 19).

FRONT BRAKE DISCS

REMOVAL

21 To remove the front brake disc carry out the following:

21.1 Remove the front hub assembly (refer to Chap 5).

21.2 Remove the five brake disc to hub retaining bolts.

21.3 Using a mallet, tap the brake disc to separate from the hub.

EXAMINATION

22 Examine the disc for cracks, pitting and deep scoring. The disc may be reclaimed if scoring or pitting exists by machining an equal amount off each face as long as the overall vented-disc thickness is not reduced to less than 22 mm (0.86 in.). If the disc is cracked or the finished thickness is below the minimum stated a new disc must be fitted.

REFITTING

23 To refit the front brake disc proceed as follows:

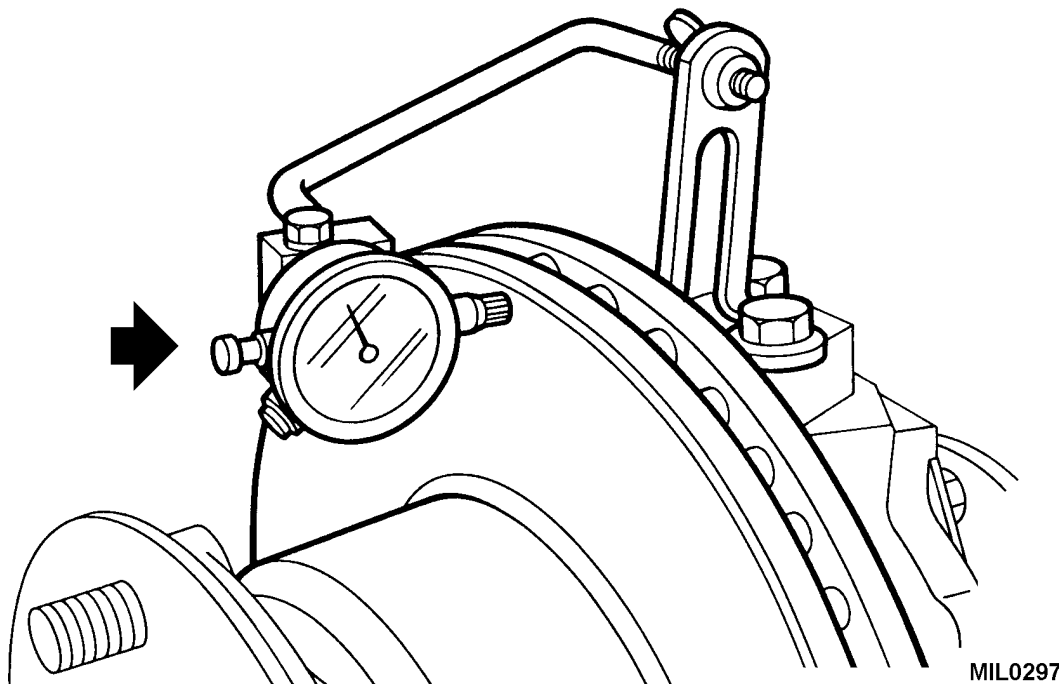
23.1 Ensure that the disc and hub mating faces are clean and free from burrs or any other irregularities that could cause the disc to run out excessively.

23.2 Assemble the disc to the hub with the five retaining bolts and tighten evenly to a torque of 73 Nm (54 lbf ft).

23.3 Fit the hub and disc assembly to the axle (refer to Chap 5).

23.4 Mount a dial test indicator on top of the swivel assembly (Fig 7) and rest the stylus of the dial indicator on the disc face near to the periphery. The maximum run out must not exceed 0.15 mm (0.006 in.). If necessary reposition the disc.

23.5 Continue with the front hub reassembly (refer to Chap 5).



MIL0297

Fig 7 Checking brake disc run out

REAR BRAKE DISCS

REMOVAL

- 24 To remove the rear brake disc carry out the following:
- 24.1 Remove the rear hub assembly (refer to Chap 6).
 - 24.2 Remove the five disc to hub retaining bolts.
 - 24.3 Using a mallet, tap the brake disc to separate from the hub.

EXAMINATION

25 Examine the brake disc for cracks, pitting or deep scoring. The disc may be reclaimed if pitting or scoring exists by machining equal amounts off each face so long as the final disc thickness is not less than 12 mm (0.47 in). If the disc is cracked or the finished thickness is less than the minimum thickness allowed a new disc must be fitted.

REFITTING

- 26 To fit the rear brake disc proceed as follows:
- 26.1 Ensure that the disc and hub mating faces are clean and free from burrs or any other irregularities that could cause the disc to run out excessively.
 - 26.2 Assemble the disc to the hub, secure with the five retaining bolts and evenly tighten to a torque of 73 Nm (54 lbf ft).
 - 26.3 Fit the hub and disc assembly to the axle (refer to Chap 6).
 - 26.4 Using a suitable bracket and dial test indicator mounted on the axle. Rest the stylus of the dial test indicator on the disc face near to the periphery and check the disc run out, this must not exceed 0.15 mm (0.006 in). If necessary reposition the disc.
 - 26.5 Continue with the rear hub assembly (refer to Chap 6).

MASTER CYLINDER

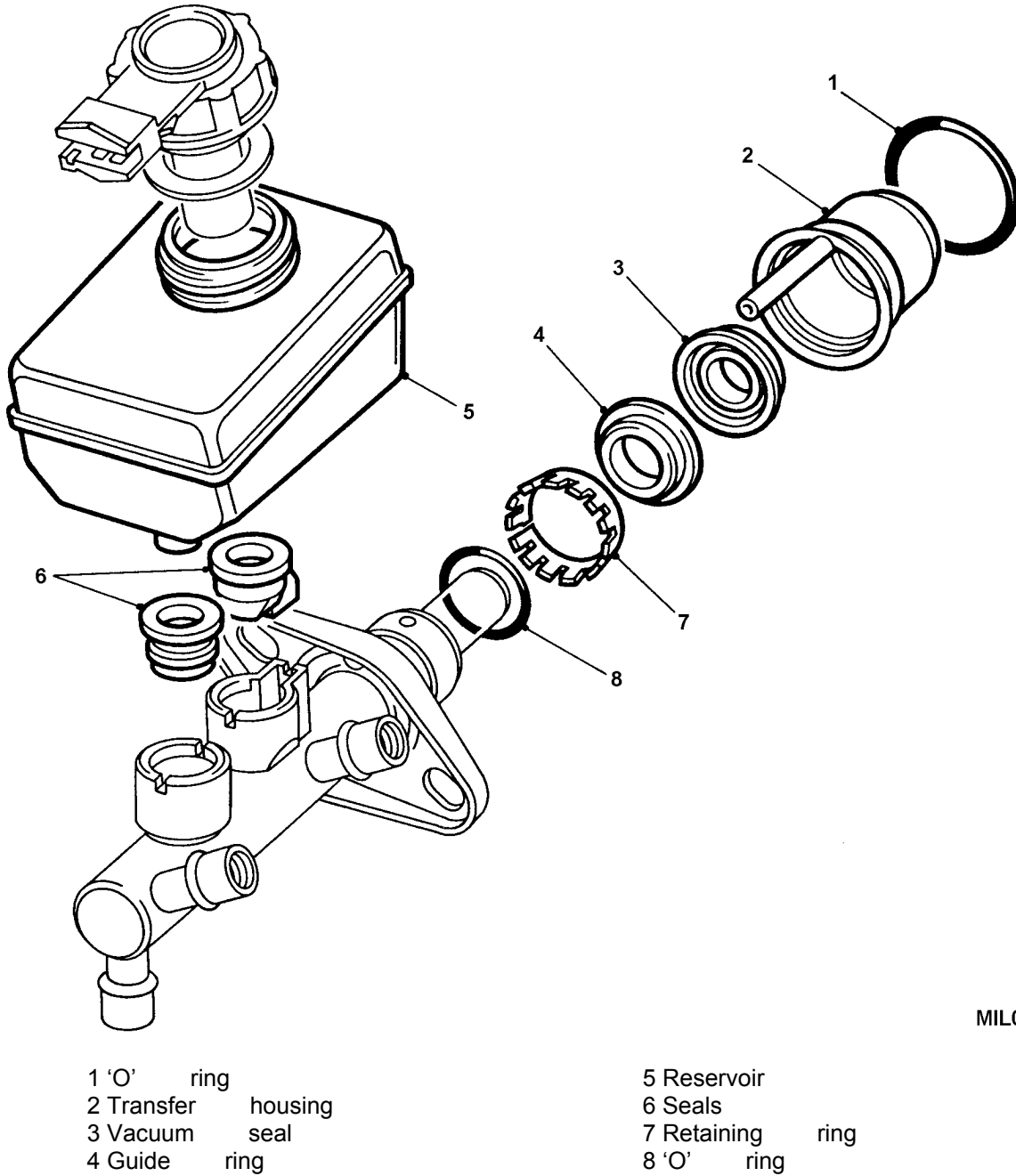
CAUTION

BRAKE FLUID. Brake fluid is corrosive, if any fluid comes into contact with the paintwork, immediately wash down with a large quantity of clean fresh water and wipe clean with a soft cloth.

REMOVAL

- 27 To remove the master cylinder from the brake system carry out the following:
- 27.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
 - 27.2 Place a suitable container under the master cylinder to catch any brake fluid which may seep from the cylinder when the brake pipes are disconnected from the outlet ports.
 - 27.3 Thoroughly clean the immediate area around the outlet ports. Remove each of the brake pipes from the master cylinder in turn, sealing each pipe and outlet port with suitable plugs to prevent dirt ingress and excessive loss of fluid.

- 27.4 Disconnect the electrical connector from the low fluid switch located on the reservoir cap.
- 27.5 Remove the nuts and washers securing the master cylinder to the servo unit.
- 27.6 Detach the master cylinder from the servo, remove the reservoir cap and drain the brake fluid reservoir into a suitable container.



MIL0298

Fig 8 Master cylinder arrangement

Dismantling

28 To dismantle the master cylinder proceed as follows:

WARNING

CLEANING BRAKE SYSTEM. USE ONLY CLEAR METHYLATED SPIRITS OR UNUSED BRAKE FLUID TO CLEAN ANY PART OF THE BRAKE SYSTEM. DO NOT USE PETROL, KEROSENE OR OTHER MINERAL BASED FLUIDS.

28.1 Before dismantling the master cylinder, ensure that it is thoroughly clean; inspect the outer surfaces for damage/condition, renew the complete assembly if necessary.

28.2 Carefully ease the reservoir (Fig 8 (5)) from the master cylinder by rolling it from the seals (6), taking care not to damage the two outlet ports on the bottom of the reservoir.

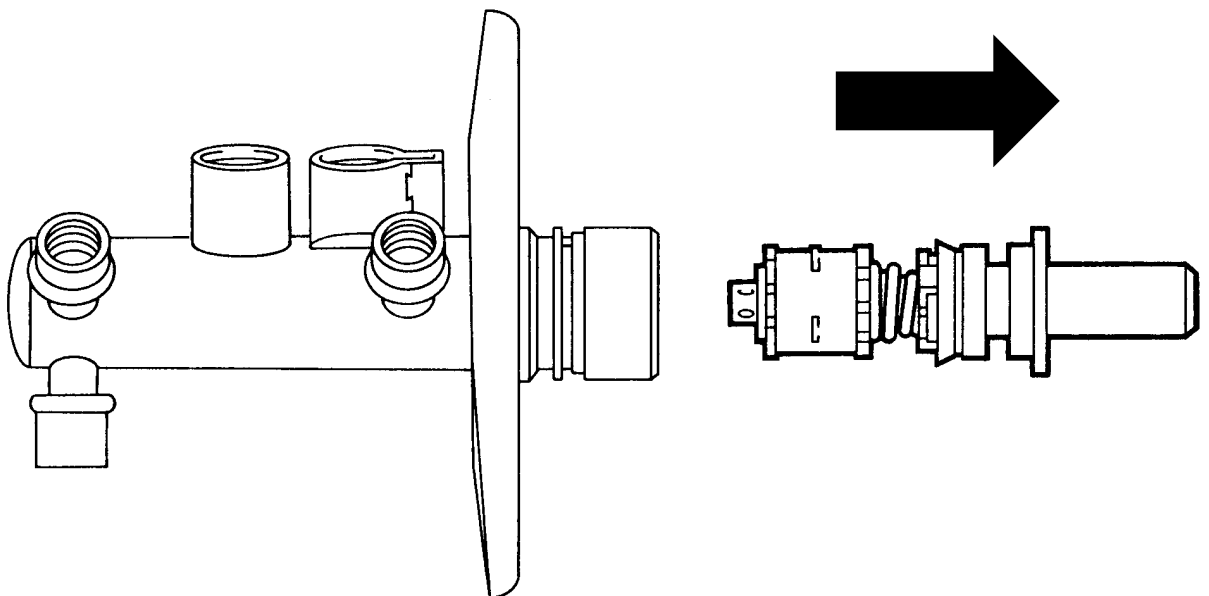
28.3 Using soft jaws, one either side of the master cylinder flange, clamp the flange in a suitable vice. Remove the water ingress 'O' ring (1) from the master cylinder to servo flange and discard.

28.4 Grip the outside of the transfer housing (2) with a suitable pair of pliers, carefully pull, while working the pliers in a backwards and forwards rocking motion to ease the housing off the master cylinder. Discard the housing and vacuum seal (3).

28.5 Withdraw the two reservoir seals from the master cylinder inlet ports, the seals are different and this should be noted for assembly, discard both of the seals.

28.6 Remove the retaining ring (7) and 'O' ring (8) from the machined outer surface of the master cylinder. Discard both the seal and retaining ring.

28.7 Remove the guide ring (4) from the mouth of the master cylinder which supports the primary plunger assembly and place to one side, this component is not part of the master cylinder service kit and is to be refitted on assembly of the unit.



MIL0299

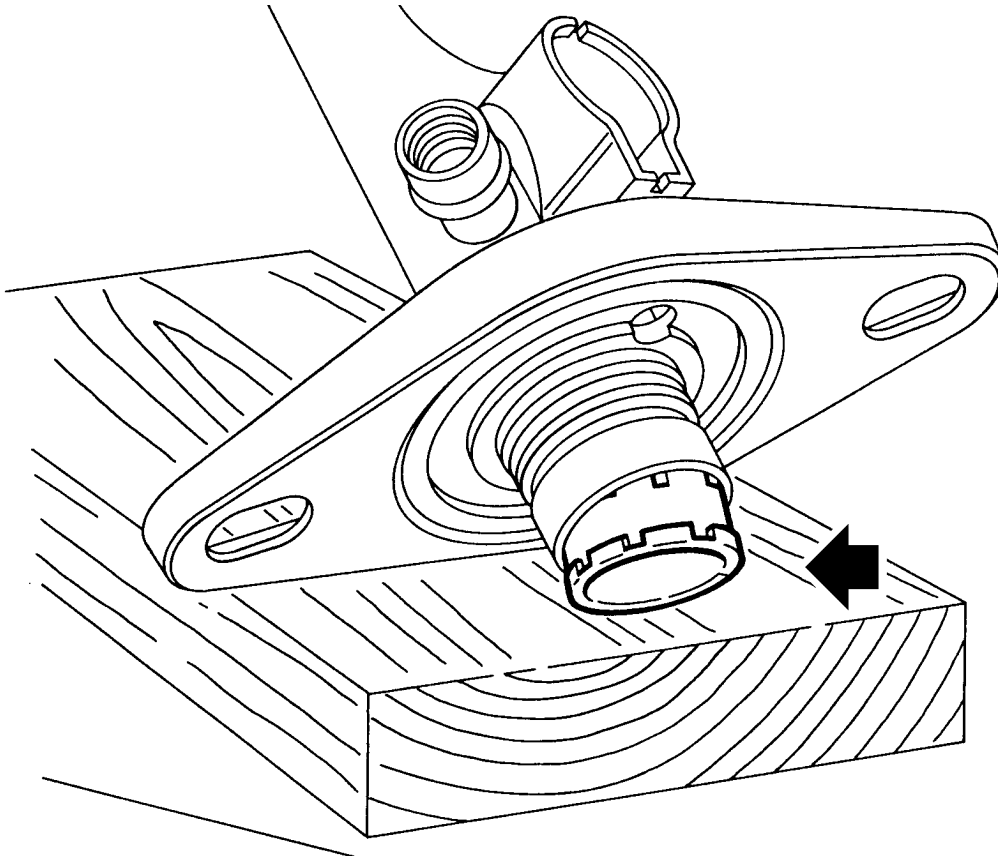
Fig 9 Primary plunger assembly

28.8 Pull the primary plunger assembly (refer to Fig 9) out of the master cylinder.

NOTE

The primary plunger assembly cannot be broken down any further and is serviced as a complete unit. Discard the assembly.

28.9 The secondary plunger assembly will remain at the bottom of the master cylinder bore, the plunger can be easily expelled by tapping the assembly on a piece of wood until the plunger appears at the cylinder mouth, carefully pull the plunger out of the master cylinder.



MIL0300

Fig 10 Swirl tube

28.10 If the swirl tube was not expelled at the same time as the secondary plunger, repeat the previous operation to expel it from the bottom of the master cylinder bore (Fig 10) and discard.

28.11 Clean all parts with new brake fluid (refer to Table 2 Serial 1) and place the cleaned parts on to a clean surface. Inspect the cylinder bore and plungers for signs of corrosion, ridges and score marks. Providing the working surfaces are in perfect condition, new seals from a repair kit may be used.

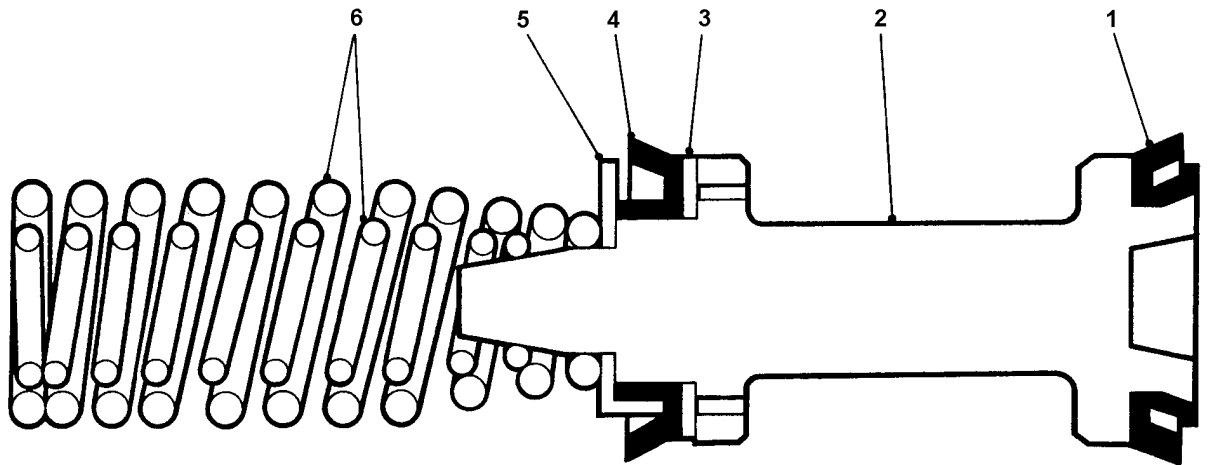
Renewing secondary plunger seals

NOTES

- (1) A small screwdriver with the end rounded off and polished is required to remove the 'L' seal. DO NOT damage the secondary plunger.
- (2) Thoroughly check that no debris of any description is lodged in any of the fluid passage ways and drillings. If debris is found, carefully remove, reclean the cylinder and re-check.

29 To renew the secondary plunger seals proceed as follows:

29.1 Remove and discard the seals from the secondary plunger.



MIL0303

1 'L' seal
2 Plunger
3 Washer

4 Recuperating seal
5 Seal retainer
6 Springs

Fig 11 Secondary plunger assembly

29.2 Coat the new seals in unused brake fluid and first fit the 'L' seal (Fig 11 (1)) to the plunger (2).

29.3 Fit the washer (3) followed by the recuperating seal (4). Fit the seal retainer (5) and springs (6). Ensure the springs are correctly seated.

Reassembly

WARNING

USED BRAKE FLUID. DO NOT USE BRAKE FLUID PREVIOUSLY DRAINED OR BLED FROM THE SYSTEM.

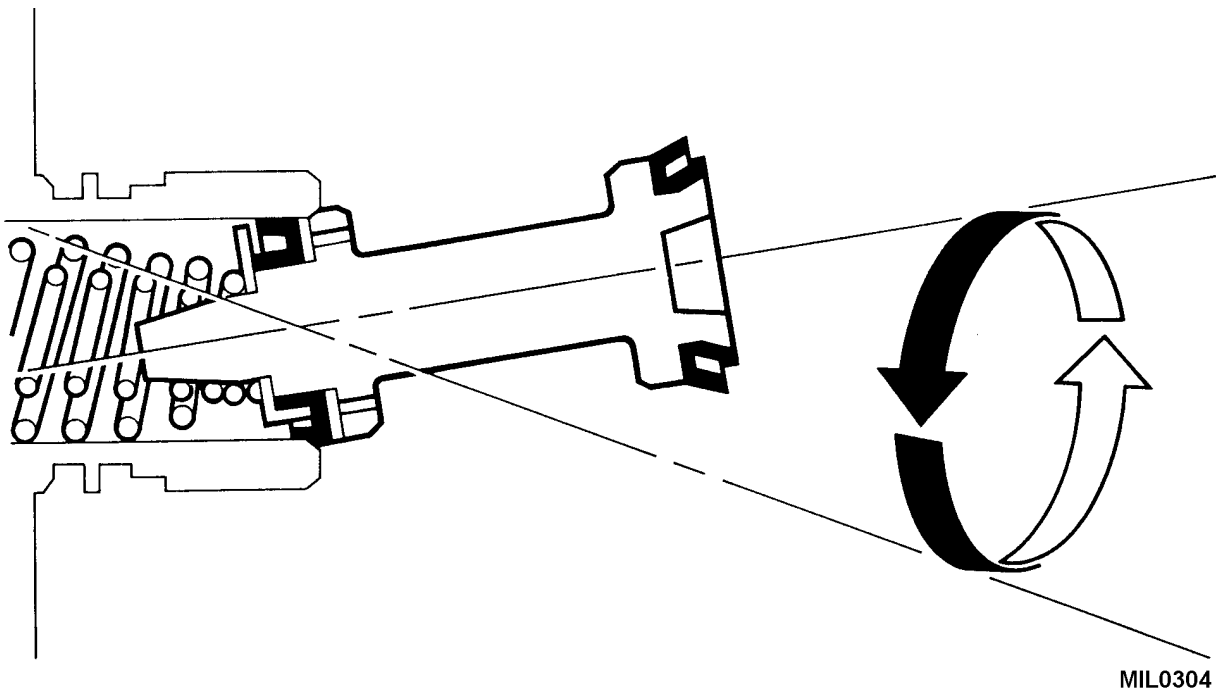
CAUTION

NEW SEALS. It is important that the following instructions are carried out precisely, otherwise damage could be caused to the new seals when inserting the plungers into the cylinder bore. Generous amounts of new brake fluid should be used to lubricate the parts during assembly.

30 To reassemble the master cylinder proceed as follows:

30.1 Fit the new swirl tube to the bottom of the cylinder bore.

30.2 Lubricate the secondary plunger (Fig 11 (2)) and cylinder bore. Offer the plunger assembly to the cylinder until the recuperation seal (4) is resting centrally in the mouth of the bore. Gently introduce the plunger with a circular rocking motion (refer to Fig 12). Ensuring that the seal does not become trapped, ease the seal into the bore and slowly push the plunger down the bore in one continuous movement.



MIL0304

Fig 12 Secondary plunger fitting

- 30.3 Fit the primary plunger assembly using the same method as for the secondary plunger. Push the plunger down the bore.
- 30.4 Fit the original guide ring to support the primary plunger.
- 30.5 Coat a new 'O' ring with brake fluid (refer to Table 2 Serial 1) and fit to its respective groove on the outer location surface of the master cylinder.

NOTE

The 'O' ring should be rolled down the outer location surface of the master cylinder but should be slightly stretched and eased down the cylinder and into its groove. DO NOT over stretch the seal.

- 30.6 Fit a new retaining ring on the outer surface of the master cylinder ensuring that the serrations on the outer surface of the ring are facing the mounting flange.
- 30.7 Fit the two new reservoir seals in their respective ports.
- 30.8 Fit a new vacuum seal to either the primary plunger or to the bottom of the transfer housing bore, open face of the seal towards the primary plunger guide ring.
- 30.9 Lubricate the vacuum seal with brake fluid (refer to Table 2 Serial 1). Fit the transfer housing to the master cylinder and push the housing fully up to the cylinder mounting flange.

NOTE

Do not adjust the transfer housing after fitting.

- 30.10 Lubricate a new water ingress seal with new brake fluid (refer to Table 2 Serial 1), slightly stretch the seal and ease it down the housing until the seal is in the correct position between the housing and flange.

30.11 Roll the reservoir into the top of the master cylinder, reversing the procedure described (refer to Para 28.2).

REFITTING

WARNING

BRAKE FLUID. DO NOT USE BRAKE FLUID PREVIOUSLY DRAINED OR BLED FROM THE SYSTEM.

31 To refit the master cylinder to the servo proceed as follows:

31.1 Fit the master cylinder to the servo, fit the plain washers and secure in position with the two retaining nuts. Tighten to a torque of 14 Nm (10 lbf ft).

31.2 Fit the brake pipes to the master cylinder ports and tighten to a torque of 13 Nm (10 lbf ft).

31.3 Top-up the reservoir with the correct grade of brake fluid (refer to Table 2 Serial 1), taken from a sealed container and bleed the brake system (refer to Para 19).

31.4 Fit the reservoir cap with combined low level fluid switch and reconnect the electrical lead.

31.5 Connect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

SERVO ASSEMBLY

REMOVAL

32 To remove the servo assembly carry out the following:

32.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

32.2 Remove the master cylinder from the servo unit (refer to Para 27).

32.3 Disconnect the vacuum hose from the servo unit.

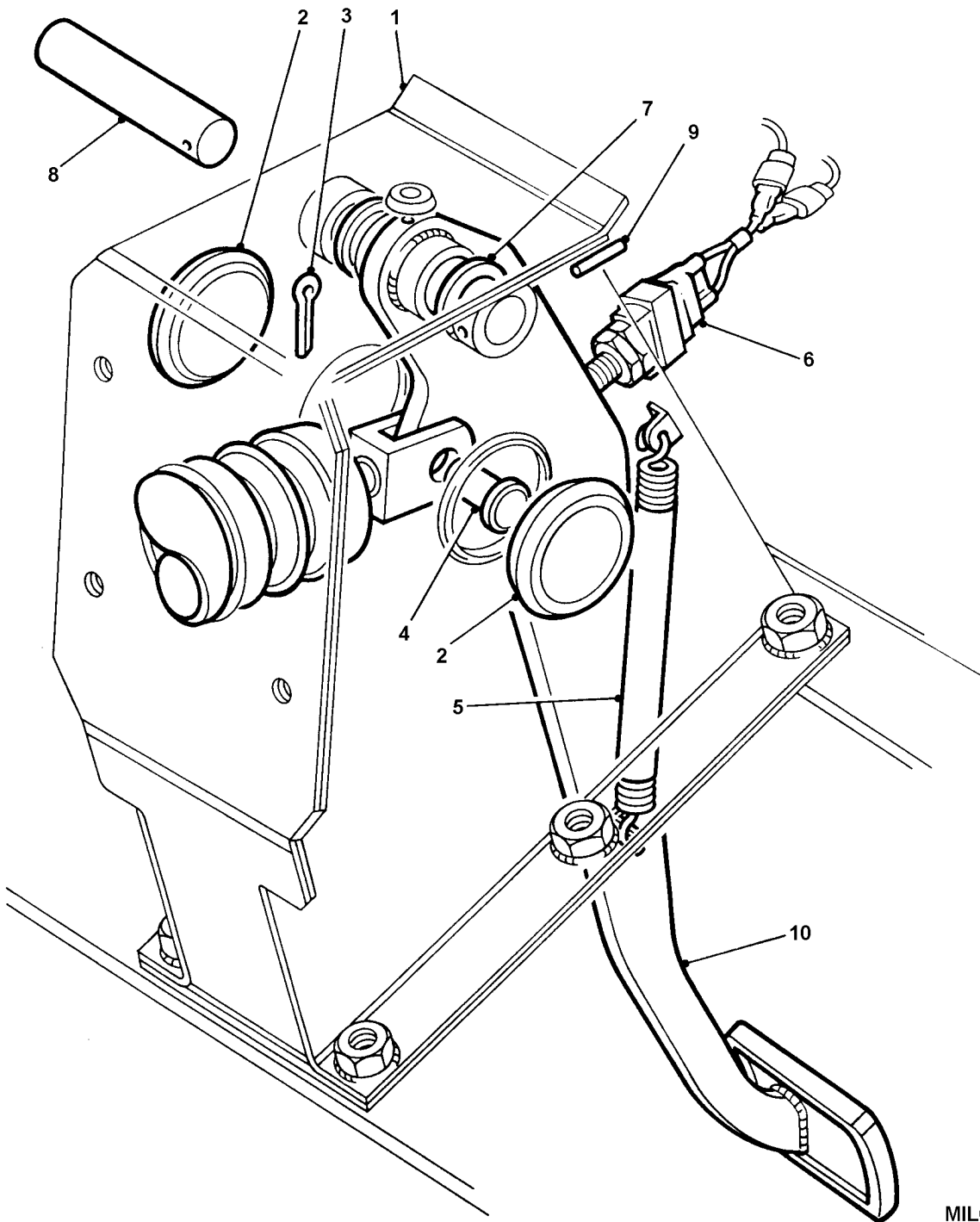
32.4 From inside the vehicle, release the two brake pedal return springs (Fig 13 (5)).

32.5 Disconnect the electrical connectors from the brake light switch (6) at the rear of the pedal box (1).

32.6 Remove the blanking grommets (2) from each side of the pedal box.

32.7 Remove the split pin (3) and clevis pin (4) securing the servo push rod to the brake pedal.

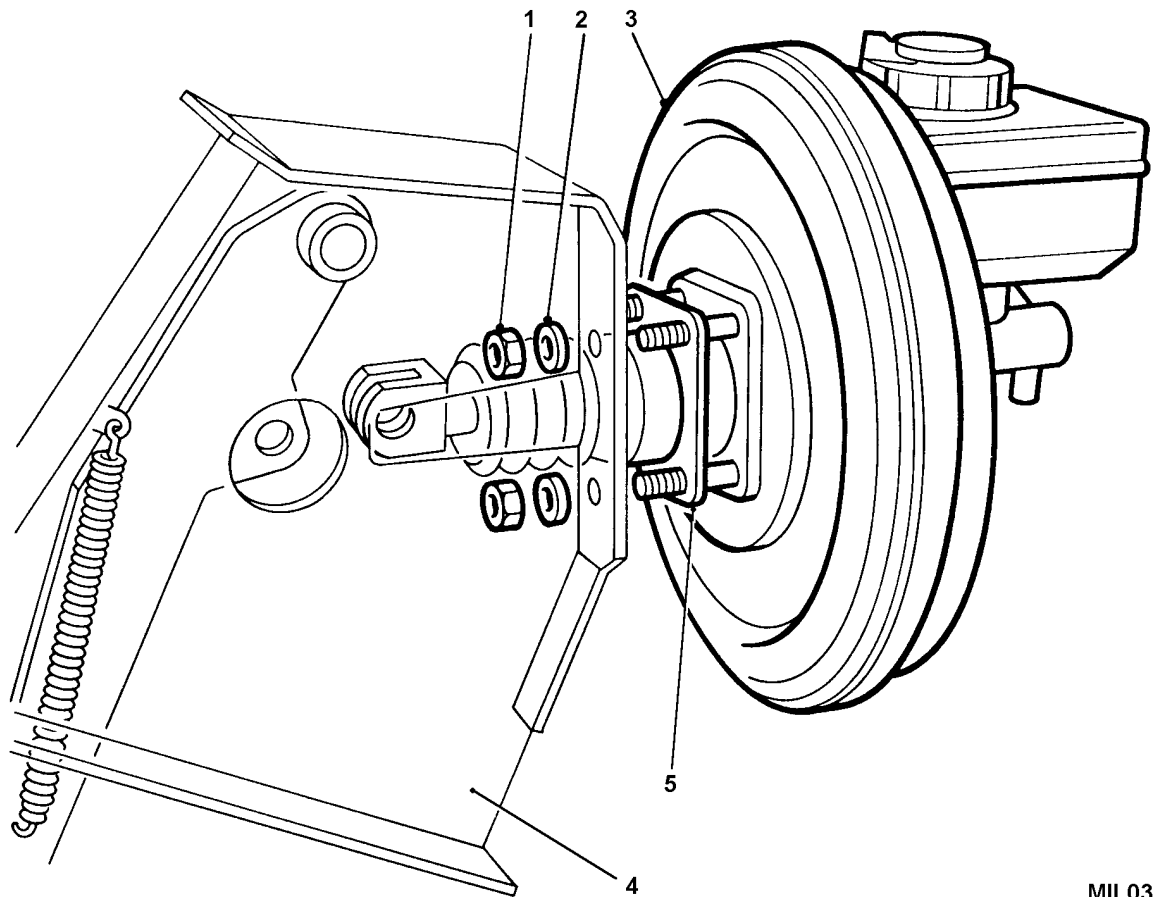
32.8 Remove the four nuts (Fig 14 (1)) and washers (2) retaining the servo (3) to the pedal box (4) and remove servo and rubber washer (5) from the vehicle.



MIL0307

- | | |
|---------------------|----------------------|
| 1 Pedal box | 6 Brake light switch |
| 2 Blanking grommets | 7 Pivot bush |
| 3 Split pin | 8 Pivot shaft |
| 4 Clevis pin | 9 Securing pin |
| 5 Return spring | 10 Brake pedal |

Fig 13 Brake pedal removal



MIL0305

- | | | | |
|---|----------|----------|--------|
| 3 | 1 Nut | 4 Pedal | box |
| | 2 Washer | 5 Rubber | washer |
| | Servo | | |

Fig 14 Servo unit to pedal connections

REFITTING

33 To refit the brake servo proceed as follows:

- 33.1 Fit the servo and rubber washer to the pedal box and secure with the four washers and nuts, tighten evenly to a torque of 14 Nm (10 lbf ft).
- 33.2 Connect the brake pedal to the servo with the clevis pin and a new split pin.
- 33.3 Fit the blanking grommets, each side of the pedal box and from inside the vehicle attach the pedal return springs.
- 33.4 Connect the vacuum hose to the servo non-return valve. Ensure that the hose is in good condition.
- 33.5 Fit the master cylinder to the servo (refer to Para 31).
- 33.6 Connect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

Non-return valve renewal

34 To renew the servo non-return valve proceed as follows:

34.1 Disconnect the brake vacuum hose (Fig 15 (3)) from the servo non-return valve (1).

34.2 Remove the non-return valve (1) from the servo.

NOTE

The valve is a push fit in the servo and to remove it, carefully prise the valve out with a screwdriver blade between the valve and grommet. Take care not to exert too much pressure on the vacuum chamber.

34.3 Remove the rubber grommet (2) taking care not to allow it to fall into the vacuum chamber.

34.4 Check the valve for correct operation; it should not be possible to pass air through into the servo in the direction of the arrows. Do not use compressed air. If the operation of the valve is not satisfactory a new valve must be fitted.

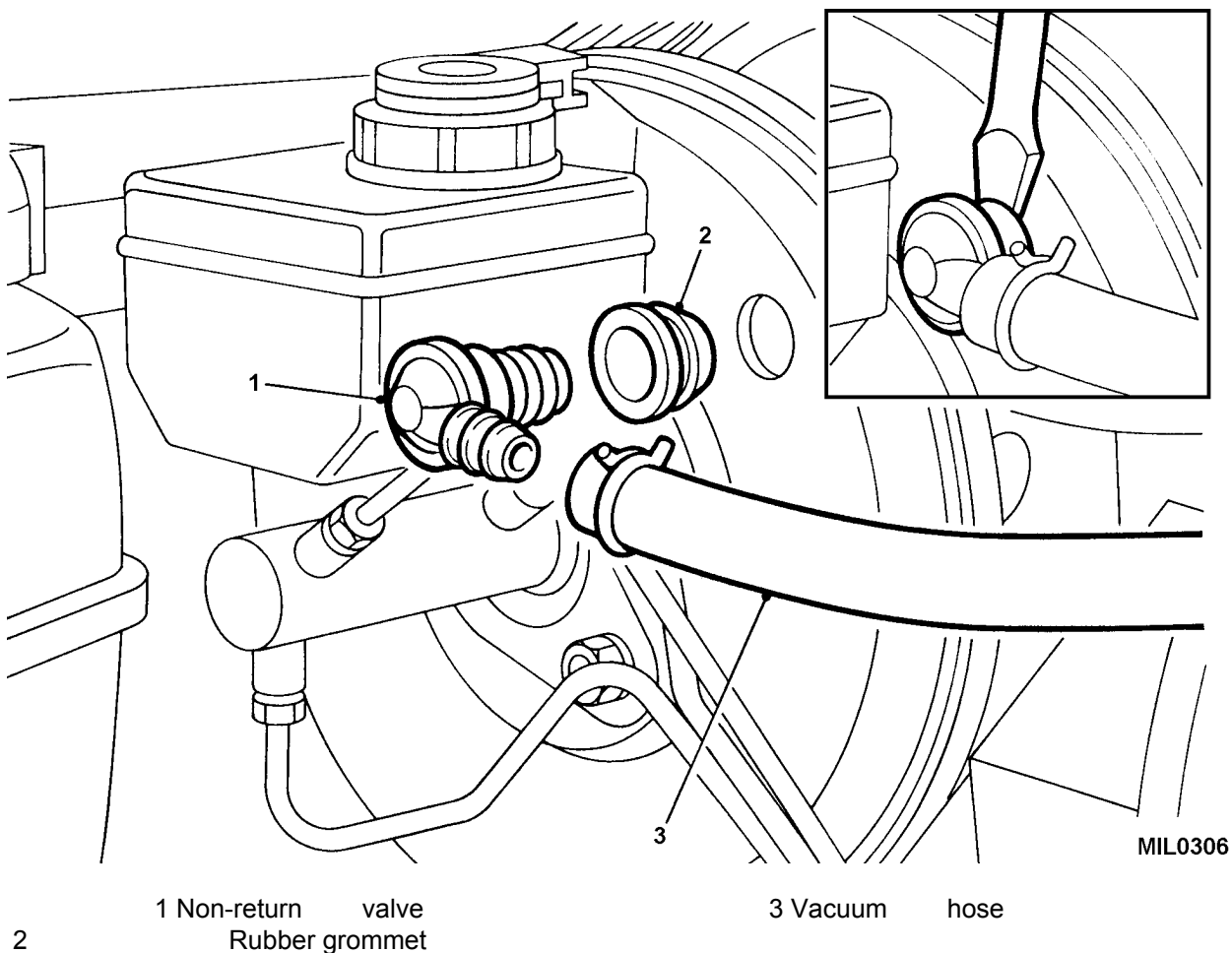


Fig 15 Servo non-return valve replacement

34.5 Fit a new rubber grommet (Fig 15 (2)) to the servo vacuum chamber.

34.6 Smear the ribs of the non-return valve (1) with grease (refer to Table 2 Serial 2) to assist assembly, and push the valve fully home.

- 34.7 Reconnect the vacuum hose (3) to the valve.

BRAKE PEDAL BOX

REMOVAL

- 35 To remove the brake pedal box proceed as follows:

35.1 Remove the servo assembly (refer to Para 32).

35.2 Remove the six bolts securing the pedal box to the bulkhead.

35.3 Taking care not to damage the brake fluid pipes remove the pedal box from the bulkhead complete with the brake pedal assembly and gasket.

Dismantling

- 36 To dismantle the pedal box assembly carry out the following:

36.1 Detach the ends of the return springs (Fig 13 (5)) from the bosses in the pedal box (1) and remove the springs

36.2 Using a suitable punch, drift out the securing pin (9) and withdraw the pedal pivot shaft (8).

36.3 Withdraw the brake pedal (10) complete with pivot bushes (7).

Examination

- 37 Examine the components for damage and wear, renew as necessary.

Repair and replacement

- 38 If it is necessary to fit new pivot bushes to the pedal, after fitment they must be reamed to 15.87 mm with a tolerance of + 0.020 mm (0.62 in +0.0024 in.).

REASSEMBLY

- 39 To reassemble the brake pedal box proceed as follows:

39.1 Lubricate the pivot shaft and bushes with a general purpose grease (refer to Table 2 Serial 2).

39.2 Fit the pedal to the pedal box, insert the pivot shaft and secure with a new split pin.

39.3 Attach the return springs to the bosses in the pedal box.

39.4 Refit the assembled pedal box to the bulkhead and secure with six retaining bolts.

39.5 Refit the brake servo (refer to Para 33).

39.6 Refit the brake master cylinder (refer to Para 31).

TRANSMISSION BRAKE**DISMANTLING**

40 To dismantle the transmission brake carry out the following:

40.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2) , chock the road wheels for safety and release the handbrake.

40.2 Disconnect the propeller shaft from the output flange (refer to Chap 4).

40.3 Remove the retaining screw (Fig 16 (9)) securing the brake drum (8) to the flange and withdraw the drum to expose the brake assembly.

40.4 Slacken off the park brake drum adjusting screw.

40.5 Detach and remove, pull-off springs (13) and (23) from the brake shoes (4) and (18).

40.6 Remove each hold down spring (6) and (17) as follows:

40.6.1 Grip dished washer (7) or (16) with a pair of pliers.

40.6.2 Depress the washer and turn it through 90°.

40.6.3 Remove the washer together with spring and hold down pin (19) or (20).

40.7 Move the brake shoes out of adjuster slides (11) and (14) and away from the back plate (22). Separate the shoes from the abutment plate (21). Remove the adjuster slides from the backplate.

40.8 Release the cable (10) from the cable lever (5).

40.9 Remove the 'C' clip (3) securing the cable lever (5) to the shoe, the flat washer, two bevelled washers (2) and pivot pin (1) and separate the cable lever from the brake shoe.

40.10 Release cable (10) from backplate (22) and remove the adjuster bolt (15) and nut (12) from the backplate.

40.11 Remove the four securing bolts and detach the backplate (22) from the transfer box.

Examination

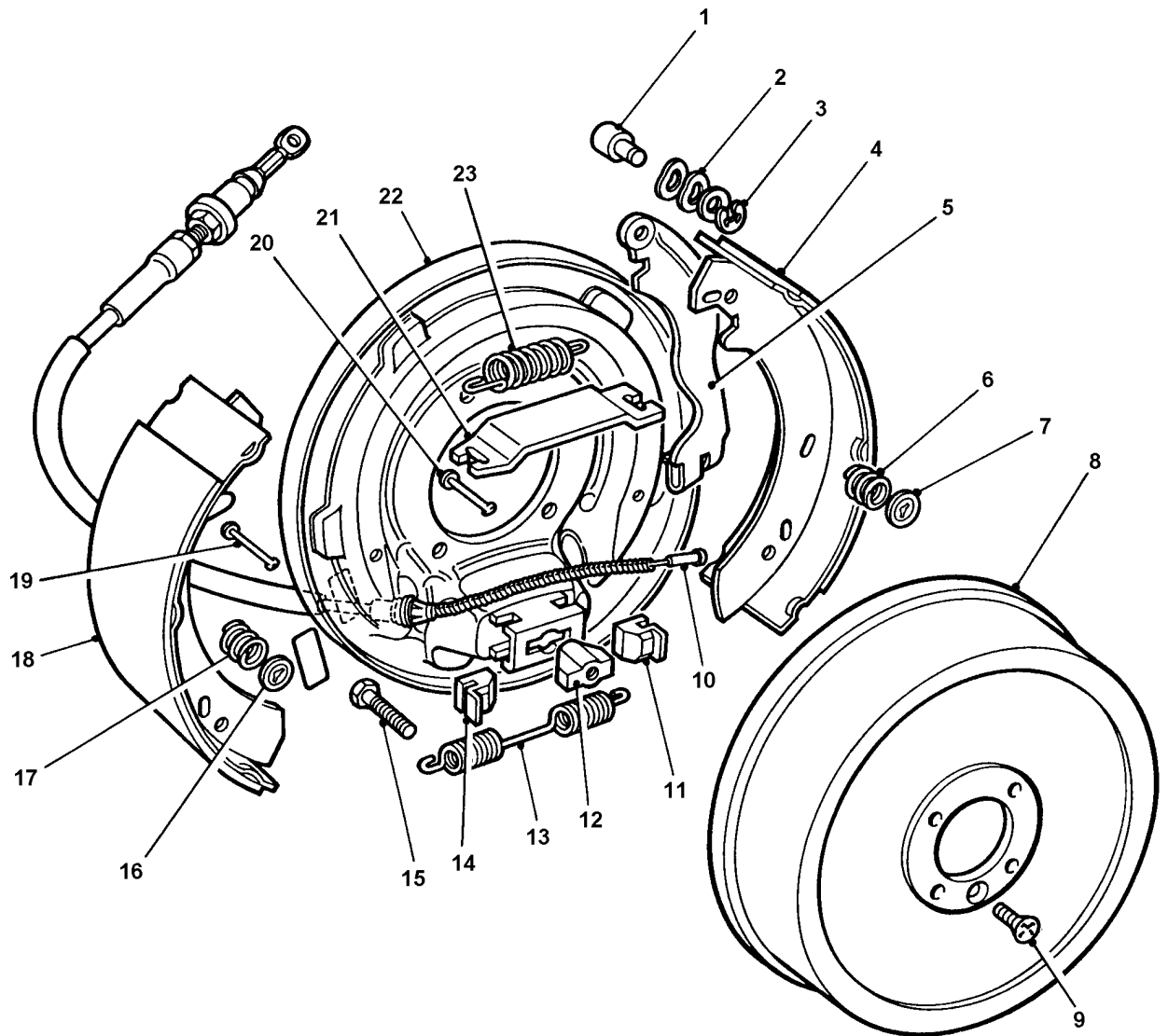
41 Examine the transmission brake components as follows:

41.1 Examine the brake drum for internal scoring and ovality. Renew if necessary.

41.2 Check that springs are satisfactory for continued use. If new brake shoes are being fitted the springs should also be renewed.

41.3 Check that the brake shoes have sufficient lining material for continued use and that they are free from contamination.

41.4 If the brake linings are oil contaminated check and, if necessary, renew the output shaft oil seal.



MIL0289

- | | | | |
|----|------------------|----|------------------|
| 1 | Pivot pin | 13 | Pull-off spring |
| 2 | Washer | 14 | Adjuster slide |
| 3 | 'C' clip | 15 | Adjuster bolt |
| 4 | Brake shoe | 16 | Dished washer |
| 5 | Cable lever | 17 | Hold down spring |
| 6 | Hold down spring | 18 | Brake shoe |
| 7 | Dished washer | 19 | Hold down pin |
| 8 | Brake drum | 20 | Hold down pin |
| 9 | Retaining screw | 21 | Abutment plate |
| 10 | Brake cable | 22 | Backplate |
| 11 | Adjuster slide | 23 | Pull-off spring |
| 12 | Adjuster nut | | |

Fig 16 Transmission brake assembly

REASSEMBLY

42 To reassemble the transmission brake carry out the following:

- 42.1 Loosely assemble the adjuster bolt (15) and adjuster nut (12) to the backplate (22).
- 42.2 Position the backplate (22) on the transfer box and secure with the four retaining bolts, tighten evenly to a torque of 72 Nm (53 lbf ft).
- 42.3 Fit brake cable (10) to backplate, ensuring that its correctly seated.
- 42.4 Assemble hand brake cable lever (5) to the brake shoe (4) using pivot pin (1) washers (2) and 'C' clip (3).
- 42.5 Fit adjuster slides (11) and (14) to backplate.
- 42.6 Locate brake shoe (4) in slide (11) and connect cable to hand brake lever. Secure brake shoe and lever assembly to backplate using hold down pin (20), hold down spring (6) and dished washer (7).
- 42.7 Locate brake shoe (18) in slide (14).
- 42.8 Fit abutment plate (21) between brake shoes and secure brakeshoe (18) to backplate using hold down pin (19), spring (17) and dished washer (16).
- 42.9 Fit the pull-off springs (13) and (23) to the brake shoes.
- 42.10 Refit the brake drum (8) and secure with screw (9), tighten to a torque of 25 Nm (18 lbf ft).
- 42.11 Adjust the brake shoes as follows:
 - 42.11.1 Check that the transmission brake lever in the cab is released.
 - 42.11.2 Screw in and tighten the adjuster bolt (15) until the brake drum will not rotate by hand.
 - 42.11.3 Further tighten the adjuster bolt using a torque wrench set at 25 Nm (18 lbf ft), to ensure the brake drum is locked.
 - 42.11.4 Slacken off the adjusting bolt by one and a half turns to give the shoes running clearance. Check that the drum is free to rotate.
- 42.12 Adjust the hand brake cable (Fig 17 (2)) to give the pawl two notches free movement on the ratchet before being fully operational on the third notch (brake shoes are fully expanded against the drum).

NOTE

Cable adjustment is for new cable or to compensate for cable stretch. Cable adjustment must not be used to take up brake shoe wear.

- 42.13 Connect the propeller shaft and evenly tighten the retaining nuts to a torque of 46 Nm (34 lbf ft) (refer to Chap 4).
- 42.14 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2) and remove the chocks from the road wheels.

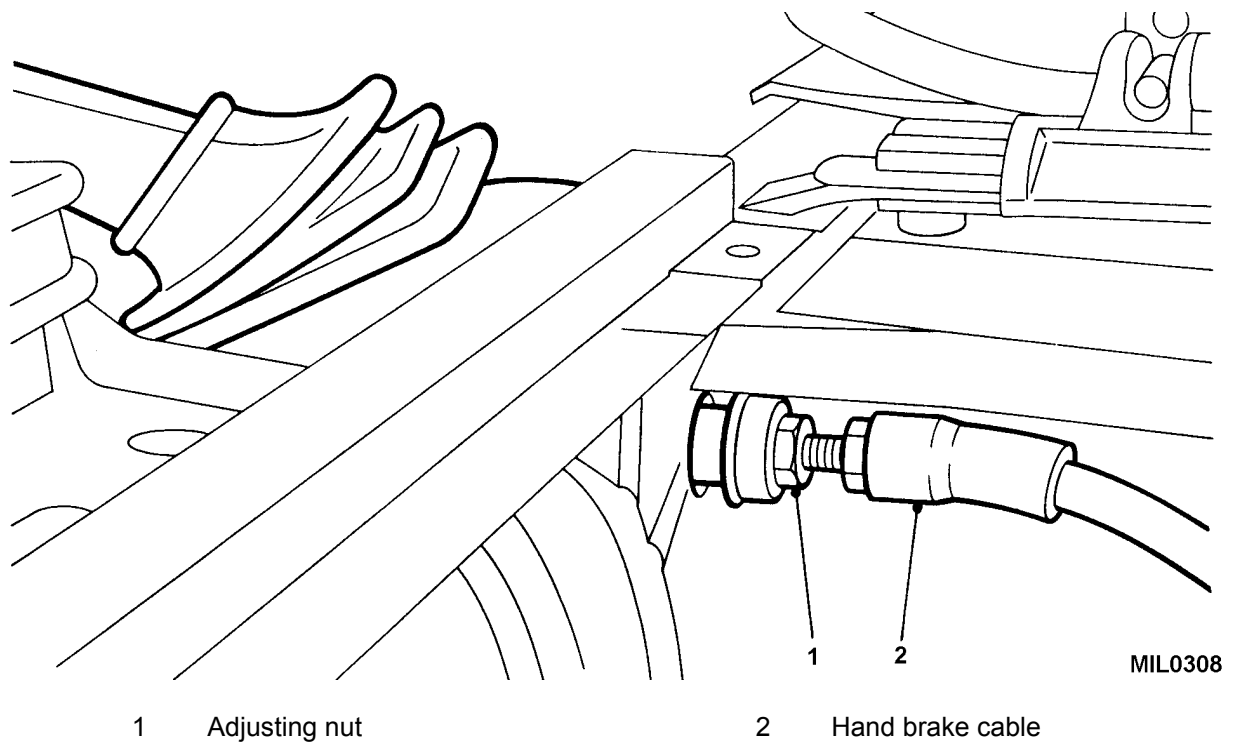


Fig 17 Brake cable adjustment

HAND BRAKE LEVER

REMOVAL

43 To remove the hand brake lever proceed as follows:

43.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2). Chock the road wheels for safety and release the hand brake.

43.2 From inside the vehicle remove the three hand brake gaiter trim buttons and pull the gaiter (Fig 18 (2)) back over the handbrake lever (1).

43.3 Remove the split pin (6) and washer (5), withdraw the clevis pin (4) securing the handbrake cable (3) to the lever.

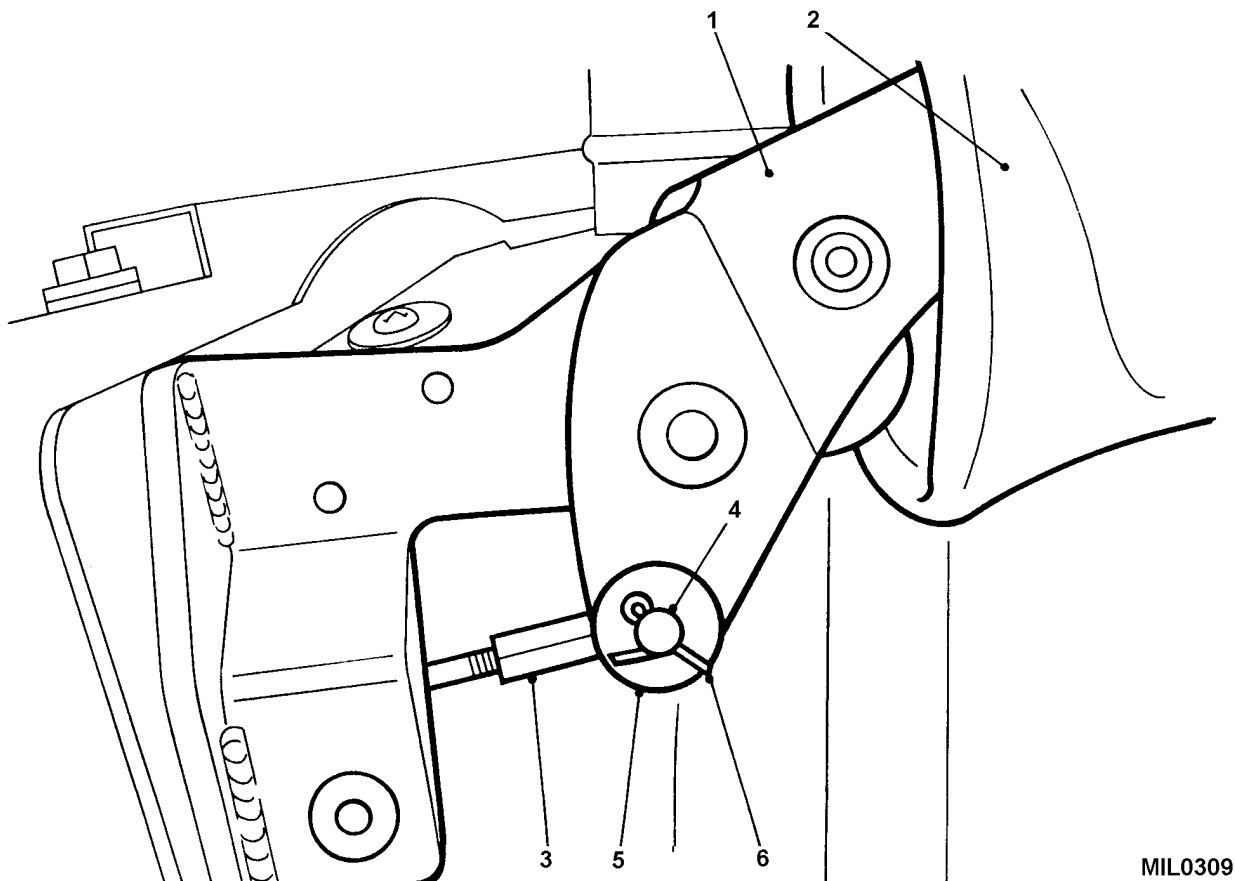
43.4 Remove the kit retention bar, matting and centre panel from between the seats, to gain access to the rear of the hand brake mounting.

43.5 Pull the cable from the hand brake lever mounting plate to release it, and withdraw the cable from the hand brake lever assembly.

43.6 Remove the two retaining nuts, bolts, spring and plain washers and withdraw the hand brake lever assembly.

REFITTING

44 To refit the handbrake lever assembly, reverse the removal procedure using a new split pin to secure the clevis pin.



MIL0309

- | | | | |
|---|------------------|---|------------|
| 1 | Hand brake lever | 4 | Clevis pin |
| 2 | Gaiter | 5 | Washer |
| 3 | Hand brake cable | 6 | Split pin |

Fig 18 Hand brake lever assembly

BRAKE VACUUM PUMP**REMOVAL**

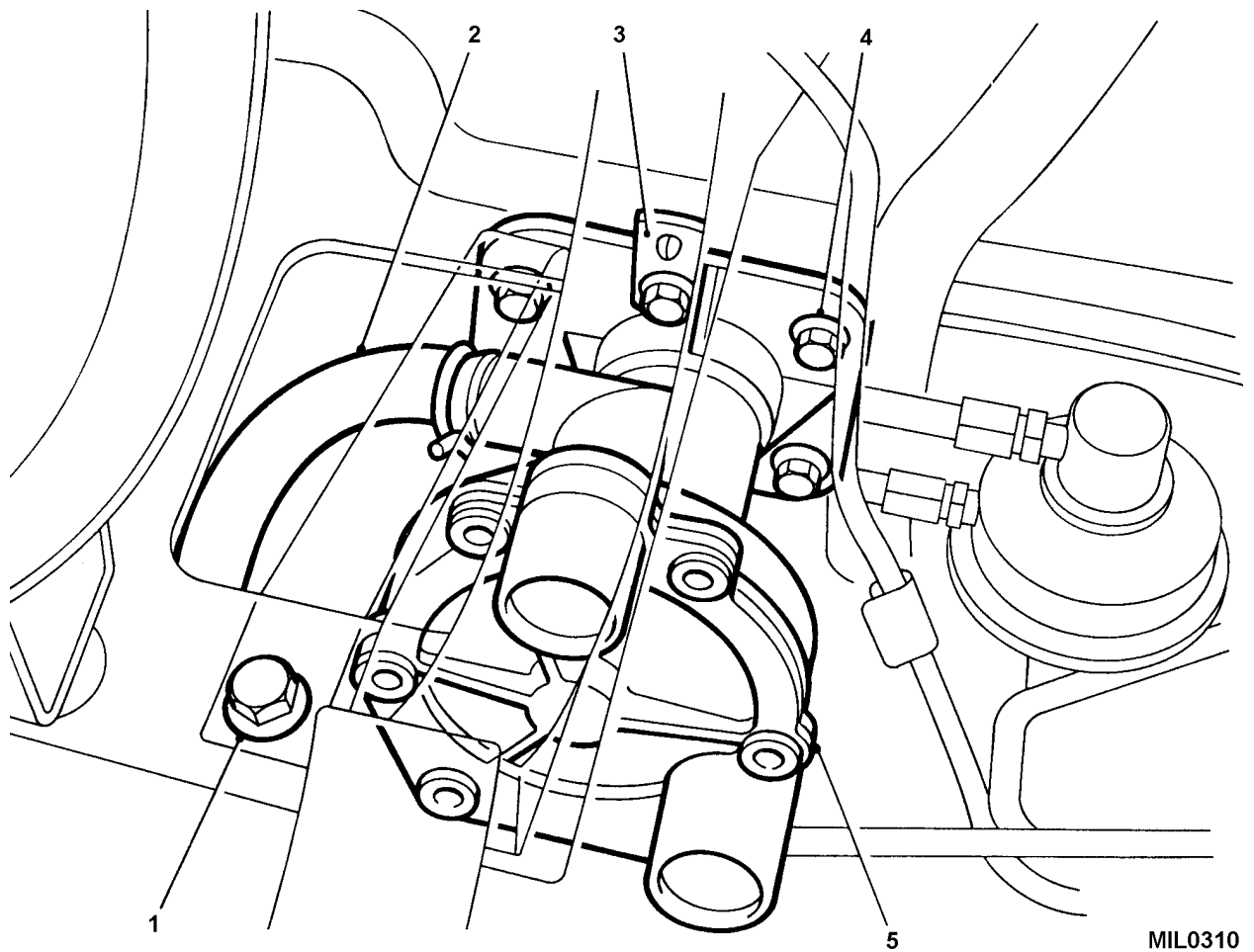
45 To remove the brake vacuum pump proceed as follows:

- 45.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 45.2 Remove the air cleaner assembly (refer to Chap 11-1).
- 45.3 Remove bolt (Fig 19 (1)) securing air cleaner support bracket strut.

NOTE

To ease vacuum pump removal set the engine to T.D.C. on No.1 cylinder.

- 45.4 Detach the vacuum hose (2) from the vacuum pump.
- 45.5 Remove the six bolts (4) securing vacuum pump to engine cylinder block. Detach the pump complete with strut and electrical harness bracket noting their location.
- 45.6 Remove and discard the gasket.



MIL0310

- | | | | |
|---|----------------------|---|----------------|
| 1 | Strut retaining bolt | 4 | Retaining bolt |
| 2 | Vacuum hose | 5 | Vacuum pump |
| 3 | Harness bracket | | |

Fig 19 Brake vacuum pump removal

REFITTING

46 To refit the brake vacuum pump proceed as follows:

46.1 Clean the mating faces of the vacuum pump and cylinder block.

46.2 Loosely assemble the pump to the block with a new gasket and with the air cleaner strut and harness bracket correctly located under their respective bolt heads.

46.3 Evenly tighten the retaining bolts to depress the pump plunger, finally tighten to a torque of 25 Nm (18 lbf ft).

46.4 Secure the strut to the air cleaner bracket.

46.5 Reconnect the vacuum hose and secure with clip.

46.6 Refit the air cleaner (refer to Chap 11-1).

46.7 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

CHAPTER 10-2

WINTER/WATER

CONTENTS

Para

- 1 Introduction
- 2 General
Torque list
Brake servo assembly
- 3 Remove
- 4 Refit (CAUTIONS)

Table

Page

1	Sealants, adhesives and lubricants	1
2	Service kits.....	1

Fig

1	Brake pedal removal.....	3
2	Brake servo removal.....	4
3	Fitting the rubber gaiter.....	6

INTRODUCTION

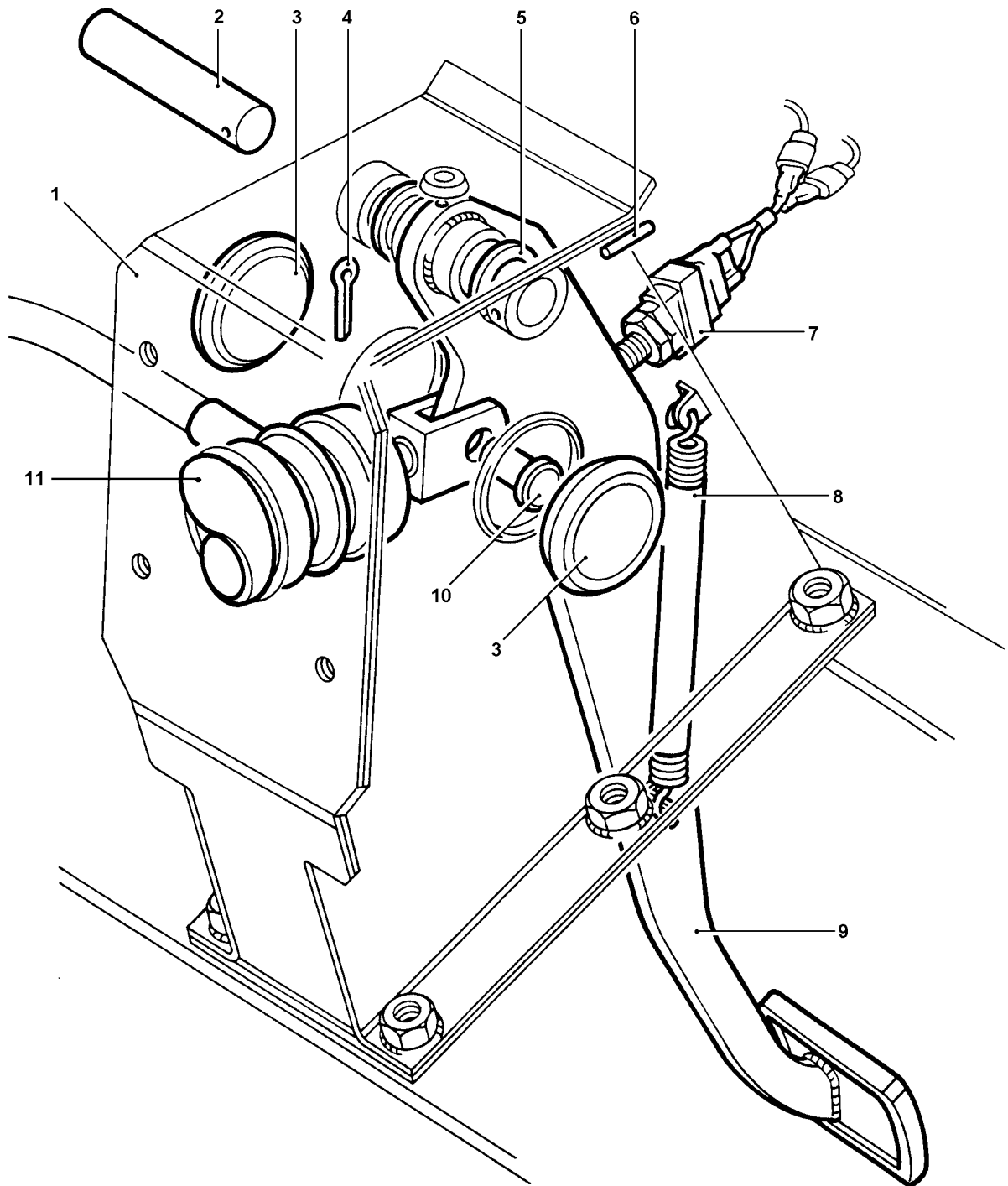
1 This chapter details the field repairs for the brake system fitted to Truck Utility Light (TUM) HS and Truck Utility Medium (TUM) HS winter/water vehicles fitted with the 24 volt electrical system. The information given is applicable to both left and right hand drive vehicles.

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	PX7	9150-99-910-0488	Light grease
2	XG 250	6850-99-224-8404	Silicon grease

TABLE 2 SERVICE KITS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Brake servo	2530-99-573-6559	Seal kit

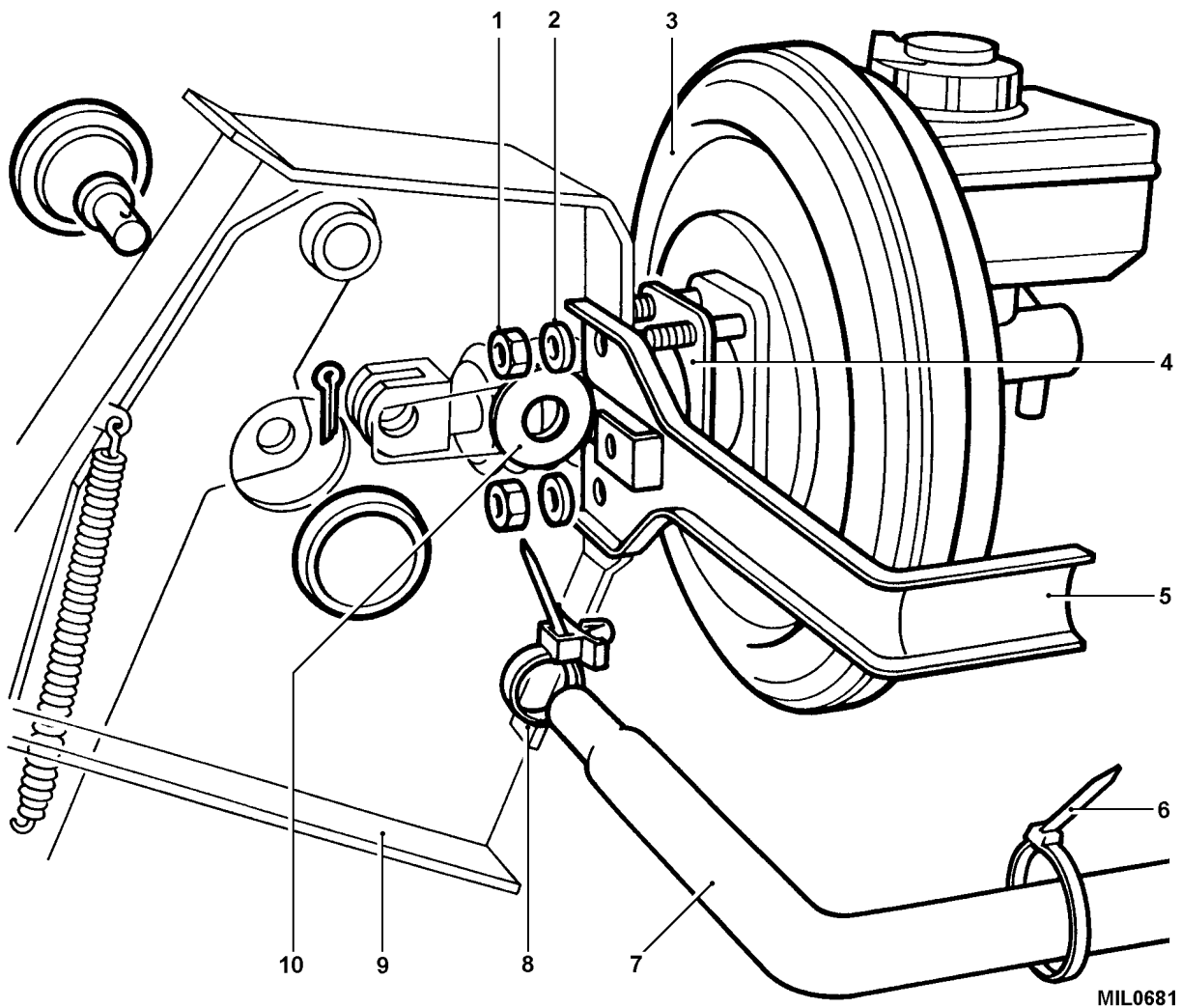


MIL0680

- | | |
|---------------------|----------------------|
| 1 Pedal box | 7 Brake light switch |
| 2 Pivot shaft | 8 Return spring |
| 3 Blanking grommets | 9 Brake pedal |
| 4 Split pin | 10 Clevis pin |
| 5 Pivot bush | 11 Rubber gaiter |
| 6 Securing pin | |

6

Fig 1 Brake pedal removal



MIL0681

- | | |
|-----------------------------|----------------------------|
| 1 Nuts | 6 Cable tie |
| 2 Washers | 7 Breather hose |
| 3 Servo | 8 Cable tie |
| 4 Rubber washer | 9 Pedal box |
| 5 Breather mounting bracket | 10 Adhesive sealing washer |

Fig 2 Brake servo removal

- 3.8 Remove the four nuts (Fig 2 (1)) and washers (2) retaining the servo (3) and breather mounting bracket (5) to the pedal box (9).
- 3.9 Remove cable ties (6, 8) securing breather hose (7) to mounting bracket (5) and free hose from rubber gaiter connection.
- 3.10 Remove breather mounting bracket (5).
- 3.11 Push rubber boot breather connection through hole in pedal box taking care not to damage the adhesive sealing washer (10).
- 3.12 Remove servo (3) and rubber washer (4) from the vehicle.

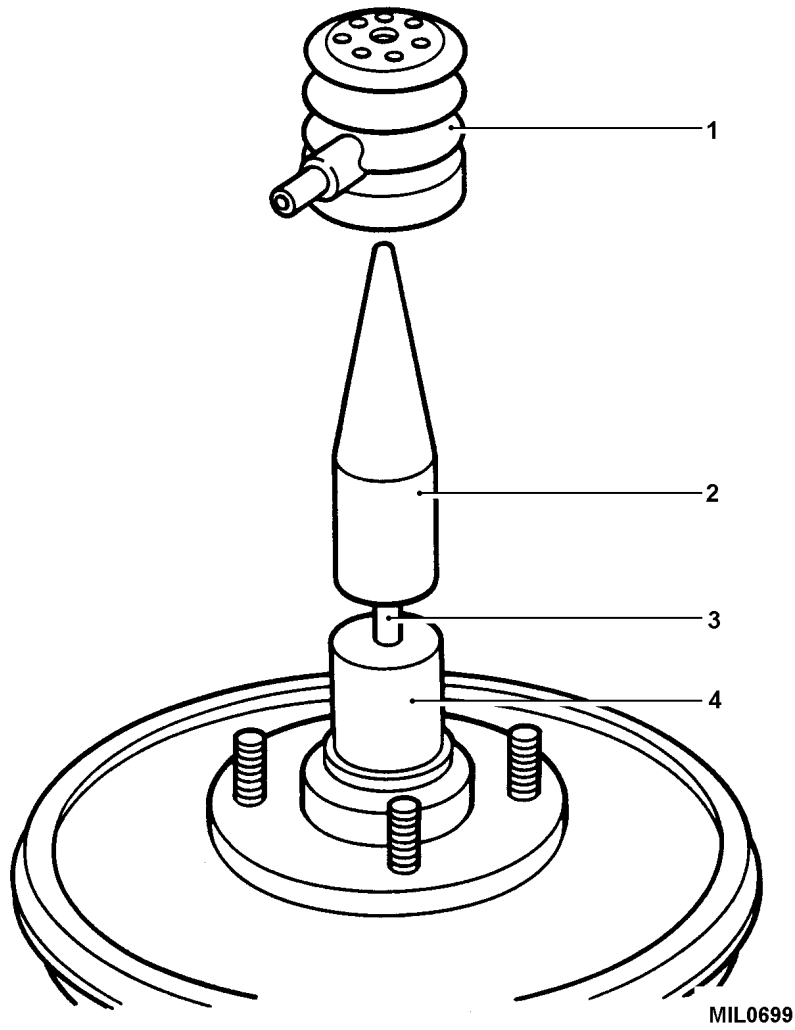
Refit

CAUTIONS

- (1) **CLEANING.** Before use ensure tool is clean of dust, dirt or grease.
- (2) **DAMAGE.** Ensure tool is not damaged prior to use.

NOTES

- (1) A new servo unit will be supplied with a standard rubber gaiter. A waterised rubber gaiter will be supplied with the service kit (refer to Table 2 Serial 1) and should be fitted to the new servo unit.
 - (2) To prevent damage to the rubber gaiter whilst fitting over the push rod clevis a special tool is included in the service kit.
- 4 To fit the rubber boot carry out the following
 - 4.1 Carefully remove standard gaiter.
 - 4.2 Apply grease (refer to Table 1, Serial 1) to tool and servo with brush.
 - 4.3 Locate tool (Fig 3 (2)) over servo push rod (3) and carefully feed gaiter (1) over tool until gaiter is seated against servo (4).
 - 4.4 Pull tool through gaiter and ensure gaiter is seated correctly on servo unit.
 - 4.5 Secure boot to servo unit
 - 4.6 Apply grease (refer to Table 1, Serial No 2) around push rod and gaiter.
 - 5 To refit the brake servo proceed as follows:
 - 5.1 Fit the servo (3) and rubber washer (4) to the pedal box (9), ensure that rubber boot breather connection is located through hole in pedal box. Renew adhesive sealing washer (Fig 2 (10)) if required.
 - 5.2 Fit breather mounting bracket (5) and secure bracket and servo with the four washers (2) and nuts (1), tighten evenly to a torque of 14 Nm (10 lbf ft).
 - 5.3 Connect the brake pedal to the servo with the clevis pin (Fig 1 (10)) and a new split pin (4).
 - 5.4 Fit the blanking grommets (3), each side of the pedal box and from inside the vehicle attach the pedal return springs (8).
 - 5.5 Connect the vacuum hose to the servo non-return valve. Ensure that the hose is in good condition (refer to Chap 10-1).
 - 5.6 Connect the breather hose (Fig 2 (7)) to the connection on the side of the pedal box.
 - 5.7 Secure breather hose (7) to mounting bracket (5) with cable ties (6,8).
 - 5.8 Fit the master cylinder to the servo (refer to Chap 10-1).
 - 5.9 Connect the vehicle batteries (refer to Chapter 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).



1 Rubber gaiter
2 Tool

3 Push rod
4 Servo

Fig 3 Fitting the rubber gaiter

CHAPTER 11

FUEL AND EXHAUST SYSTEM

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

1 This chapter gives the Unit repair for the fuel and exhaust systems as fitted to Truck Utility Light (TUL) HS, and Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles.

General

2 This chapter has been sub-chaptered to allow for the various types of vehicle fuel and exhaust systems as detailed below.

2.1 Chapter 11-1 Non Electronic exhaust gas recirculation (EEGR).

2.2 Chapter 11-2 Electronic exhaust gas recirculation (EEGR).

2.3 Chapter 11-3 Winter/water

2.4 Chapter 11-4 Winterised

CHAPTER 11-1

FUEL AND EXHAUST SYSTEM – NON EEGR

CONTENTS

Para	
1	Introduction FUEL SYSTEM Torque list Fuel injection pump
2	Removal
3	Refitting Fuel injectors
4	General (WARNING)
5	Removal
6	Refitting Fuel lift pump
7	Removal
8	Testing
9	Refitting Fuel sedimenter
10	General
12	Cleaning
13	Removal
14	Refitting Fuel filter
15	Renewing filter element
16	Removal
17	Refitting Fuel tanks (WARNINGS)
18	General Removal
19	Side mounted fuel tank (TUL)
20	Rear mounted fuel tank (TUM) Refitting
21	Side mounted fuel tank (TUL)
22	Rear mounted fuel tank (TUM) Fuel level unit
	Removal
23	Side mounted fuel tank (TUL)
24	Rear mounted fuel tank (TUM)
25	Refitting Heater plugs
26	Removal
27	Refitting Heater plug control unit
28	Removal
29	Refitting Air cleaner
30	Removal
31	Refitting Intercooler
32	Removal
33	Refitting

(continued)

CONTENTS (continued)

Para

Induction manifold

34 Removal

35 Refitting

Priming the fuel system

36 Sedimenter and fuel filter

37 Fuel injection pump

Throttle cable

38 Removal

39 Refitting

40 Adjustment

41 Accelerator pedal adjustment

42 High and low idle speed adjustment

EXHAUST SYSTEM

43 Removal (WARNINGS)

44 Refitting (WARNING)

Turbo-charger inlet hose

45 Removal

46 Refitting

Turbo-charger oil feed pipe

47 Removal (CAUTION)

48 Refitting

Turbo-charger oil drain pipe

49 Removal (CAUTION)

50 Refitting

Turbo-charger and exhaust manifold

51 Removal

52 Refitting

Turbocharge boost pressure

53 Checking turbocharger boost pressure

Table

Page

1 Special tools 4

2 Sealants, adhesives and lubricants..... 4

Fig

1 Flywheel timing pin insertion 5

2 Injection pump timing pin insertion 5

3 Fitting pump drive gear retaining tool 6

4 Injection pump support bracket 7

5 Fitting injector supply pipes 9

6 Injector removal from cylinder head 11

7 Fuel lift pump connections..... 13

8 Fuel sedimenter..... 14

9 Fuel filter 16

10 Side mounted fuel tank removal 18

11 Rear mounted fuel tank removal 20

12 Fuel level unit removal..... 23

13 Heater plug removal 24

14 Heater plug control unit removal 25

15 Air cleaner removal..... 26

16 Intercooler removal..... 28

(continued)

CONTENTS (continued)

Fig		Page
17	Induction manifold removal.....	29
18	Priming the fuel filter.....	30
19	Fuel injector bleed point.....	31
20	Throttle cable removal.....	31
21	Accelerator pedal adjustment.....	33
22	High and low idle speed adjustment.....	34
23	Exhaust system (TUL).....	36
24	Exhaust system (TUM).....	37
25	Turbo-charger inlet hose removal.....	38
26	Turbo-charger oil feed pipe removal.....	40
27	Turbo-charger oil drain pipe removal.....	41
28	Turbo-charger and exhaust manifold.....	42
29	Exhaust manifold removal.....	43
30	Turbocharger boost pressure.....	44

INTRODUCTION

1 This chapter details the Unit repairs for the fuel and exhaust - non electronic exhaust gas recirculation (EEGR) systems fitted to the Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS, and (TUM) Ambulance HS vehicles.

FUEL SYSTEM

TORQUE LIST

Pump to timing gear housing	25 Nm/18 lbf ft
Pump to support bracket	25 Nm/18 lbf ft
Support bracket to cylinder block	25 Nm/18 lbf ft
Spill return to pump banjo bolt	25 Nm/18 lbf ft
Main fuel pipe banjo bolt	25Nm/18 lbf ft
Boost signal pipe banjo bolt	10 Nm/7 lbf ft
Gear lock plate 25	Nm/18 lbf ft
Pump gear retaining bolts	25 Nm/18 lbf ft
Flywheel housing blanking plug	12 Nm/9 lbf ft
High pressure pipes injectors and injection pump	29 Nm/21 lbf ft
Access plate to front timing cover	25 Nm/18 lbf ft
Injector clamp plate	25 Nm/18 lbf ft
Fuel injector spill return banjo bolt	10 Nm/7 lbf ft
Lift pump to cylinder block	25 Nm/18 lbf ft
Fuel lift pump high pressure pipes	29 Nm/21 lbf ft
Heater plugs 23	Nm/17 lbf ft
Crankcase ventilation valve to rocker cover	25 Nm/18 lbf ft
Induction manifold to engine	25 Nm/18 lbf ft
Turbo oil feed pipe to turbo banjo bolt	20 Nm/15 lbf ft
Turbo oil feed pipe to cylinder block banjo bolt	25 Nm/18 lbf ft
Oil drain pipe to turbo charger bolts	25 Nm/18 lbf ft
Oil drain pipe to cylinder block	38 Nm/28 lbf ft
Exhaust manifold nuts	45 Nm/33 lbf ft

NOTE

The special tools listed in the following table will be referred to in the text, where used, by the serial number shown in the table.

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	LRT-12-045	6MT2/5120-99-257-9322	Fuel injection pump gear retainer and locking pin
2	LRT-12-044	6MT2/5120-99-562-4195	Flywheel timing pin

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

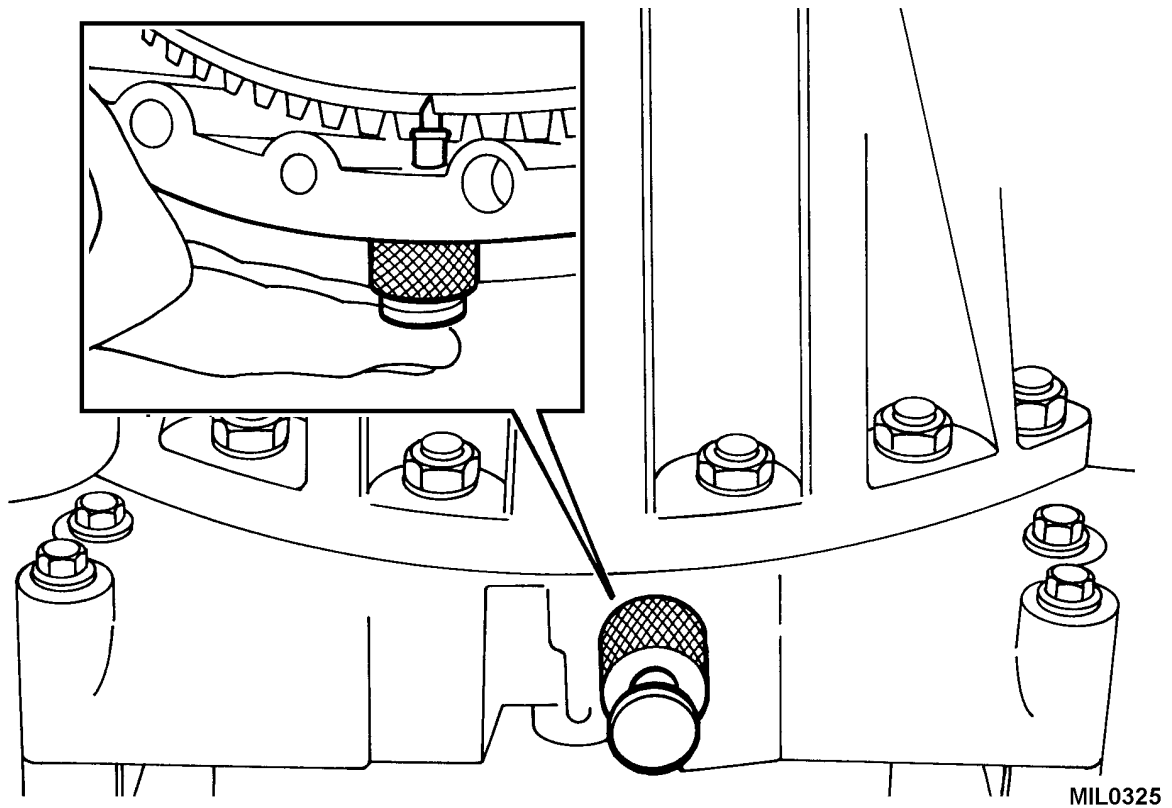
Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Celloseal	8030-99-225-0232	Anti-seize compound
2	Kerosene	9140-99-460-6730	NATO F-58 Kero/B
3	XG 279	9150-99-250-7742	Grease
4	OX90	9510-99-361-7232	Engine oil

FUEL INJECTION PUMP**Removal**

- 2 To remove the fuel injection pump carry out the following:
 - 2.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
 - 2.2 On FFR vehicles remove the 24 volt alternator (refer to Chap 13-2).
 - 2.3 Remove the cooling fan and viscous unit (refer to Chap 12-1).
 - 2.4 Remove the oil filler cap from the rocker cover.
 - 2.5 Viewing the valve mechanism through the filler aperture, turn the crankshaft clockwise, using a socket on the crankshaft pulley bolt until No.1 cylinder is just before Top Dead Centre (TDC). Check that the valves of No.1 cylinder are closed.
 - 2.6 Remove the blanking plug from the bottom of the flywheel housing.
 - 2.7 Fit the timing pin (refer to Table 1 Serial 2) to the flywheel housing, do not engage the centre pin at this stage (refer to Fig 1).
 - 2.8 Carefully rotate the crankshaft clockwise until the centre pin of the timing tool engages the appropriate timing slot in the flywheel.

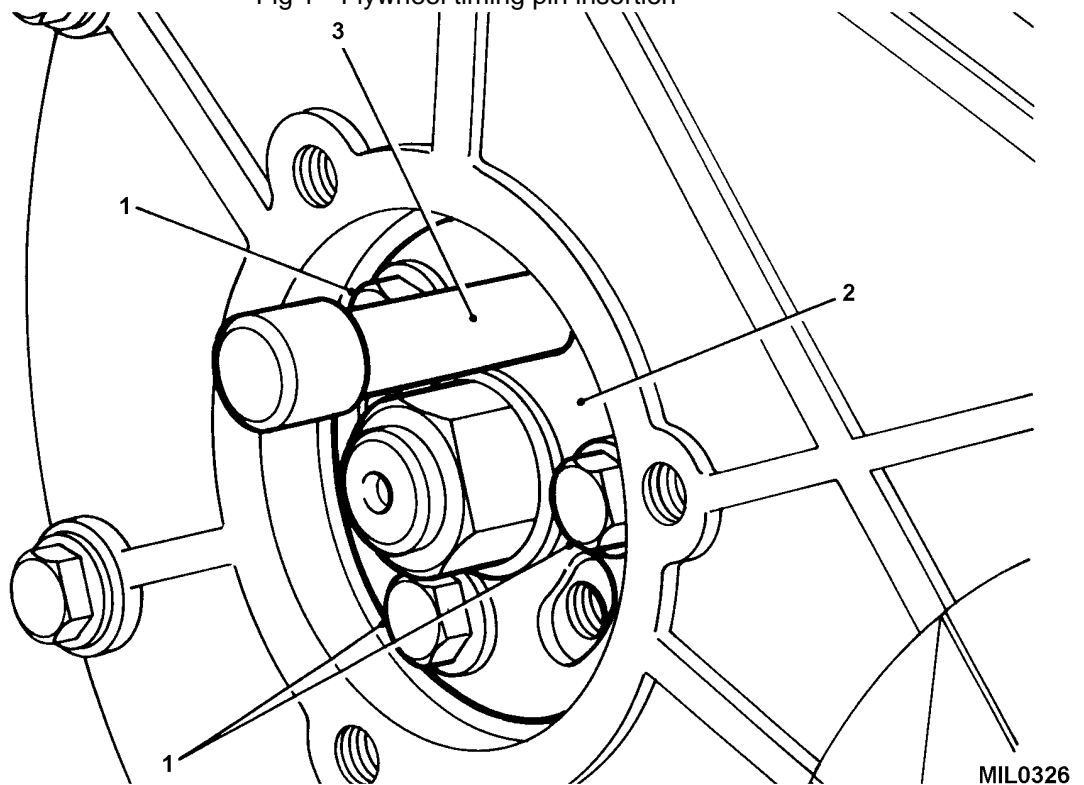
NOTE

There are two slots in the flywheel, the narrowest one determines TDC for this engine.



MIL0325

Fig 1 Flywheel timing pin insertion

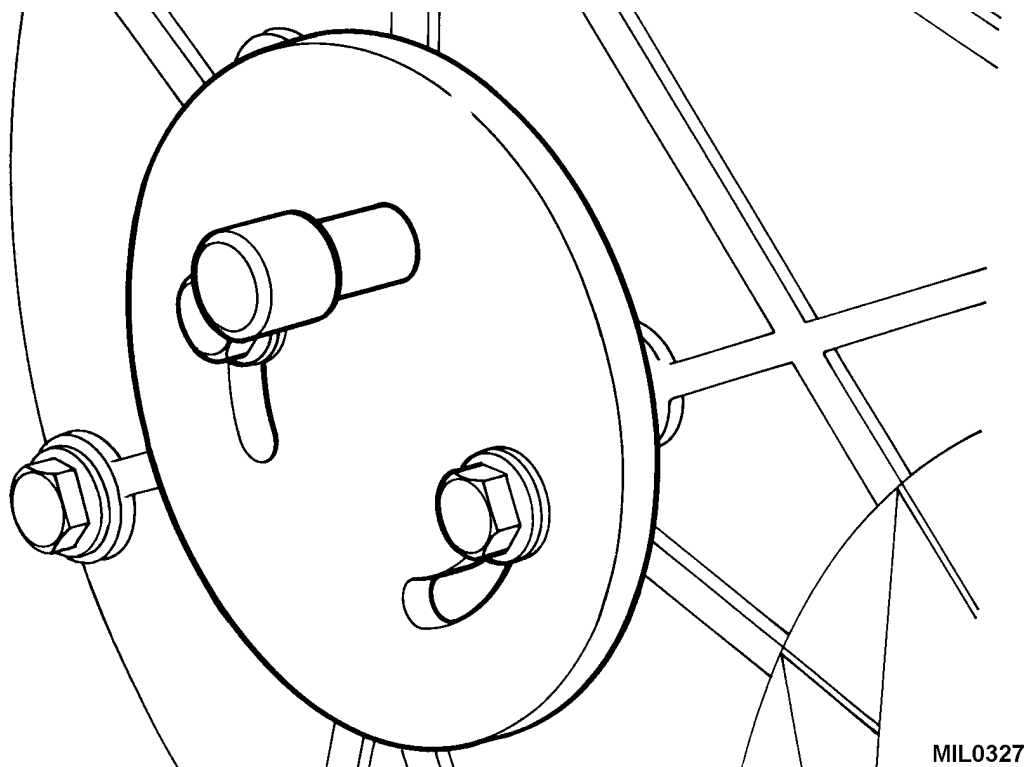


MIL0326

- 1 Fixing bolts
- 2 Plate

- 3 Locking pin (Table 1 Serial 1)

Fig 2 Injection pump timing pin insertion



MIL0327

Fig 3 Fitting pump drive gear retaining tool

- 2.9 Refit the oil filler cap.
- 2.10 Remove the injection pump access plate, complete with gasket.
- 2.11 On FFR vehicles remove the 24 volt alternator belt tensioner from the front timing cover (refer to Chap 13-2).
- 2.12 Fit the locking pin from the special tool (refer to Table 1 Serial 1) into the injection pump gear (Fig 2 (3)).
- 2.13 Remove the three drive gear to pump hub fixing bolts (1) and plate (2).
- 2.14 Using a spanner, carefully rotate the pump hub nut in a clockwise direction sufficiently to release the locking pin.
- 2.15 Remove the locking pin.
- 2.16 Fit the fuel injection pump gear retainer and locking pin (refer to Table 1 Serial 1) align and tighten the two bolts with a 1.5 to 2mm thick washer, under each bolt head in addition to the existing washer (Fig 3).
- 2.17 Remove the injector pipes and disconnect the throttle cable and stop solenoid connector.

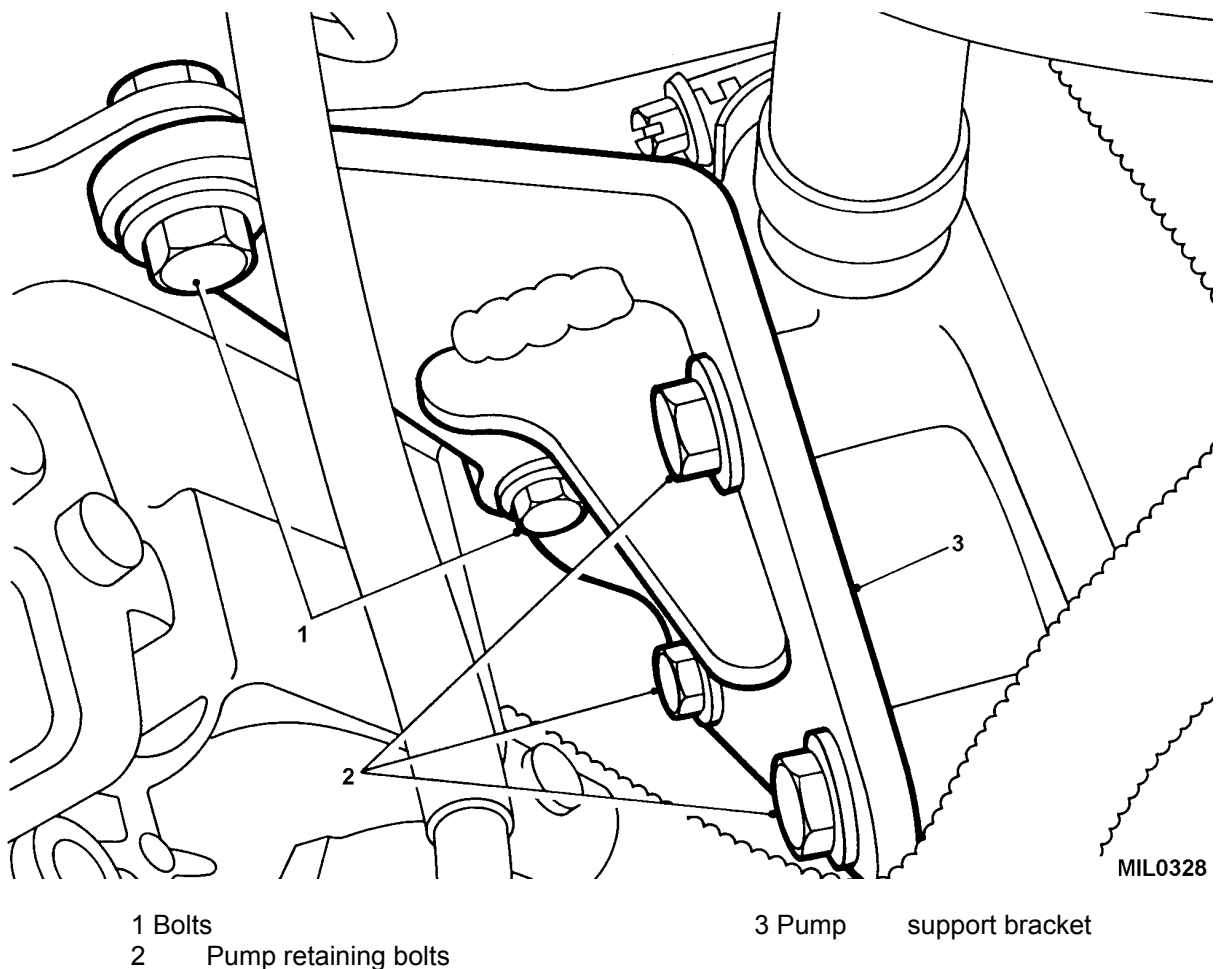


Fig 4 Injection pump support bracket

- 2.18 Remove the banjo bolts securing spill return, main fuel and boost signal pipes, refit banjo bolts after disconnecting pipes.
- 2.19 Remove the two bolts (Fig 4 (1)) securing the rear of the pump to the support bracket (3).
- 2.20 Remove the three pump retaining nuts at the flange on the timing gear housing and withdraw pump and gasket.
- 2.21 Fit blanks to the inlet and outlet ports to prevent ingress of dirt.

Refitting

3 To refit the fuel injection pump proceed as follows:

- 3.1 Clean the pump flange and front cover mating surface and place a new gasket in position over the studs.
- 3.2 Remove blanking plugs from the pump.
- 3.3 Slacken the three bolts (Fig 4 (2)) securing the injection pump support bracket (3) to the cylinder block, sufficiently to allow the bracket to move.
- 3.4 Fit pump to timing gear housing and secure with the three nuts. Tighten evenly to a torque of 25 Nm (18 lbf ft).
- 3.5 Loosely attach pump to support bracket with nuts and bolts, then tighten pump to support bracket and support bracket to cylinder block fixings finger tight only.
- 3.6 To ensure the correct fitting and alignment of the injection pump tighten the two bolts (1) securing the pump to the support bracket to 25 Nm (18 lbf ft), then tighten the three bolts (2) securing the bracket (3) to the cylinder block also to a torque of 25 Nm (18 lbf ft).
- 3.7 Reconnect the spill return and main fuel pipes with new sealing washers and secure with banjo bolts tightened to 25 Nm (18 lbf ft).
- 3.8 Reconnect boost signal pipe using new sealing washers and secure with banjo bolt tighten to a torque of 10 Nm (7 lbf ft).
- 3.9 Reconnect the stop solenoid lead and refit the throttle cable (refer to Para 39).
- 3.10 Remove pump gear retaining tool.
- 3.11 Carefully turn the pump hub in a clockwise direction sufficiently enough, to enable the locking pin (refer to Table 1 Serial 1) to be inserted into the pump.
- 3.12 Fit gear lock plate and secure with three retaining bolts. Tighten evenly to a torque of 25 Nm (18 lbf ft).
- 3.13 Remove locking pin.
- 3.14 Ensure the flywheel timing pin (refer to Table 1 Serial 2) is disengaged from the slot in the flywheel.
- 3.15 Turn the crankshaft through two complete revolutions. Check timing pin from special tool (refer to Table 1 Serial 1) can be fully and easily inserted into the pump, and at the same time that the flywheel timing pin (refer to Table 1 Serial 2) can be inserted into the appropriate slot in the flywheel.

3.16 If, with the flywheel timing pin located, the timing pin cannot be inserted cleanly into the injection pump, carry out the following:

3.16.1 Ensure the timing pin is disengaged from the slot in the flywheel.

3.16.2 Slacken the three pump gear retaining bolts.

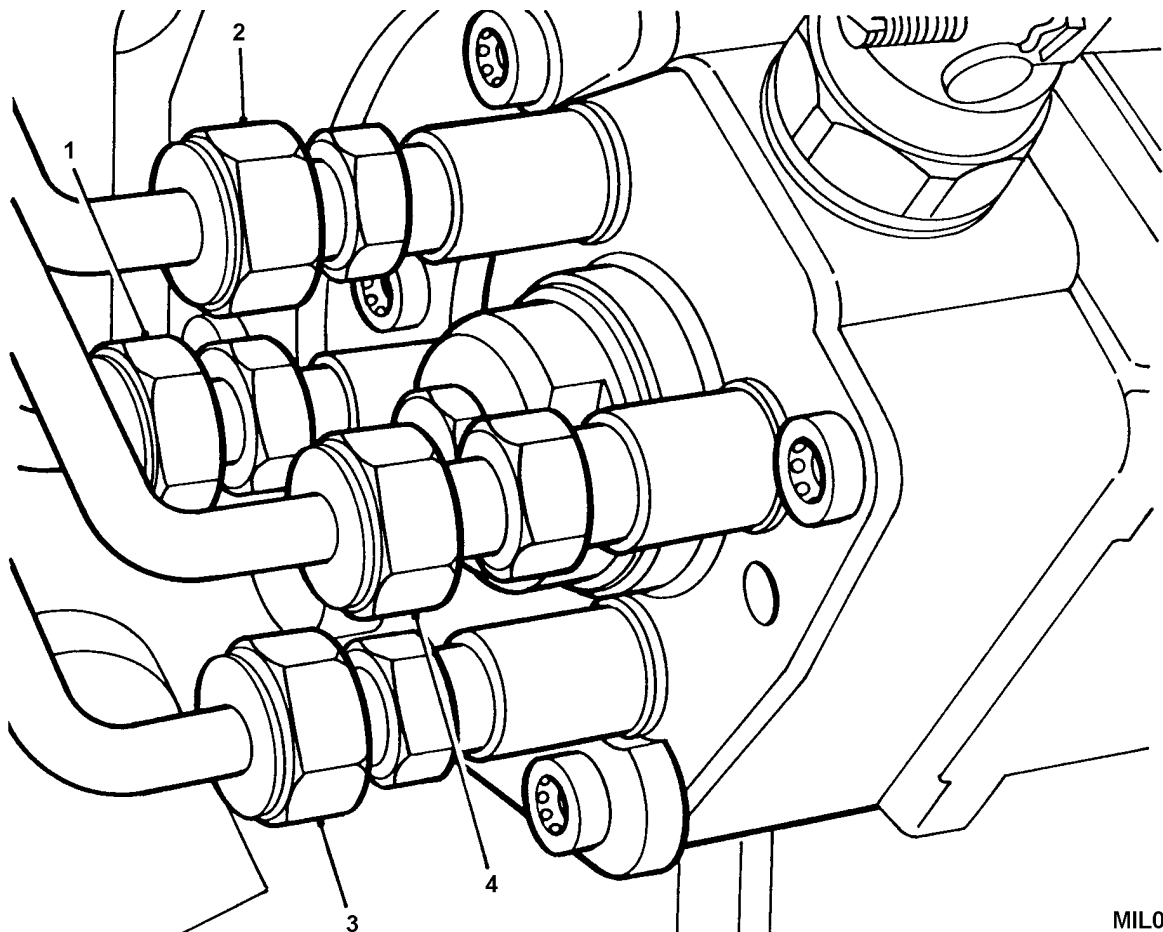
3.16.3 Turn the hub nut in a clockwise direction, the small amount necessary to enable the locking pin to be cleanly inserted into the injection pump. Keeping the tension on the hub nut, check that the flywheel timing pin locates with the slot in the flywheel and tighten the pump gear retaining bolts to 25 Nm (18 lbf ft).

3.17 Remove the locking pin from the pump and the tool from the flywheel housing.

3.18 Using anti-seize compound (refer to Table 2 Serial 1), refit the blanking plug to the flywheel housing. Tighten to a torque of 12 Nm (9 lbf ft).

3.19 Refit the injector supply pipes securing each end loosely to their respective locations (Fig 5), then tighten each in turn to a torque of 29 Nm (21 lbf ft).

3.20 Fit access plate with gasket to front timing cover, tighten bolts to a torque of 25 Nm (18 lbf ft).



MIL0329

1 No. 1 injector pipe
2 No. 2 injector pipe

3 No. 3 injector pipe
4 No. 4 injector pipe

Fig 5 Fitting injector supply pipes

- 3.21 On FFR vehicles fit the 24 volt alternator, belt and tensioner (refer to Chap 13-2).
- 3.22 Fit the cooling fan and viscous coupling (refer to Chap 12-1).
- 3.23 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

FUEL INJECTORS

General

4 When a fuel injector is considered to be the cause of irregular running and loss of power, the only permissible course of action is to substitute each injector in turn with a donor set of injectors to determine which injector is at fault.

WARNING

INJECTOR TESTING. DO NOT ATTEMPT TO DISMANTLE OR CARRY OUT ANY TESTS ON THE TDI ENGINE FUEL INJECTORS. BACKLOAD THEM FOR REPAIR/OVERHAUL.

Removal

- 5 To remove the fuel injectors carry out the following:
 - 5.1 Disconnect the high pressure fuel supply pipes (Fig 6 (1)) from the fuel injectors (3) and their respective injection pump connections and remove.
 - 5.2 Undo the Banjo bolt (6), remove the washers (7) and disconnect the spill return hoses (5) from the injectors.
 - 5.3 Plug pipes and connections to prevent the ingress of dirt and foreign matter.
 - 5.4 Remove the clamp nut (8) securing each injector clamp plate (2) to the cylinder head and remove the clamp.
 - 5.5 Remove the injectors from the cylinder head and discard the sealing washers (4).

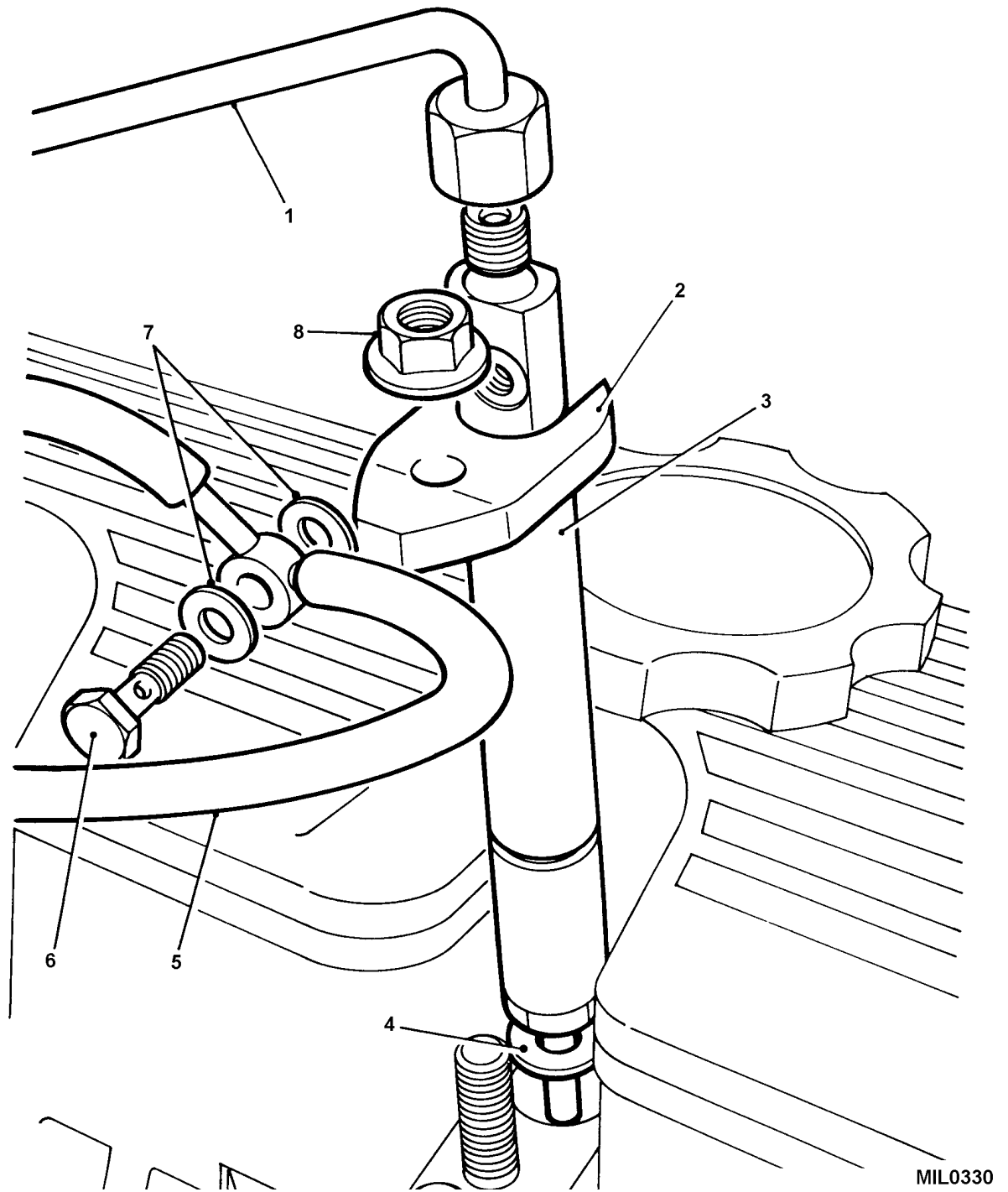
Refitting

- 6 To refit the fuel injectors carry out the following:
 - 6.1 Ensure the injectors and seating in the cylinder head are clean.
 - 6.2 Lightly grease (refer to Table 2 Serial 3) a new copper sealing washer and position on each of the injectors.
 - 6.3 Fit the injectors to the cylinder head with spill return outlets facing outward.
 - 6.4 Secure each injector with clamp plate and nut, tighten to a torque of 25 Nm (18 lbf ft).

NOTE

The clamp plates are slightly curved and should be fitted with the convex side uppermost.

- 6.5 Fit the spill return pipe with a single copper washer under the head of the banjo bolt and one between the injector and the banjo. Tighten each banjo to a torque of 10 Nm (7 lbf ft).
- 6.6 Loosely connect the high pressure fuel supply pipes to the injectors and their respective connections on the fuel injection pump. Finally tighten union nuts to a torque of 29 Nm (21 lbf ft).



- | | | | |
|---|-----------------------|---|-------------------|
| 1 | Fuel supply pipes | 5 | Spill return hose |
| 2 | Clamp plate | 6 | Banjo bolt |
| 3 | Injectors | 7 | Copper washers |
| 4 | Copper sealing washer | 8 | Clamp nut |

Fig 6 Injector removal from cylinder head

FUEL LIFT PUMP

Removal

NOTE

Blank off pipe ends and connections to prevent the ingress of dirt.

7 To remove the fuel lift pump carry out the following:

7.1 Remove the high pressure injectors from the injection pump fuel supply pipes, (refer to Para 5.1).

7.2 Disconnect the fuel inlet (Fig 7 (1)) and outlet (2) pipes from the fuel lift pump (7).

7.3 Remove the two securing bolts (3) and withdraw the lift pump and gasket from the engine cylinder block.

Testing

8 To conduct a basic test on the fuel lift pump proceed as follows:

8.1 Immerse the pump in a bath of clean kerosene and operate the priming lever (Fig 7 (4)) several times to flush the pump.

8.2 Hold the pump clear of the bath and continue to operate the priming lever until the pump is empty, then place a finger over the inlet port and operate the hand primer several times. A distinct 'pop' should be heard when the finger is removed from the inlet port, denoting a reasonable degree of suction has been developed.

8.3 Place a finger over the outlet port and again operate the priming lever. Air pressure should be felt for two to three seconds after movement of the priming mechanism has ceased.

8.4 Build up the air pressure in the pump again, and with a finger held firmly over the outlet port, submerge the pump completely in the kerosene bath, then observe the pump body for signs of air leakage.

NOTE

The fuel lift pump cannot be dismantled. If the unit is found to be defective the pump should be replaced.

Refitting

9 To refit the fuel lift pump proceed as follows:

9.1 Clean the mating faces of the pump and cylinder block.

9.2 Fit the lift pump to the cylinder block with a new gasket, ensuring the correct location of operating lever on camshaft and secure with bolts. Tighten to a torque of 25 Nm (18 lbf ft).

9.3 Reconnect the inlet and outlet pipes using new nuts (5) and olives.

9.4 Refit the injector high pressure fuel supply pipes and tighten the union nuts to a torque of 29 Nm (21 lbf ft) (refer to Para 3.19).

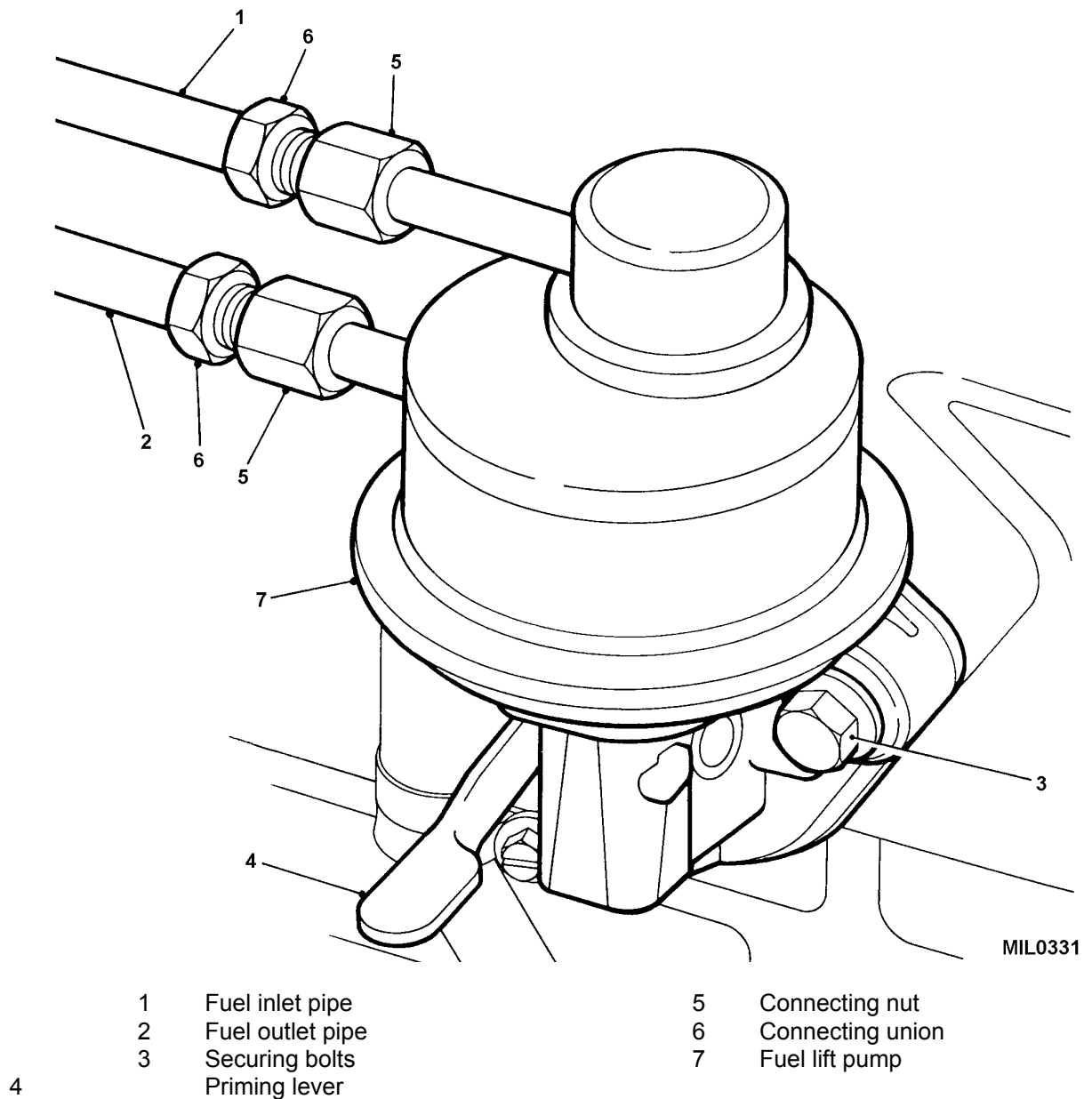


Fig 7 Fuel lift pump connections

FUEL SEDIMENTER

General

10 The fuel sedimenter is located on the right hand side of the chassis, towards the rear of the side mounted fuel tank on the TUL vehicles and to the rear face of the chassis outrigger on the TUM vehicles.

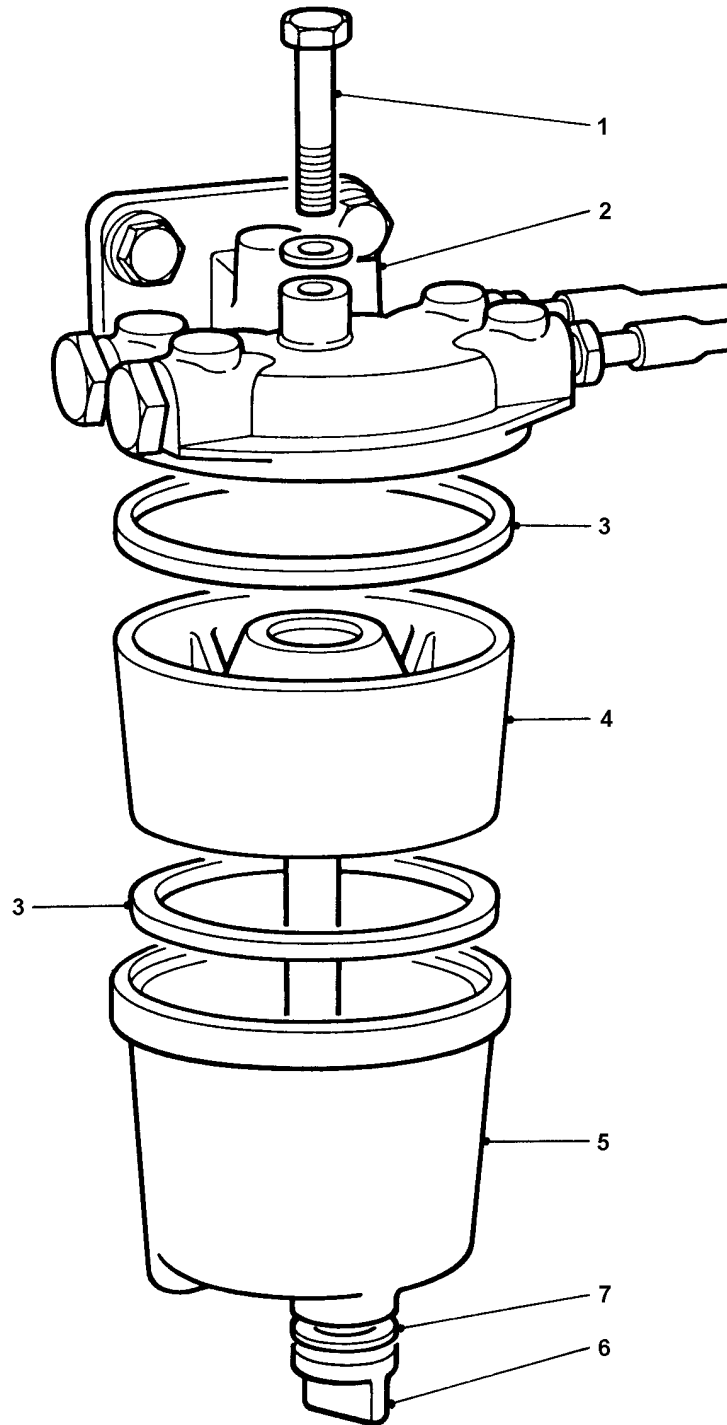
11 The following procedures for removal/refitting and cleaning the sedimenter remain the same for both locations.

Cleaning

12 To clean the fuel sedimenter proceed as follows:

12.1 Disconnect the fuel inlet pipe from the sedimenter. Raise the pipe above the level of the tank and support in this position to prevent fuel draining from the tank.

12.2 Slacken off the drain plug (Fig 8 (6)) at the bottom of the sedimenter bowl (5) and drain into a container of suitable capacity.



MIL0332

1 Centre bolt
2 Sedimenter head
3 Seals
4 Separator

5 Bowl
6 Drain plug
7 Drain plug washer

Fig 8 Fuel sedimenter

- 12.3 Support the sedimenter bowl, unscrew the bolt (1) on top of the head (2) and remove.
- 12.4 Remove the bowl, separator (4) and seals (3).
- 12.5 Discard the seals and clean all parts in kerosene (refer to Table 2 serial 2).
- 12.6 Fit new seals and reassemble the sedimenter.
- 12.7 Reconnect the fuel inlet pipe, slacken off the drain plug until diesel fuel flows then tighten the plug.
- 12.8 Start the engine and check the sedimenter for leaks.

Removal

13 To remove the sedimenter carry out the following:

- 13.1 Disconnect the inlet and outlet fuel pipes and drain the sedimenter.
- 13.2 Remove the two bolts securing the sedimenter head to the chassis mounting and withdraw the unit.

Refitting

14 To refit the sedimenter carry out the following:

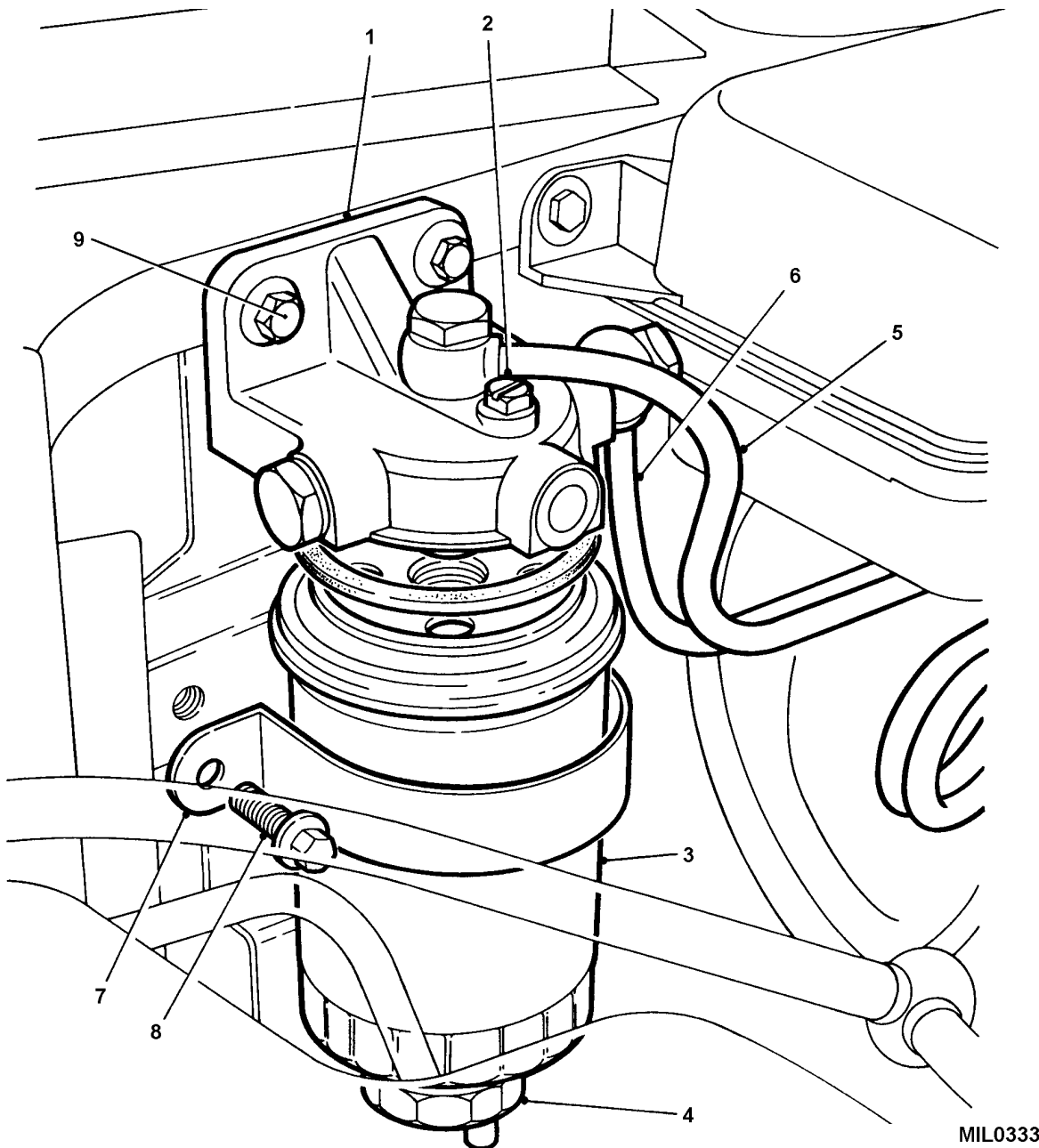
- 14.1 Refit the sedimenter to the chassis mounting with the two securing nuts, bolts and washers.
- 14.2 Reconnect the inlet and outlet fuel pipes, slacken off the drain plug until diesel fuel free from air flows then tighten the drain plug.
- 14.3 Prime the vehicle fuel system (refer to Para 36 and 37).

FUEL FILTER

Renewing filter element

15 To renew the filter element carry out the following:

- 15.1 Clean the area around the filter head (Fig 9 (1)) and loosen the bleed screw (2).
- 15.2 Place a suitable container beneath the filter element (3), loosen the drain tap (4) and allow the fuel to drain into the container.
- 15.3 Remove the two mounting bolts (8) and the element retaining strap (7).
- 15.4 Unscrew the filter element, remove and discard.
- 15.5 Clean the seal seating in the filter head.
- 15.6 Lubricate the filter element seal with clean diesel fuel.
- 15.7 Screw the filter element to the filter head and hand tighten.
- 15.8 Refit the element retaining strap and secure with retaining bolts.
- 15.9 Prime the vehicle fuel system (refer to Para 36 and 37).



MIL0333

- | | | | |
|---|-----------------|---|------------------|
| 1 | Filter head | 6 | Fuel outlet pipe |
| 2 | Bleed screw | 7 | Retaining strap |
| 3 | Filter element | 8 | Mounting bolt |
| 4 | Drain tap | 9 | Fixing bolt |
| 5 | Fuel inlet pipe | | |

Fig 9 Fuel filter

Removal

16 To remove the fuel filter proceed as follows:

- 16.1 Place a suitable container beneath the filter bowl and loosen the bleed screw on the filter head.
- 16.2 Loosen the drain tap and allow the fuel to drain from the filter bowl.

- 16.3 Slacken the fuel inlet (Fig 9 (5)) and outlet (6) pipe banjo connections.
- 16.4 Remove the two securing bolts and the element retaining strap.
- 16.5 Remove the two fixing bolts (9) securing the filter unit to the inner wing and detach the inlet and outlet fuel pipes.
- 16.6 Blank off fuel pipe ends to prevent the ingress of dirt and remove the filter from the vehicle.

Refitting

17 Refit the fuel filter unit in the reverse order of the removal procedure, ensuring the correct connection of the fuel inlet and outlet pipes and using new copper sealing washers either side of the fuel pipe banjo connections. Finally prime the fuel system (refer to Para 36 and 37) to remove any air which may be trapped in the filter.

FUEL TANKS

WARNINGS

- (1) FIRE HAZARD. DANGER OF FIRE ALWAYS EXISTS WHEN WORKING ON OR REMOVING FUEL TANKS FROM VEHICLES. WORK MUST BE CARRIED OUT IN A WELL VENTILATED AREA.**
- (2) FIRE EXTINGUISHERS. FIRE EXTINGUISHING EQUIPMENT MUST BE AVAILABLE AT ALL TIMES AND THE VEHICLE BATTERIES MUST BE COMPLETELY DISCONNECTED.**
- (3) WARNING SIGNS. NOTICES SUCH AS "NO SMOKING", "HIGHLY FLAMMABLE VAPOUR", "RESTRICTED AREA" ETC, MUST BE DISPLAYED SO AS TO BE VISIBLE FROM ALL APPROACHES.**

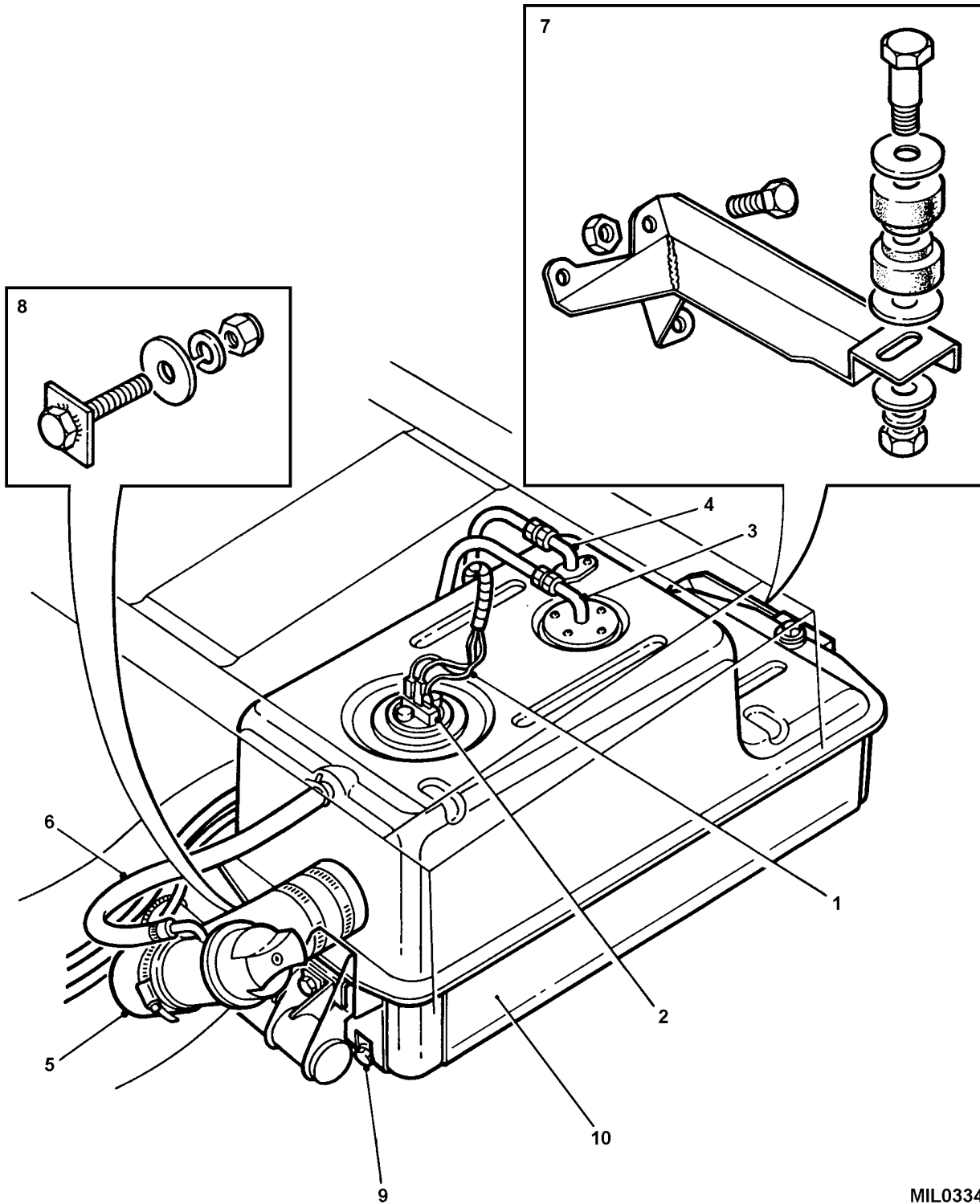
General

18 The position of the fuel tank differs between the TUL and TUM vehicles. On TUL the fuel tank is fitted on the right hand side of the vehicle, whereas on the TUM the fuel tank is fitted at the rear of the vehicle and is centrally mounted between the chassis members.

Removal

Side mounted fuel tank (TUL)

- 19 To remove the side mounted fuel tank proceed as follows:
- 19.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
 - 19.2 Remove the fuel filler cap.
 - 19.3 Remove the fuel tank drain plug (Fig 10 (9)), allow the fuel to drain into a clean container of suitable capacity and refit the plug.
 - 19.4 Remove the right hand seat cushion and lift the seat base cover to reveal the fuel tank.
 - 19.5 Disconnect the electrical connection (1) from the fuel level unit (2)
 - 19.6 Separate the union and detach the fuel feed pipe (3) from the outlet pipe on top of the tank.



MIL0334

- | | |
|-------------------------|-------------------------------|
| 1 Electrical connection | 6 Breather pipe |
| 2 Fuel level unit | 7 Front mounting bracket assy |
| 3 Fuel feed pipe | 8 Rear mounting assembly |
| 4 Spill return pipe | 9 Drain plug |
| 5 Filler hose | 10 Stone guard |

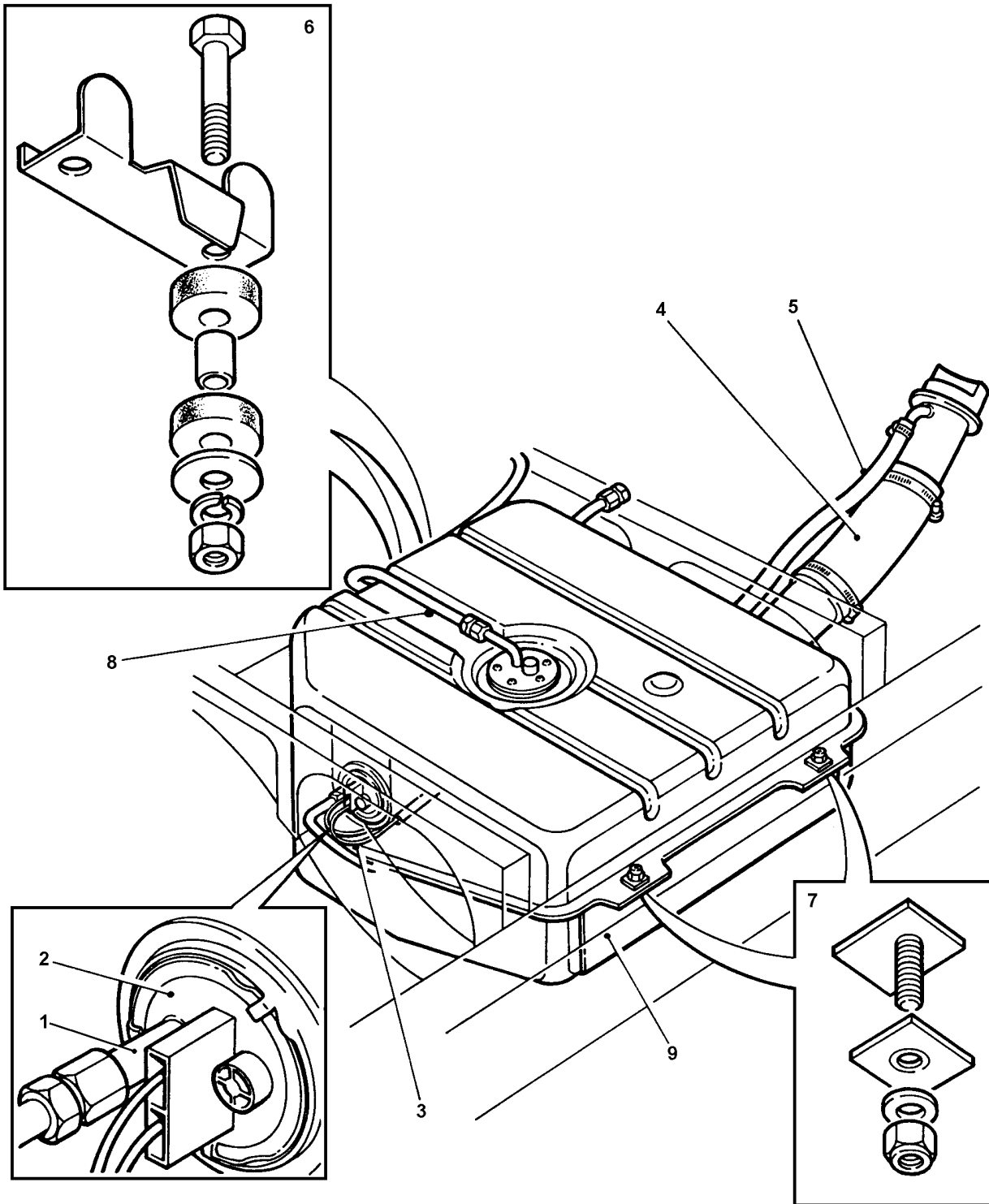
Fig 10 Side mounted fuel tank removal

- 19.7 Disconnect the spill return pipe (4) from the connection on top of the tank.
- 19.8 Disconnect the breather pipe (6) from the fuel filler tube.
- 19.9 Release the hose clip and remove the filler hose (5) from the filler tube.
- 19.10 From the rear of the tank, remove the two nuts and washers securing the tank mounting captive-headed bolts (8).
- 19.11 Support the rear of the tank and remove the captive bolts.
- 19.12 Remove the single bolt fixing assembly, securing the tank front mounting bracket (7) to the chassis.
- 19.13 Remove the three securing nuts and bolts and withdraw the mounting bracket from the chassis.
- 19.14 Lower the front of the tank whilst turning it anti-clockwise and remove complete with stone guard from the vehicle.
- 19.15 If required, remove the two screws and withdraw the spill return pipe (4) and similarly the five screws and withdraw the fuel feed pipe (3) from the tank.
- 19.16 Remove the fuel level unit (refer to Para 23) if required.

Rear mounted fuel tank (TUM)

20 To remove the rear mounted fuel tank proceed as follows:

- 20.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 20.2 Remove the fuel filler cap.
- 20.3 Remove the fuel tank drain plug, allow the fuel to drain into a clean container of suitable capacity and refit the plug.
- 20.4 Slacken the clips at the tank connections of the fuel filler (Fig 11 (4)) and breather hose (5) and disconnect the hoses.
- 20.5 From the left hand side of the tank disconnect the electrical connection (3) and the fuel feed pipe (1) from the outlet pipe union on the fuel level unit (2).
- 20.6 Remove the left-hand rear lashing eye from the chassis.
- 20.7 Place a support under the tank preferably one that can be progressively lowered.
- 20.8 Remove the two nuts that secure the front mounting assembly (6) of the tank and stone guard then remove the tank rear mounting nuts (7).
- 20.9 Carefully lower the tank sufficiently to enable the nut and olive of the spill return to be disconnected from the elbow at the tank top connection.
- 20.10 Continue lowering the tank until it can be withdrawn complete with the stone guard vehicle.
- 20.11 Remove the stone guard from the tank.
- 20.12 If required, remove the five screws and withdraw the spill return pipe (8) and remove the fuel level unit (refer to Para 24).



MIL0335

- | | | | |
|---|-----------------------|---|-------------------|
| 1 | Fuel feed pipe | 6 | Front mounting |
| 2 | Fuel level unit | 7 | Rear mounting |
| 3 | Electrical connection | 8 | Spill return pipe |
| 4 | Filler hose | 9 | Stone guard |
| 5 | Breather hose | | |

Fig 11 Rear mounted fuel tank removal

Refitting

Side mounted fuel tank (TUL)

21 To fit the side mounted fuel tank carry out the following:

- 21.1 If removed, refit the fuel pick-up pipe (Fig 10 (3)) to the tank using a new sealing washer and evenly tighten the five retaining screws.
- 21.2 Also fit the spill return (4) with a new joint washer and evenly tighten the two screws.
- 21.3 If removed, refit the fuel level unit (2)(refer to Para 25).
- 21.4 Fit the filler hose (5) and clip to the tank but do not fully tighten. Ensure that the screw of the clip is positioned so that it is accessible when the tank is fitted.
- 21.5 Fit the breather hose (6) and secure with the clip.
- 21.6 Fit the tank into position in the vehicle and loosely secure the mounting bracket (7) to the front of the tank with the special bolt and rubber bushes.
- 21.7 Secure the mounting bracket to the chassis with the three bolts and washers and tighten.
- 21.8 Tighten the tank front securing bolt assembly.
- 21.9 Connect the spill return (4) and fuel pick-up pipes (3) and tighten the union nuts.
- 21.10 Reconnect the electrical plug (1) to the fuel level unit.
- 21.11 Fit the filler hose to the filler tube and tighten the upper and lower securing clips.
- 21.12 Check that the drain plug (9) is tight, fill the tank with fuel, connect the battery, prime the fuel system (refer to Para 36 and 37) and start the engine. Check for fuel leaks and that the gauge operates.
- 21.13 Fit the seat base cover and refit the seat cushion.

Rear mounted fuel tank (TUM)

22 To refit the rear mounted fuel tank proceed as follows:

- 22.1 If removed, fit the spill return pipe (Fig 11 (8)) using a new sealing washer and evenly tighten the five retaining screws.
- 22.2 Fit the fuel level unit (2)(refer to Para 25).
- 22.3 Raise the tank into position until it is possible to connect the spill return pipe to the elbow with the nut and olive.
- 22.4 Continue to raise the tank so that the front (6) and rear (7) mounting bolts locate in the respective holes. Fit and tighten the securing nuts.
- 22.5 Reconnect the fuel supply pipe (1) to the fuel level unit.
- 22.6 Fit the fuel filler hose (4) and the breather pipe (5) to the filler tube and secure with retaining clips.
- 22.7 Refit the left-hand rear lashing eye to the chassis and tighten the retaining nut.

22.8 Check that the drain plug is tight, fill the tank with fuel, connect the battery, prime the fuel system (refer to Para 36 and 37) and start the engine. Check for leaks and operation of the fuel gauge.

FUEL LEVEL UNIT

Removal

Side mounted fuel tank (TUL)

23 To remove the fuel level unit from the tank carry out the following:

23.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

23.2 If the level of the fuel in the tank is high, drain off sufficient fuel to prevent it from overflowing when the level unit is removed.

23.3 Remove the right hand seat cushion and lift the seat base cover to reveal the fuel tank.

23.4 Disconnect the electrical connections (Fig 12 (2)) from the level unit.

23.5 Using special tool (refer to Table 1 Serial 2) turn the level unit locking ring (4) anti-clockwise and lift out the level unit (3) and sealing washer.

Rear mounted fuel tank (TUM)

24 To remove the fuel level unit from the fuel tank carry out the following:

24.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

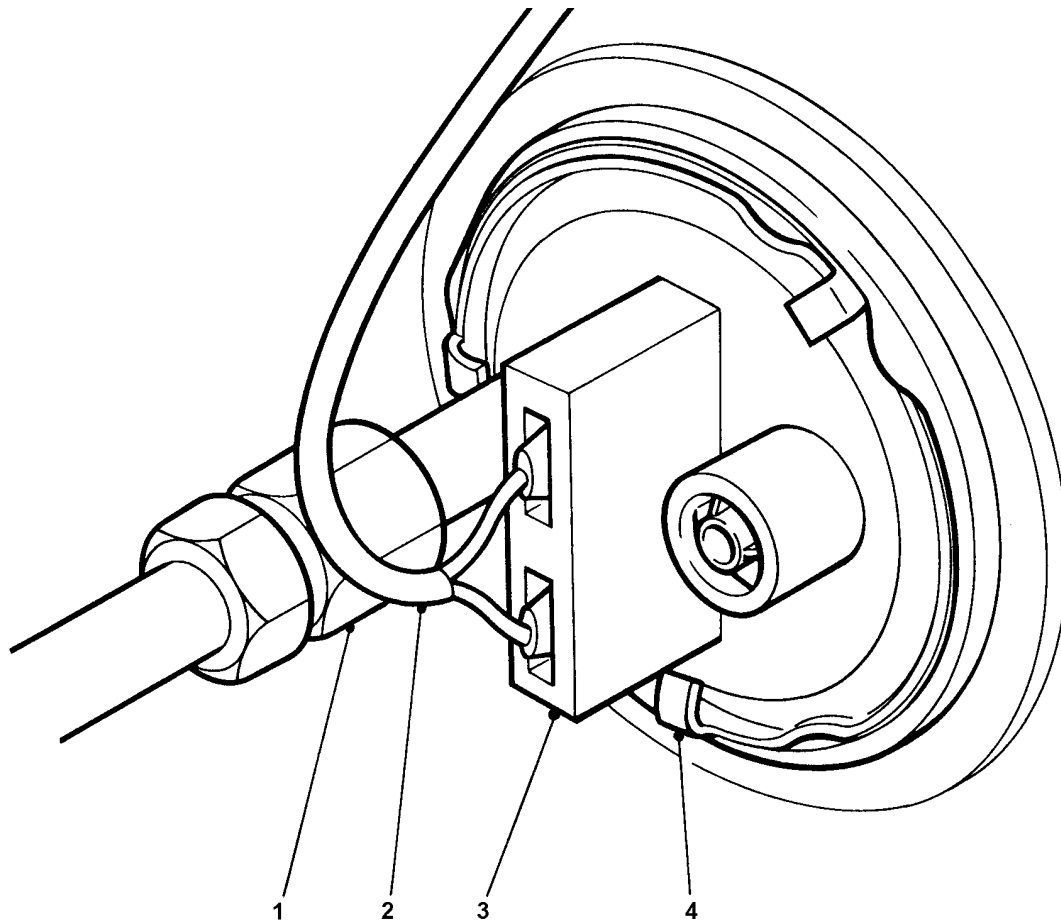
24.2 Drain off sufficient fuel to bring the level below the bottom of the fuel level unit aperture in the tank.

24.3 Disconnect the electrical connections (Fig 12 (2)) and the fuel outlet pipe (1).

24.4 Using special tool (refer to Table 1 Serial 2) turn the level unit locking ring (4) anti-clockwise and withdraw the level unit (3) and sealing washer.

Refitting

25 To refit the fuel level unit on both side and rear mounted fuel tanks reverse the removal procedure, fill the tank with fuel and check for leaks.



MIL0336

- | | | | |
|---|-----------------------------|---|--------------|
| 1 | Fuel outlet pipe (TUM only) | 3 | Level unit |
| 2 | Electrical connections | 4 | Locking ring |

Fig 12 Fuel level unit removal

HEATER PLUGS

Removal

26 To remove the heater plugs carry out the following:

- 26.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 26.2 On FFR vehicles remove the 24 volt alternator (refer to Chap 13-2) to gain access to No. 1 heater plug.
- 26.3 Remove the bolt securing the crankcase ventilation valve to the rocker cover and withdraw the valve, remove and discard the 'O' ring.
- 26.4 Remove the terminal nut (Fig 13 (1)) and locking washers (3), disconnect the electrical connection (2) from each heater plug terminal.
- 26.5 Remove the heater plugs (4) from the cylinder head.

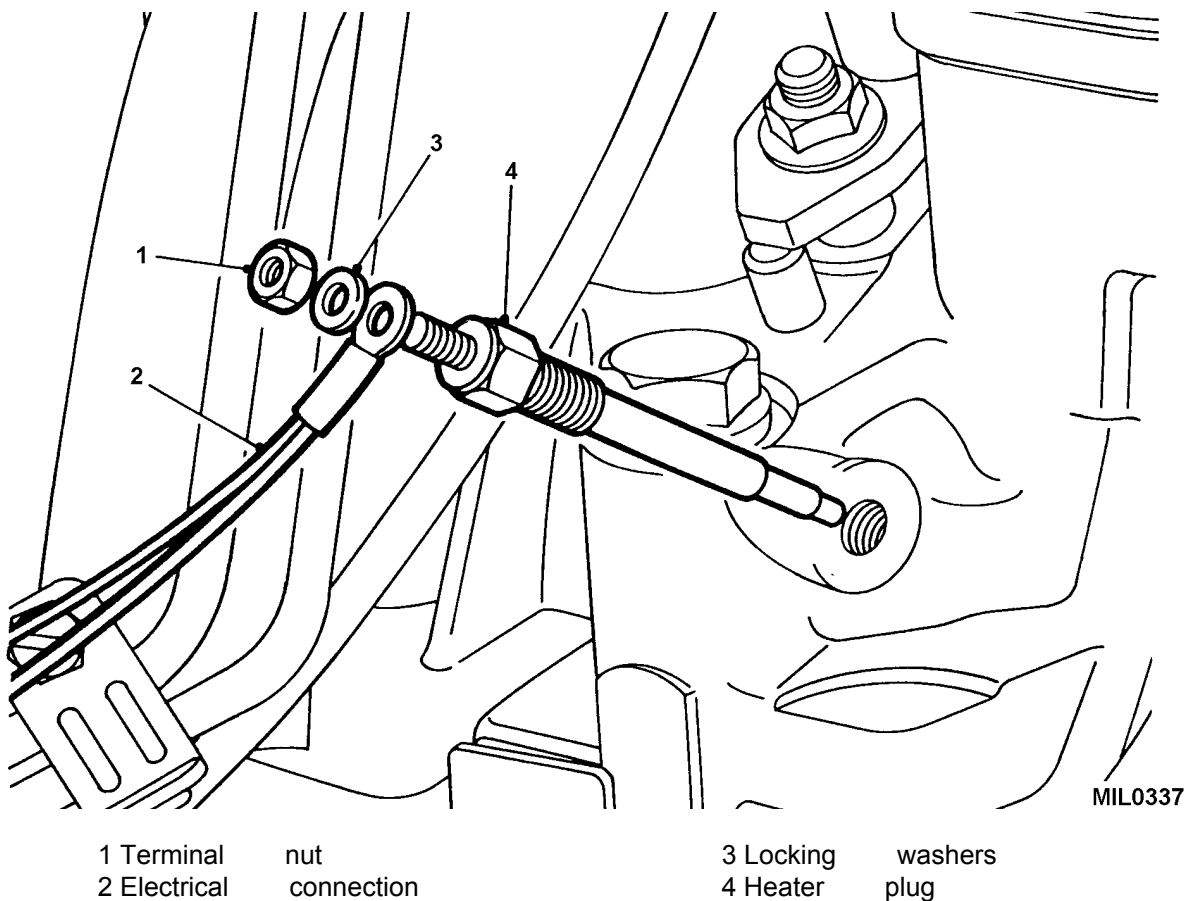


Fig 13 Heater plug removal

Refitting

27 To refit the heater plugs proceed as follows:

- 27.1 Clean the heater plugs and seating.
- 27.2 Coat the threads of each heater plug with a suitable anti-seize compound operational to a temperature of 1000 deg C (1832 deg F).
- 27.3 Fit the heater plugs and tighten to a torque of 23 Nm (17 lbf ft).
- 27.4 Connect the wires to each heater plug terminal and secure with nuts and locking washers.

NOTE

The electrical feed wire must be connected to No. 4 heater plug terminal.

- 27.5 Lubricate a new 'O' ring with engine oil and fit to the crankcase ventilation valve. Fit the ventilation valve to the rocker cover and secure with retaining bolt. Tighten to a torque of 25 Nm (18 lbf ft).
- 27.6 On FFR vehicles fit the 24 volt alternator (refer to Chap 13-2).
- 27.7 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

HEATER PLUG CONTROL UNIT

Removal

28 To remove the heater plug control unit carry out the following:

- 28.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 28.2 Remove the fixing screw (Fig 14 (2)) and washer securing the control unit (1).
- 28.3 Disconnect the electrical multi-plug (3) and remove the control unit.

Refitting

29 To refit the heater plug control unit reverse the removal procedure.

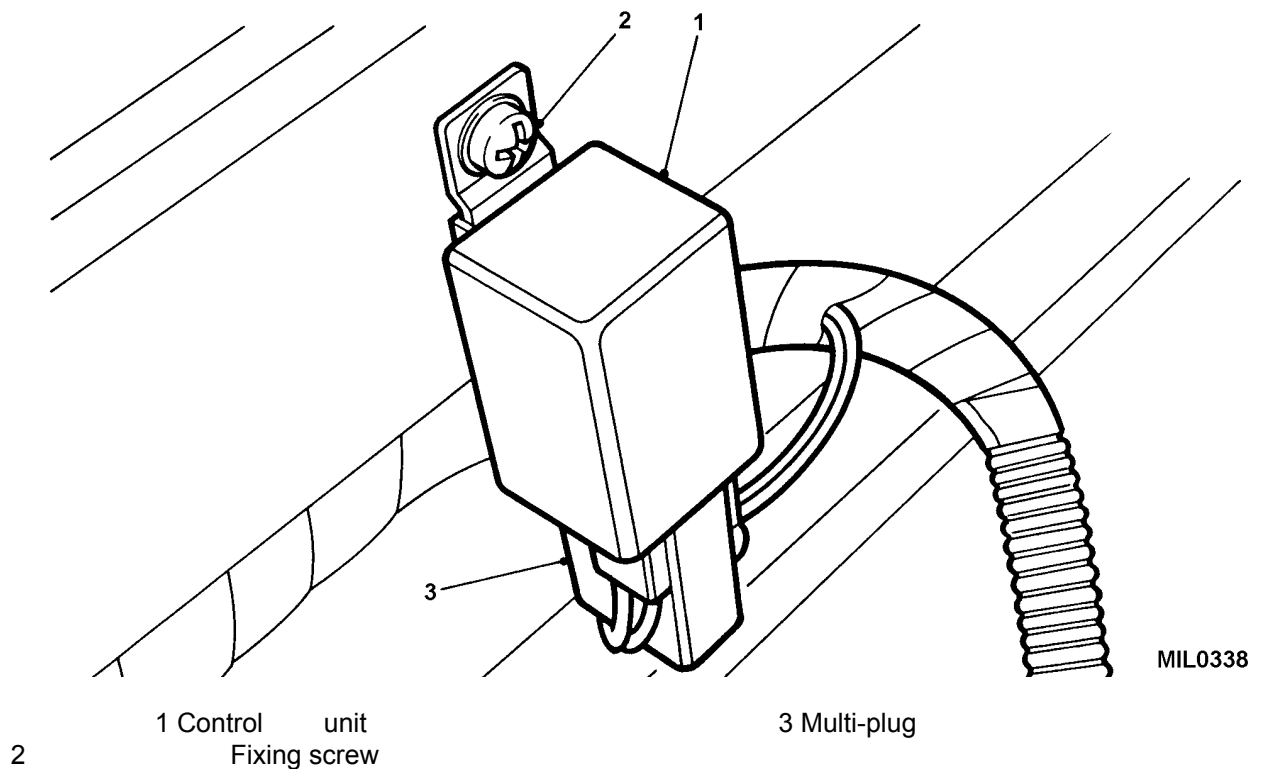


Fig 14 Heater plug control unit removal

AIR CLEANER

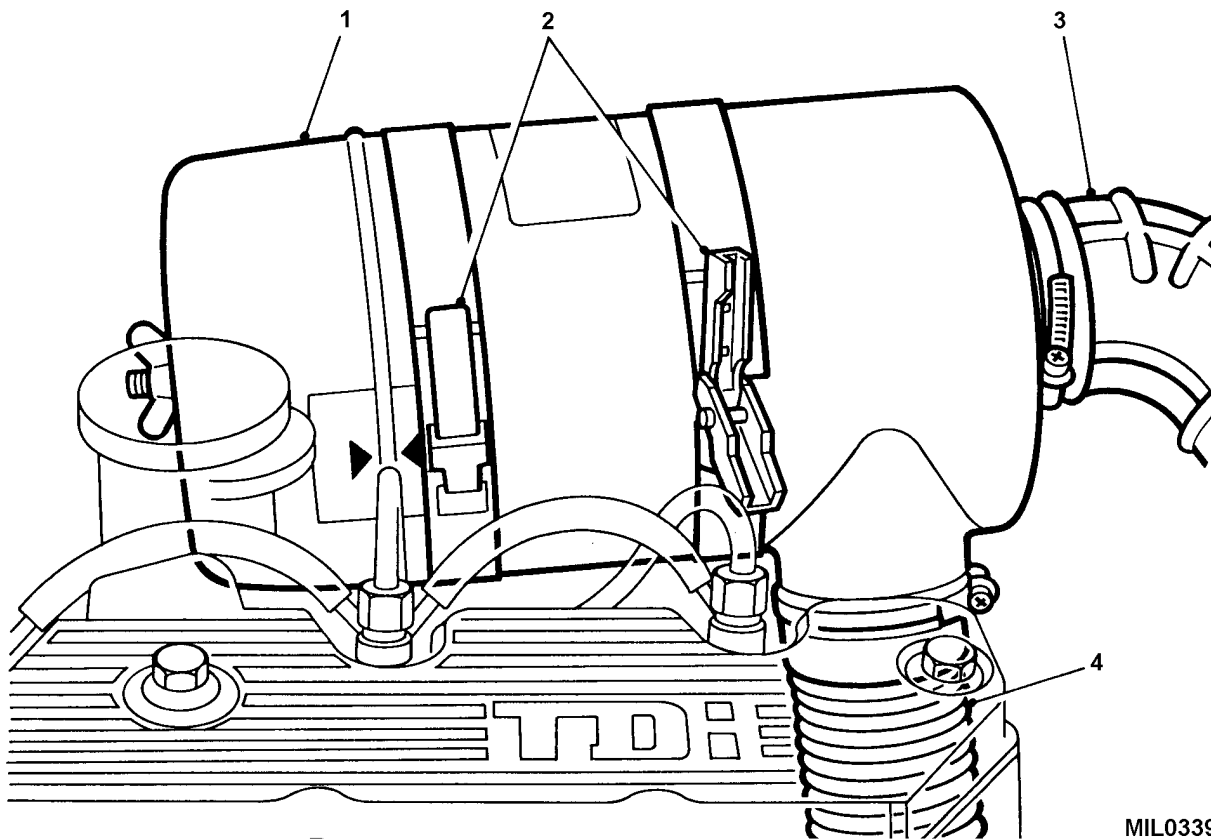
Removal

30 To remove the air cleaner proceed as follows:

- 30.1 Slacken the hose clip at the rear of the air cleaner canister and remove the outlet hose (Fig 15 (3)).
- 30.2 Release the two air cleaner canister retaining clips (2).
- 30.3 Lift up the air cleaner (1), slacken the hose clip and detach the inlet hose (4).
- 30.4 Withdraw the air cleaner unit from the vehicle.

Refitting

31 Refit the air cleaner unit to the vehicle reversing the removal procedure.



MIL0339

1 Air cleaner
2 Retaining clips

3 Outlet hose
4 Inlet hose

Fig 15 Air cleaner removal

INTERCOOLER**Removal**

32 To remove the intercooler proceed as follows:

- 32.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 32.2 Remove the cooling fan and viscous assembly (refer to Chap 12-1).
- 32.3 Remove the nuts securing the fan cowl (Fig 16 (1)) to the radiator top cover (5).
- 32.4 Loosen the clips and remove the top hose, intercooler to inlet manifold.
- 32.5 Remove the retaining clamp securing the turbo-charger to intercooler connecting pipe to the inner wheel arch.
- 32.6 Loosen the clips and disconnect the bottom intercooler hose and turbo-charger outlet hose from the connecting pipe, and remove.

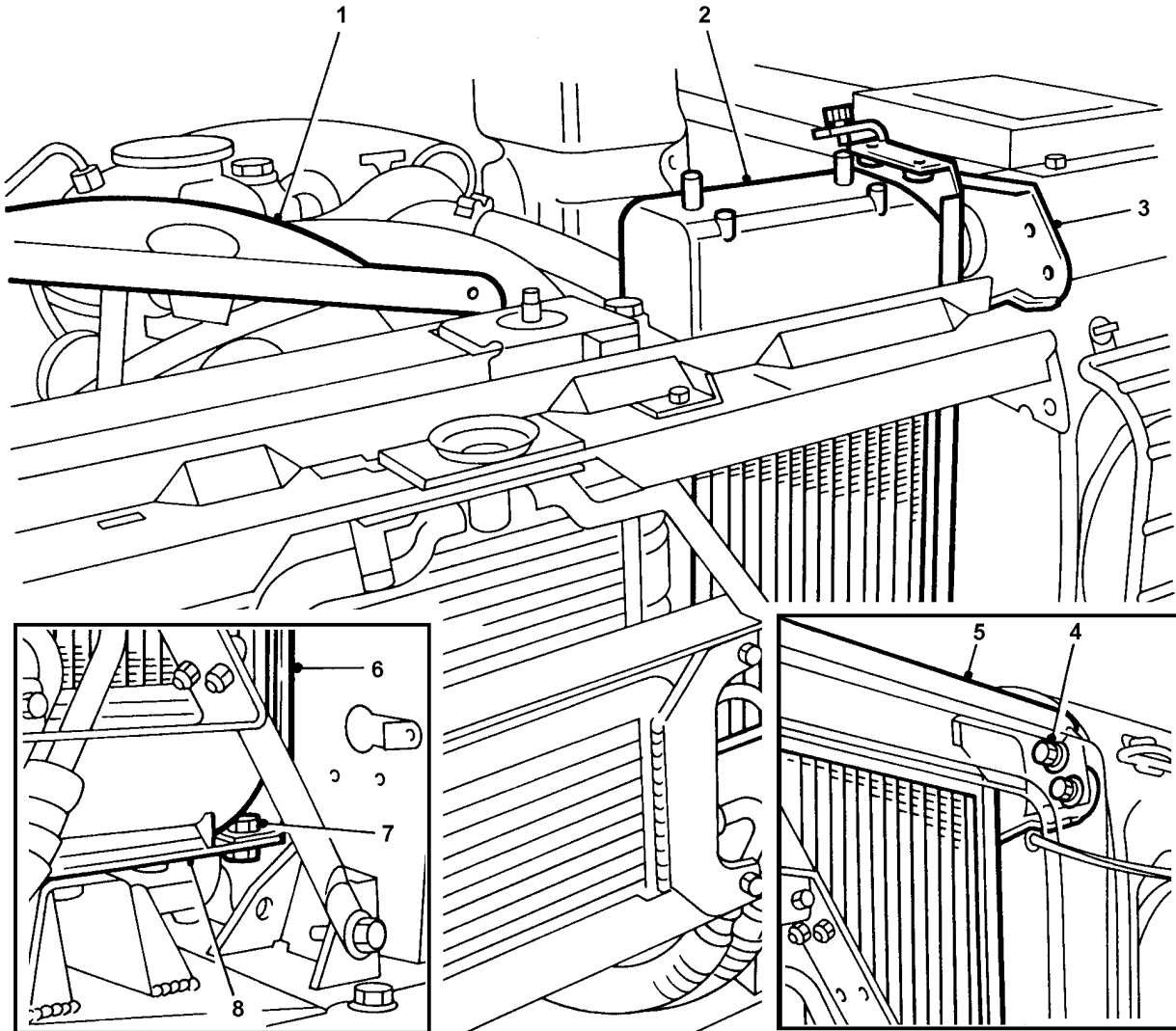
- 32.7 Remove the retaining screws and withdraw the radiator grille, to gain access to the radiator mounting bracket/grille surround panel bolts.
- 32.8 Remove horn mounting bracket screws and move horn to one side.
- 32.9 Remove six securing bolts and four self tapping screws, withdraw the radiator grille surround panel and spacers.
- 32.10 Remove the two remaining bolts (4) securing the left-hand radiator top mounting bracket (3).
- 32.11 Remove the four bolts securing the radiator top cover and remove.
- 32.12 Remove the two bolts (7) securing the left-hand radiator side frame (6) to the bottom support frame (8).
- 32.13 Move the fan cowl aside and manoeuvre the intercooler (2), together with the side frame, upwards and away from the radiator.
- 32.14 Detach the side frame and withdraw the intercooler from the vehicle.
- 32.15 Slacken the clip and remove the bottom hose from the intercooler.

Refitting

33 To refit the intercooler carry out the following:

- 33.1 Fit the bottom hose to the intercooler and secure with retaining clip.
- 33.2 Manoeuvre the intercooler (Fig 16 (2)) together with the radiator left-hand side frame into position above the radiator. With the fan cowl moved to one side, carefully lower the intercooler and side frame into position. Ensure that the lugs on the intercooler locate correctly into the radiator bottom support frame.
- 33.3 Fit the two retaining bolts, (7) bottom support frame (8) to left-hand radiator side frame (6) and tighten evenly.
- 33.4 Fit the radiator top cover (5) and secure with four retaining bolts (4).
- 33.5 Secure the left-hand radiator top mounting bracket (Fig 16 (3)) in place with the two rear retaining bolts, and tighten.
- 33.6 Refit the radiator grille surround panel, ensure the correct position of the lower fixing spacers and the alignment of the upper radiator mounting brackets, secure with six bolts and four self-tapping screws.
- 33.7 Refit the horn and mounting bracket, secure with the two retaining washers, spring washers and bolts.
- 33.8 Refit the radiator grille and secure with the retaining screws.
- 33.9 Fit the connecting pipe to the turbo-charger outlet hose and the intercooler bottom hose and tighten the retaining clips.
- 33.10 Refit the connecting pipe clamp to the inner wheel arch and secure with retaining nut, bolt and washer.
- 33.11 Refit the top hose, intercooler to inlet manifold and secure with retaining clips.

- 33.12 Manoeuvre fan cowl (1) into position and secure to radiator top cover with retaining nuts.
- 33.13 Refit the cooling fan and viscous assembly (refer to Chap 12-1).
- 33.14 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).



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- | | | | |
|---|-------------------------------|---|----------------------|
| 1 | Fan cowl | 5 | Radiator top cover |
| 2 | Intercooler | 6 | Side frame |
| 3 | Radiator top mounting bracket | 7 | Retaining bolt |
| 4 | Securing bolt | 8 | Bottom support frame |

Fig 16 Intercooler removal

INDUCTION MANIFOLD**Removal**

34 To remove the induction manifold carry out the following:

- 34.1 Slacken the retaining clips and remove the hose, intercooler to induction manifold (Fig 17 (1)).

- 34.2 Remove the induction manifold rear heat shield.
- 34.3 Slacken the induction manifold lower retaining nuts (4), located below the exhaust manifold.
- 34.4 Remove the induction manifold upper retaining bolts (3) and lift the manifold (2) clear of the engine.
- 34.5 Plug the apertures in the cylinder head with a clean suitable material to prevent any items falling into the engine.
- 34.6 Check the manifold gasket is satisfactory for further use.

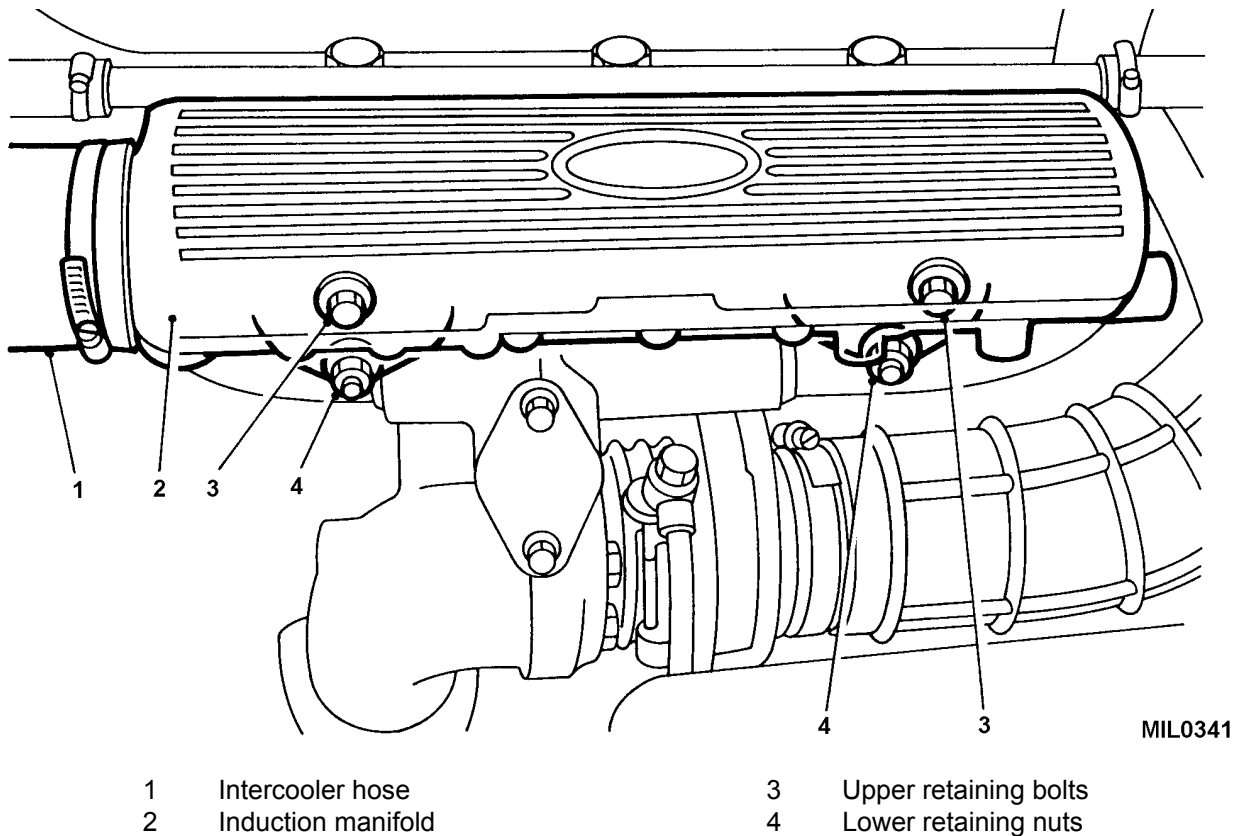


Fig 17 Induction manifold removal

Refitting

- 35 To refit the induction manifold carry out the following:
 - 35.1 Clean the induction manifold mating face.
 - 35.2 Fit the induction manifold in the reverse order to removal and tighten the securing nuts and bolts to a torque of 25 Nm (18 lbf ft).
 - 35.3 Refit the intercooler to induction manifold hose and secure with retaining clips.

PRIMING THE FUEL SYSTEM**NOTES**

- (1) If the fuel system has been completely drained carry out the procedures for priming both the sedimenter and fuel filter, and the fuel injection pump.
- (2) Always ensure that the fuel pump lever is on the bottom of the operating cam when priming, otherwise maximum movement of the lever cannot be achieved.

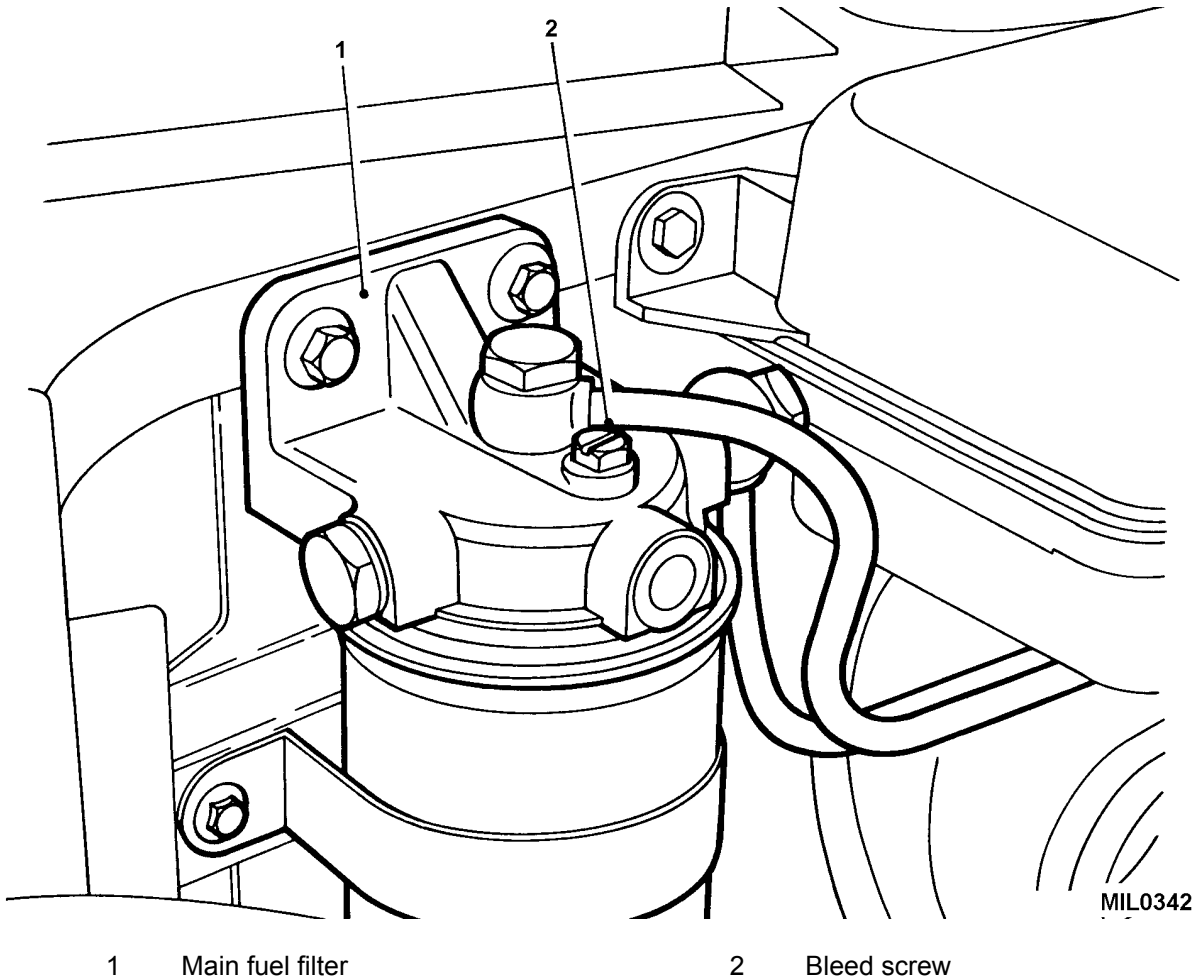
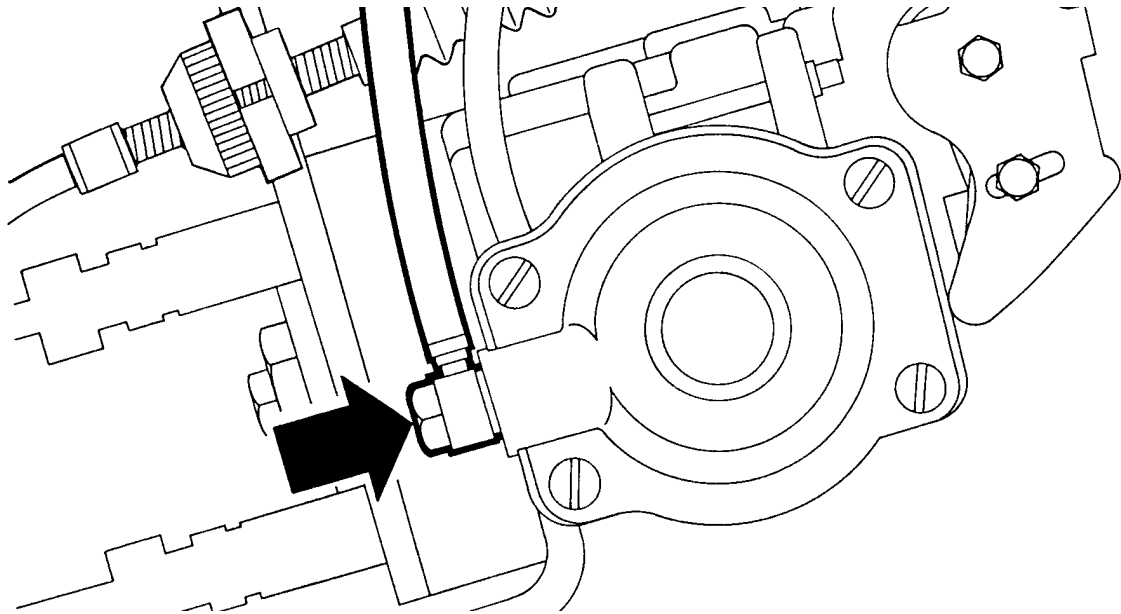


Fig 18 Priming the fuel filter

Sedimenter and fuel filter

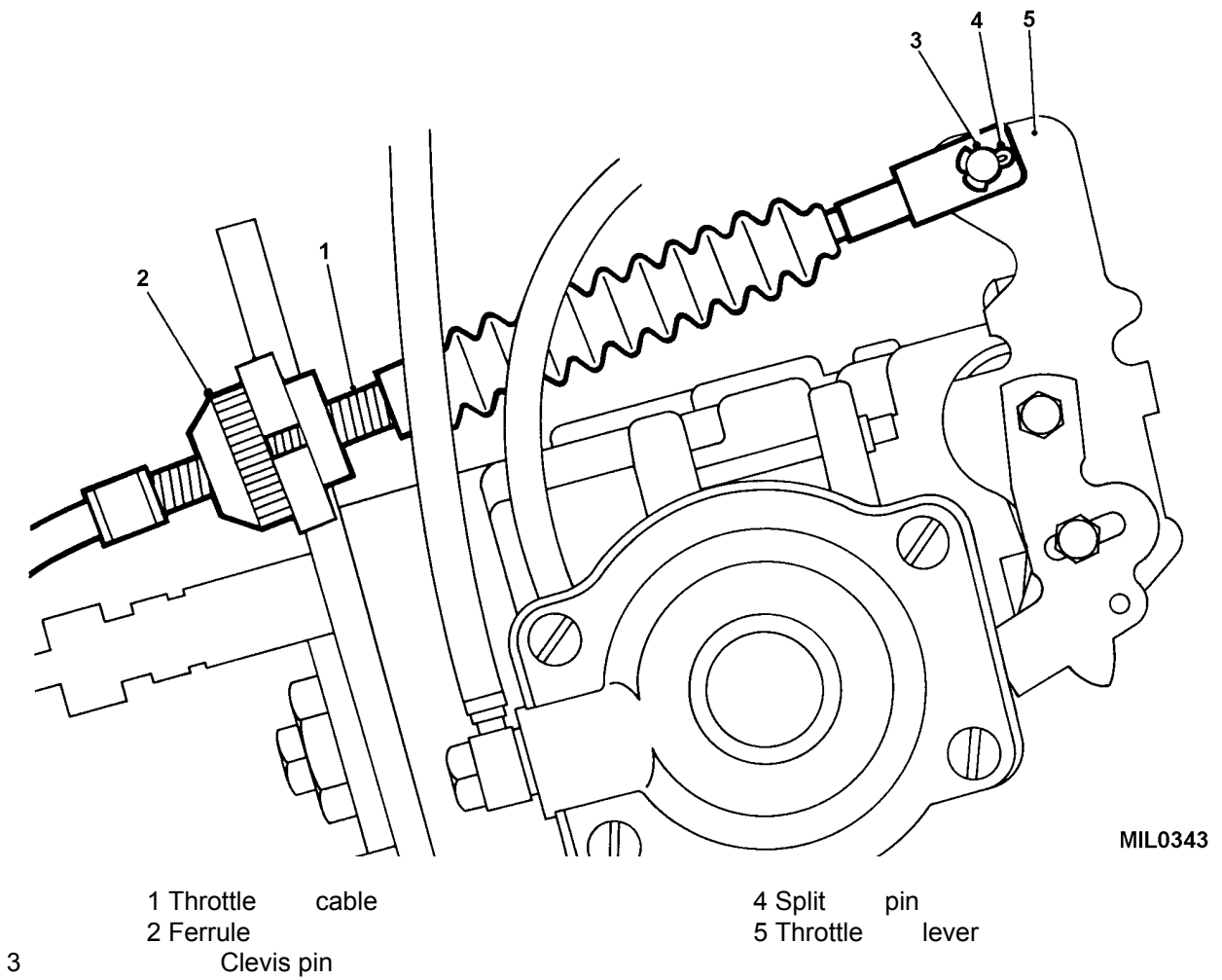
36 If the sedimenter or fuel filter have been dismantled and air has entered the system the following procedure should be carried out:

- 36.1 Slacken the bleed screw (Fig 18 (2)) on top of the main fuel filter (1).
- 36.2 Operate the hand priming lever on the fuel lift pump until air free fuel emerges.
- 36.3 Tighten the bleed screw whilst fuel is still emerging.



MIL0344

Fig 19 Fuel injector bleed point



MIL0343

Fig 20 Throttle cable removal

Fuel injection pump

37 If the fuel injection pump has been removed or renewed carry out the following:

- 37.1 Slacken the fuel inlet pipe banjo bolt on top of the injection pump (refer to Fig 19).
- 37.2 Operate the hand priming lever on the fuel lift pump until fuel free from air bubbles emerges.
- 37.3 Tighten the banjo bolt whilst fuel is still emerging.
- 37.4 Crank the engine until fuel is drawn through the system and the engine starts, check for leaks.

THROTTLE CABLE**Removal**

38 To remove the throttle cable carry out the following:

- 38.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted for Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 38.2 Remove the split pin (Fig 20 (4)) and clevis pin (3) securing the throttle cable to the throttle lever on the fuel injection pump.
- 38.3 Depress the tags on the throttle cable ferrule (2), pull from the abutment bracket and withdraw the throttle cable (1).
- 38.4 Release the throttle cable from the clip on the bulkhead.
- 38.5 From inside the vehicle, remove the pin and clevis pin securing the throttle cable to the accelerator pedal.
- 38.6 Release the grommet from the bulkhead and withdraw the throttle cable from the engine compartment.

Refitting

39 To refit the throttle cable proceed as follows:

- 39.1 From the engine compartment pass the cable through the bulkhead and fit the cable grommet in position.
- 39.2 Using a new split pin secure the cable to the accelerator pedal with the clevis pin.
- 39.3 Guide the throttle cable through the location hole in the abutment bracket at the rear of the injection pump and push the ferrule (2) until it locates.
- 39.4 Using a new split pin (4) secure the cable end to the throttle lever, on the fuel injection pump, with the clevis pin (3).
- 39.5 Adjust the throttle cable (refer to Para 40).
- 39.6 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

Adjustment

40 To adjust the throttle cable proceed as follows:

- 40.1 Slacken the throttle cable adjustment ferrule (Fig 20 (2)).
- 40.2 Hold the throttle lever (5) on the injection pump in the fully closed position.
- 40.3 Adjust the outer cable, by rotating the ferrule , to give 1.57 mm (0.062 in.) of free play in the inner cable (1).
- 40.4 Check that the throttle opens fully when the throttle is depressed.

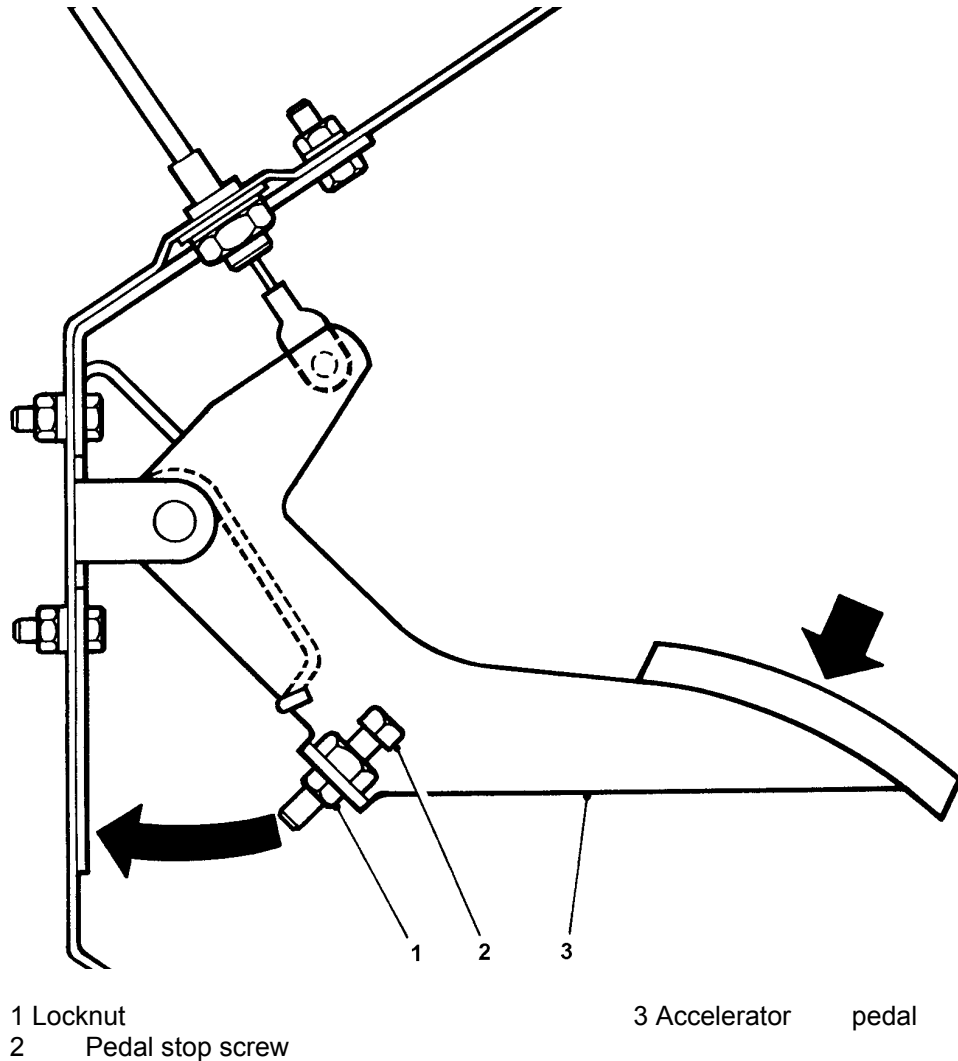


Fig 21 Accelerator pedal adjustment

Accelerator pedal adjustment

- 41 If the accelerator pedal has been renewed it will be necessary to carry out the following adjustments:
- 41.1 Remove any slack in the cable by adjustment of the cable ferrule at the injection pump end.

41.2 Depress the accelerator pedal (Fig 21 (3)), by hand, to the full extent of the injection pump linkage and adjust the pedal stop screw (2) to take up all the clearance between the adjusting screw and the scuttle panel.

41.3 Check to ensure that no strain is placed upon the injection pump linkage.

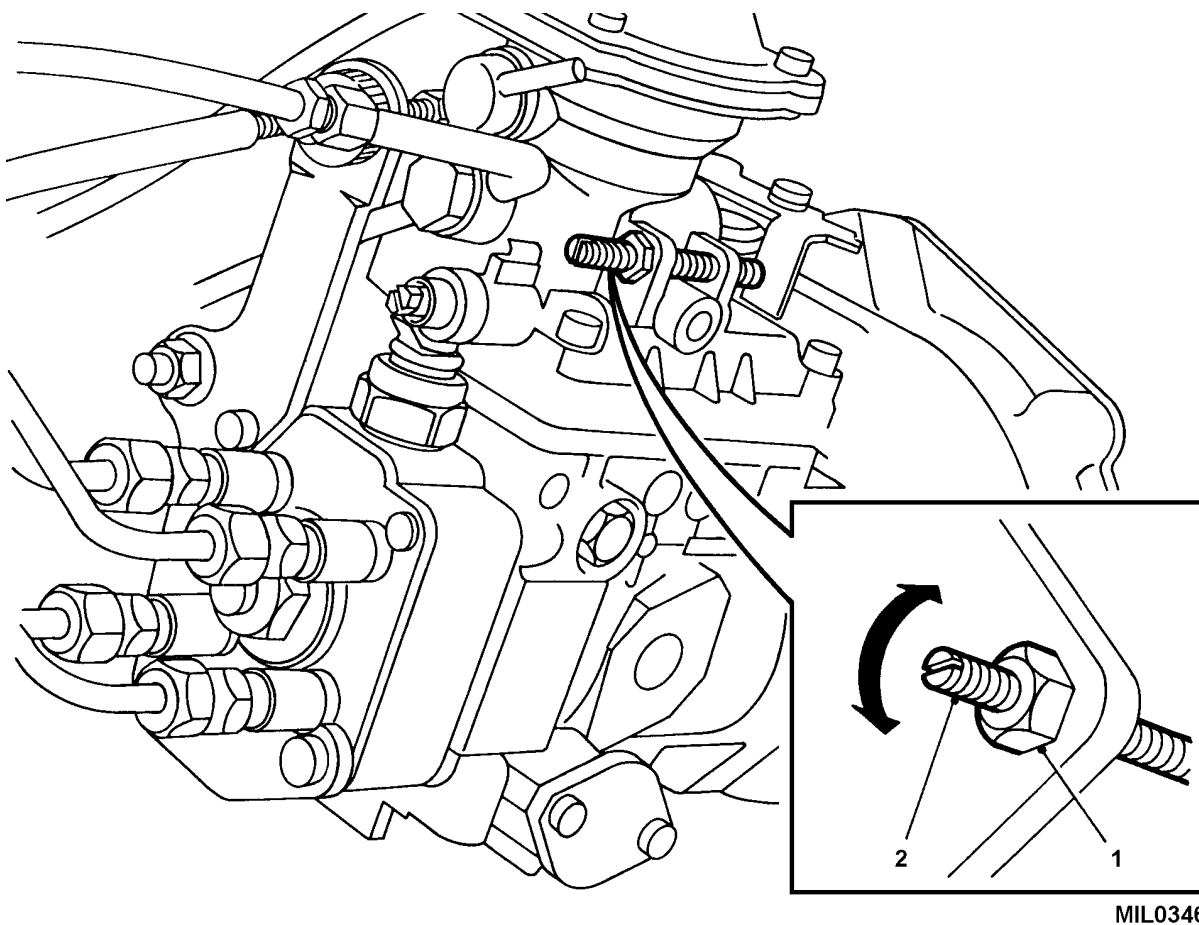
41.4 After adjustment secure the pedal stop screw with the locknut (1).

41.5 Adjust the throttle cable (refer to Para 40) and check that the throttle linkage operates fully when the accelerator is depressed.

High and low idle speed adjustment

NOTE

The high idle speed (cold start idle) is automatically set by the setting of the low idle speed and cannot be adjusted individually.



1 Locknut

2 Adjusting screw

Fig 22 High and low idle speed adjustment

42 To check and adjust the idle speed proceed as follows:

42.1 Check the throttle cable free play and adjust (refer to Para 40) if necessary.

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

42.3 Using a suitable tachometer, check the engine idle speed. The correct figure for this setting is 760 ± 20 rev/min.

42.4 If adjustment is necessary, loosen the locknut (Fig 22 (1)) on the injector pump.

42.5 Turn the adjustment screw (2) either clockwise to increase the engine speed or anti-clockwise to decrease the speed. Run the engine at an increased speed for a few seconds then check the idle speed again.

42.6 When the correct speed has been achieved, hold the adjuster screw steady while tightening the locknut.

NOTE

The low idle speed control is the only permitted adjustment in service. Any additional adjustments required must be performed when the pump is backloaded for repair/overhaul.

EXHAUST SYSTEM

NOTE

The following procedure covers the removal of the exhaust system of the TUM vehicles. A similar procedure should be adopted for the exhaust system of the TUL vehicles as only the shape of the intermediate and final stage components, and the location of their mountings differ.

REMOVAL

43 To remove the exhaust system proceed as follows:

WARNINGS

(1) HEAT INJURY HAZARD. COMPONENTS WILL BECOME EXTREMELY HOT WHEN THE ENGINE IS RUNNING. IN ORDER TO PREVENT THE POSSIBILITY OF SEVERE PERSONAL INJURY, ADEQUATE TIME MUST BE ALLOWED FOR THE SYSTEM TO COOL, BEFORE ANY WORK IS UNDERTAKEN.

(2) VEHICLE SAFETY. ENSURE THE VEHICLE IS SAFELY POSITIONED ON RAMPS BEFORE ANY WORK IS ATTEMPTED FROM UNDER THE VEHICLE.

43.1 Remove the nuts securing exhaust front down pipe to the exhaust manifold flange.

43.2 Remove the through bolt securing front down pipe mounting bracket to the chassis.

43.3 Remove the bracket and rubber mounting (Fig 23 (3) and 24 (3)) from the exhaust pipe.

43.4 Remove the flange nuts securing front down pipe (2) to the intermediate exhaust pipe (4) and separate the flanges.

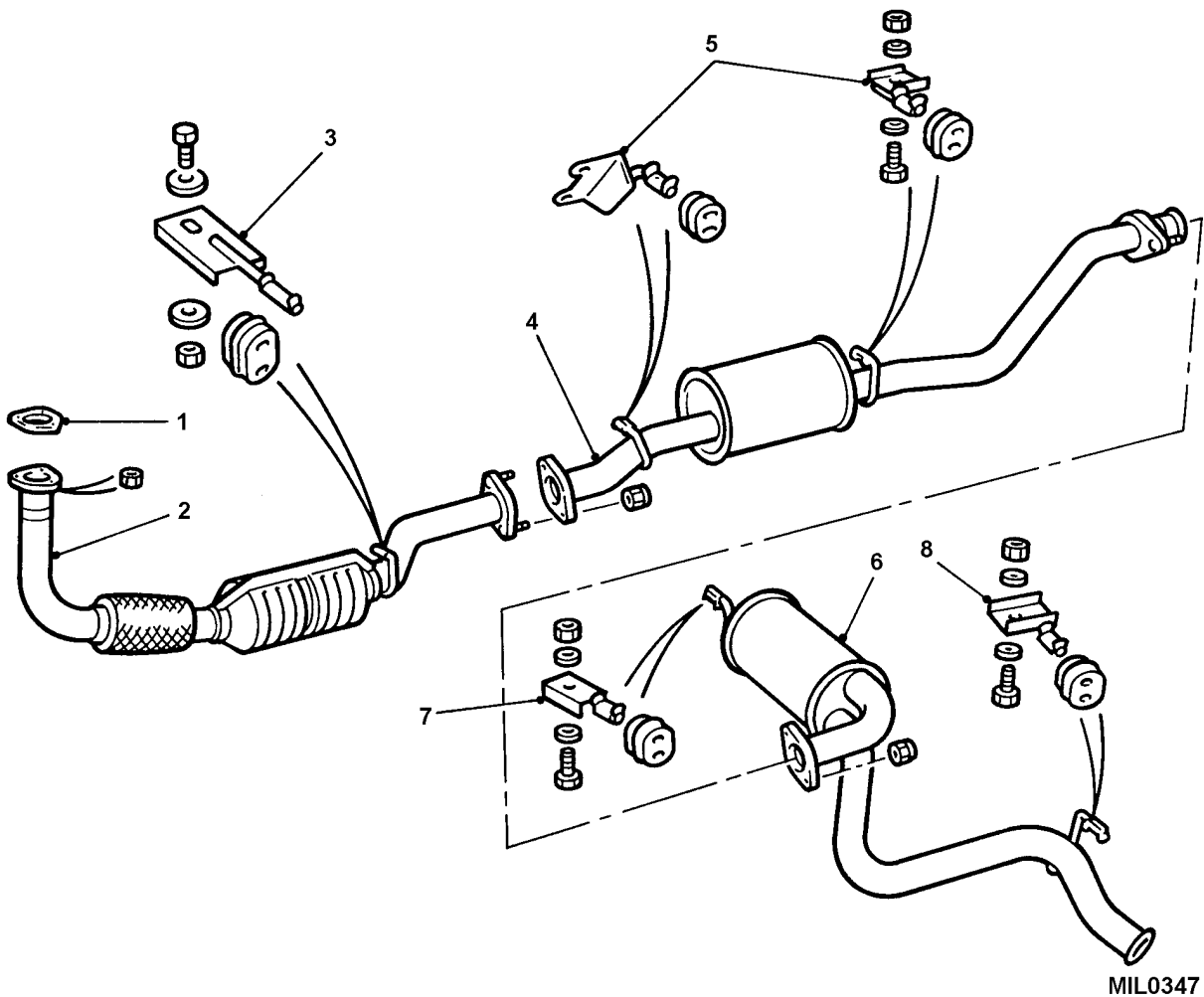
43.5 Release the front down pipe at the manifold and remove the gasket (1).

43.6 Move the front down pipe rearwards, lower the front end and at the same time twist toward the propeller shaft. Move the pipe forward and withdraw from under the vehicle.

43.7 Support the intermediate silencer and remove the flange nuts securing the intermediate exhaust pipe (4) to the final stage silencer (6) and separate the flanges.

43.8 Remove the nut, bolt and washer securing the intermediate support bracket (5) to the chassis mounting, and withdraw the intermediate exhaust silencer from under the vehicle.

- 43.9 Remove the bracket and rubber mounting from the exhaust pipe.
- 43.10 Support the final stage silencer and remove the nut, bolt and washer securing the tail pipe mounting (8) to the rear chassis cross-member.
- 43.11 Remove the nut, bolt and washer securing the final stage silencer front mounting (7) to the chassis mounting.
- 43.12 Lower the silencer and manoeuvre the exhaust pipe over the rear axle and withdraw from under the vehicle.
- 43.13 Remove the brackets and rubber mountings from the exhaust pipe noting their relative positions.



- | | |
|--------------------------------------|---------------------------------|
| 1 Gasket | 5 Intermediate support brackets |
| 2 Down pipe with catalytic converter | 6 Final stage silencer |
| 3 Front mounting bracket | 7 Final stage silencer mounting |
| 4 Intermediate exhaust pipe | 8 Tail pipe mounting |

Fig 23 Exhaust system (TUL)

REFITTING

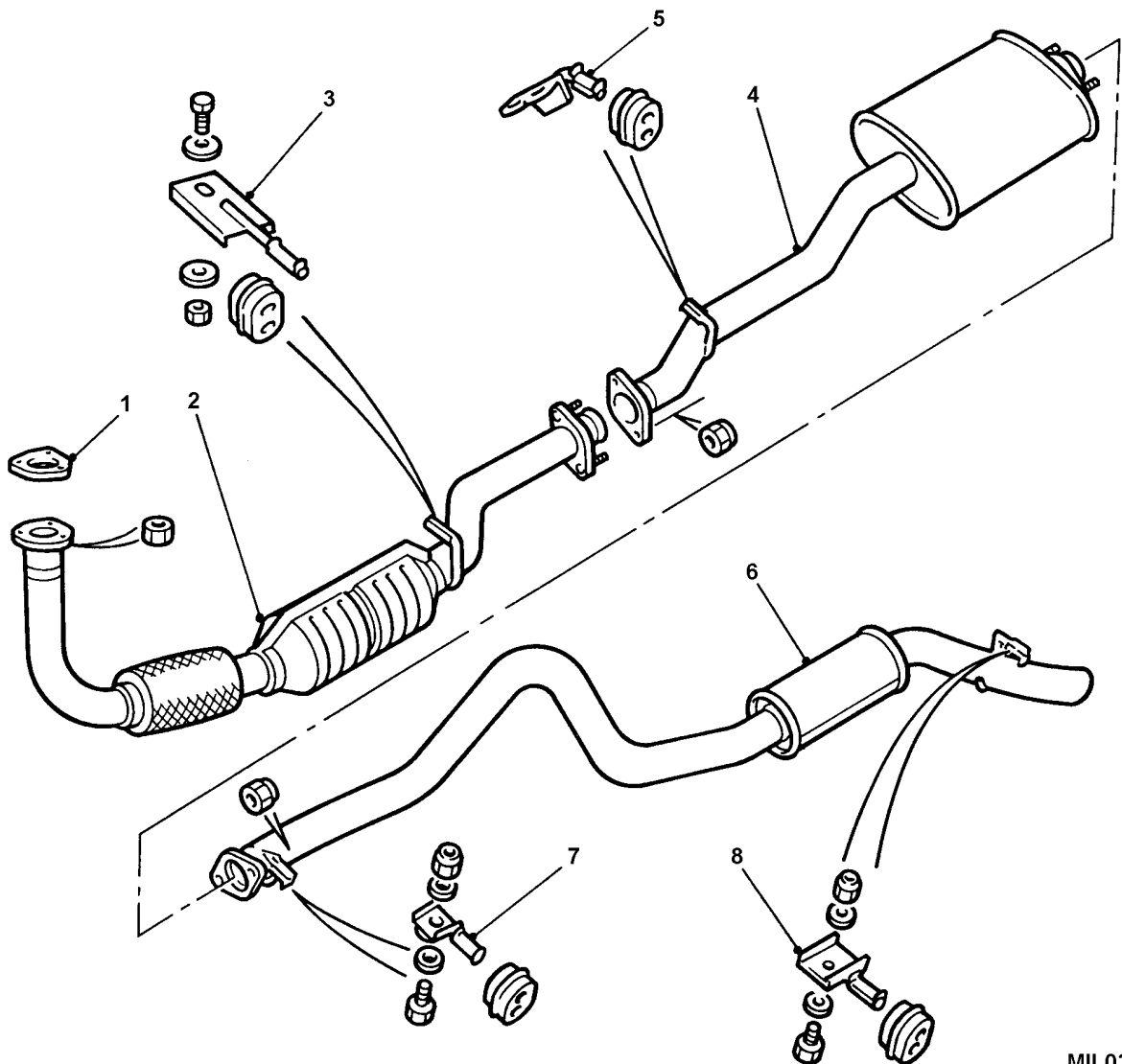
44 To refit the exhaust system, reverse the removal procedure, using a new exhaust manifold gasket and replacing the mounting rubbers where necessary.

WARNING

VEHICLE SAFETY. ENSURE THE VEHICLE IS SAFELY POSITIONED ON RAMPS BEFORE ANY WORK IS ATTEMPTED FROM UNDER THE VEHICLE.

NOTE

The type of jointing arrangement adopted, allows easier fitting and ensures a more efficient seal.



MIL0348

- 1 Gasket
- 2 Downpipe with catalytic converter
- 3 Front mounting bracket
- 4 Intermediate exhaust pipe

- 5 Intermediate support bracket
- 6 Final stage silencer
- 7 Final stage silencer front mounting
- 8 Tail pipe mounting

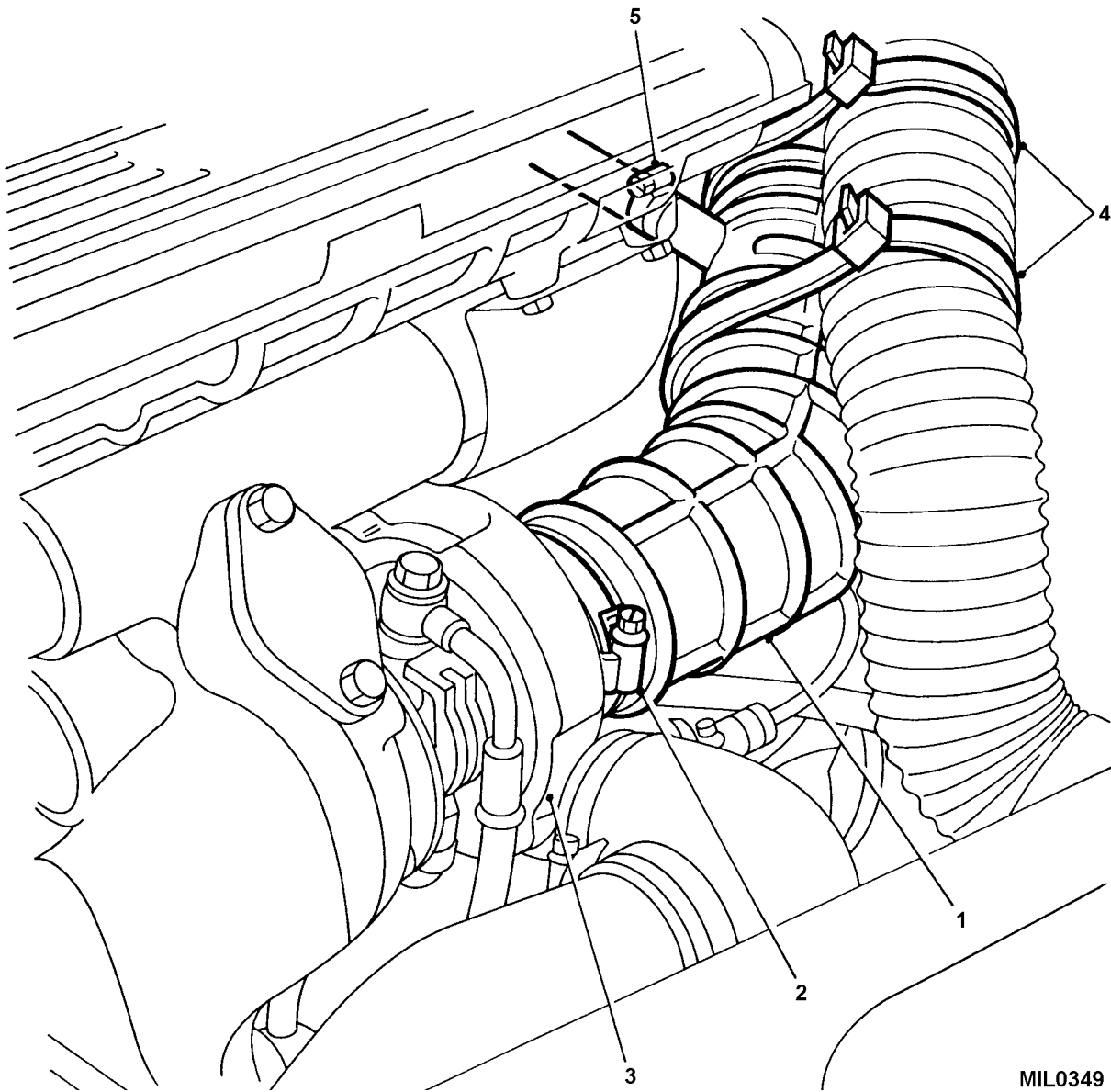
Fig 24 Exhaust system (TUM)

TURBO-CHARGER INLET HOSE

Removal

45 To remove the turbo-charger inlet hose carry out the following:

- 45.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 45.2 Loosen the hose clip (Fig 25 (2)) and disconnect the inlet hose (1) from the turbo-charger (3).
- 45.3 Loosen the hose clip and disconnect the breather hose (5) from the inlet hose.



MIL0349

1 Inlet hose
2 Hose clip
3 Turbo-charger

4 Hose ties
5 Breather hose

3

Fig 25 Turbo-charger inlet hose removal

45.4 Loosen the hose clip and disconnect the inlet hose from the air cleaner.

45.5 Remove the two hose ties (4) securing the inlet hose to the left hand side air intake hose and remove the inlet hose.

Refitting

46 To refit the turbo-charger inlet hose reverse the removal procedure. Using new hose ties secure the inlet hose to the air intake hose and securely tighten the hose retaining clips.

TURBO-CHARGER OIL FEED PIPE

Removal

47 To remove the oil feed pipe carry out the following:

47.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

47.2 Remove the banjo bolt (Fig 26 (1)) securing the oil feed pipe (3) to the top of the turbo-charger and discard the two sealing washers (2).

47.3 Unscrew the oil feed pipe union (4) and disconnect from the adapter on the cylinder block.

CAUTION

CONTAMINATION. Plug the connections to prevent the ingress of dirt.

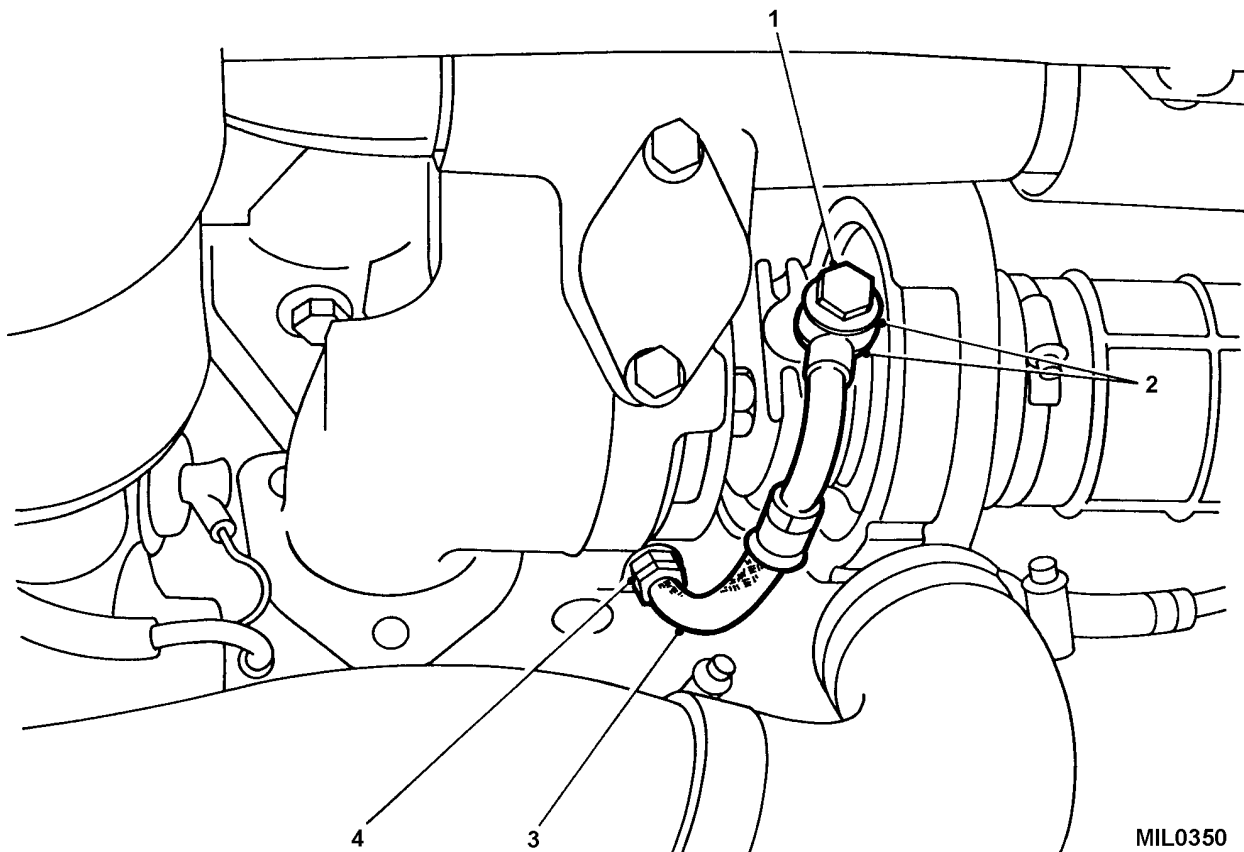
47.4 Manoeuvre the oil feed pipe clear of the turbo-charger and intercooler pipe and remove.

Refitting

48 To refit the turbo-charger oil feed pipe carry out the following:

48.1 Reverse the removal procedure, using new sealing washers tighten the banjo bolt to the turbo-charger to a torque of 20 Nm (15 lbf ft), and tighten the oil feed pipe union to cylinder block adapter to a torque of 25 Nm (18lbf ft).

48.2 Check the engine oil level and top-up if necessary (refer to Table 2 Serial 4).



- | | | | |
|---|-----------------|---|-----------------|
| 1 | Banjo bolt | 3 | Oil feed pipe |
| 2 | Sealing washers | 4 | Feed pipe union |

Fig 26 Turbo-charger oil feed pipe removal

TURBO-CHARGER OIL DRAIN PIPE

Removal

49 To remove the turbo-charger oil drain pipe proceed as follows:

49.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted for Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

49.2 Unscrew the union and disconnect the oil drain pipe (Fig 27 (2)) from the union (3) on the cylinder block.

49.3 Remove the two bolts (1) securing the oil drain pipe to the base of the turbo-charger.

49.4 Remove the oil drain pipe (2). Remove and discard the gasket.

CAUTION

CONTAMINATION. Plug the connections to prevent the ingress of dirt.

Refitting

50 To refit the turbo-charger oil drain pipe carry out the following:

- 50.1 Ensure the mating surfaces of the oil drain pipe, turbo-charger and engine block adapter are clean.
- 50.2 Reverse the removal procedure using a new gasket at the pipe flange to turbo-charger.
- 50.3 Tighten the oil drain pipe to turbo-charger bolts to a torque of 25 Nm (18 lbf ft) and the union to the cylinder block to a torque of 38 Nm (28 lbf ft).
- 50.4 Check the engine oil level and top-up if necessary (refer to Table 2 serial 4).

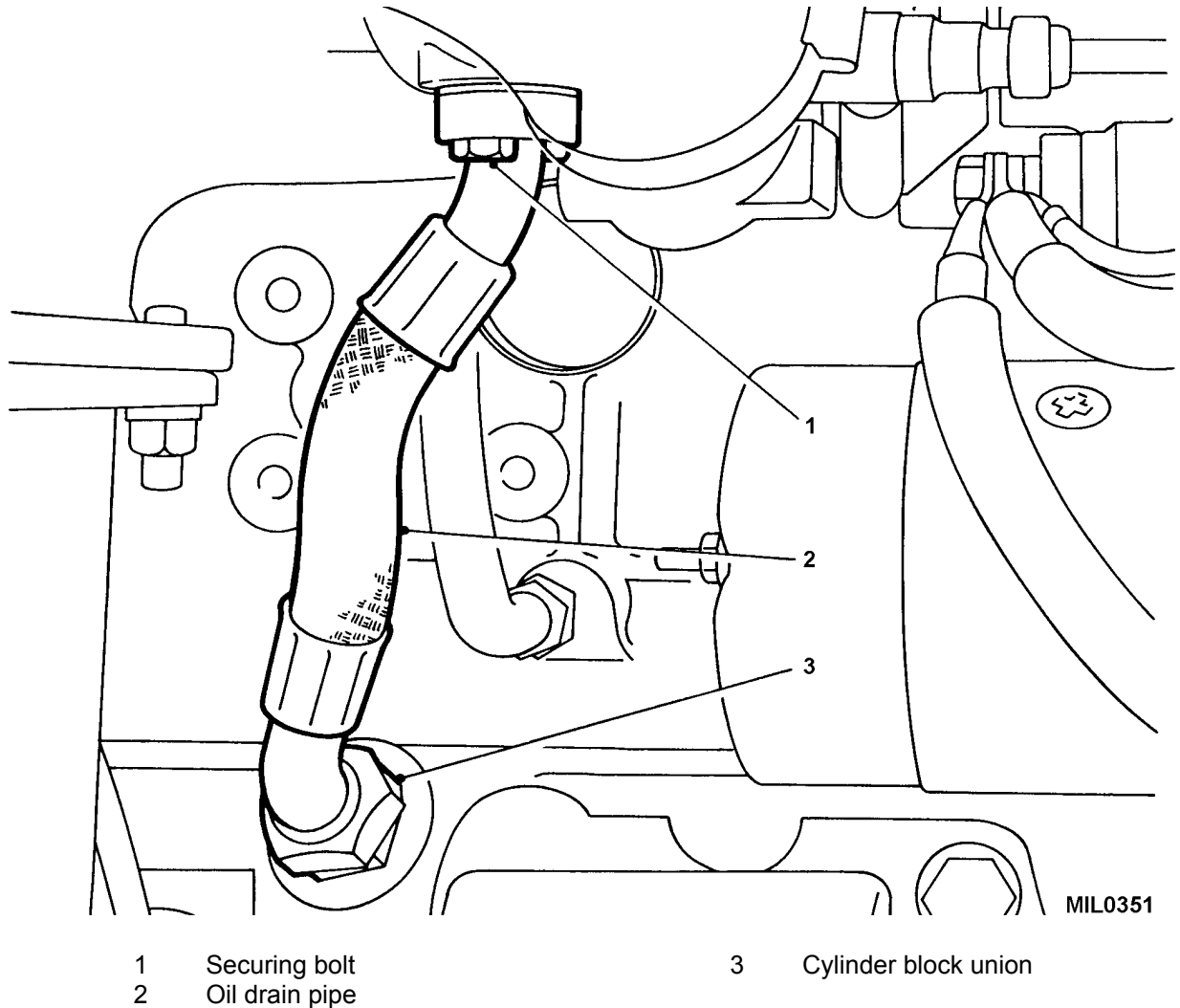


Fig 27 Turbo-charger oil drain pipe removal

TURBO-CHARGER AND EXHAUST MANIFOLD

Removal

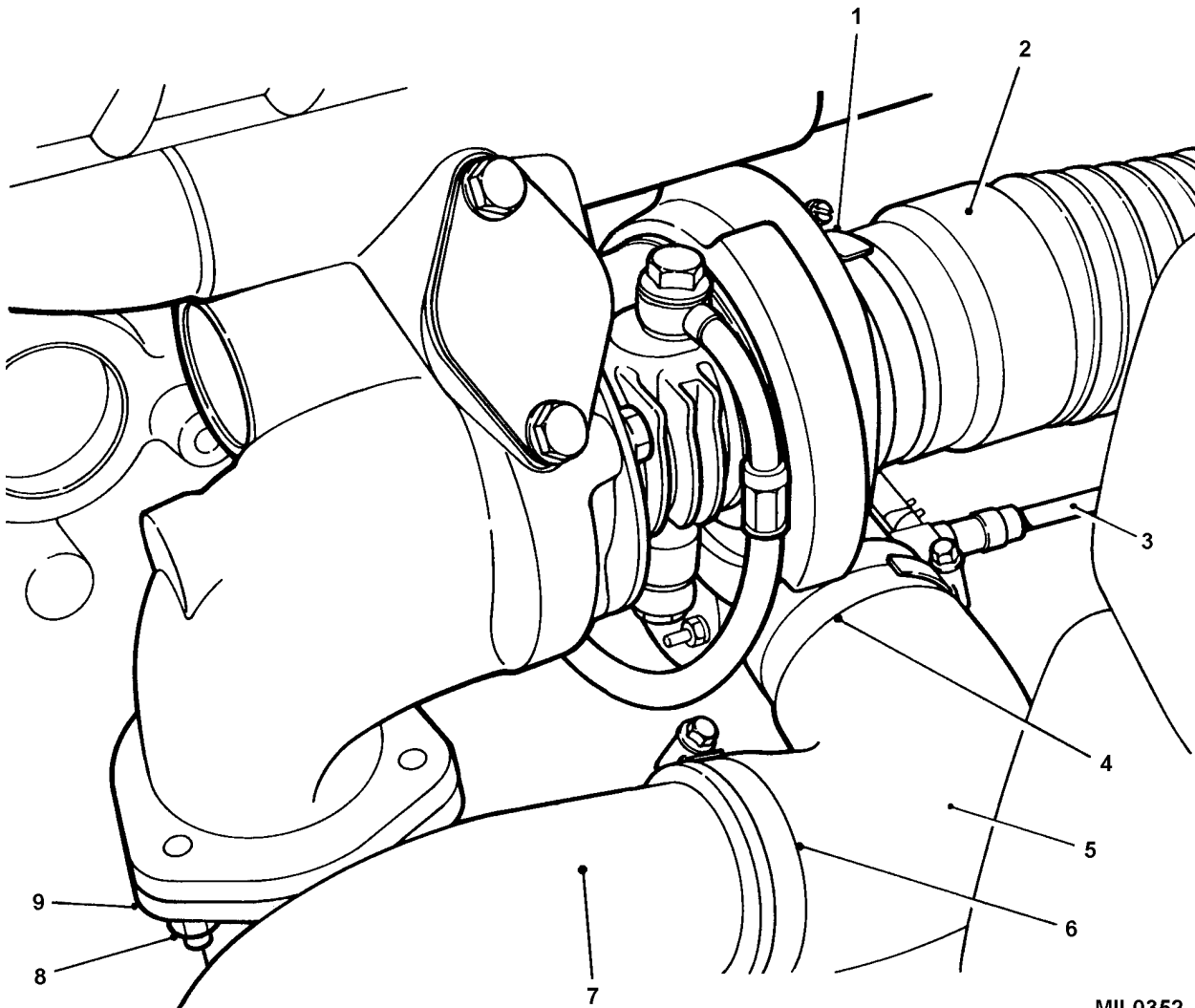
51 To remove the turbo-charger and exhaust manifold proceed as follows:

- 51.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 51.2 Release the turbo-charger to air cleaner hose retaining clip (Fig 28 (1)) and move the hose (2) to one side.

51.3 Loosen the clips and remove the top hose, intercooler to inlet manifold.

51.4 Remove the retaining clamp securing the lower intercooler connecting pipe (7) to the inner wheel arch.

51.5 Loosen the clips (4 and 6) and disconnect the lower intercooler connecting pipe and turbo-charger outlet pipe (5) from the connecting pipe, and remove.



MIL0352

- | | |
|-----------------------------|-------------------------------------|
| 1 Clip | 6 Clip |
| 2 Air cleaner hose | 7 Lower intercooler connecting pipe |
| 3 Boost pressure pipe | 8 Nut |
| 4 Clip | 9 Exhaust down pipe |
| 5 Turbo-charger outlet pipe | |

Fig 28 Turbo-charger and exhaust manifold

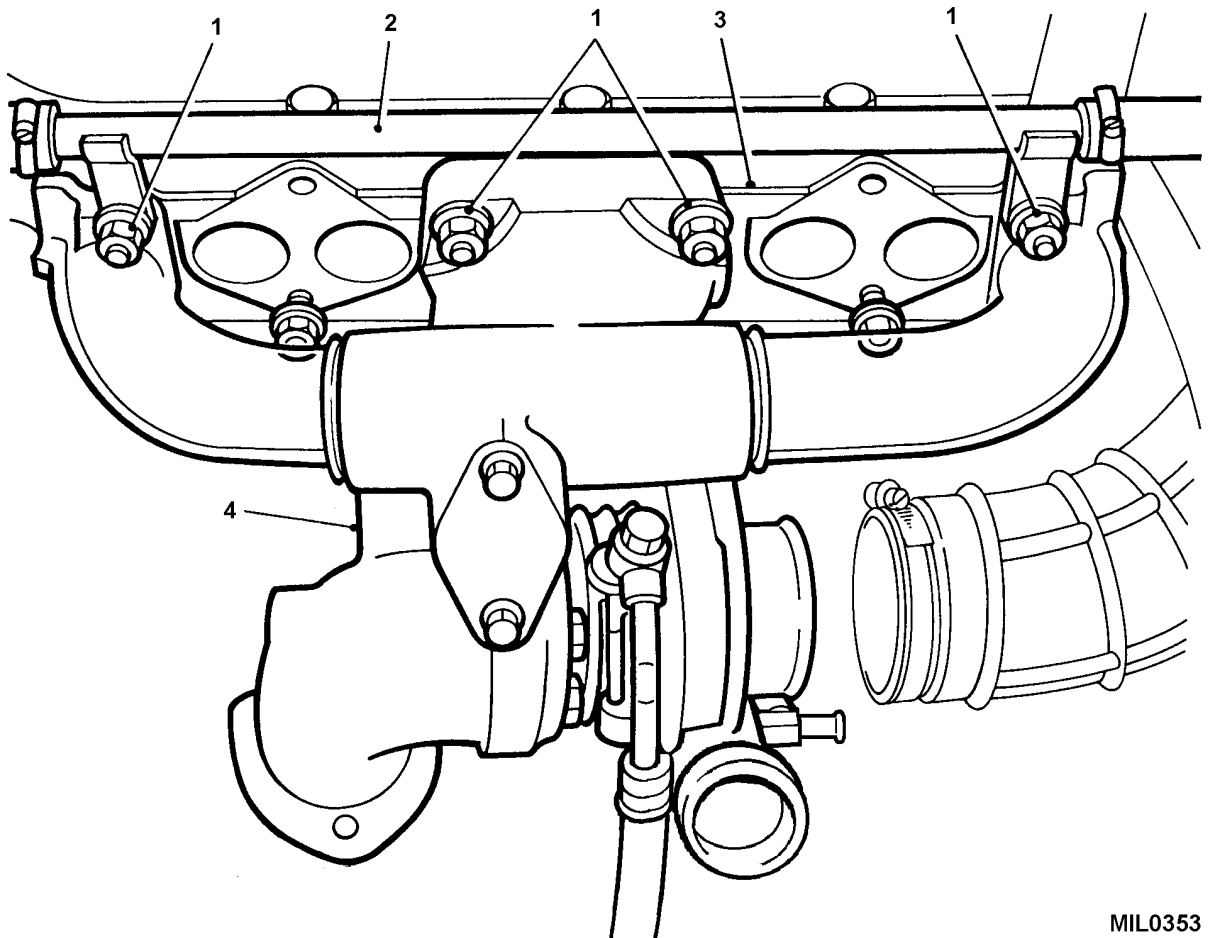
51.6 Release the turbo-charger oil pipes from the cylinder block (refer to Para 47 and 49).

51.7 Remove the turbo-charger boost pressure pipe (3) from the union.

51.8 Remove the nuts (8) securing the exhaust down pipe (9) to the exhaust manifold flange.

51.9 Remove the induction manifold (refer to Para 34).

51.10 Remove the seven nuts (Fig 29 (1)) securing the exhaust manifold. Release the heater rail (2) and remove the exhaust manifold and induction manifold unit (4) complete with manifold gasket (3).



MIL0353

- | | | | |
|---|----------------------|---|-------------------------|
| 1 | Exhaust manifold nut | 3 | Gasket |
| 2 | Heater rail | 4 | Induction manifold unit |

Fig 29 Exhaust manifold removal

Refitting

52 To refit the turbo-charger and exhaust manifold assembly carry out the following:

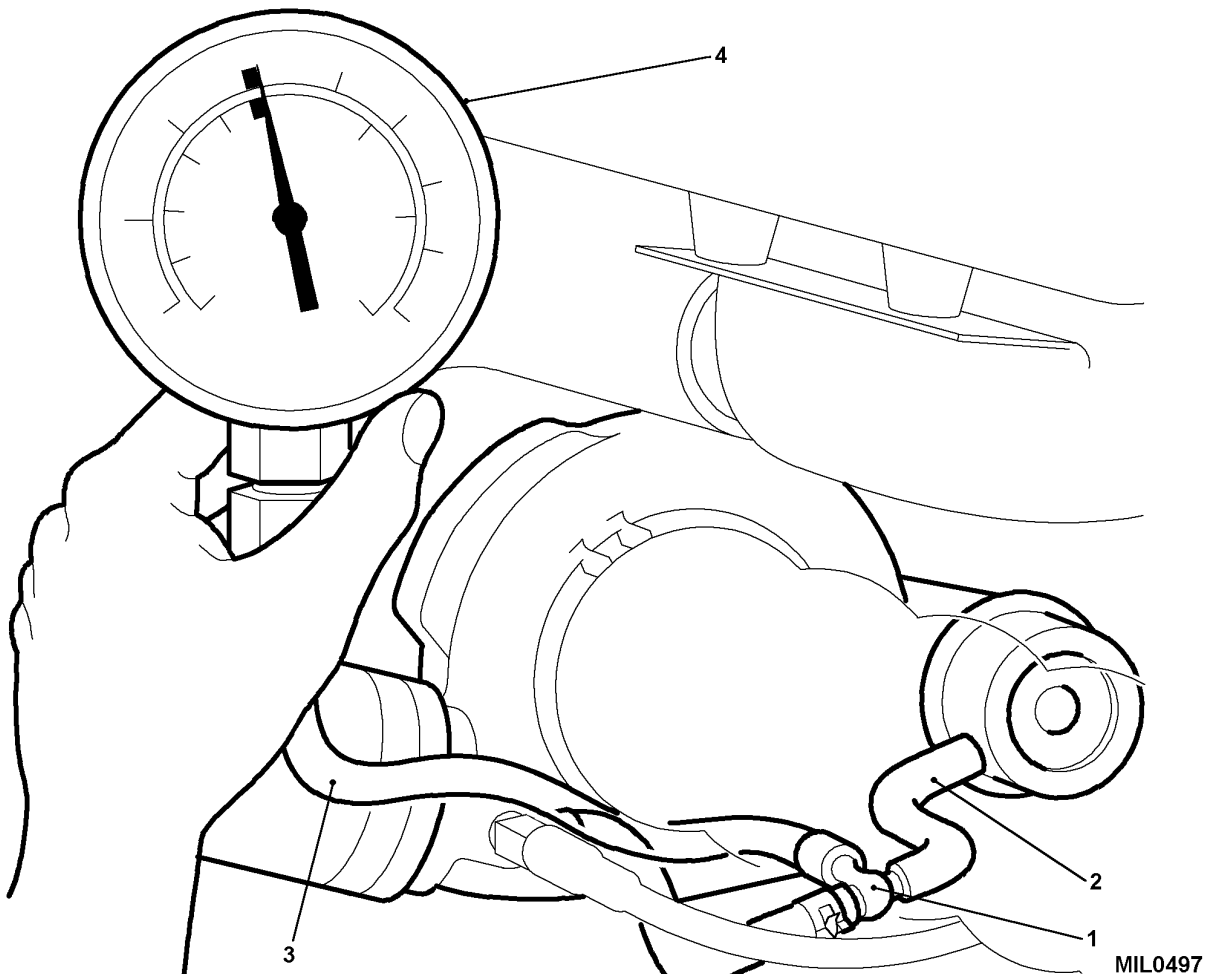
- 52.1 Reverse the removal procedure, using a new exhaust/induction manifold gasket and tighten the exhaust manifold securing nuts to a torque of 45 Nm (33 lbf ft).
- 52.2 Refit the induction manifold.
- 52.3 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2). Start the engine and check for leaks.

TURBO-CHARGER BOOST PRESSURE

Testing the turbocharger boost pressure

53 To test the turbocharger boost pressure proceed as follows:

- 53.1 Disconnect actuator hose from turbocharger and insert a suitable 'T' piece connector (Fig 30 (1)).
- 53.2 Connect a short length of hose (2) to the turbocharger and 'T' piece.



1 'T' piece connector
2 Hose

3 Hose
4 Gauge

Fig 30 Turbocharger boost pressure

- 53.3 Connect a further hose (3) to the 'T' piece and pressure gauge (4).

NOTE

The pressure gauge hose must be long enough to reach into the vehicle cab so that the gauge can be observed by the driver or passenger.

- 53.4 To check maximum boost pressure, drive vehicle normally, but in such a manner that full throttle can be maintained whilst climbing a hill with engine speed held steady between 2500 and 3000 rpm.
- 53.5 Under these circumstances boost pressure should read 0.95 - 1.09 Kgf cm³ (13.5 - 15.5 lb in²).
- 53.6 If turbocharger fails to meet the required readings, replace the turbocharger.

CHAPTER 11-2

ELECTRONIC EXHAUST GAS RECIRCULATION (EEGR)

CONTENTS

Para

- 1 Introduction
Torque list
ELECTRONIC EXHAUST GAS RECIRCULATION
EGR valve
- 2 Remove
- 3 Refit
VALVE MODULATOR
- 4 Remove
- 5 Refit
THROTTLE POTENTIOMETER
- 6 Remove
- 7 Refit
ELECTRONIC CONTROL UNIT
- 8 Remove
- 9 Refit

Fig

Page

1	EEGR valve removal.....	2	
2	Valve modulator removal		3
3	Throttle potentiometer.....	4	
4	Electronic control unit.....	5/6	

INTRODUCTION

1 This chapter details the Unit repairs for the electronic exhaust gas recirculation system (EEGR) fitted to the Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles.

TORQUE LIST

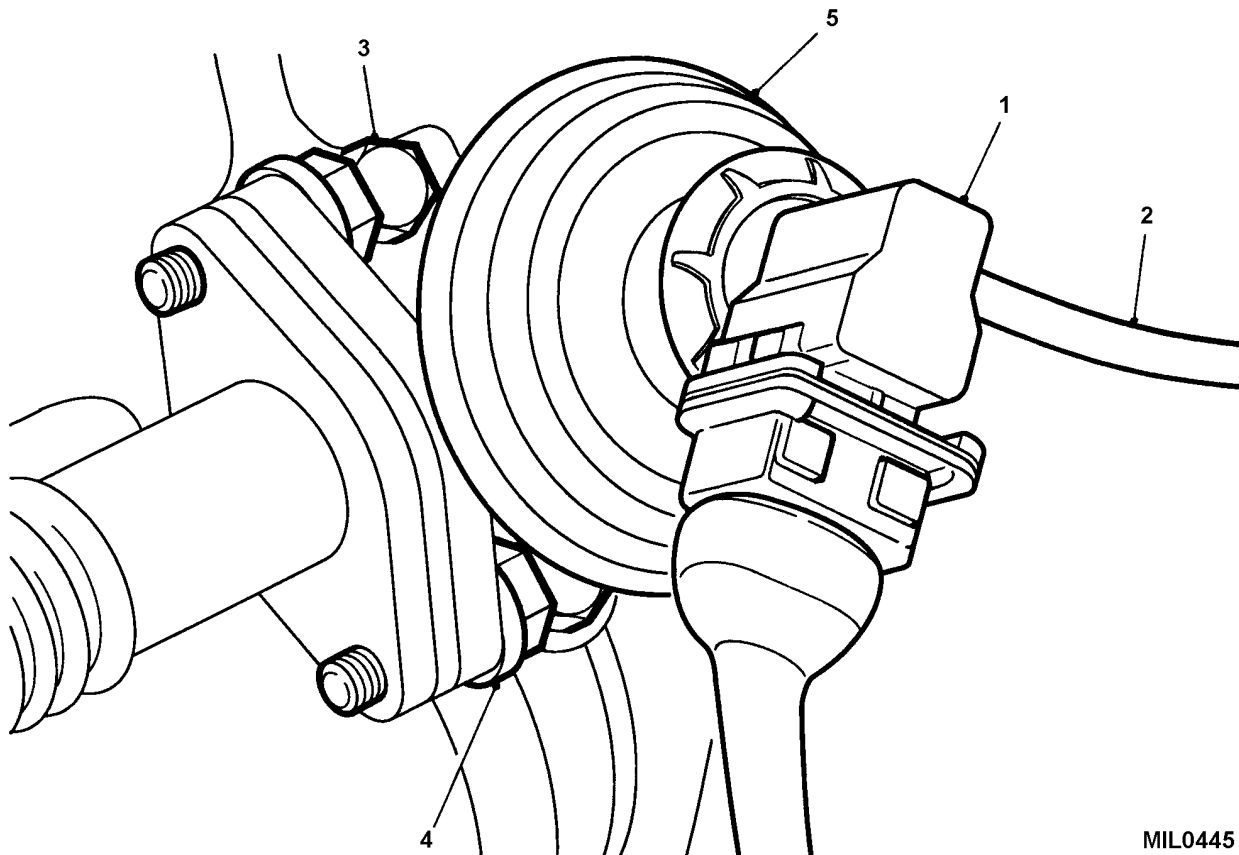
EGR valve to delivery tube	25 Nm/18 lbf ft
EGR valve to exhaust manifold	25 Nm/18 lbf ft
EGR modulator flexible mountings	8 Nm/6 lbf ft

EEGR VALVE

Remove

- 2 To remove the EEGR valve carry out the following:
 - 2.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
 - 2.2 Disconnect the multiplug (Fig 1 (1)) from the valve.
 - 2.3 Disconnect the vacuum pipe (2) from the valve.
 - 2.4 Remove the two screws (3) securing valve to exhaust manifold.

- 2.5 Remove two bolts (4) securing air inlet delivery tube to valve.
- 2.6 Remove (5) EEGR valve and discard gaskets.



MIL0445

- | | |
|----------------|--------------|
| 1 Multiplug | 4 Bolt |
| 2 Vacuum pipe | 5 EEGR valve |
| 3 Allen screws | |

Fig 1 EEGR valve removal

Refit

- 3 Refit the EEGR valve as follows:
 - 3.1 Clean mating surfaces of valve and exhaust manifold.
 - 3.2 Position new gaskets and fit valve to delivery tube and exhaust manifold. Tighten bolts to a torque of 25 Nm (18 lbf/ft).
 - 3.3 Fit vacuum pipe and multiplug to the valve.
 - 3.4 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

VALVE MODULATOR**Remove**

- 4 To remove the valve modulator carry out the following:

- 4.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 4.2 Disconnect the multiplug (Fig 1 (1)) from the modulator.
- 4.3 Disconnect spill pipe (2) modulator to air cleaner hose.
- 4.4 Disconnect vacuum pipe (3) modulator to EGR valve.
- 4.5 Disconnect vacuum pipe (4) modulator to brake servo pipe.
- 4.6 Unscrew two nuts (5) securing modulator to flexible mountings.
- 4.7 Remove modulator (6).

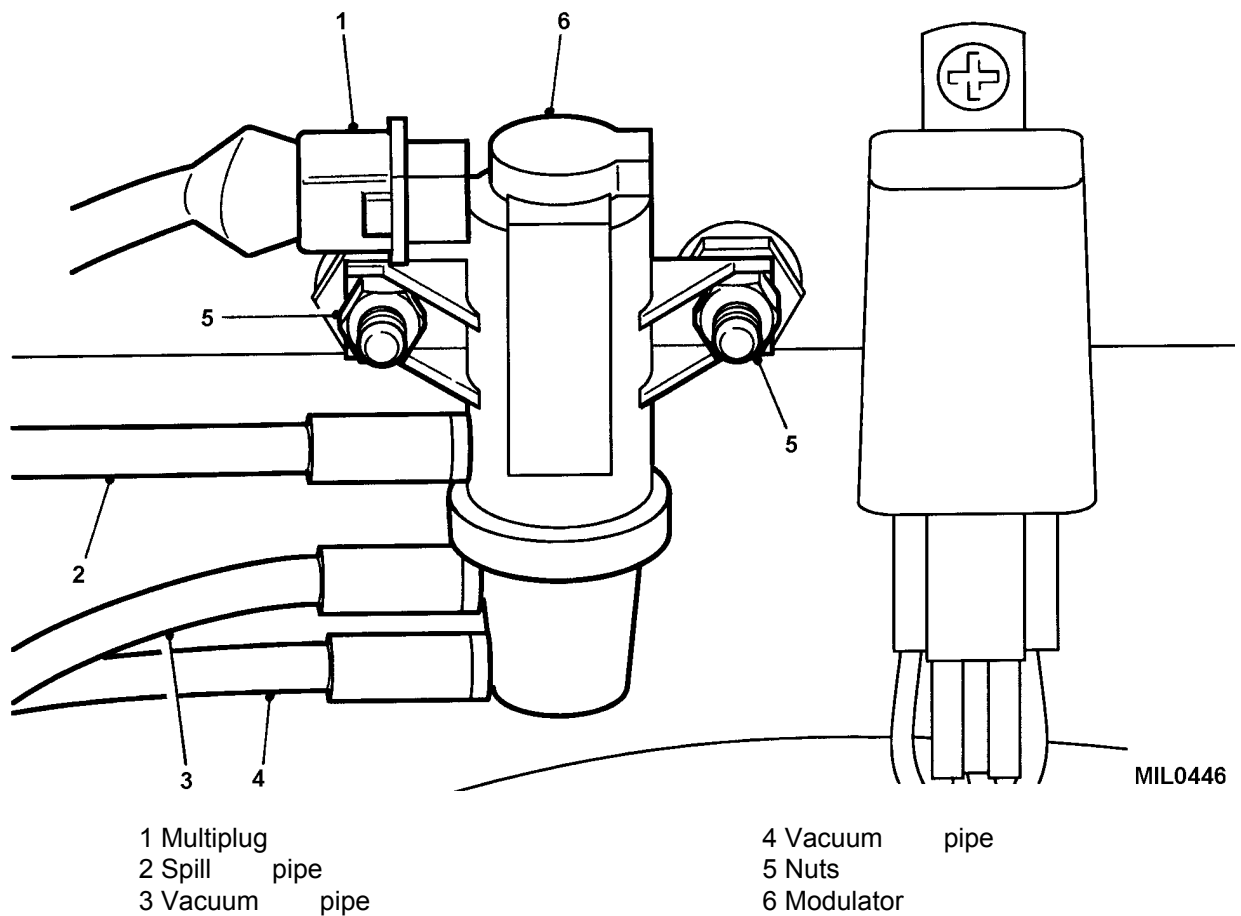


Fig 2 Valve modulator removal.

Refit

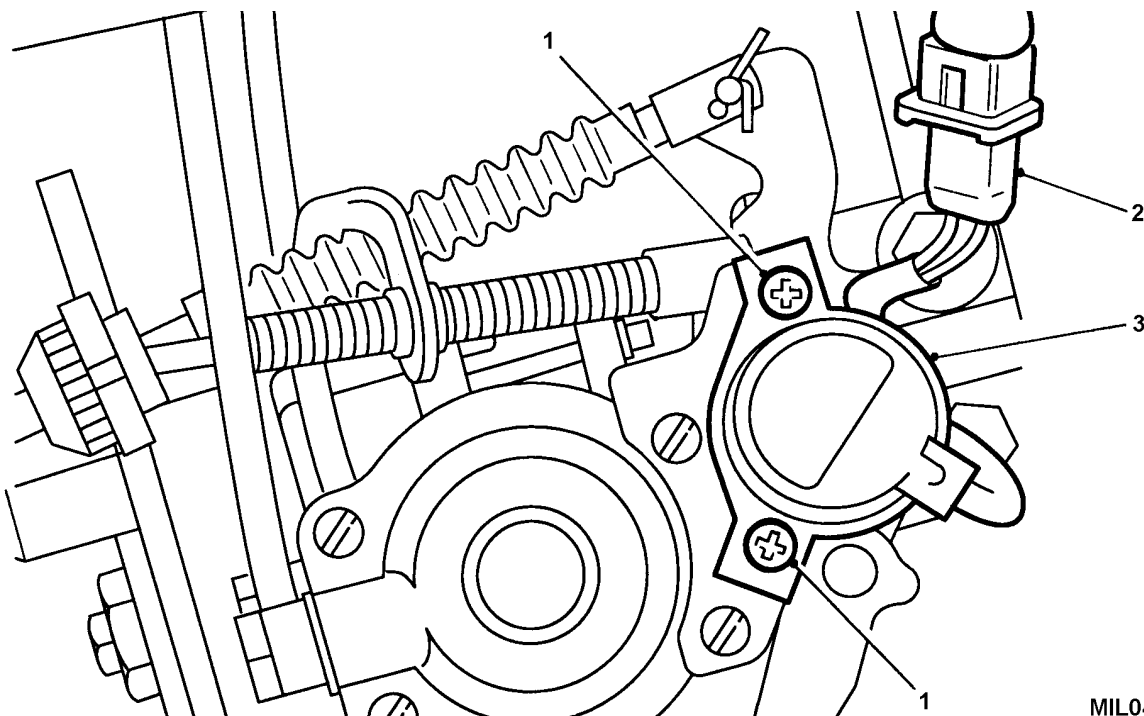
- 5 To refit the EGR valve modulator carry out the following:
 - 5.1 Fit modulator to flexible mountings and tighten nuts to a torque of 8 Nm (6 lbf/ft)
 - 5.2 Fit modulator pipes ensuring they are connected to the correct ports.
 - 5.3 Connect modulator multiplug.

- 5.4 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

THROTTLE POTENTIOMETER

Remove

- 6 To remove the throttle potentiometer carry out the following:
- 6.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
 - 6.2 Remove two screws (Fig 3 (1)) securing potentiometer mounting plate to injection pump.
 - 6.3 Disconnect potentiometer multiplug (2).
 - 6.4 Remove potentiometer (3) assembly.



MIL0447

- 2 1 Screw
Multiplug 3 Potentiometer

Fig 3 Throttle potentiometer removal

Refit

- 7 To refit the throttle potentiometer carry out the following:
- 7.1 Position potentiometer assembly on injection pump and secure with screws.
 - 7.2 Connect multiplug.
 - 7.3 Adjust potentiometer

7.4 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

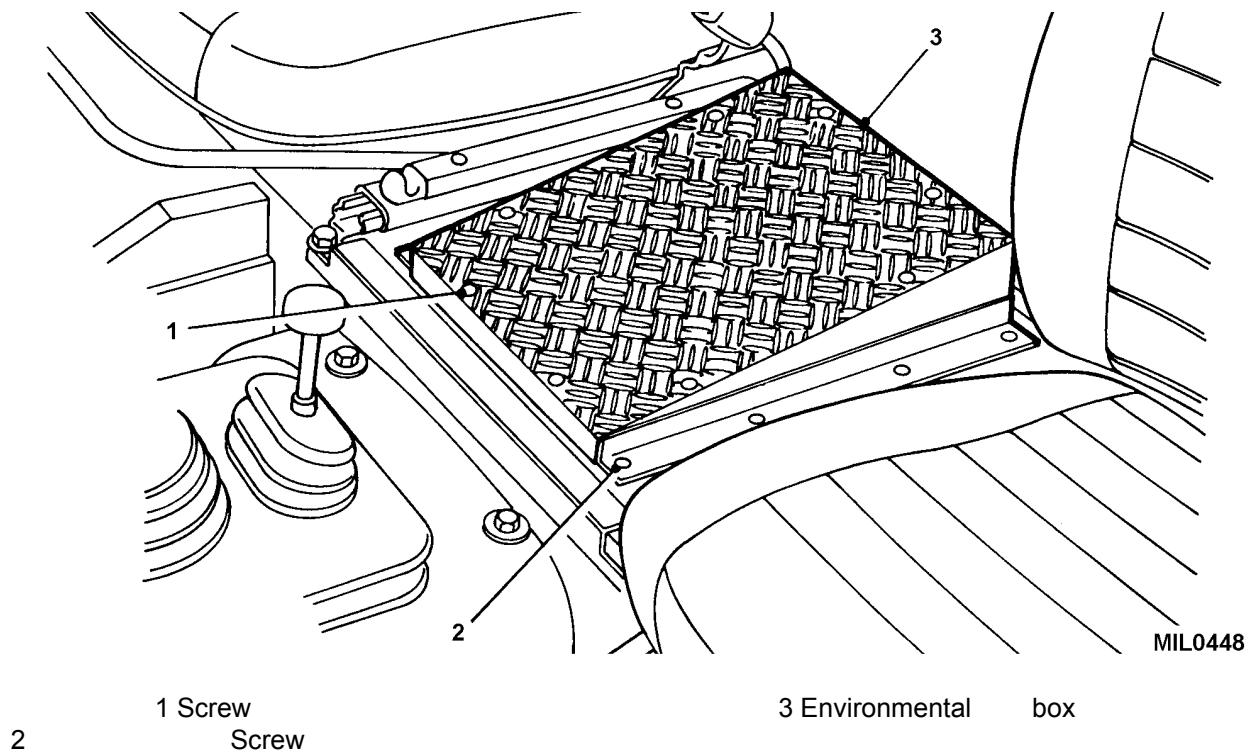


Fig 4 EEGR environmental control box removal.

EEGR ELECTRONIC CONTROL UNIT (ECU)

NOTE

The Electronic Control Unit (ECU), DC/DC converter and filter are all located in an environmental box located between the driver and passenger seats. If any of these components fail, the complete environmental box assembly must be replaced.

Remove

8 To remove the ECU environmental box carry out the following:

8.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

8.2 Remove the eight screws (Fig 4 (1)) securing the environmental box lid and remove lid.

8.3 Disconnect the multiplugs.

8.4 Remove eight screws (2) securing environmental box (3) to seat box and remove from vehicle.

Refit

9 Refit the ECU environmental box in the reverse order of removal.

CHAPTER 11-3

WINTER/WATER

CONTENTS

Para

- 1 Introduction
- 2 General
 - Torque list
 - Raised air intake assembly
- 3 Remove
- 4 Refit
 - Fuel lift pump (WARNINGS)
- 5 Remove
- 6 Testing
- 7 Refit
- FUEL LIFT PUMP AND INJECTION PUMP BREATHER SYSTEM
 - Air buffer chamber
 - 8 Remove
 - 9 Refit
 - Water heater fuel Pump
 - 10 Remove/refit
 - Air Cleaner
 - 11 Remove
 - 12 Refit

Fig

Page

1	Raised air intake assembly removal	3
2	Fuel lift pump removal.....	5
3	Air buffer chamber removal.....	7
4	Air cleaner removal	9/10

INTRODUCTION

1 This chapter details the Unit repairs for the fuel system and breather system fitted to Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS winter/water vehicles fitted with the 24 volt electrical system. The information given is applicable to both left and right hand drive vehicles.

GENERAL

2 The fuel system fitted to this vehicle is identical to the fuel system fitted to TUL (HS) and TUM (HS) vehicles except for the items as detailed in this chapter. These modifications are to ensure the waterproof integrity of the fuel system during deep water wading.

TORQUE LIST

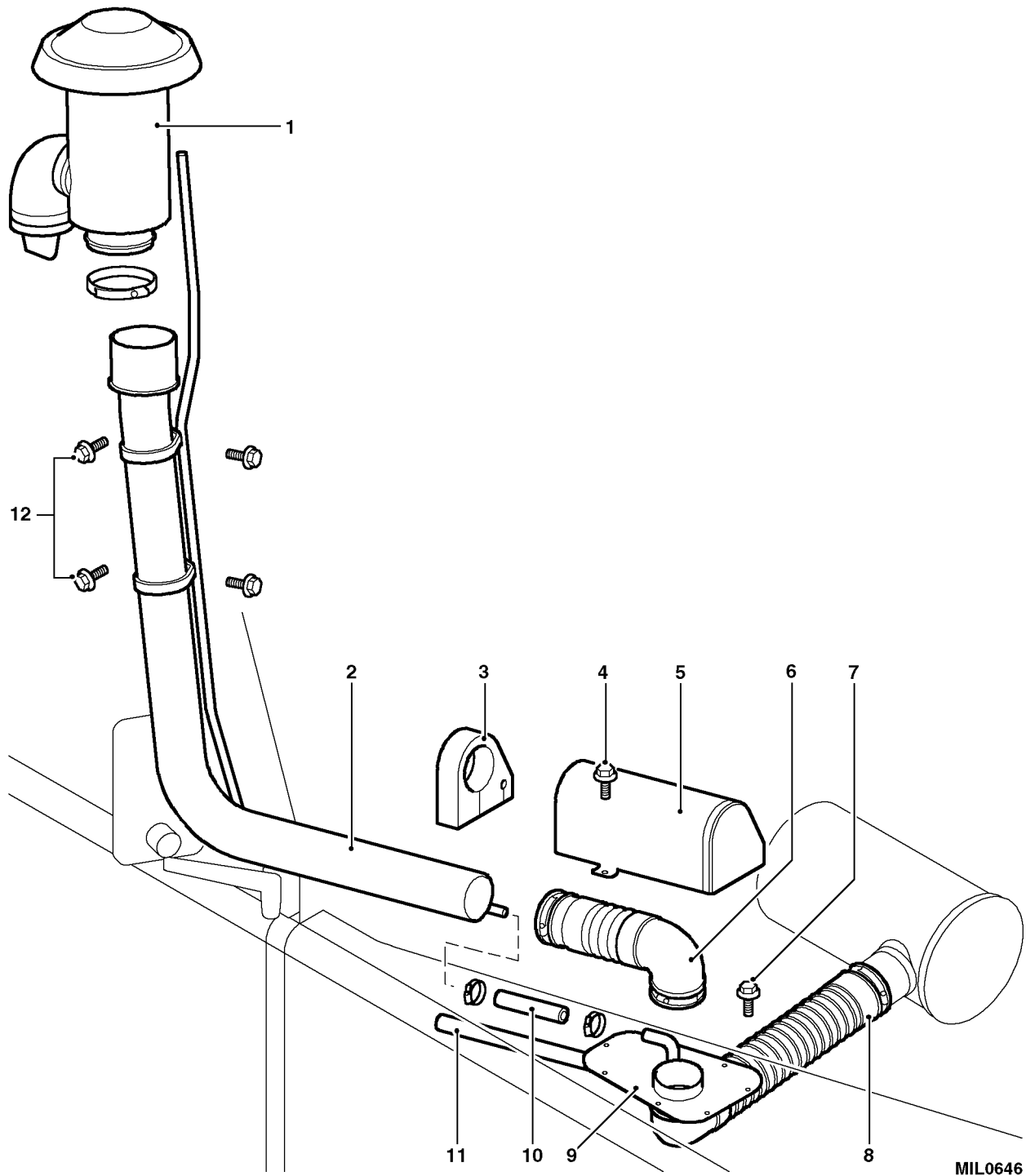
Fuel lift pump to cylinder block	25 Nm/18 lbf ft
Fuel lift pump supply pipes	29 Nm/21 lbf ft

RAISED AIR INTAKE ASSEMBLY**Remove**

- 3 To remove the raised air intake carry out the following:
 - 3.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
 - 3.2 Remove filter (Fig 1 (1) from top of intake.
 - 3.3 Remove 3 screws (4) securing hose cover (5) to wing plate (9) and remove cover.
 - 3.4 Remove foam gasket (3) from intake.
 - 3.5 Disconnect wing adapter hose (10) and breather pipe hose (6) from wing plate (9).
 - 3.6 Remove 4 fixings (12) securing air intake to windscreen and remove intake stack assembly (2) from vehicle.
 - 3.7 If required remove wing adapter hose (6) and breather pipe hose (10) from air intake stack.
 - 3.8 Raise bonnet and disconnect the air cleaner hose (7).
 - 3.9 Remove the remaining screws (8) securing the wing plate (9).
 - 3.10 From under the wing disconnect the manifold breather pipe (11) from the wing plate.
 - 3.11 Remove the wing plate from the top of the wing complete with air cleaner hose.
 - 3.12 If required remove air cleaner hose from wing plate.

Refit

- 4 Refit the raised air intake as follows:
 - 4.1 Refit the raised air intake in the reverse order of removal.
 - 4.2 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).



MIL0646

- | | | | |
|---|--------------|----|------------------------|
| 1 | Filter | 7 | Screws |
| 2 | Intake stack | 8 | Air cleaner hose |
| 3 | Foam gasket | 9 | Wing plate |
| 4 | Screws | 10 | Breather pipe hose |
| 5 | Cover | 11 | manifold breather pipe |
| 6 | Adapter hose | 12 | Screws |

Fig 1 Raised air intake assembly

FUEL LIFT PUMP**WARNINGS**

- (1) **FIRE HAZARD. DANGER OF FIRE ALWAYS EXISTS WHEN WORKING ON OR REMOVING FUEL TANKS AND PUMPS FROM VEHICLES. WORK MUST BE CARRIED OUT IN A WELL VENTILATED AREA.**
- (2) **FIRE EXTINGUISHERS. FIRE EXTINGUISHING EQUIPMENT MUST BE AVAILABLE AT ALL TIMES AND THE VEHICLE BATTERIES MUST BE COMPLETELY DISCONNECTED.**
- (3) **WARNING SIGNS. NOTICES SUCH AS "NO SMOKING", "HIGHLY FLAMMABLE VAPOUR", "RESTRICTED AREA" ETC, MUST BE DISPLAYED SO AS TO BE VISIBLE FROM ALL APPROACHES.**

Remove

NOTE

Blank off pipe ends and connections to prevent the ingress of dirt.

- 5 To remove the fuel lift pump carry out the following:

- 5.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 5.2 Loosen unions securing fuel injection pipes to injectors and injection pump (refer to Chap 11-1).
- 5.3 Remove injection pipes (refer to Chap 11-1).
- 5.4 Disconnect the fuel supply inlet (Fig 2 (1)) and outlet (2) pipes from the fuel lift pump (5).
- 5.5 Disconnect the breather tube (8) from the pump.

NOTE

The breather tube can be removed by using a circular motion on the tube to remove it from the connector.

- 5.6 Remove the two securing bolts (6) and withdraw the lift pump (5) and gasket (9) from the engine cylinder block.

Testing

- 6 To conduct a basic test on the fuel lift pump (refer to Chap 11-1).

Refit

NOTE

When fitting a new fuel pump ensure the replacement pump has the correct breather connector fitted.

- 7 To refit the fuel lift pump proceed as follows:

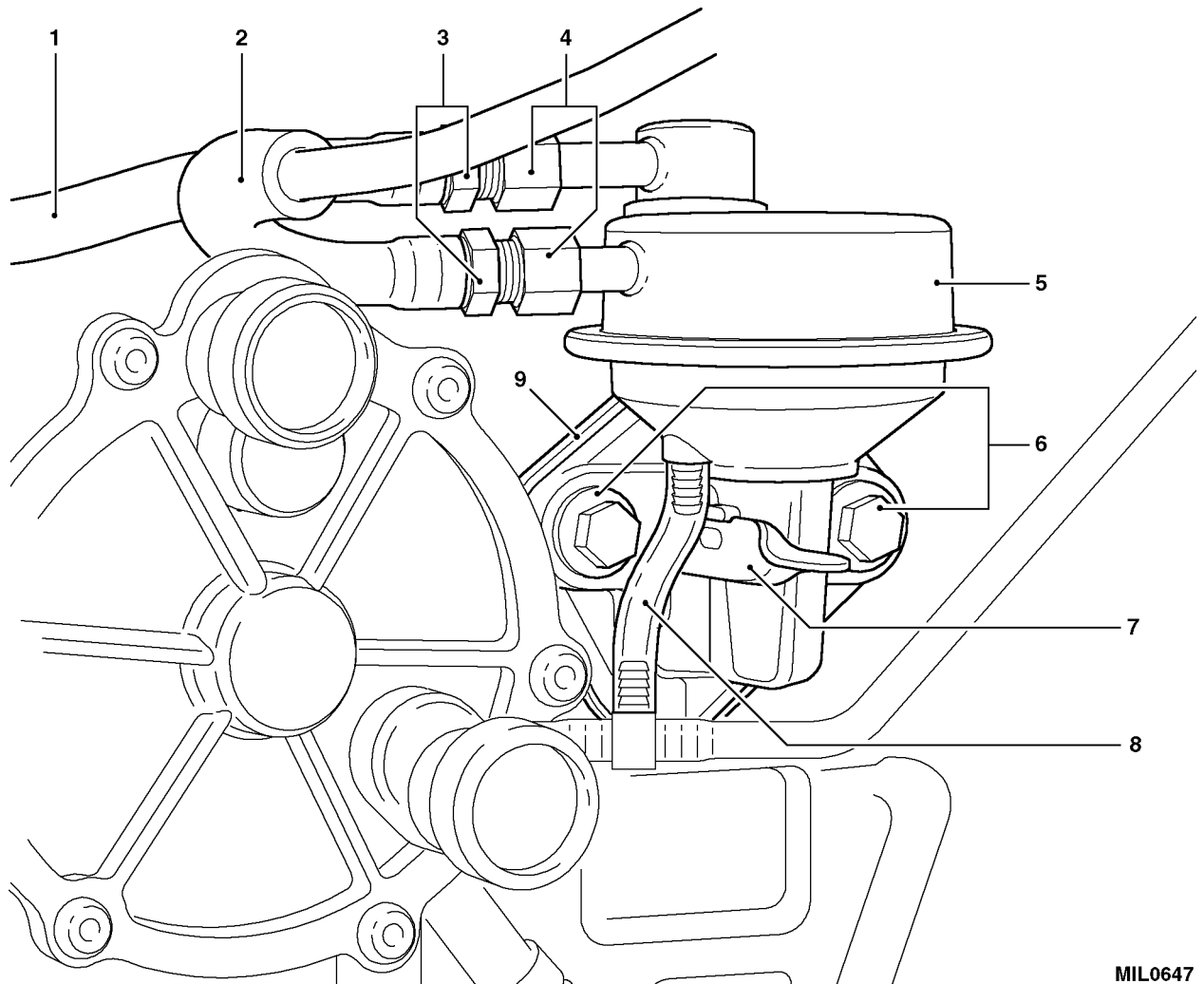
- 7.1 Clean the mating faces of the pump and cylinder block.
- 7.2 Fit the lift pump (5) to the cylinder block with a new gasket (9), ensuring the correct location of priming lever (7) on camshaft and secure with bolts. Tighten to a torque of 25 Nm (18 lbf ft).

7.3 Reconnect the breather tube (8) to the pump connector.

7.4 Refit the fuel supply pipes and tighten the union nuts to a torque of 29 Nm (21 lbf ft).

7.5 Fit injector pipes to injectors and injection pump and secure unions (refer to Chap 11-1).

7.6 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries, (refer to Chap 13-2).



MIL0647

- | | | | |
|---|------------------|---|----------------|
| 1 | Fuel supply pipe | 6 | Securing bolts |
| 2 | Fuel supply pipe | 7 | Priming lever |
| 3 | Connecting union | 8 | Breather tube |
| 4 | Connecting nut | 9 | Gasket |
| 5 | Fuel lift pump | | |

Fig 2 Fuel lift pump connections

FUEL LIFT PUMP AND INJECTION PUMP BREATHER SYSTEM**AIR BUFFER CHAMBER**

The breather system allows both the fuel lift pump diaphragm and the injection pump boost pressure diaphragm to breathe normally whilst the vehicle is under going deep water wading. The system consists of an air buffer chamber connected by small bore tubing to both the fuel lift pump and injection pump diaphragm breather connections.

Remove

8 To remove the air buffer chamber carry out the following:

8.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

8.2 Remove the air cleaner to allow access to the air chamber (refer to Para 12).

8.3 Remove the fuel lift pump (refer to Para 4)

8.4 Disconnect the clip (Fig 3 (3)) securing the breather tube (2) to the fuel distributor pump.

8.5 Release the bolt (6) securing the 'P' clip (4) and release the air buffer chamber (5) from the engine block.

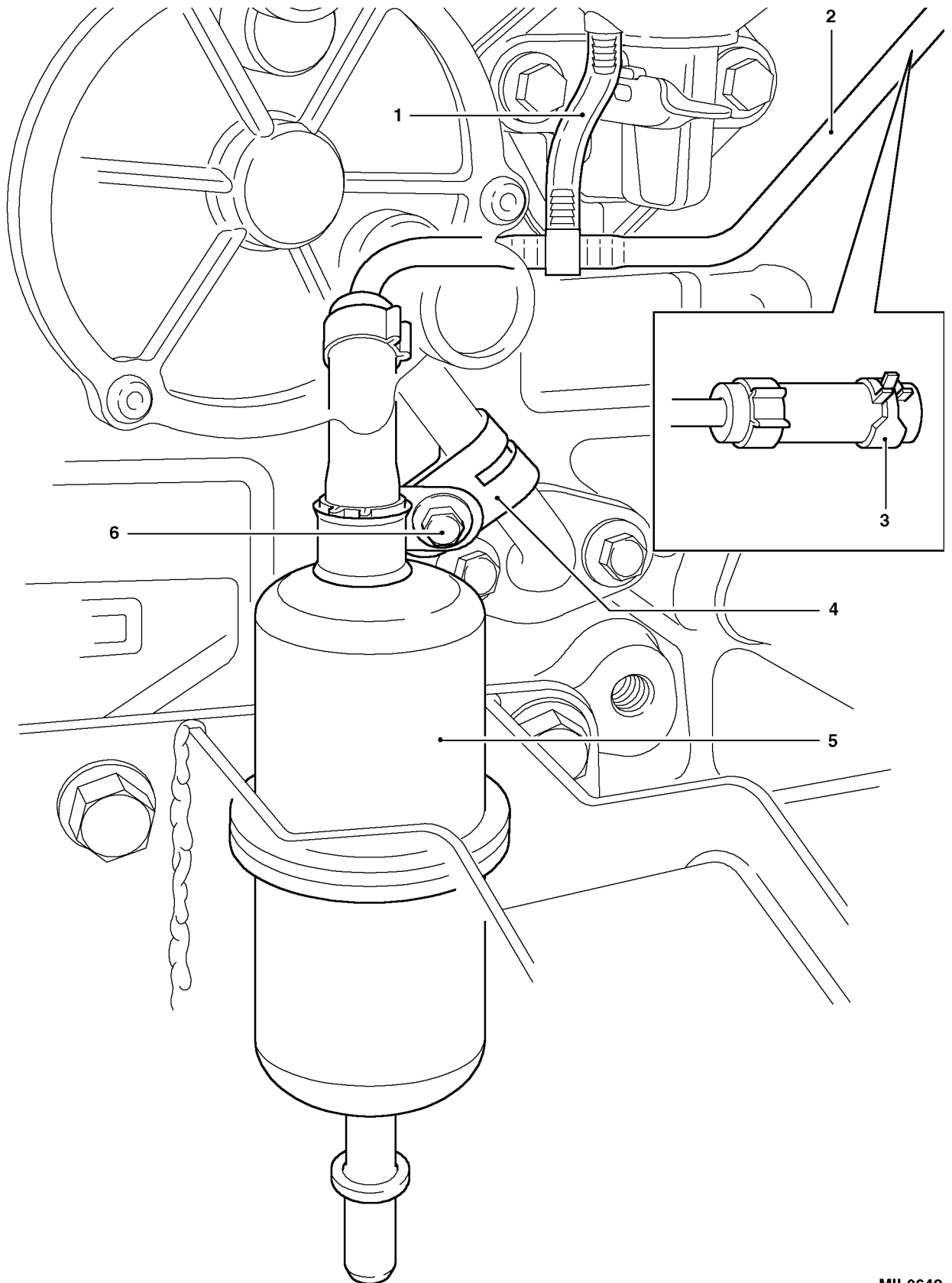
8.6 Remove the air chamber complete with tubing from the vehicle.

Refit

9 To refit the air chamber carry out the following:

9.1 Refit the air chamber in the reverse order of removal ensuring that the vent on the underside of the air chamber locates in the hole in the engine mount.

9.2 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).



MIL0648

- | | |
|----------------------------------|------------------|
| 1 Breather tube | 4 'P' clip |
| 2 Fuel distributor breather tube | 5 Buffer chamber |
| 3 Clip | 6 Bolt |

Fig 3 Air buffer chamber removal

WATER HEATER FUEL PUMP**Remove/refit**

10 For the remove/refit of the water heater fuel pump (refer to Chap 11-4).

AIR CLEANER**Remove**

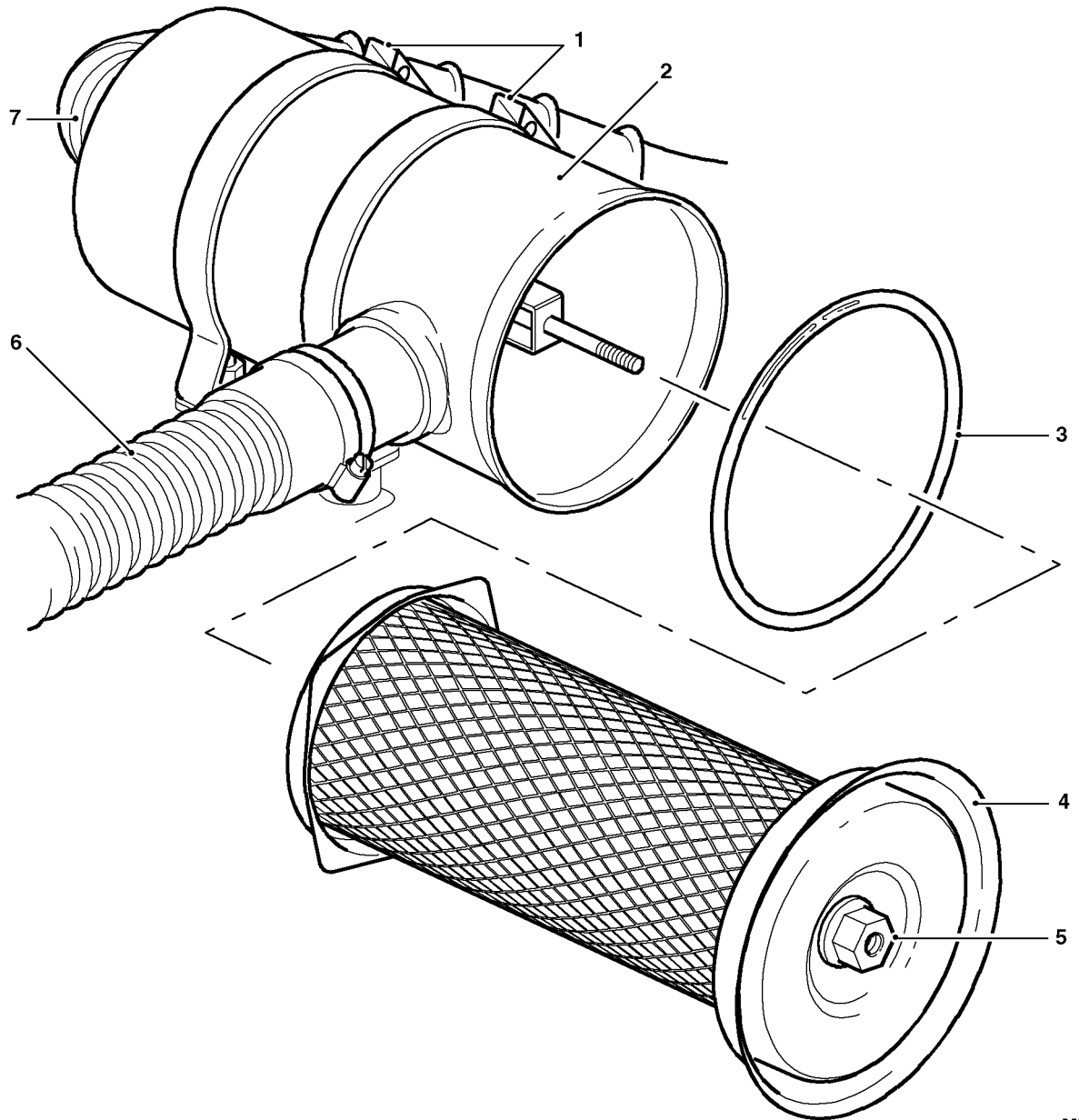
11 To remove the air cleaner carry out the following:

- 11.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 11.2 Release the two retaining clips (Fig 4 (1)) securing the air cleaner (2) in its cradle.
- 11.3 Disconnect the air inlet hose (6) from the wing plate.
- 11.4 Move the air cleaner forward to gain access to the rear hose connection (7) and disconnect the rear hose.
- 11.5 Lift the air cleaner clear of the engine and remove from the vehicle.

Refit

12 To refit the air cleaner carry out the following:

- 12.1 Refit the air cleaner in the reverse order of removal.
- 12.2 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).



MIL0650

- | | | | |
|---|-----------------|---|----------------|
| 1 | Retaining clips | 5 | Nut |
| 2 | Air cleaner | 6 | Air inlet hose |
| 3 | Seal | 7 | Hose |
| 4 | Element | | |

Fig 4 Air cleaner removal

CHAPTER 11-4

WINTERISED

CONTENTS

Para

- 1 Introduction
- 2 General
- 3 Water heater fuel pump (WARNINGS)
- 5 Remove
- 5 Refit

Fig

Page

- 1 Water heater fuel pump removal 2

INTRODUCTION

This chapter details the Unit repairs for the fuel system fitted to Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS winterised vehicles fitted with the 24 volt electrical system. The information given is applicable to both left and right hand drive vehicles.

GENERAL

The fuel system fitted to this vehicle is identical to the fuel system fitted to TUL (HS) and TUM (HS) vehicles except for the items as detailed in this chapter.

WATER HEATER FUEL PUMP

WARNINGS

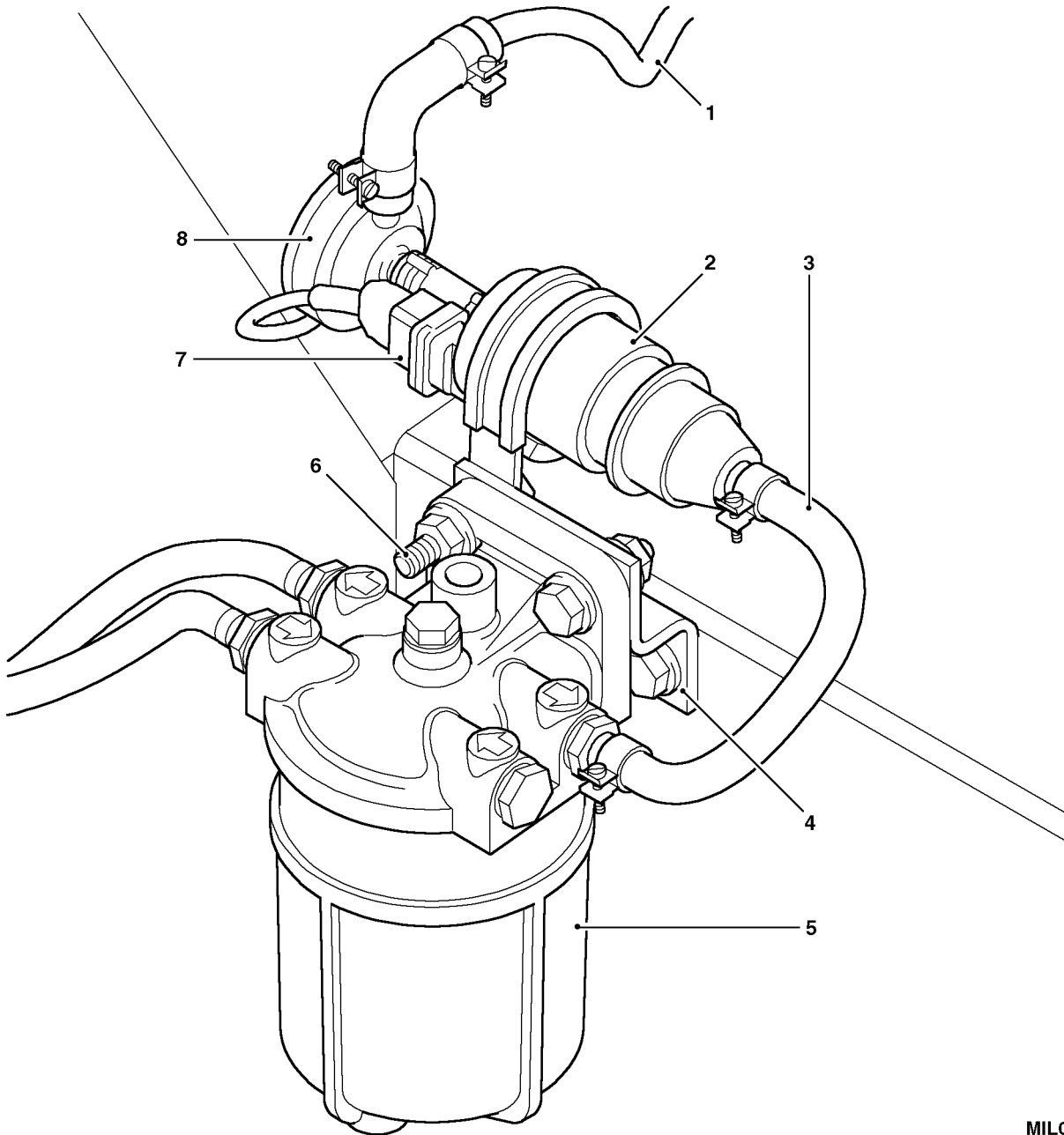
- (1) **FIRE HAZARD. DANGER OF FIRE ALWAYS EXISTS WHEN WORKING ON OR REMOVING FUEL TANKS AND PUMPS FROM VEHICLES. WORK MUST BE CARRIED OUT IN A WELL VENTILATED AREA.**
- (2) **FIRE EXTINGUISHERS. FIRE EXTINGUISHING EQUIPMENT MUST BE AVAILABLE AT ALL TIMES AND THE VEHICLE BATTERIES MUST BE COMPLETELY DISCONNECTED.**
- (3) **WARNING SIGNS. NOTICES SUCH AS "NO SMOKING", "HIGHLY FLAMMABLE VAPOUR", "RESTRICTED AREA" ETC, MUST BE DISPLAYED SO AS TO BE VISIBLE FROM ALL APPROACHES.**

Remove

The water heater fuel pump is located under the rear right hand wheel arch bolted to the fuel sedimenter mounting.

To remove the water heater fuel pump carry out the following:

- 1.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 1.2 Disconnect the electrical connector (Fig 1 (7)).



MIL0649

- | | |
|--------------------|-------------------------|
| 1 Fuel pipe | 5 Fuel sedimenter |
| 2 Fuel pump | 6 Bolt |
| 3 Fuel pipe | 7 Electrical connection |
| 4 Mounting bracket | 8 Damper |

Fig 1 Water heater fuel pump removal

- 1.3 Disconnect the fuel pipe (3) from the fuel sedimenter (5).
- 1.4 Disconnect the fuel pipe (1) from the fuel pump (2).
- 1.5 Plug the ends of the connections to prevent the ingress of foreign matter.
- 1.6 Remove the bolt (6) securing the pump to the fuel sedimenter mounting bracket (4) and remove the pump from the vehicle.
- 1.7 Drain any surplus fuel from the pump into a suitable container.

Refit

Refit the water heater fuel pump in the reverse order of removal.

- 1.8 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

CHAPTER 12

ENGINE COOLING SYSTEM

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

This chapter gives the Unit repair for the engine and cooling systems as fitted to Truck Utility Light (TUL) HS, and Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles.

General

This chapter has been sub-chaptered to allow for the various types of vehicle fuel and exhaust systems as detailed below.

- 1.1 Chapter 12-1 Engine cooling system.
- 1.2 Chapter 12-2 Winterised.

CHAPTER 12-1

ENGINE COOLING SYSTEM

CONTENTS

Para

- 1 Introduction (WARNING)
 - Torque list
- 2 General
- 7 Recommended anti-freeze solution
- 8 Draining
- 9 Filling
- Radiator
 - 10 Remove
 - 11 Refit
- Thermostat
 - 12 Remove
 - 13 Testing
 - 14 Refit
- Viscous coupling and fan
 - 15 Remove
 - 16 Repairs and replacement
 - 17 Refit
- Fan pulley
 - 18 Remove
 - 19 Refit
- Water pump
 - 20 Remove
 - 21 Refit
- Auxiliary mounting bracket
 - 22 Remove
 - 23 Refit
- Gearbox oil cooler
 - 24 Remove
 - 25 Refit

Table

	Page
1 Special tools.....	2
2 Sealants, adhesives and lubricants	2

Fig

1 Radiator removal.....	4
2 Radiator lower location	5
3 Thermostat removal	7
4 Fan and viscous coupling removal	8
5 Water pump removal.....	10
6 Auxiliary mounting bracket removal.....	12
7 Gearbox oil cooler removal.....	14

INTRODUCTION

1 This chapter details the Unit repairs for Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles cooling system.

WARNING

PRESSURISED COOLING SYSTEM. DO NOT REMOVE THE RADIATOR OR EXPANSION TANK FILLER CAP WHEN THE ENGINE IS HOT. THE COOLING SYSTEM IS PRESSURISED AND PERSONAL SCALDING COULD RESULT.

NOTE

The special tools listed in the following table will be referred to in the text, where used, by the serial number shown in the table.

TORQUE LIST

Radiator filler plug	5-6 Nm/4-5 lbf ft
Thermostat outlet elbow	28 Nm/21 lbf ft
Fan pulley retaining bolts	25 Nm/18 lbf ft
Water pump retaining bolts	25 Nm/18 lbf ft
Auxiliary mounting fixings	25 Nm/18 lbf ft

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	LRT - 12 - 093	6MT2/5120-99-957-3749	Viscous coupling spanner
2	LRT - 12 - 094	6MT2/5120-99-568-5750	Pulley restraining tool

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	AL-39	6850-99-220-2348	Anti-freeze

General

2 To prevent corrosion of the aluminium engine parts it is vital that the cooling system is filled with a solution of clean fresh water and the correct type of anti-freeze (refer to Table 2 Serial 1), winter and summer.

3 Never fill or top-up with water only, always use anti-freeze. Never use salt water otherwise corrosion will occur. In certain territories where the only available water may have some salt content, use only clean rain water or distilled water.

4 Anti-freeze can remain in the cooling system and will provide adequate protection for two years. The specific gravity of the coolant must be checked before the onset of the second winter and topped up with new anti-freeze as required. The specific gravity can be checked using a hydrometer. A 50% concentration of anti-freeze at 68° F (20° C) should give a reading of 1.075.

5 During manufacture, vehicles have the cooling system filled with a 50% anti-freeze mixture. This gives protection against frost down to -47 ° C (-53 ° F). Vehicles prepared with this mixture can be identified by a label affixed to the windscreen and radiator.

6 After the second winter the system should be drained and thoroughly flushed. Before adding new anti-freeze examine all joints and renew any defective hoses to ensure the system is leak proof.

Recommended anti-freeze solution

7 The solution recommended for use in TUL, TUM and Ambulance vehicles should be one part anti-freeze to one part water (50% concentration).

Draining

8 To drain the cooling system carry out the following:

- 8.1 Remove the cap from the expansion tank and the filler plug from the top of the radiator.
- 8.2 Disconnect the bottom hose and allow the coolant to drain into a suitable container.
- 8.3 Remove the cylinder block drain plug, which is situated on the left hand side of the engine immediately below the front core plug.
- 8.4 Allow the coolant to completely drain then refit the plug.
- 8.5 On completion of draining reconnect the radiator bottom hose.
- 8.6 To drain the expansion tank, disconnect the hoses and allow to drain into a suitable container, remove the tank.
- 8.7 Flush the tank with clean water, refit the tank to the vehicle and reconnect the hoses.

Filling

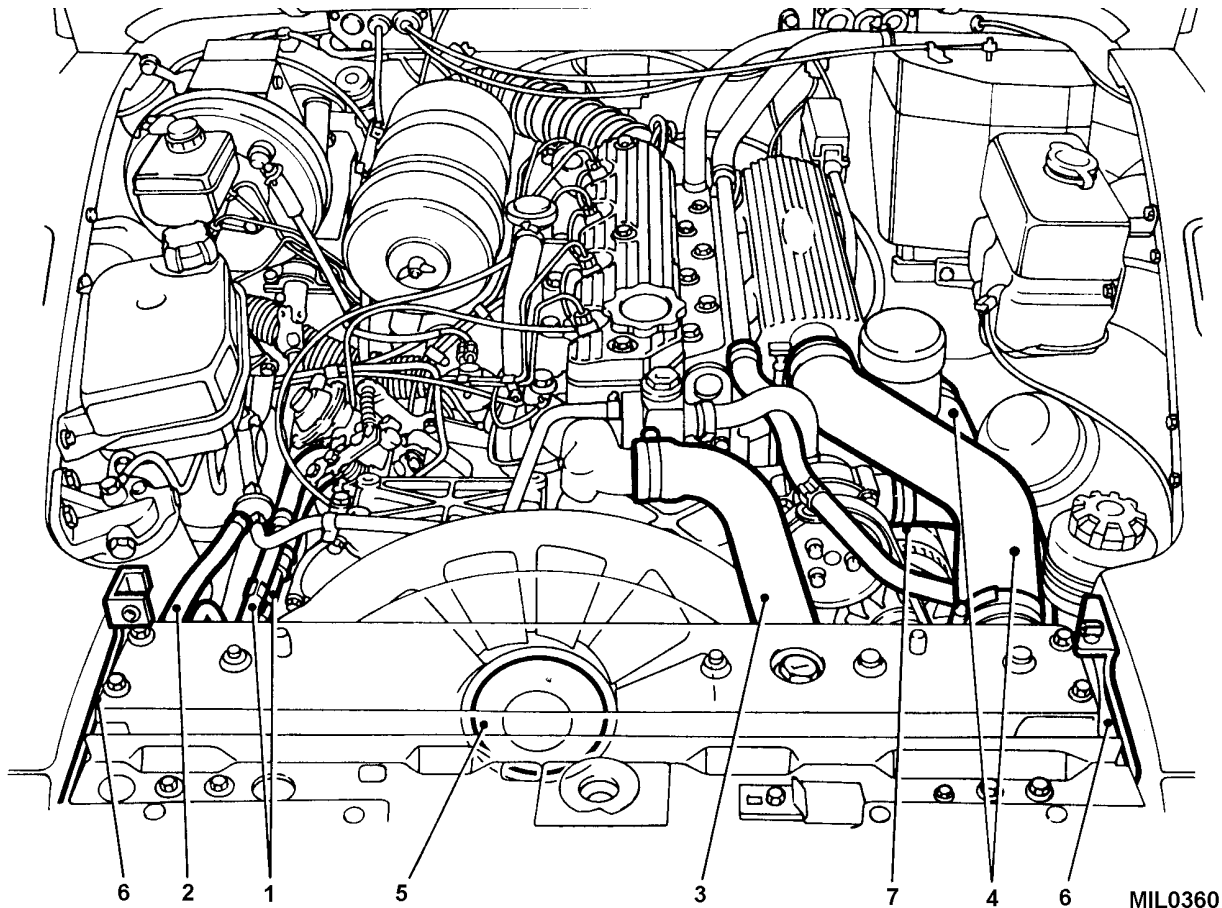
9 To fill the cooling system carry out the following:

- 9.1 Using a separate container mix a solution of anti-freeze with clean water to the required concentration. Prepare a quantity in excess of the capacity of the system to allow for topping up and for filling the expansion tank.
- 9.2 Check all hoses, connections and drain plugs for security.
- 9.3 Fill the radiator until the coolant is just below the filler neck and refit the filler plug.
- 9.4 Fill the expansion tank to approximately half full and refit the cap.
- 9.5 Run the engine until normal operating temperature is reached.
- 9.6 Allow the engine to cool completely, then remove the radiator filler plug and expansion tank cap. If necessary, top-up the radiator to just below the filler neck. Top-up the expansion tank to the top of the level indicator and refit the radiator filler plug and expansion tank cap. After refitting tighten the radiator filler plug to a torque of 5 to 6 Nm (4 to 5 lbf ft).
- 9.7 Finally, examine the cooling system for leaks.

RADIATOR**Remove**

10 To remove the radiator carry out the following:

- 10.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 10.2 Disconnect the earth bonding straps and remove the bonnet (refer to Chap 16-1).
- 10.3 Drain the cooling system (refer to Para 8).



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- | | | | |
|---|---------------------|---|-----------------------|
| 1 | Oil cooler pipes | 5 | Viscous coupling |
| 2 | Expansion tank pipe | 6 | Radiator top brackets |
| 3 | Top hose | 7 | Bottom hose |
| 4 | Intercooler hoses | | |

Fig 1 Radiator removal

- 10.4 Using a suitable container disconnect the engine oil cooler pipes (Fig 1 (1)) at the radiator and allow the excess oil to drain away.
- 10.5 Disconnect the expansion tank pipe (2) at the radiator.
- 10.6 Disconnect the top (3) and bottom (7) hoses at the radiator.
- 10.7 Disconnect the top and bottom intercooler hoses (4).

- 10.8 Remove the viscous coupling (5) and fan assembly from the pulley (refer to Para 15).
- 10.9 Remove the nuts and washers securing the top of the fan cowl to the radiator and detach the expansion tank bottom hose from the clips on the fan cowl.
- 10.10 Remove the fan cowl.
- 10.11 Remove the radiator grille from the front of the vehicle to gain access to the front radiator top bracket (6) mounting bolts.
- 10.12 Remove the four bolts securing each of the radiator top brackets and lift out the radiator assembly complete with intercooler, brackets and bonnet prop (6).
- 10.13 Remove the mounting brackets from the radiator assembly.

Refit

- 11 To refit the radiator assembly carry out the following:

- 11.1 Lower the radiator assembly, with the top brackets located on their lugs, into the vehicle ensuring that the two pegs at the bottom of the radiator locate in the corresponding rubber pads in the chassis crossmember brackets (Fig 2).

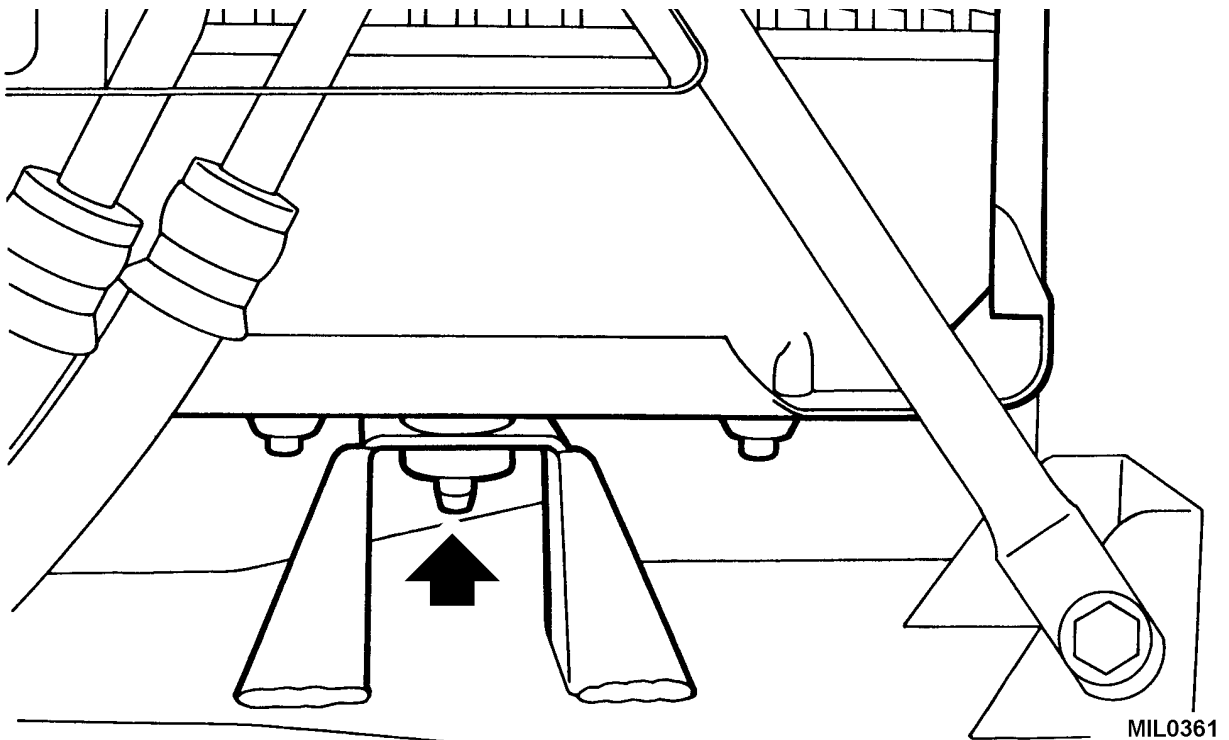


Fig 2 Radiator lower location

- 11.2 Secure the top of the radiator with the two brackets and eight retaining bolts, spring washers and plain washers.
 - 11.3 Fit the radiator cowl and secure with the nuts and washers.
 - 11.4 Refit the intercooler top and bottom hoses.
 - 11.5 Refit the radiator top and bottom hoses

- 11.6 Refit the expansion tank pipe to the top of the radiator and reconnect the engine oil cooler pipes to their respective adapters.
- 11.7 Refit the fan and viscous coupling (refer to Para 17).
- 11.8 Refit the radiator grille, bonnet and earth bonding straps (refer to Chap 16-1).
- 11.9 Check that all coolant hose clips are tight and refill the cooling system with the appropriate coolant (refer to Para 9)
- 11.10 Top up the engine with oil as necessary (refer to Chap 1).
- 11.11 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

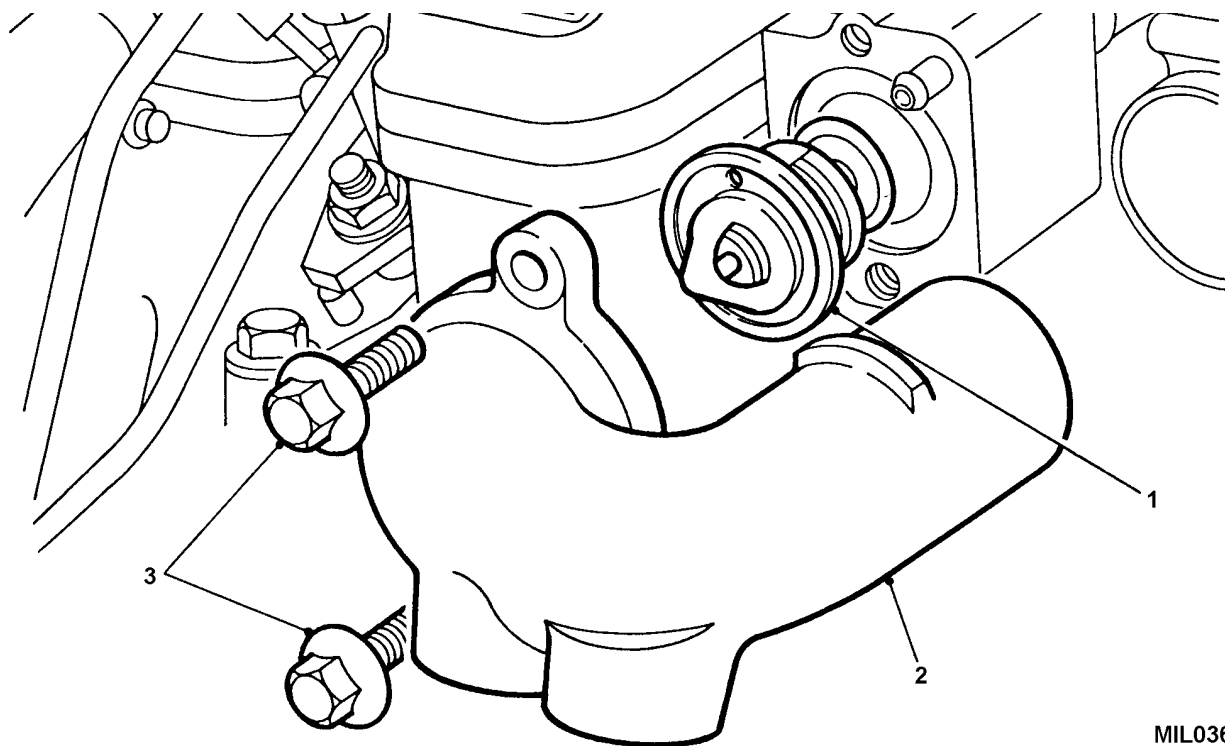
THERMOSTAT

Remove

- 12 To remove the thermostat carry out the following:
 - 12.1 Partially drain the cooling system, until the coolant level is below the thermostat housing.
 - 12.2 Disconnect the radiator top hose from the outlet elbow (Fig 3 (2)) and the expansion tank pipe from the thermostat housing.
 - 12.3 Disconnect the electrical connection to the coolant temperature sensor.
 - 12.4 Undo the bolts (3) and remove the outlet elbow and withdraw the thermostat (1).

Testing

- 13 The rating of the thermostat is 88° C (190° F). To test its operation carry out the following:
 - 13.1 Place the thermostat in a suitable container of water. Heat the water and observe the temperature at which the thermostat begins to open.
 - 13.2 If the thermostat opens between 85° C (185° F) and 89 ° C (192° F) the unit is operating satisfactory.



MIL0362

2 1 Thermostat 3 Bolts
 Outlet elbow

Fig 3 Thermostat removal

Refit

14 To refit the thermostat proceed as follows:

14.1 Insert the thermostat with jiggle pin/vent hole upper most (12 o'clock position) into the housing ensuring rubber seal is seated correctly.

14.2 Refit the outlet elbow and tighten the securing bolts to 28 Nm (21 lbf ft).

14.3 Reconnect the radiator top hose to the outlet elbow, the expansion tank pipe to the thermostat housing and the electrical connection to the coolant temperature sensor.

14.4 Top up the coolant system as necessary (refer to Para 9) and check for leaks around all connections and joint faces.

14.5 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

VISCOUS COUPLING AND FAN

Remove

15 To remove the viscous coupling and fan assembly carry out the following:

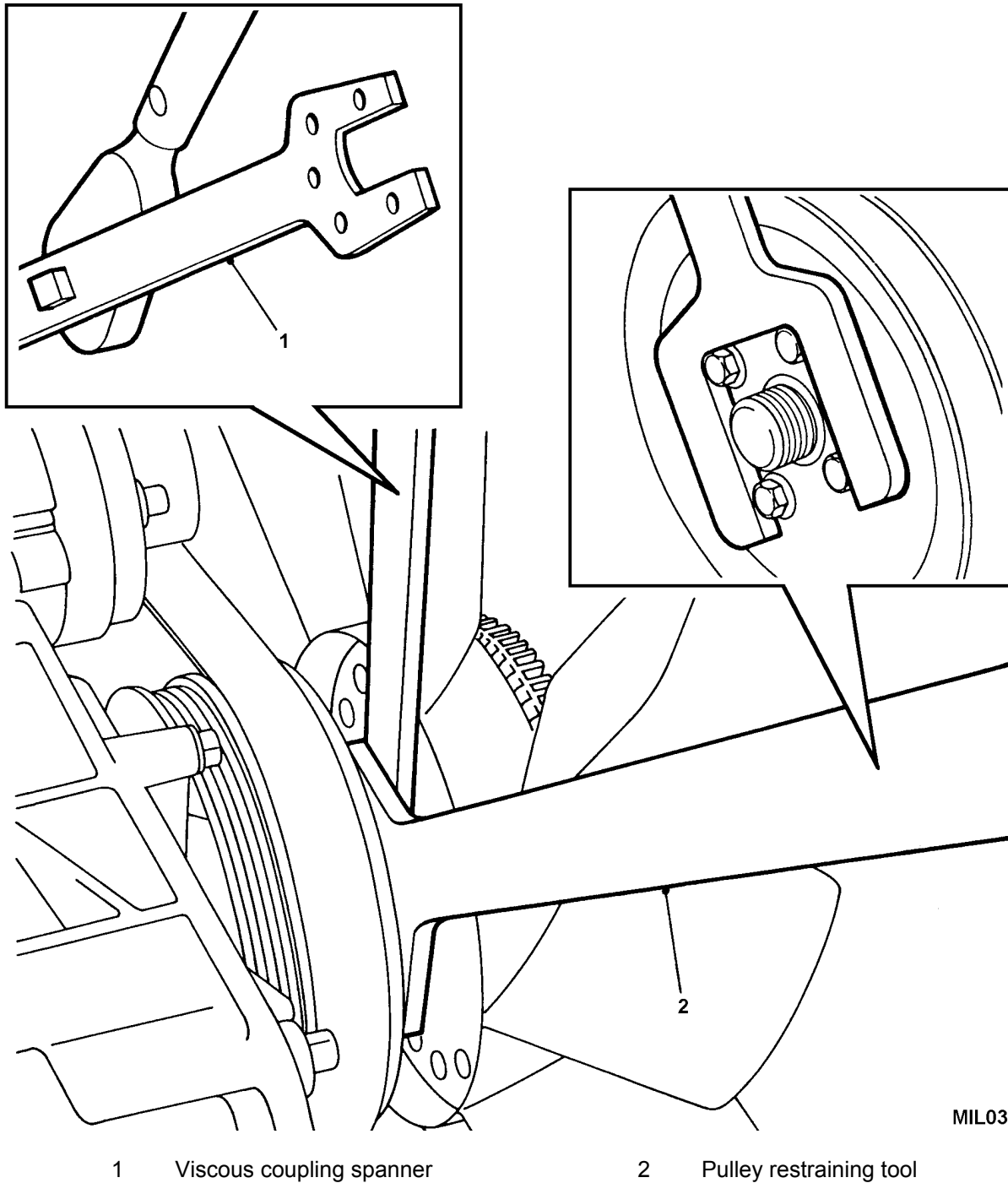
15.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2) to prevent the engine being started whilst working on the fan assembly.

NOTE

The nut securing the viscous coupling to the pulley has a left hand thread. To release the nut, turn in a clockwise direction when viewed from the front of the viscous unit.

15.2 Using the special tool (refer to Table 1 Serial 2) and special spanner (refer to Table 1 Serial 1), remove the viscous coupling and fan assembly from the pulley centre boss (Fig 4).

15.3 Withdraw the assembly from the radiator cowl.



MIL0363

Fig 4 Fan and viscous coupling removal

15.4 If necessary, remove the bolts securing the fan to the viscous unit and detach the fan.

Repairs and replacement

16 The viscous coupling is non-repairable. Should it be found to be defective a new unit must be fitted.

Refit

17 Refit the viscous coupling and fan in the reverse order of removal using the special tools (refer to Table 1 Serial 1 and Serial 2), remembering that the nut securing the viscous unit has a left hand thread.

17.1 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

FAN PULLEY

Remove

18 To remove the fan pulley proceed as follows:

18.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2) to prevent the engine being started whilst working on the fan assembly.

18.2 Remove the viscous coupling and fan assembly (refer to Para 15).

18.3 Before removing the serpentine belt, slacken the fan pulley retaining bolts.

18.4 Using a hexagonal socket and tommy bar on the auto tensioner pulley nut, tension the auto-tensioning unit and remove the drive belt.

18.5 Remove the four retaining bolts and detach the fan pulley

Refit

19 To fit the fan pulley carry out the following:

19.1 Refit the fan pulley and secure in place with the four retaining bolts.

19.2 Fit the drive belt using the same method of tensioning the auto-tensioner as for removal (refer to Para 18.4).

19.3 Tighten the fan pulley retaining bolts to a torque of 25 Nm (18 lbf ft).

19.4 Refit the viscous coupling and fan assembly (refer to Para 17).

19.5 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

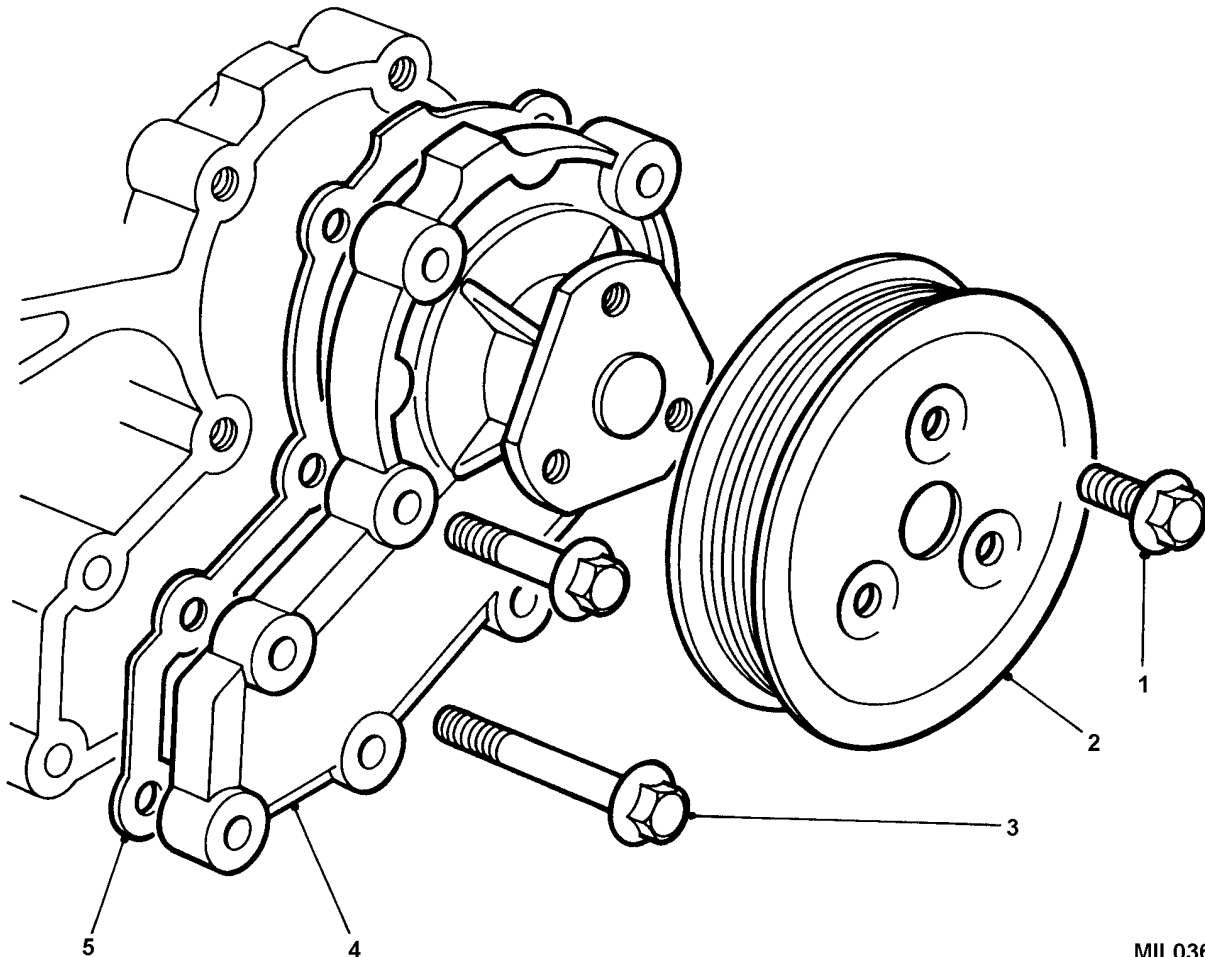
WATER PUMP

Remove

20 To remove the water pump proceed as follows:

20.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2) to prevent the engine being started whilst working on the water pump.

- 20.2 Drain the cooling system (refer to Para 8).
- 20.3 Remove the top hose, radiator to thermostat.
- 20.4 Remove the top hose, intercooler to induction manifold.
- 20.5 Disconnect the hose, heater rail to bottom hose, release from the retaining clip on the water pump and move to one side.



MIL0364

1 Pulley retaining bolt
2 Drive pulley
3 Securing bolt

4 Water pump
5 Gasket

Fig 5 Water pump removal

- 20.6 Before removing the serpentine belt, slacken the power steering pump and the water pump pulley retaining bolts.
- 20.7 Using a hexagonal socket and tommy bar on the tensioner pulley nut, tension the auto tensioning unit and remove the belt.
- 20.8 Remove the belt auto tensioner.
- 20.9 Remove the three securing bolts (Fig 5 (1)) from the water pump pulley (2) and remove the pulley.

- 20.10 Remove the three power steering pump pulley retaining bolts and remove the pulley.
- 20.11 Remove the eight bolts (3) securing the water pump, noting the location of the three through bolts into the cylinder block and the heater rail hose clip bracket.
- 20.12 Withdraw water pump (4) complete with gasket (5).

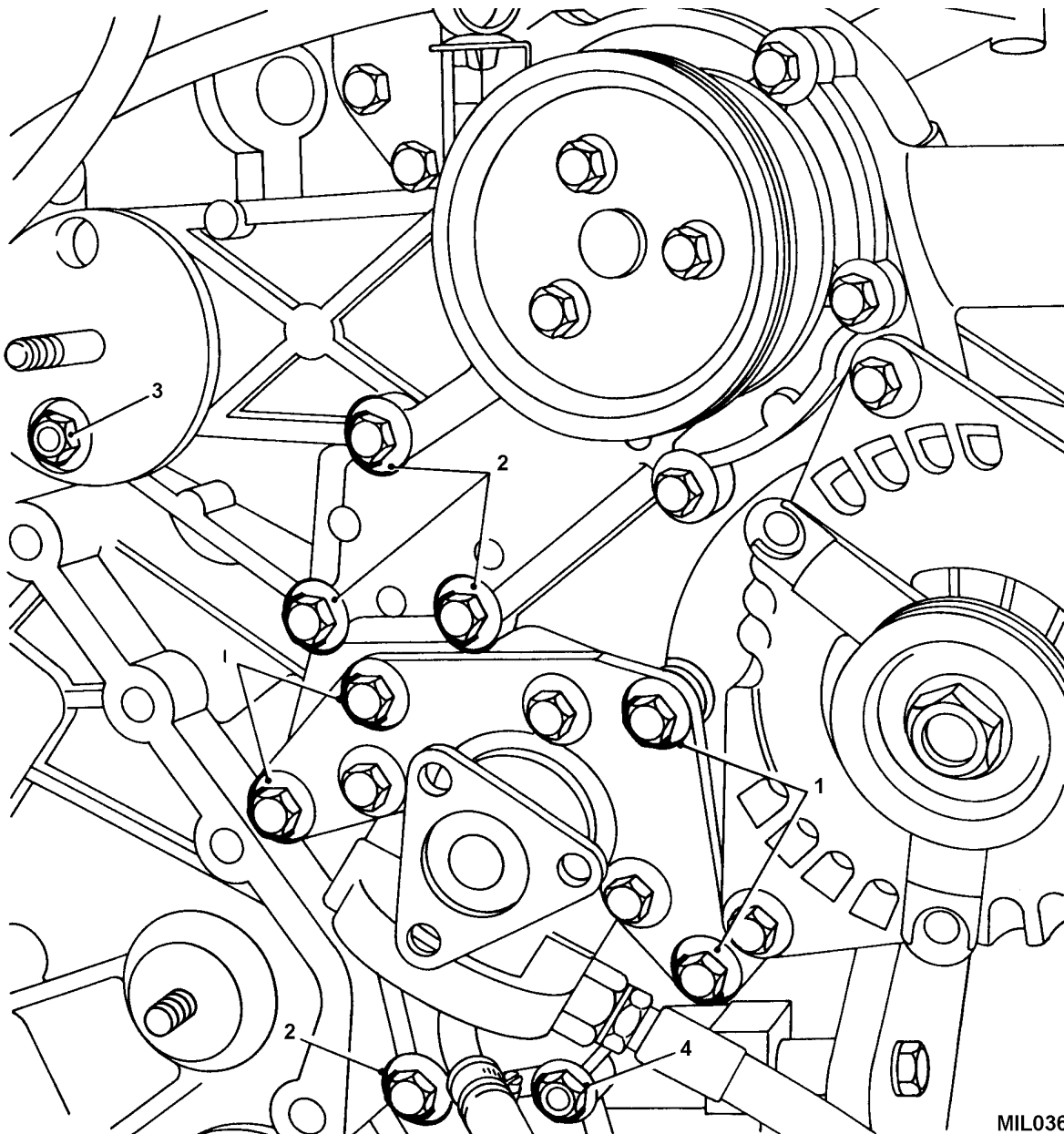
Refit

- 21 To refit the water pump proceed as follows:
 - 21.1 Clean all gasket material from the mating faces and using a new gasket refit the water pump to the auxiliary mounting bracket.
 - 21.2 Fit the eight securing bolts to their respective locations and evenly tighten to a torque of 25 Nm (18 lbf ft).
 - 21.3 Fit the pulley to the water pump shaft and secure with the three retaining bolts.
 - 21.4 Refit the power steering pump pulley.
 - 21.5 Fit the belt auto tensioner and refit the serpentine belt using the reverse procedure as for removal. Tighten the steering pump and water pump pulley retaining nuts.
 - 21.6 Refit the radiator top hose, intercooler hose and heater rail hose, ensuring the radiator bottom hose to heater rail is correctly located in its retaining clip.
 - 21.7 Refill the cooling system (refer to Para 9).
 - 21.8 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

AUXILIARY MOUNTING BRACKET

Remove

- 22 To remove the auxiliary mounting bracket proceed as follows:
 - 22.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
 - 22.2 Drain the cooling system (refer to Para 8).
 - 22.3 Remove the top hose, radiator to thermostat.
 - 22.4 Remove the top hose, intercooler to induction manifold.
 - 22.5 Remove the viscous coupling and fan assembly (refer to Para 15).
 - 22.6 Remove the nuts and washers securing the top of the fan cowl to the radiator and detach the expansion tank bottom hose from the clips on the fan cowl.



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- | | | | |
|---|---------------------------------------|---|---|
| 1 | Power steering mounting bracket bolts | 3 | Auxiliary mounting bracket nut |
| 2 | Auxiliary mounting bracket bolts | 4 | Auxiliary mounting bracket nut and bolt |

Fig 6 Auxiliary mounting bracket removal

22.7 Remove the fan cowl.

22.8 Before removing the serpentine drive belt, slacken off the power steering pump and water pump pulley retaining bolts.

22.9 Using a hexagonal socket and tommy bar on the tensioner pulley nut, tension the auto-tensioner unit and remove the serpentine drive belt.

22.10 Remove the auto-tensioner.

22.11 Remove the power steering pump pulley.

- 22.12 Remove the four bolts (Fig 6 (1)) securing the power steering pump mounting bracket to the auxiliary mounting bracket.
- 22.13 Lower the pump and bracket assembly and move to one side. Do not disconnect the power steering pump fluid pipes.
- 22.14 Remove the alternator (refer to Chap 13-1).
- 22.15 Release the hose clip above the water pump, disconnect the bottom hose from the heater rail, radiator and water pump and remove.
- 22.16 Disconnect the by-pass hose between the thermostat housing and water pump and remove.
- 22.17 Remove the four bolts (2), one nut (3) and one nut and bolt (4) securing the auxiliary mounting bracket to the engine cylinder block.
- 22.18 Withdraw the auxiliary mounting bracket complete with water pump.
- 22.19 Remove the gasket and clean mating faces.
- 22.20 If necessary remove the remaining water pump securing bolts and withdraw the water pump (refer to Para 20).

Refit

- 23 To refit the auxiliary mounting bracket carry out the following:
 - 23.1 Using two slave studs to support a new gasket, refit the auxiliary mounting bracket in the reverse order to removal. Tighten the securing nuts and bolts to a torque of 25 Nm (18 lbf ft).

GEARBOX OIL COOLER

Remove

- 24 To remove the gearbox oil cooler carry out the following:
 - 24.1 Remove the front radiator grille to gain access to the oil cooler.
 - 24.2 From underneath the vehicle disconnect the oil cooler flexible hose union, from the lower gearbox oil pipe and drain the contents into a suitable container. Reconnect the union.
 - 24.3 Disconnect the oil cooler supply and return pipes (Fig 7 (1)) at the oil cooler connections and cover the ends of the pipes to prevent any ingress of dirt.
 - 24.4 Remove the four bolts (2) securing the oil cooler to the 'A' frame verticals and remove the cooler from the vehicle.

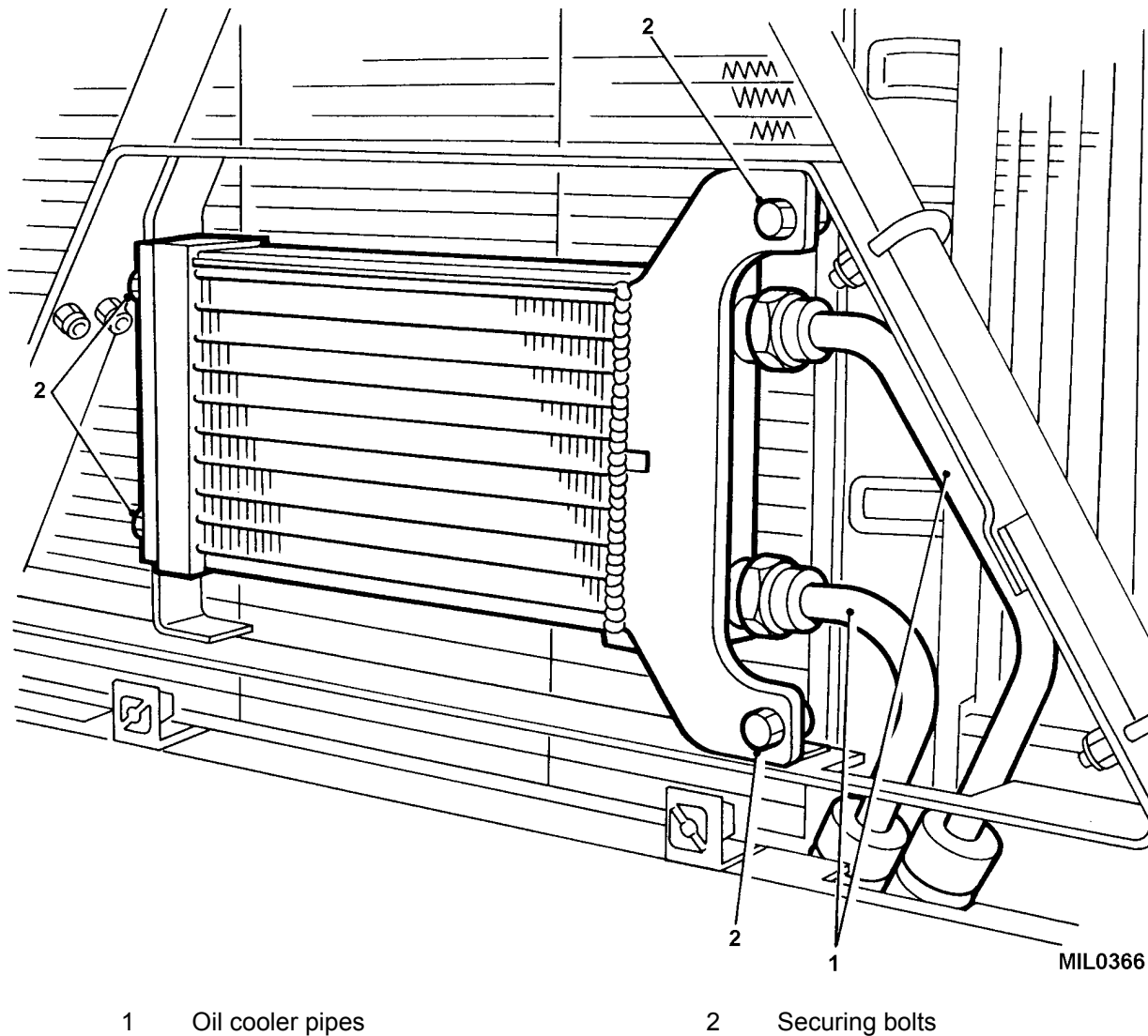


Fig 7 Gearbox oil cooler removal

Refit

25 To refit the oil cooler carry out the following:

- 25.1 Secure the oil cooler to the 'A' frame verticals using the four bolts.
- 25.2 Reconnect the oil cooler supply and return pipes.
- 25.3 From underneath the vehicle check that the flexible hose unions have been tightened.
- 25.4 Replenish the gearbox oil level (refer to Cat 201), run the engine and check for leaks.
- 25.5 Refit the front radiator grille.

CHAPTER 12-2

WINTERISED

CONTENTS

Para

- 1 Introduction
- 3 General
 - 9 Expansion tank filler cap
 - 10 Bleeding the system (WARNINGS) (CAUTIONS)
 - 12 Cooling system protection
 - 13 Recommended anti-freeze solution

Table

- 1 Sealants, Adhesives and Lubricants..... 2

Page

Fig

- 1 Bleeding the heater system 3

INTRODUCTION

1 This chapter details the Unit repairs for the cooling system fitted to Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS winterised vehicles fitted with the 24 volt electrical system. The information given is applicable to both left and right hand drive vehicles.

2 This chapter can be referred to for all winter/water vehicles as they have an identical systems.

GENERAL

3 The cooling system fitted to these vehicles incorporates the Webasto water heating system which provides preheated water to both the engine and vehicle interior to maintain comfortable operating conditions inside the vehicle and aid engine starting in sub-zero temperatures.

4 To prevent corrosion of the aluminium engine parts it is vital that the cooling system is filled with a solution of clean fresh water and the correct type of anti-freeze (refer to Table 1 Serial 1), winter and summer.

5 Never fill or top-up with water only, always use anti-freeze. Never use salt water otherwise corrosion will occur. In certain territories where the only available water may have some salt content, use only clean rainwater or distilled water.

6 Anti-freeze can remain in the cooling system and will provide adequate protection for two years.

7 During manufacture, winterised vehicles have the cooling system filled with a 60% anti-freeze mixture. This gives protection against frost down to -46 ° C (-52° F). A label affixed to the windscreen and radiator can identify vehicles prepared with this mixture.

8 After the second winter the system should be drained and thoroughly flushed. Before adding new anti-freeze examine all joints and renew any defective hoses to ensure the system is leak proof.

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	AL-39	6850-99-225-0424	Anti-freeze

EXPANSION TANK FILLER CAP

9 To remove and refit the expansion tank filler cap proceed as follows:

9.1 Turn the cap anti-clockwise a quarter of a turn and allow the pressure to escape before turning further in the same direction to lift it off.

9.2 When replacing the expansion cap it is important to ensure that it is tightened down fully.

BLEEDING THE SYSTEM**WARNINGS**

(1) **PRESSURISED SYSTEM. WHEN THE ENGINE IS HOT THE COOLING SYSTEM IS PRESSURISED AND THE RAPID RELEASE OF HOT COOLANT COULD RESULT IN PERSONAL INJURY. DO NOT REMOVE THE RADIATOR OR EXPANSION TANK FILLER CAPS OR THERMOSTAT HOUSING BLEED SCREW UNTIL THE ENGINE HAS COOLED SUFFICIENTLY.**

(2) **OVERHEATING. INADEQUATE BLEEDING COULD RESULT IN THE WATER HEATER OVERHEAT SWITCH ACTUATING DURING OPERATION.**

(3) **BLEEDING. DO NOT USE THE RADIATOR BLEED VALVES WHILST THE HEATER IS RUNNING AS AIR WILL BE DRAWN INTO THE SYSTEM.**

CAUTIONS

EXPANSION CAP. Failure to tighten the expansion cap may result in coolant loss with possible damage to the engine through overheating.

COOLANT. Never run the engine without coolant, not even for a very brief period as the injectors may be seriously damaged. This is due to the very high rate of heat transfer in the region of the injector nozzles.

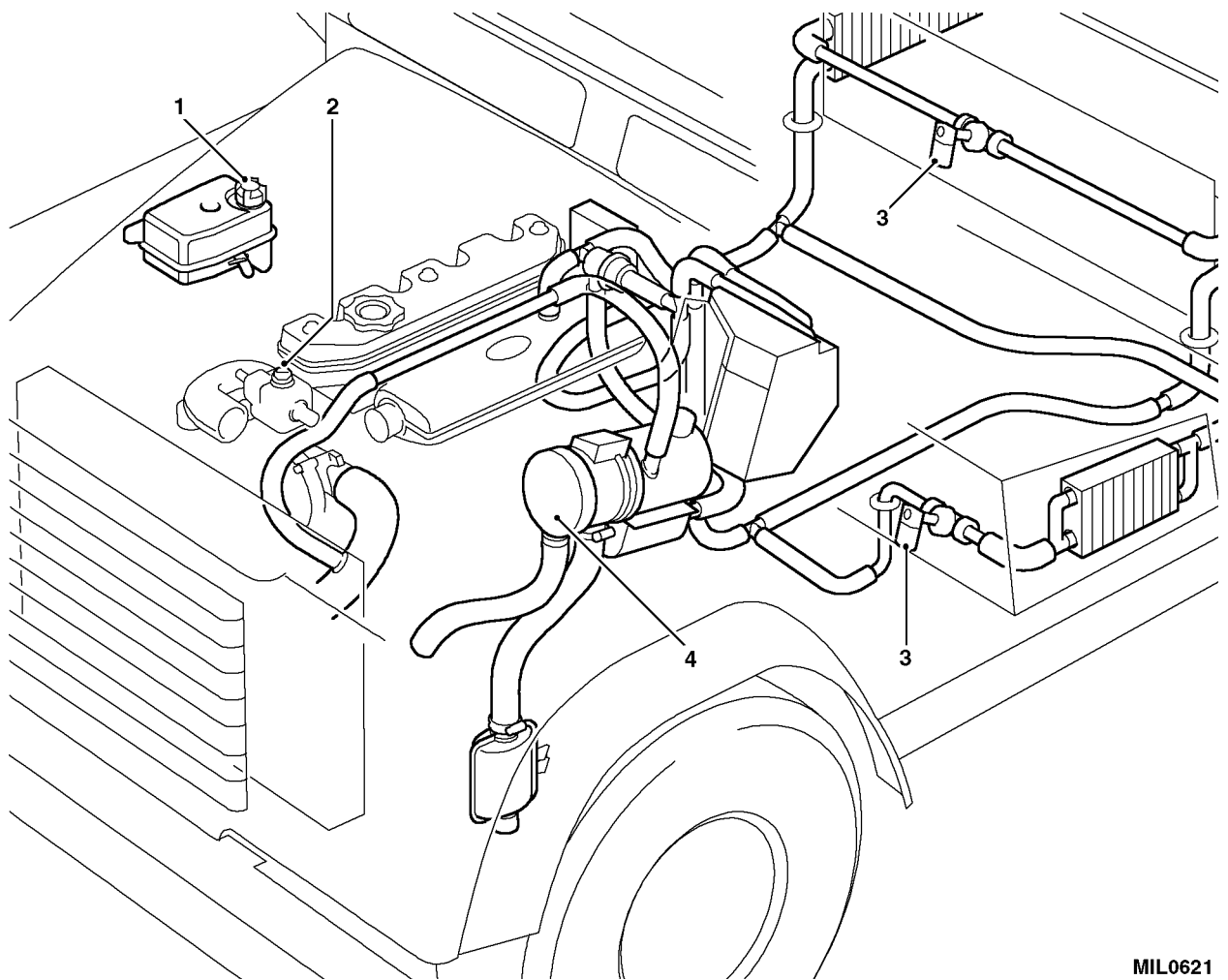
CORROSION. As a precaution against corrosion, the cooling system should be drained and flushed out as specified.

10 After any maintenance work has been carried on the water heater system or engine cooling system that has involved drainage or partial drainage of coolant from the system, it will be necessary to bleed the cooling system.

11 To bleed the cooling system carry out the following:

11.1 Ensure both stop taps (Fig 1 (3)) are open to allow the flow of coolant through the system.

11.2 Remove expansion tank cap (1) (refer to Para 8).



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- | | |
|----------------------------------|------------|
| 1 Expansion tank | 3 Stop tap |
| 2 Thermostat housing bleed screw | 4 Heater |

Fig 1 Bleeding the heater system

- 11.3 With the engine running, open the thermostat housing bleed screw (2) to allow the escape of air whilst topping up the system through the expansion tank.
- 11.4 Close the bleed screw when air free coolant is evident in the thermostat housing.
- 11.5 Switch off engine and start the heater (4) so that the circulating pump is actuated.
- 11.6 Remove the thermostat bleed screw (2) and if required, top up through the thermostat housing.
- 11.7 Repeat the procedures instructed in Paras 10.5 and 10.6 adding coolant if required until the required coolant level is reached in the expansion tank.
- 11.8 After satisfactory bleeding is achieved, the water pump will run almost without noise.
- 11.9 Refit the thermostat housing bleed screw and the expansion tank cap.

COOLING SYSTEM PROTECTION

12 The cooling system should be protected in cold and hot climates as follows:

12.1 By using the correct coolant mixture of anti-freeze and water as specified (refer to Para 13).

12.2 It is essential therefore if the cooling system is drained or topped-up at any time either in winter or summer, to refill with the correct coolant mixture, otherwise damage to the engine will occur.

RECOMMENDED ANTI-FREEZE SOLUTION

13 The solution (refer to Table 1 Serial 1) recommended for use in TUL and TUM winterised vehicles should be three part anti-freeze to two part water (60/40% concentration).

NOTE

The above solution also applies to Winter/water vehicles.

CHAPTER 13

ELECTRICAL SYSTEMS

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

1 This chapter details the Unit repair for the electrical systems as fitted to Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles.

General

2 This chapter has been sub-chaptered to allow for the various types of vehicle electrical systems as detailed below.

- 2.1 Chapter 13-1 Vehicle electrical system
- 2.2 Chapter 13-2 Fitted For Radio (FFR)
- 2.3 Chapter 13-3 Field Ambulance
- 2.4 Chapter 13-4 Winter/water
- 2.5 Chapter 13-5 Winterised
- 2.6 Chapter 13-6 Tropicalised
- 2.7 Chapter 13-7 Winterised/Waterproofed Ambulance

CHAPTER 13-1

VEHICLE ELECTRICAL SYSTEM

CONTENTS

Para	
1	Introduction Battery disconnection (CAUTIONS)
2	Disconnection
3	Reconnection Charging air portable batteries
4	Battery charging Alternator
5	Remove
6	Refit
7	Alternator functional tests (WARNING)
8	Check the alternator is charging (WARNING)
9	Check control regulator Starter motor
10	Remove
11	Refit Headlamps
12	Remove
13	Bulb replacement
14	Refit
15	Headlight setting Front indicator, tail/stop and side lights
16	Remove
17	Refit Rear indicator, fog and reverse lights.
18	Remove
19	Refit Rear light bulb holder repair
20	Repair Rear number plate light
21	Remove
22	Refit Convoy light
23	Removal and dismantling
24	Assembly and refitting Map reading light
25	Remove
26	Refit Trailer socket
27	Remove
28	Refit Directional side repeater lights
29	Remove
30	Refit Six way main lighting switch
31	Remove
32	Refit

(continued)

CONTENTS (continued)

Para

	Seven way main lighting switch
33	Remove
34	Refit
	Inspection sockets
35	Remove
36	Refit
	Warning lights panel
37	Remove
38	Refit
	Instrument panel
39	Remove
	Instrument removal
40	Remove
41	Refit
	Hazard warning switch
42	Remove
43	Refit
	Column switches and ignition switch
44	Remove
45	Refit
	Wiper motor and drive rack
46	Remove
47	Dismantle
48	Examination
49	Assembly
50	Refit

Table

Page

1	Special tools and test equipment	3
2	Sealants, adhesives and lubricants.....	3
3	Service kits	3

Fig

1	Alternator removal	6
2	Control regulator test circuit	7
3	Headlamp assembly	9
4	Headlamp adjustment.....	10
5	Front indicator, tail/stop and side lights	11
6	Rear indicator, fog and reverse light	12
7	Number plate light	15
8	Convoy light.....	16
9	Map reading light	17
10	Trailer socket	19
11	Directional side repeater lights	20
12	Six way main lighting switch	21
13	Seven way main lighting switch.....	22
14	Inspection sockets	23
15	Warning lights panel	25
16	Instrument panel fixings.....	26
17	Removing the multiplug connectors	26
18	Removing the leads and bulbs	27
19	Removing the instruments.....	28
20	Hazard warning switch, rear fog light switch and headlamp levelling switch.....	29
21	Column switches	30
22	Removing the grab handle	3

23	Removing the lower fascia panel.....	31
24	Removing the wiper motor assembly.....	32
25	Wiper motor.....	33
26	Circuit diagram.....	37/38

INTRODUCTION

1 This chapter details the Unit repairs for Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles fitted with the 24 volt electrical system. The information given is applicable to both left and right hand drive vehicles.

TABLE 1 SPECIAL TOOLS AND TEST EQUIPMENT

Serial (1)	NSN/Part Number where applicable (2)	Designation (3)
1 2	Z4/6625-99-252-3606 Z4/6625-99-253-0221	Multimeter set GP Hand held Probe set high current

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1 2 3	XG 250 OM 100 PX7	6850-99-224-8404 9150-99-944-0425 9150-99-910-0488	Silicon grease Lubricating oil Light grease

TABLE 3 SERVICE KITS

Serial (1)	NSN/Part Number where applicable (2)	Designation (3)
1 2 3 4 5	2540-99-839-7125 6140-99-665-3648 6160-99-865-1185 7XD 5940-99-481-9629 6150-99-613-2856	Front Wiper gear and link kit Air portable batteries Battery Clamp (air portable batteries) Battery terminal covers Rear light repair kit

BATTERY DISCONNECTIONS**CAUTIONS**

- (1) **Do not let the engine run with the batteries disconnected.**
- (2) **Do not use a high speed battery charger as a starting aid. When using a charger to charge the batteries, they must be disconnected from the vehicles electrical system.**
- (3) **When installing ensure the batteries are connected in correct polarity.**
- (4) **Care must be taken when disconnecting the batteries. Ensure the ignition system and all electrical components are switched off.**
- (5) **If a new battery is to be installed in the vehicle it should be of the same type and size as the original battery. When fitting ensure that terminals and leads are well clear of the battery clamp assembly.**

NOTE

When replacing standard batteries with the latest Air Portable Batteries (Table 3 Serial 2) a new retaining clamp (Table 3 Serial 3) must be fitted. Terminal covers (Table 3 Serial 4) must also be fitted to the batteries. The batteries must be replaced in matched pairs.

Disconnection

- 2 To disconnect the batteries, carry out the following:
 - 2.1 From inside the vehicle remove the left hand seat squab.
 - 2.2 Undo the overcentre catch and slide the battery box cover from the seat base.
 - 2.3 Remove terminal covers (if fitted).
 - 2.4 Disconnect the negative lead from the rear battery.
 - 2.5 Disconnect the positive lead from the front battery.

Reconnection

- 3 To reconnect the batteries, carry out the following:
 - 3.1 Clean the terminals with glass paper.
 - 3.2 Reconnect the positive lead to the front battery first.
 - 3.3 Reconnect the negative lead to the rear battery last.

NOTE

When fitted into vehicles or equipment the battery clamps should be bolted tightly onto the battery terminals and then coated with a light grease (refer to Table 2 Serial 3).

- 3.4 Refit terminal covers (if fitted).
- 3.5 Refit the battery box cover and seat squab.

CHARGING AIR PORTABLE BATTERIES

4 Air portable batteries utilise completely different technology to conventional vehicle 'wet batteries'. Users may find difficulty in recharging air portable batteries should the battery be allowed to discharge. The flow chart details the sequence the battery must be put through if it is allowed to discharge or is inadvertently flattened. Slave starting and allowing the vehicles charging system to recharge the battery, will result in a high charge rate being applied from the alternator, which the battery (once the voltage has dropped to <11.4v) will be **unable** to absorb. The longer a battery is left in a discharged state the more difficult it will be for it to recover.

If the battery is removed from the vehicle and put on a 'recovery (hospital) charge' of 2 to 3 amps (battery may not show any initial acceptance of charge) for a period of 10 to 12 hrs, the battery will then be conditioned to accept a normal charge rate for 2 hrs (workshop charge or vehicle) then left to rest (no load) for 1 hr. The battery should then be able to be put back into normal service.

ALTERNATOR

NOTE

The alternator is a non serviceable item and in the event of failure it must be renewed.

5 To remove the alternator carry out the following:

5.1 Disconnect the vehicle batteries (refer to Para 2) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

5.2 Remove the top to the air duct assembly (Fig 1 (1)) and carefully move around intercooler pipework.

5.3 Release the clip securing (2) the air duct to the rear of the alternator and remove the air duct assembly.

5.4 Disconnect the electrical connections to the back of the alternator (3).

5.5 Remove the drive belt (refer to Chap 12-1).

5.6 Remove securing bolt from bottom of alternator (4).

5.7 Remove long through bolt (5) from top fixing and withdraw alternator.

Refit

- 6 Refit the alternator by reversing the removal procedure.

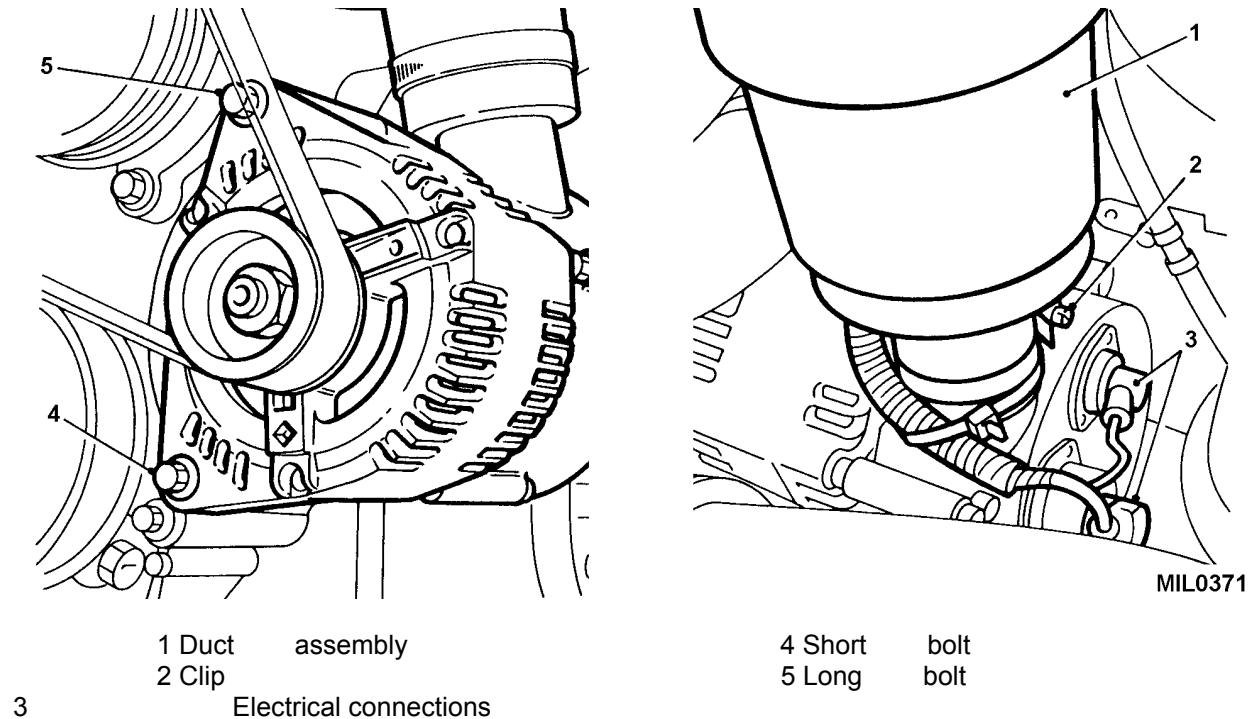


Fig 1 Alternator removal

ALTERNATOR FUNCTIONAL TESTS

- 7 This operation must be performed in two parts. The first to prove the alternators capacity to produce current. The second to prove the performance of the integral regulator.

WARNING

POLARITY SENSATIVITY. THE ALTERNATOR CONTAINS POLARITY SENSITIVE COMPONENTS THAT COULD BE PERMANENTLY DAMAGED IF SUBJECTED TO INCORRECT POLARITY. DO NOT CONNECT OR DISCONNECT ANY PART OF THE CHARGING CIRCUIT, INCLUDING THE BATTERY LEADS, WHILE THE ENGINE IS RUNNING. RUN THE ALTERNATOR WITH ALL ELECTRICAL CONNECTIONS CONNECTED OR DISCONNECTED.

Check the alternator is charging**NOTE**

The stated output may be exceeded slightly when the alternator is cold. To avoid misleading results, the check should be performed with the unit as near to its normal operating temperature as possible.

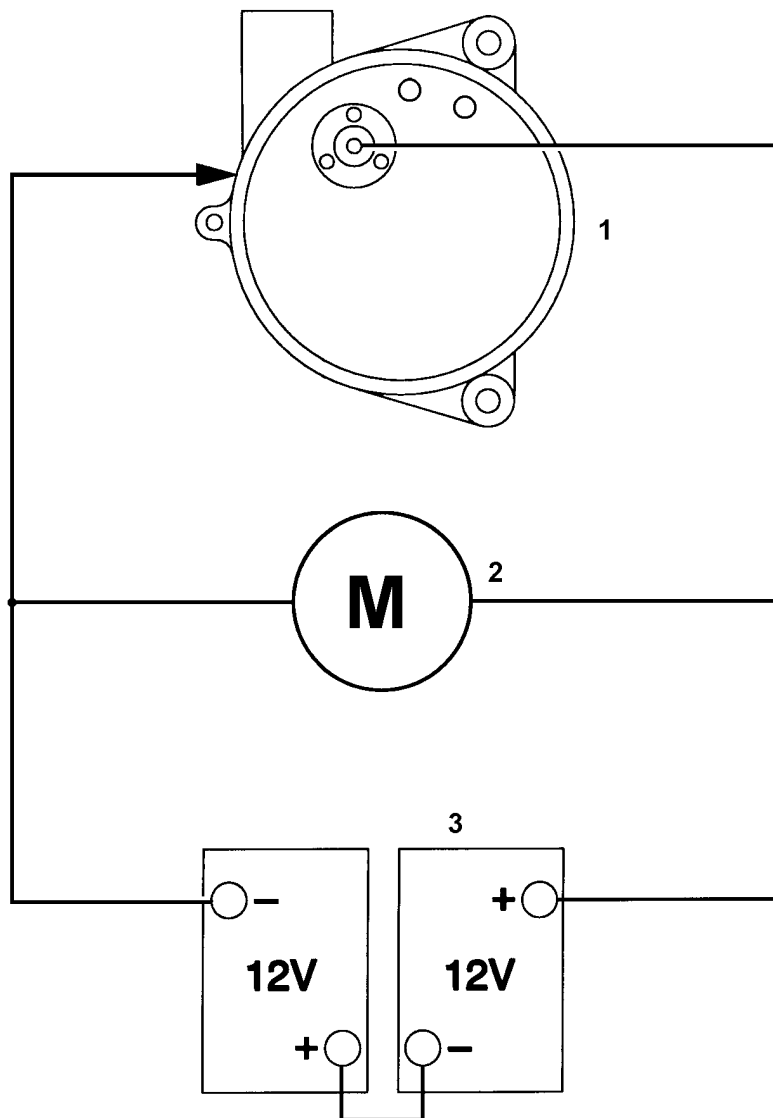
- 8 To check the alternator is charging proceed as follows:
- 8.1 Check drive belt adjustment.
 - 8.2 Check the alternator output using a high current probe and multimeter switching on all the electrics to make a load.

8.3 Run the engine and check the output current.

8.4 Stop the engine and disconnect the electrical connections to the alternator.

NOTES

- (1) At normal engine tick-over speed (approx. 700 rpm) the alternator warning light should be extinguished. (The regulator cut in operates at 1220 rpm alternator speed which equates to 406 rpm engine speed).
- (2) Hold the engine speed at approximately 2000 rpm (6000 alternator rpm). The multimeter reading should now be equal to the nominal output of 53 amps (hot) or 61 amps (cold).
- (3) If further tests are required check the control regulator.



MIL0373

2
1 Alternator
Multimeter

3 24 volt supply

Fig 2 Control regulator test circuit

Check control regulator

NOTE

The stated output may be exceeded slightly when the alternator is cold. To avoid misleading results, the check should be performed with the unit as near to operating temperature as possible.

9 To check the control regulator proceed as follows:

9.1 Check drive belt adjustment.

9.2 Disconnect the electrical connections to the alternator.

9.3 Connect a multimeter as shown (Fig 2).

9.4 Run the engine.

9.5 At normal engine tick over speed (approximately 700 rpm) the alternator warning light should be extinguished.

9.6 Increase the engine speed to 2000 rpm (approx. 6000 alternator rpm) and hold. The multimeter reading should now be steady at 27.2 to 28.8 volts.

9.7 If the multimeter reading is not steady at the above figure and a satisfactory test has been performed then the indication is that the regulator should be replaced.

9.8 After the test, stop the engine. Remove all test equipment and reconnect all vehicle wiring.

STARTER MOTOR

NOTE

The starter motor is a non serviceable item and in the event of failure it must be renewed.

Remove

10 To remove the starter motor carry out the following:

10.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).

10.2 Disconnect and move aside turbo air intake hose.

10.3 Disconnect the electrical leads to the starter motor and move aside. Retain the nut and spring washer and make sure they are used when refitting the electrical leads to the replacement motor.

10.4 Remove the two bolts and one nut securing the starter motor to the flywheel housing.

10.5 Manoeuvre the starter motor clear of the flywheel housing and remove.

Refit

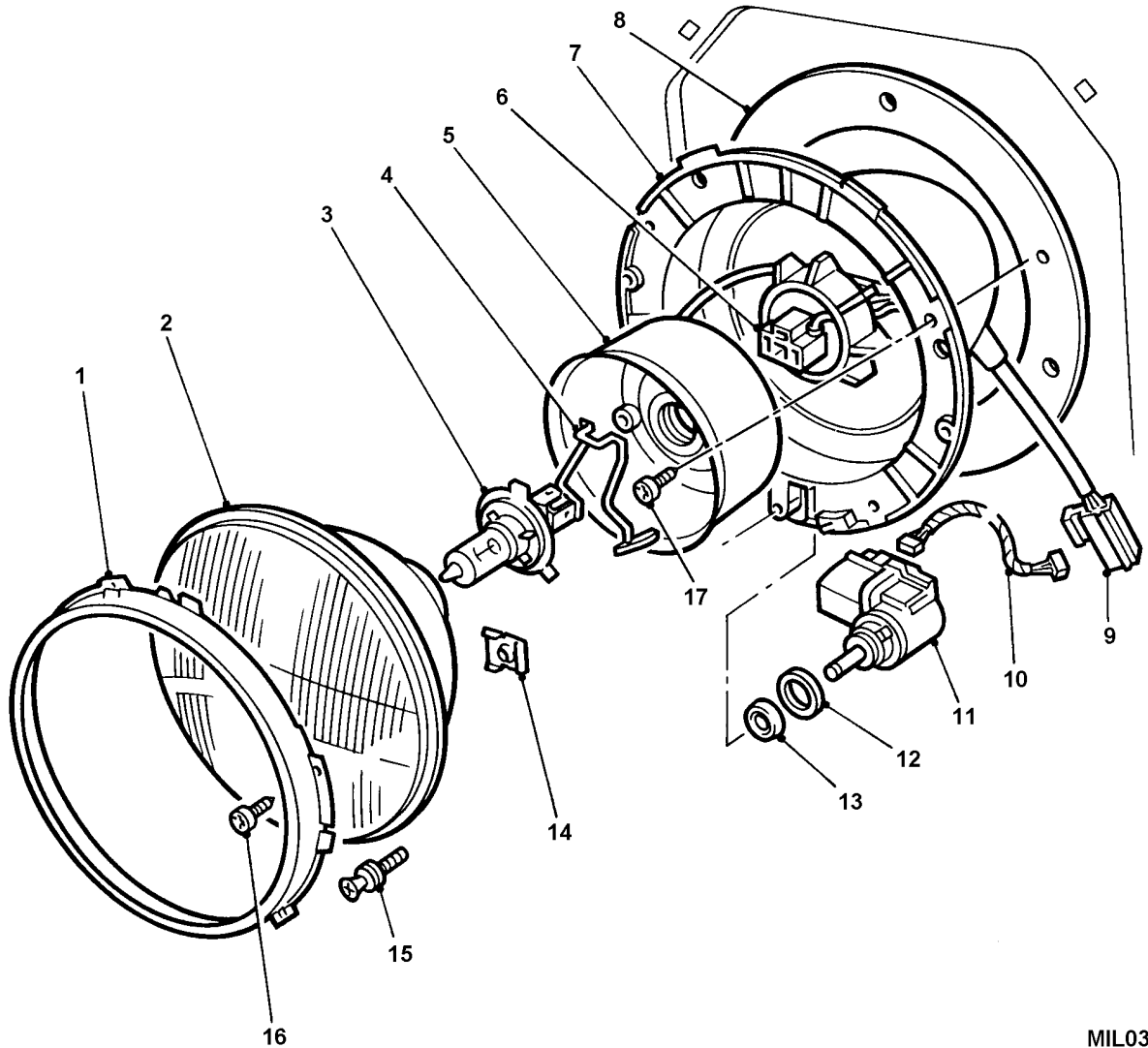
11 Refit the starter motor by reversing the removal procedure.

HEADLAMPS

Remove

NOTE

The headlamps, mounted in the front wing panels, incorporate a levelling device, which realigns the headlamps when carrying heavy loads in the rear of the vehicle.



MIL0374

- | | | | | | |
|---|---|---------------------|--|----|--------------------|
| | 1 | Headlamp bezel | | 9 | Multiplug |
| | 2 | Light unit | | 10 | Link lead |
| 3 | 3 | Bulb | | 11 | Levelling actuator |
| | 4 | Bulb retaining clip | | 12 | Rubber gasket |
| | 5 | Rubber boot | | 13 | Rubber seal |
| | 6 | Connector | | 14 | Bezel clamp plate |
| 7 | 7 | Body | | 15 | Adjusting screw |
| 8 | 8 | Gasket | | 16 | Bezel screw |

Fig 3 Headlamp assembly

12 To remove the headlights, carry out the following:

- 12.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 12.2 Unclip lamp guard and drop away.
- 12.3 Remove the four screws (Fig 3 (16)) securing the headlight assembly to the wing panel.
- 12.4 Disconnect the headlamp connector (6) and headlamp levelling (9) multiplug and withdraw the headlight assembly complete with gasket (8) from the wing panel.

Bulb replacement

13 To replace the bulb proceed as follows:

- 13.1 Unclip the headlamp bezel (Fig 3 (1)) from the headlight beam adjustment screws (15) and separate the light unit (2) from the body (7).
- 13.2 Pull off the electrical connection (6) to the headlight, remove the rubber boot (5), release the bulb retaining clip (4) and withdraw the bulb (3).

Refit

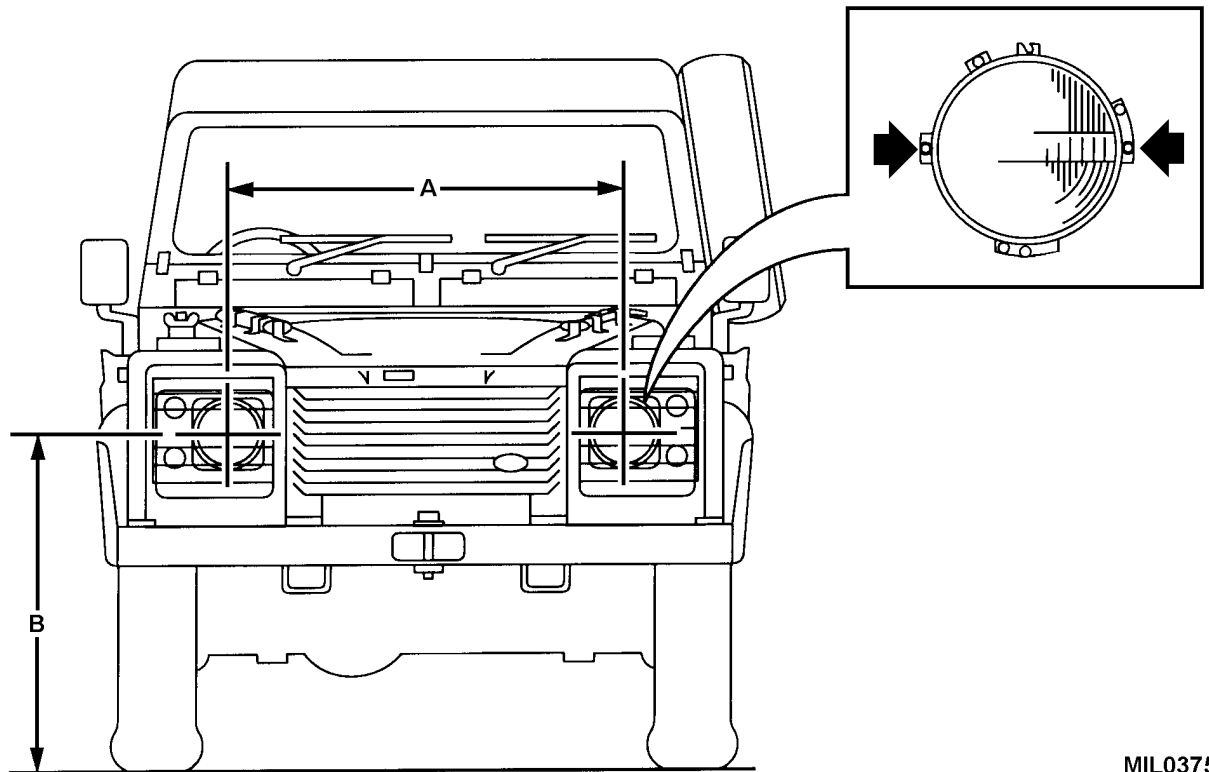
14 Refit the headlight as follows:

- 14.1 Fit a new bulb (3) and secure with retaining clip (4).
- 14.2 Refit rubber boot (5) and electrical connector (6).
- 14.3 Refit the light unit by reversing the removal procedure.

HEADLIGHT SETTING

15 The headlights should be set using beam setting equipment. If adjustment is required and specialist beam setting equipment is not available, temporary setting can be carried out using the following method, but should be checked and reset using beam setting equipment as soon as possible.

- 15.1 When setting headlights the vehicle should be unladen, on level ground and 3657.6 mm (12 ft) from a vertical wall or screen (Fig 4). The horizontal and vertical centre lines of the headlights must be accurately measured from the vehicle concerned then marked on the wall or screen. Adjust the headlights as necessary so that the area of concentrated light corresponds with the marked crosses. Ensure that the headlamps are on dip beam.



MIL0375

- A Measurement between headlight centres
- B Measurement from level floor to headlight centres.

Fig 4 Headlight adjustment

FRONT INDICATOR, TAIL/STOP AND SIDE LIGHTS

NOTE

The light units under this heading are all of a similar construction, the removal and refitting procedure is the same for each light. The construction differs only in respect of lens colours and bulb wattage.

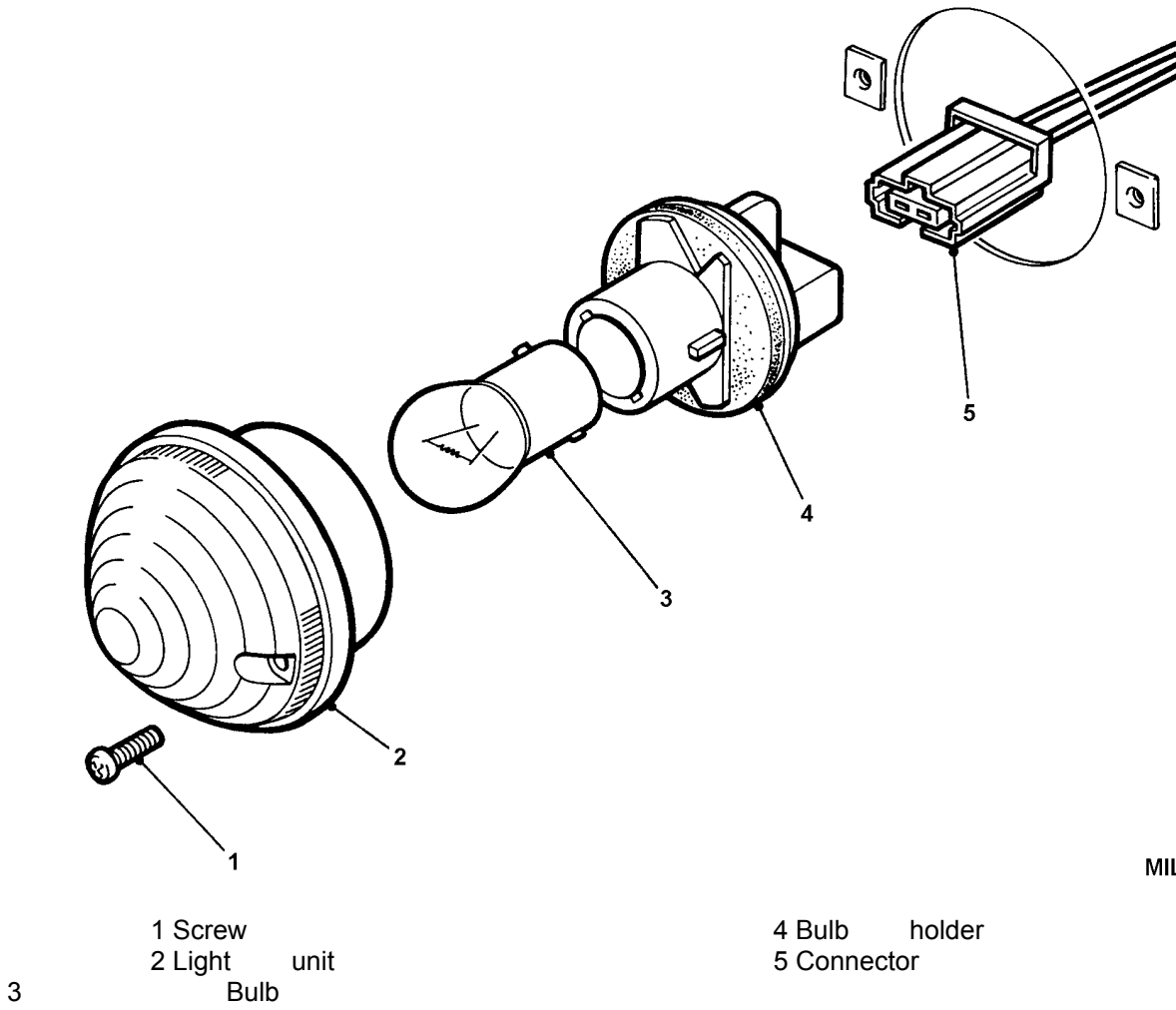
Remove

16 To remove the light unit carry out the following:

- 16.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 16.2 Remove the two screws (Fig 5 (1)) securing the light unit to the body.
- 16.3 Withdraw the unit from body, and disconnect the multiplug (5) from the light unit.
- 16.4 Remove the bulb holder (4) complete with rubber seal and mounting block and bulb (3).

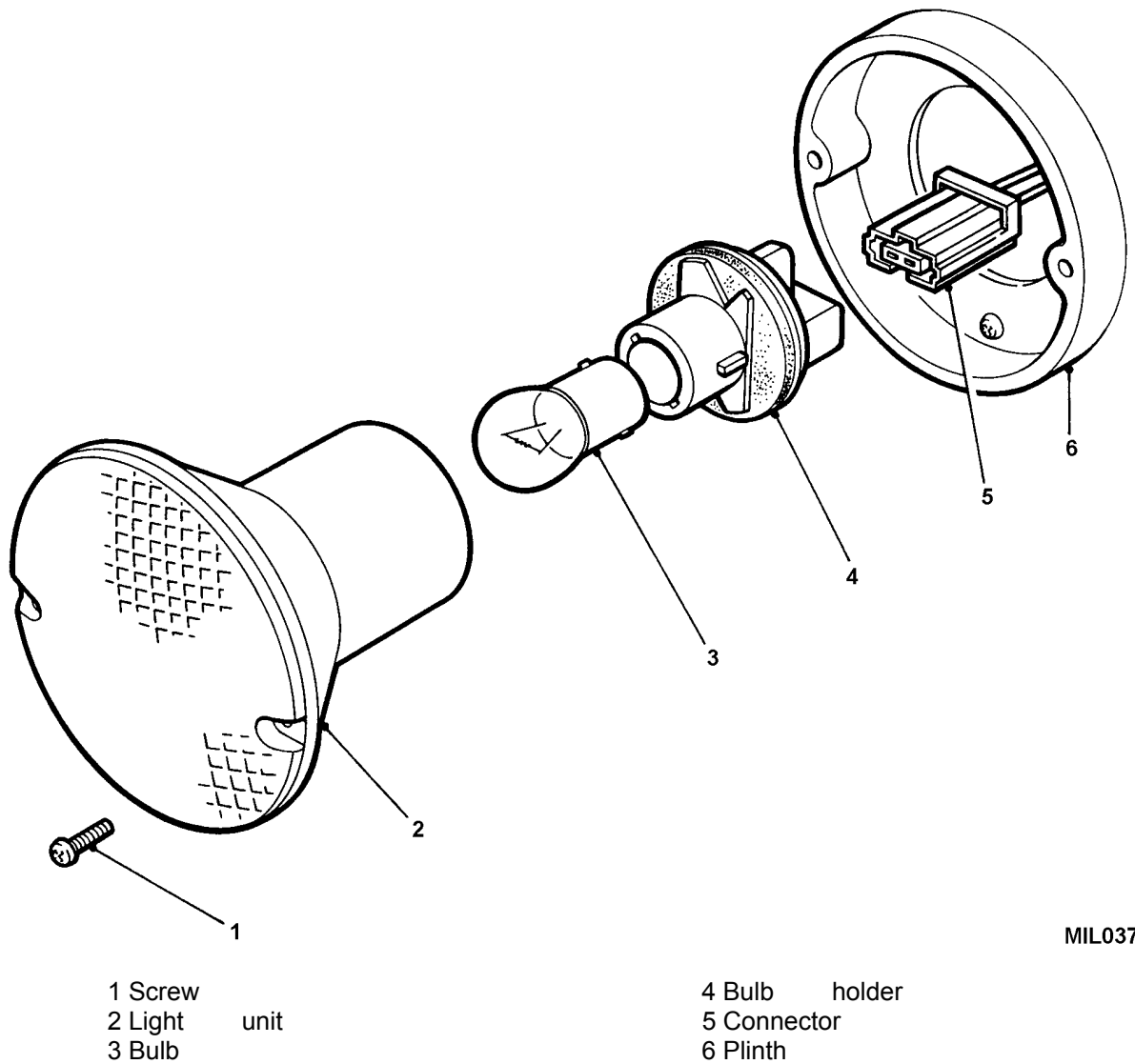
Refit

17 Refit the light unit by reversing the order of removal.



MIL0376

Fig 5 Front indicator, tail/stop and side lights



MIL0377

Fig 6 Rear indicator, fog and reverse light

REAR INDICATOR, FOG AND REVERSE LIGHTS.

NOTE

The rear indicator, fog and reverse lights are of similar construction and the remove and refitting procedure is the same for each light. The construction differs only in respect of lens colour.

Remove

18 To remove the light unit carry out the following:

- 18.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 18.2 Remove the two screws (Fig 6 (1)) securing the light unit (2) to the lamp plinth (6).
- 18.3 Withdraw the unit from the body and disconnect the multiplug (5) from the light unit.
- 18.4 Remove the bulb holder (4) complete with rubber seal and mounting block and bulb (3).

18.5 If necessary, remove the two screws securing the lamp plinth to the body and remove.

Refit

19 Refit the light unit by reversing the order of removal.

REAR LIGHT BULB HOLDER REPAIR**Repair**

20 A repair kit (refer to Table 3 Serial 5) is available for the rear lights. To replace the defective bulb holder carry out the following.

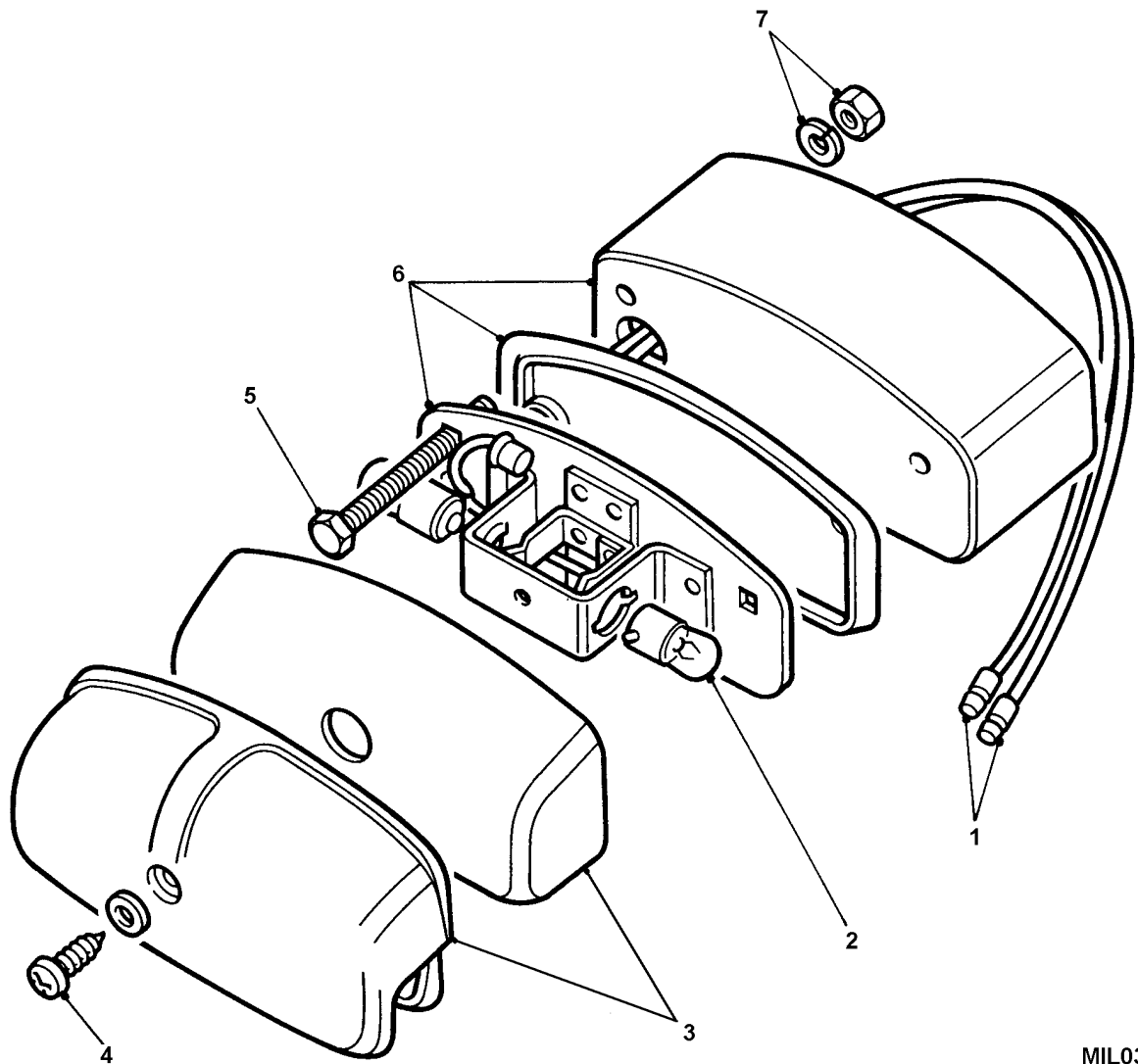
- 20.1 Remove the affected rear light from the vehicle (refer to Para 16 or 18).
- 20.2 Cut the defective bulb holder from the wiring harness.
- 20.3 Prepare the ends of the repair connector and harness.
- 20.4 Using the two crimp connectors provided in the kit crimp the repair connector to the harness.
- 20.5 Heat seal the crimp connectors to provide a waterproof seal.

NOTE

The repair connector is only supplied with red/black cables. Red to be used for supply irrespective of original colour coding, black to be used for earth.

- 20.6 Replace light (refer to Para 17 or 19).

REAR NUMBER PLATE LIGHT



MIL0378

- | | | | |
|---|---------------------|---|-------------------------|
| 1 | Socket connectors | 5 | Bolt |
| 2 | Bulb | 6 | Adapter and bulb holder |
| 3 | Lens and lens cover | 7 | Nut and washer |
| 4 | Screw | | |

Fig 7 Number plate light

Remove

21 To remove the number plate light carry out the following:

21.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).

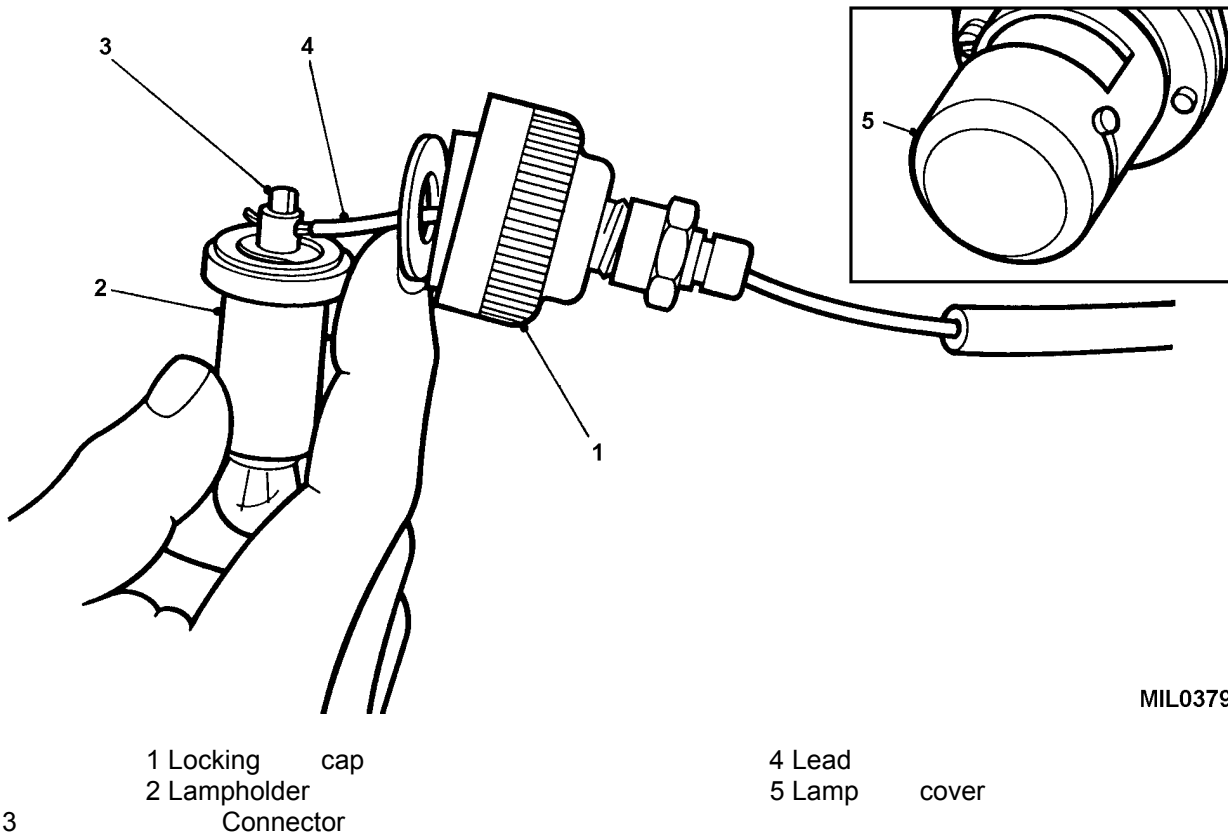
- 21.2 Undo the screw (Fig 7 (4)) securing the lens cover and lens (3) and remove.
- 21.3 Disconnect the electrical bullet leads (1) from inside the vehicle.
- 21.4 Undo the two screws (5), nuts and washers (7) securing the lamp assembly (6) to the vehicle body and remove.
- 21.5 Remove the bulb holder complete with rubber seal and mounting block (6).

Refit

- 22 Refit the light unit by reversing the order of removal.

CONVOY LIGHT**NOTE**

The convoy light is located beneath the vehicle to illuminate an area on a white plate, or a white area on the rear axle. The cover is fitted with a spring loaded light shield which may be rotated on the cover to give full illumination or restricted illumination for use in black-out conditions.



MIL0379

Fig 8 Convoy light

Removal and dismantling

- 23 To remove and dismantle the convoy light carry out the following:

- 23.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).

- 23.2 Remove mounting bracket and light assembly from the chassis.
- 23.3 Remove locking ring (Fig 9 (1)) and remove lamp cover (5).
- 23.4 Release positive connection (3) from lamp holder (2), withdraw cable (4) and remove.
- 23.5 Remove bracket from backplate.
- 23.6 Remove front cover from backplate.

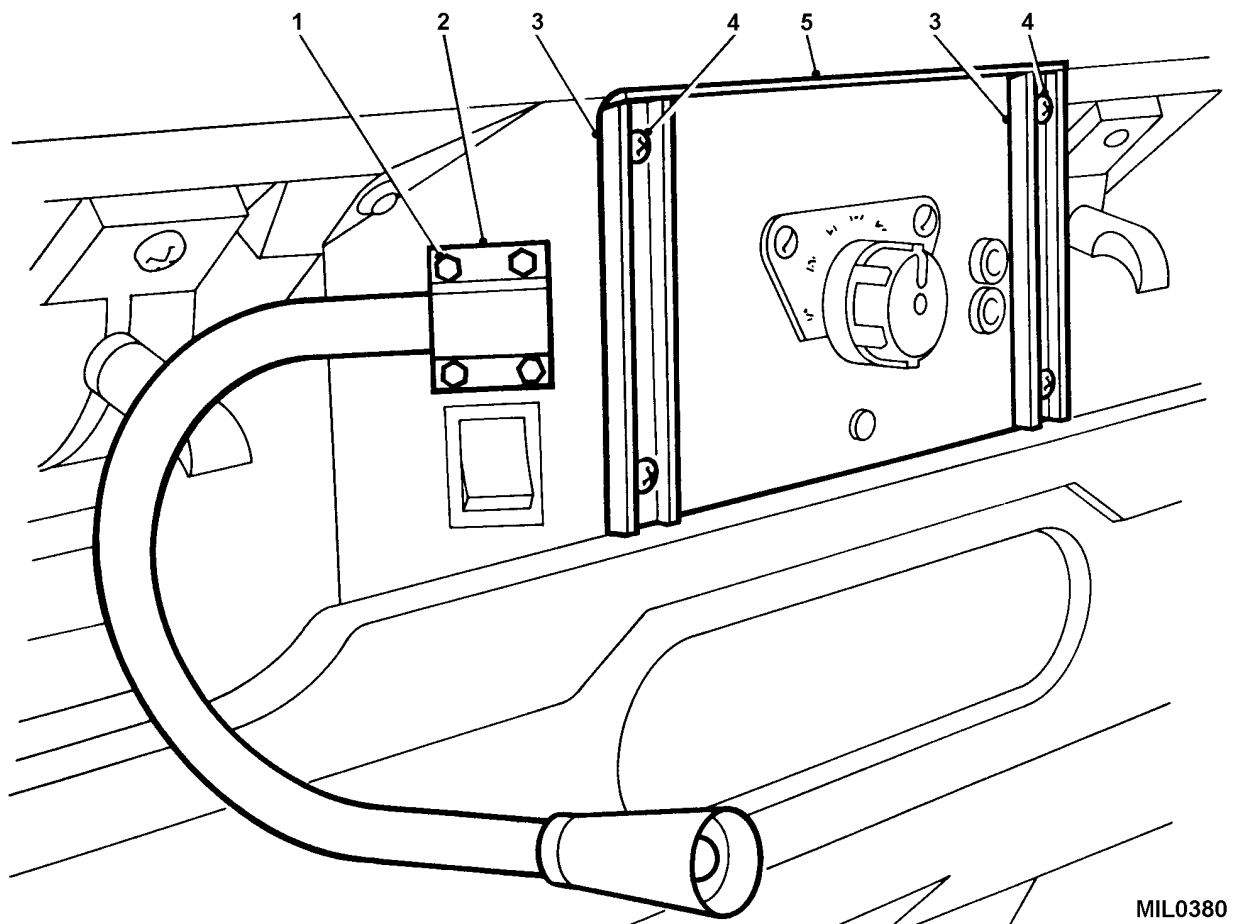
Assembly and refitting

24 Assemble and refit the light in reverse order of removal.

MAP READING LIGHT

NOTE

A switch located on the fascia illuminates the map reading light, mounted on the fascia in front of the passenger seat.



MIL0380

- 1 Mounting screws
- 2 Map leading light assembly
- 3 Retaining bracket
- 4 Screws
- 5 Mounting panel

Fig 9 Map reading light

Remove

25 To remove the map reading light carry out the following:

25.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).

25.2 Remove the four screws (Fig 9 (4)) from the retaining brackets (3), remove the mounting panel (5) from the fascia and tie aside.

25.3 Remove the four screws (1) securing the map reading light to the side panel, and from inside the fascia disconnect the multiplug and remove the map reading light unit (2).

Refit

26 Refit the map reading light by reversing the order of removal. Check all multiplugs are reconnected to the rear of the fascia panel.

TRAILER SOCKET**NOTE**

The trailer socket is located on the right of the towing hook secured to the rear chassis cross member. When not in use the socket is protected by a spring loaded cover. To use the socket, lift the cover and insert the trailer plug ensuring engagement between the lip at the end of the cover and the slot in the plug casing.

Remove

27 To remove the trailer socket carry out the following:

27.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).

27.2 Remove the screws securing the mounting panel (Fig 10 (1)).

27.3 From inside the rear of the vehicle remove the right hand cover and disconnect the snap connectors (yellow wires) from the rear of the trailer socket (2).

27.4 Cut the cable ties securing the socket harness and withdraw the harness.

27.5 From outside the vehicle, remove the four bolts (3) spring washers (4) and nuts (5) securing the trailer socket (2) and withdraw complete with leads.

Refit

28 Refit in reverse order of removal, connecting the leads in accordance with the circuit diagram (refer to Fig 26).

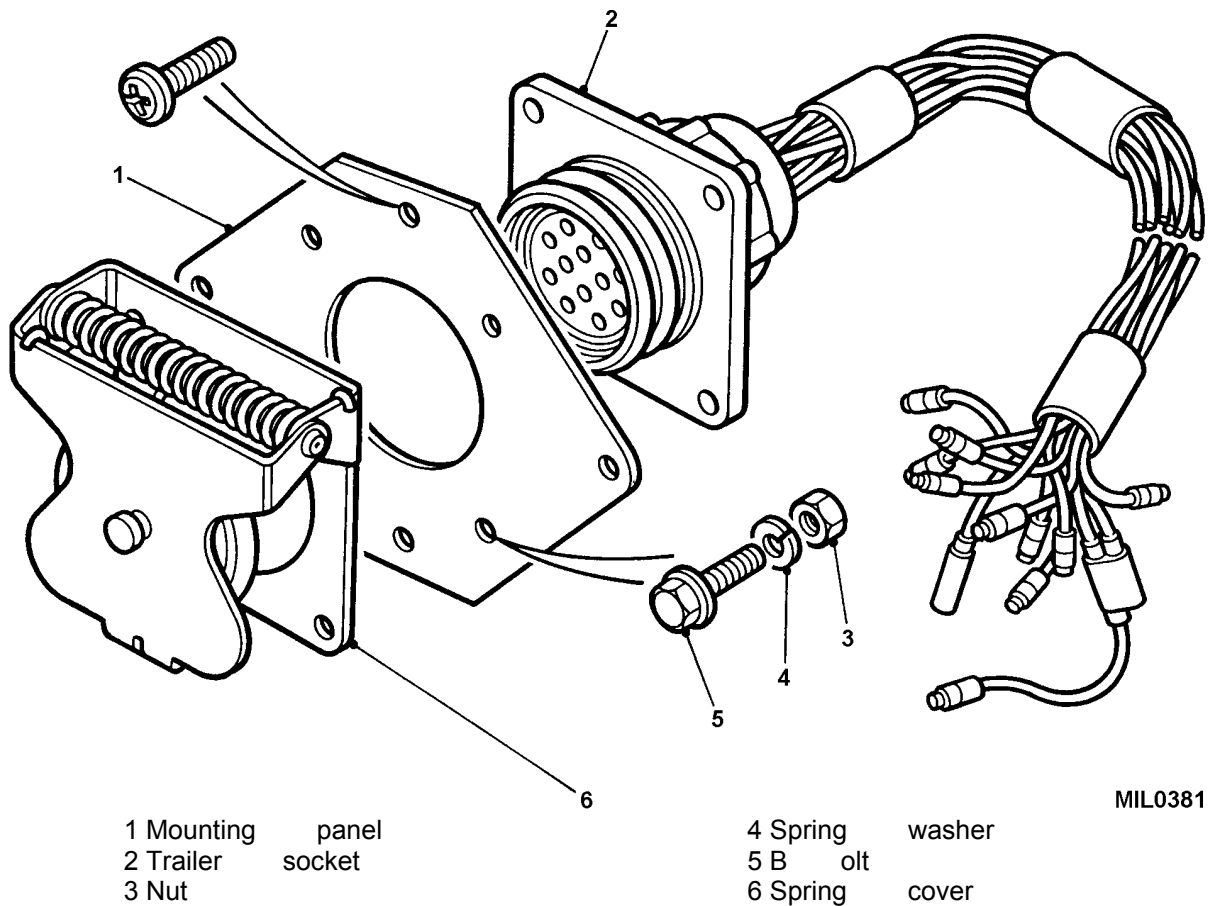


Fig 10 Trailer socket

DIRECTIONAL SIDE REPEATER LIGHTS

Remove

29 To remove the side repeater lights carry out the following:

- 29.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 29.2 Slide lens (Fig 11 (1)) in direction of free travel and prise away from the wing.
- 29.3 Pull the lead through the hole in the wing and disconnect the snap connectors (2).
- 29.4 Remove the light unit. Refit

30 Refitting the light is the reverse order of removal.

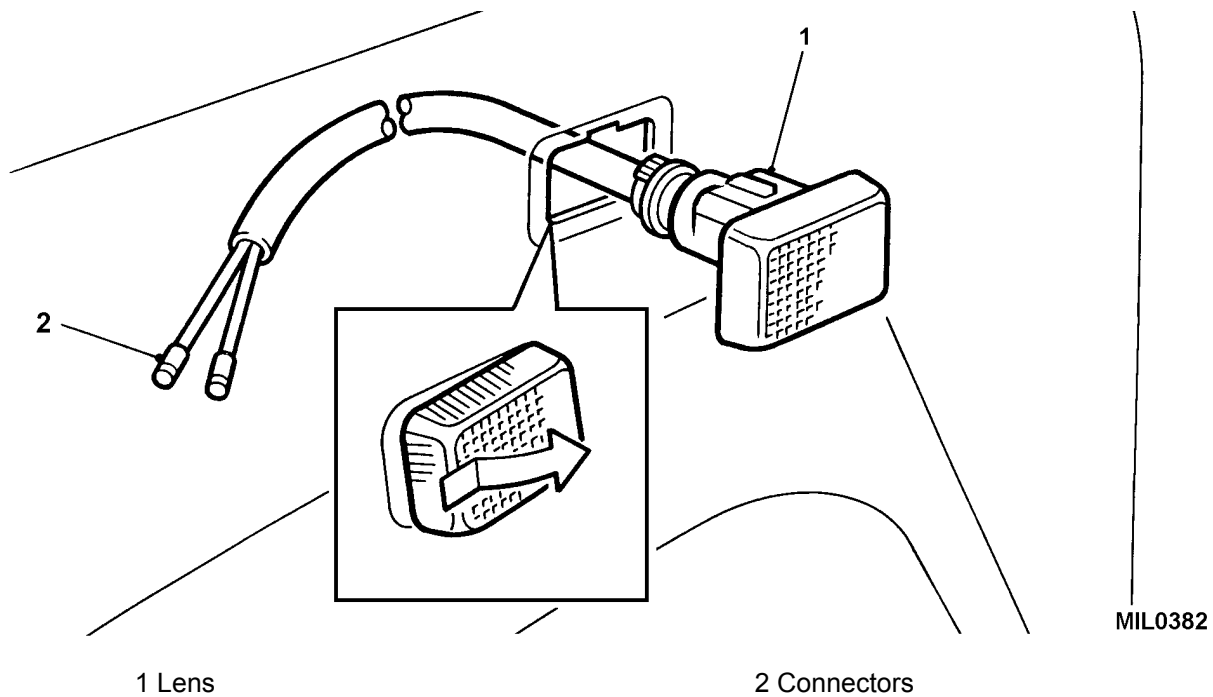


Fig 11 Directional side repeater lights

SIX WAY MAIN LIGHTING SWITCH**Remove****NOTE**

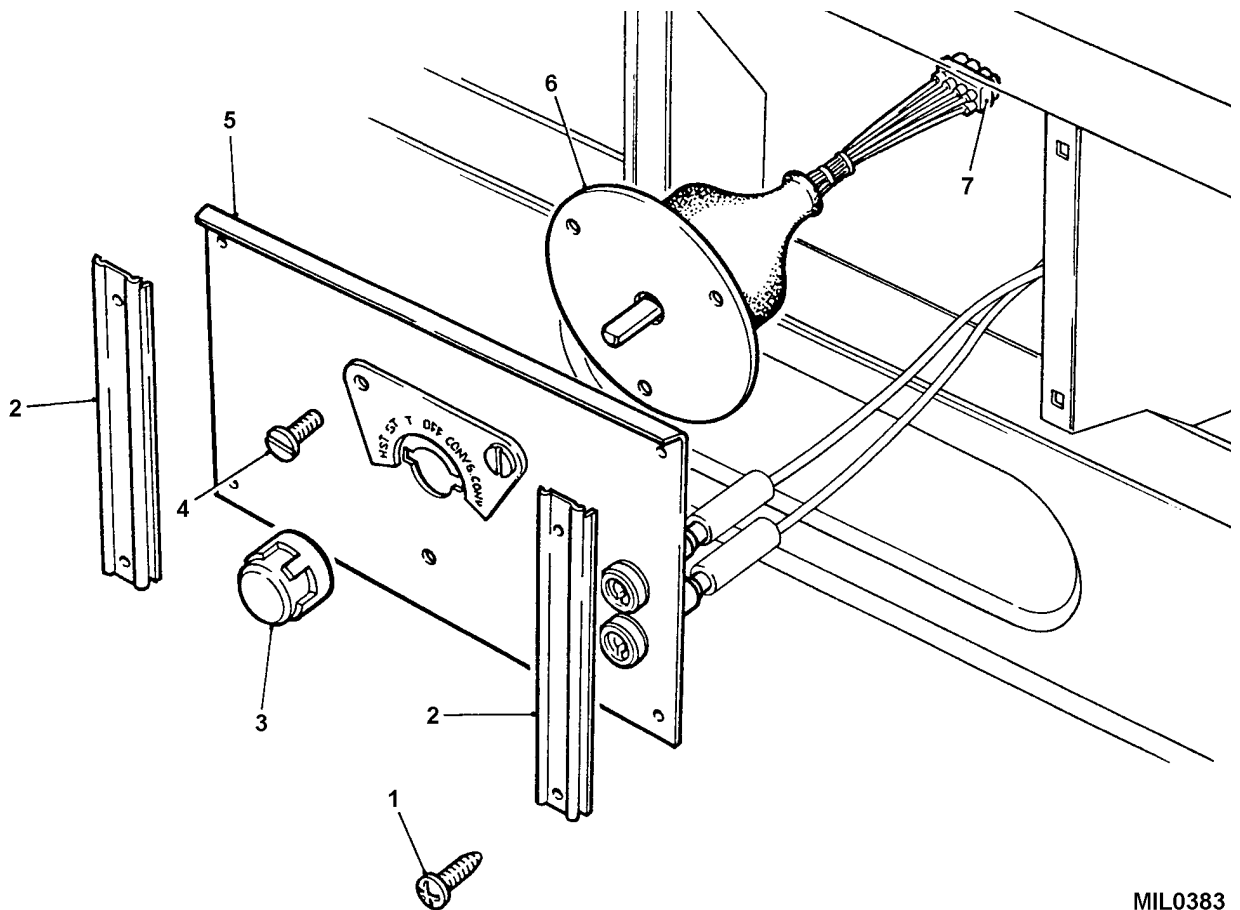
The six way main lighting switch is situated on a removable panel located in the centre of the fascia.

31 To remove the six way main lighting switch, carry out the following:

- 31.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 31.2 Undo retaining screw and remove the control knob (Fig 12 (3)) from switch (6).
- 31.3 Remove the four screws (1) from the retaining brackets (2) and remove the mounting panel (5) from the fascia.
- 31.4 Disconnect cables at connector block (7).
- 31.5 Remove the three screws (4) securing switch assembly and indicator plate to panel and withdraw switch and plate.

Refit

32 Refit the lighting switch in the reverse order of removal.



MIL0383

- | | | | |
|---|--------------------|---|------------------------------|
| 1 | Screw | 5 | Mounting panel |
| 2 | Retaining brackets | 6 | Six way main lighting switch |
| 3 | Knob | 7 | Connector |
| 4 | Screw | | |

Fig 12 Six way main lighting switch

SEVEN WAY MAIN LIGHTING SWITCH

Remove

NOTE

The seven way main lighting switch is situated on a removable panel located in the centre of the fascia.

33 To remove the seven way main lighting switch, carry out the following:

- 33.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 33.2 Undo retaining screw and remove the control knob (Fig 13 (3)) from switch (6).
- 33.3 Remove the four screws (1) from the retaining brackets (2) and remove the mounting panel (7) from the fascia.
- 33.4 Disconnect the black and the white lighting switch multi-plug connectors (8) from the main harness.

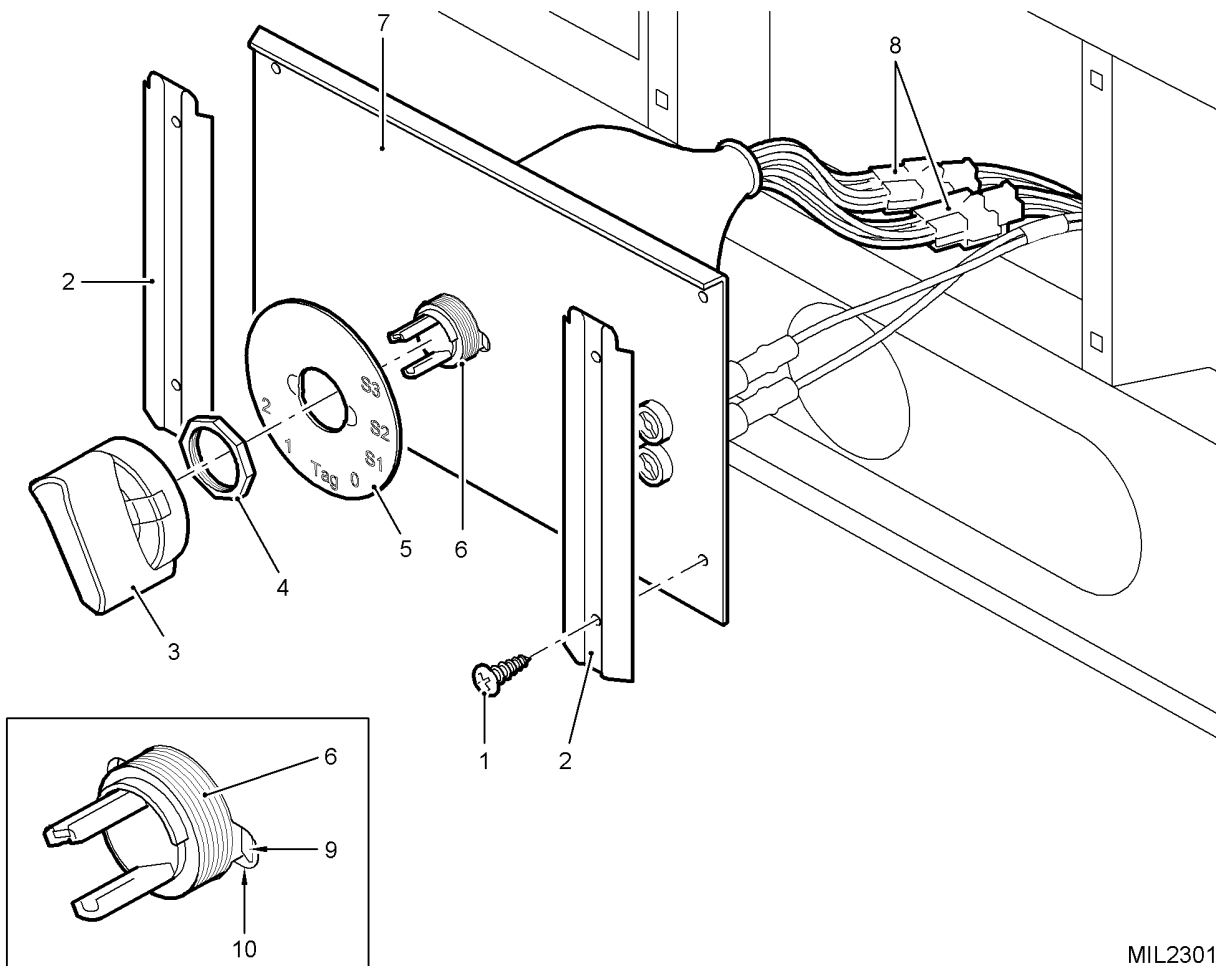
33.5 Remove the large nut (4) securing the switch assembly (6) and indicator plate (5) to panel and withdraw switch and plate.

Refit

34 Refit the lighting switch in the reverse order of removal.

NOTE

Ensure the lock tabs (9) are positioned in the recesses (10) in the mounting panel.



MIL2301

- | | | | |
|---|--------------------|----|--------------------------------|
| 1 | Screw | 6 | Seven way main lighting switch |
| 2 | Retaining brackets | 7 | Mounting panel |
| 3 | Knob | 8 | Multi-plug connectors |
| 4 | Nut | 9 | Lock tabs |
| 5 | Indicator plate | 10 | Recess |

Fig 13 Seven way main lighting switch

INSPECTION SOCKETS

Remove

35 To remove the inspection sockets carry out the following:

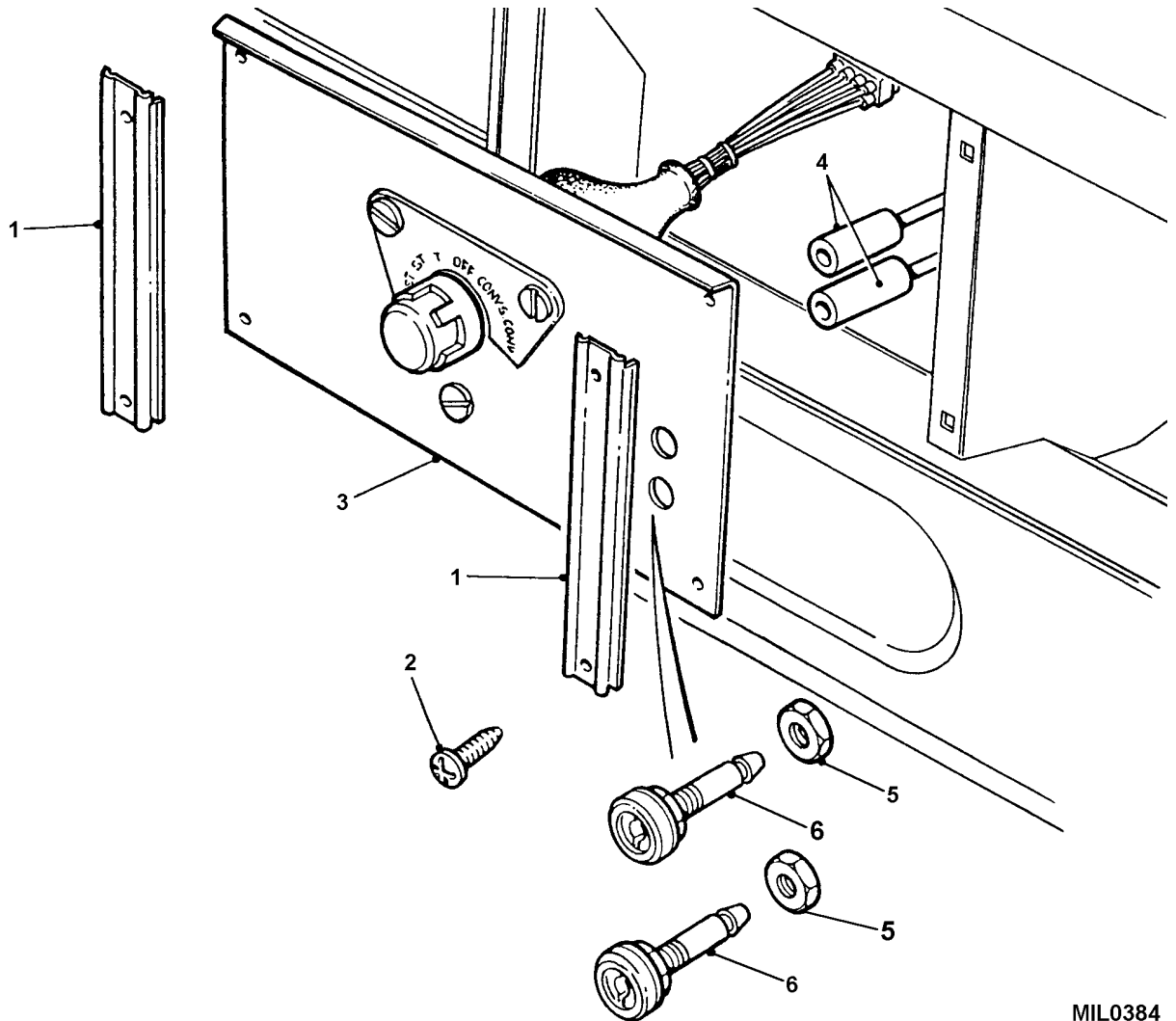
35.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries

(refer to Chap 13-2).

35.2 Remove the four screws (Fig 14 (2)) from the retaining brackets (1) and remove the mounting panel (3) from the fascia.

35.3 Disconnect the cables (4) from the sockets.

35.4 Remove the nuts (5) from the back of the panel securing the sockets (6) to the panel and withdraw sockets.



MIL0384

- | | |
|----------------------|----------------------|
| 1 Retaining brackets | 4 Cables |
| 2 Screw | 5 Nuts |
| 3 Mounting panel | 6 Inspection sockets |

Fig 14 Inspection sockets

Refit

36 Refit the light switch in reverse order of the removal.

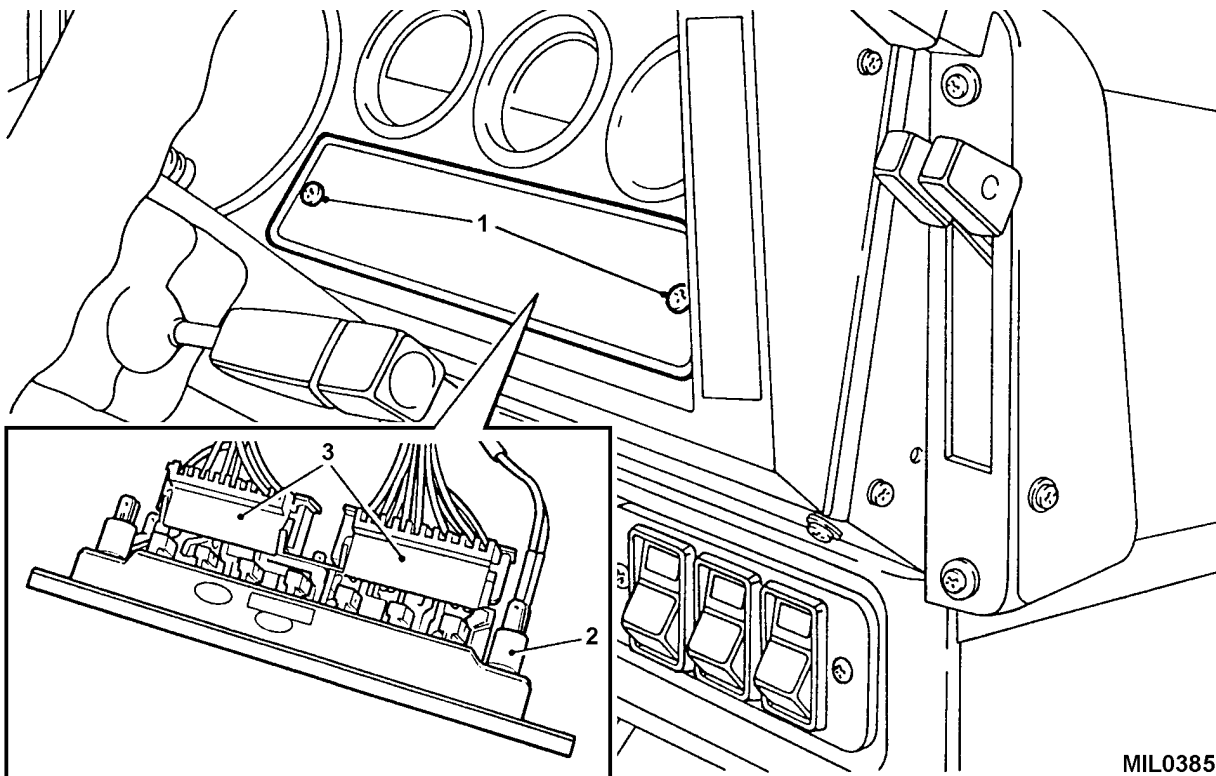
WARNING LIGHTS PANEL**Remove**

37 Remove the warning lights panel as follows:

37.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).

37.2 Remove the two screws (Fig 15 (1)) and ease the warning lights panel from the instrument panel.

37.3 Disconnect the two multiplugs (3).



MIL0385

2 1 Fixing screws
Bulb lead

3 Multiplugs

Fig 15 Warning lights panel

37.4 Disconnect the remaining bulb holders (2) and remove the panel.

Refit

38 Refit the warning light panel in the reverse order of the removal.

INSTRUMENT PANEL

Remove

39 Remove the instrument panel as follows:

39.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).

39.2 Remove the four screws (Fig 16) and ease the instrument panel forward to gain access to the rear of the panel.

39.3 Disconnect the multiplug (Fig 17 (2)), warning light multiplugs (4), to the instruments, and the speedometer cable (3).

39.4 The panel (1) can now be removed complete with the instruments.

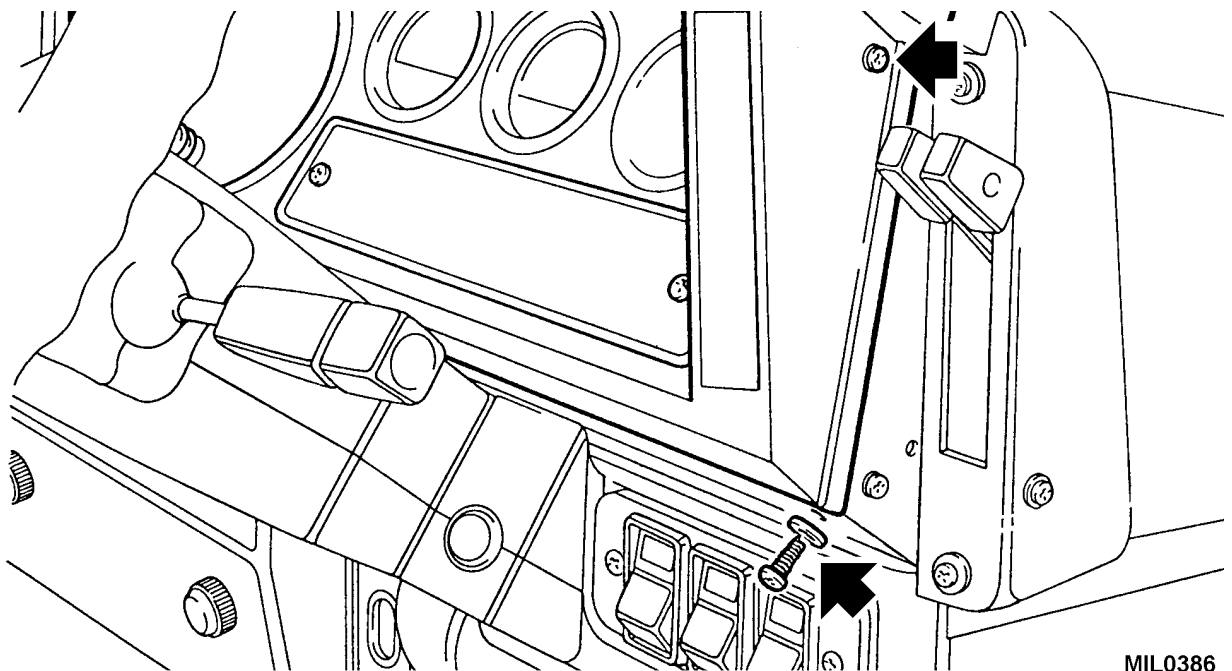
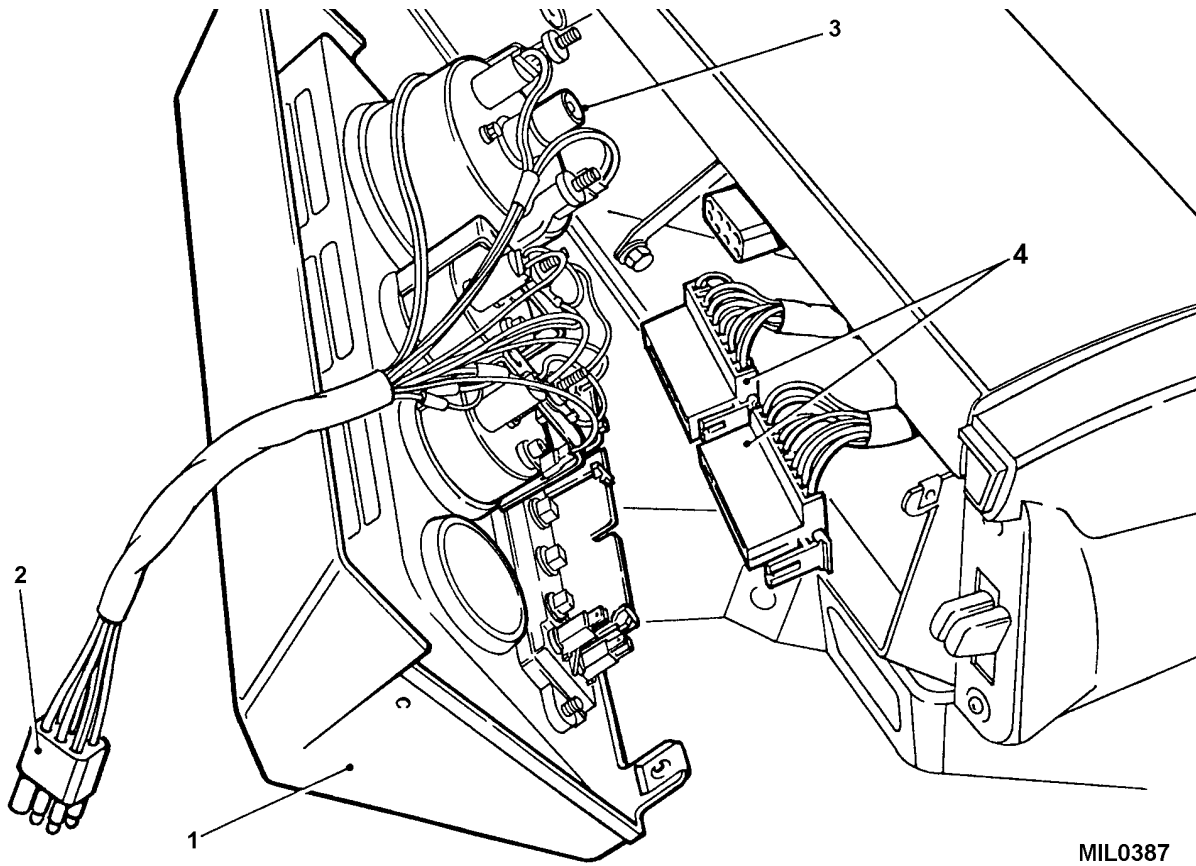


Fig 16 Instrument panel fixings



MIL0387

- 1 Instrument panel
- 2 Multiplug connector

- 3 Speedo cable connection
- 4 W/L Multiplug connector

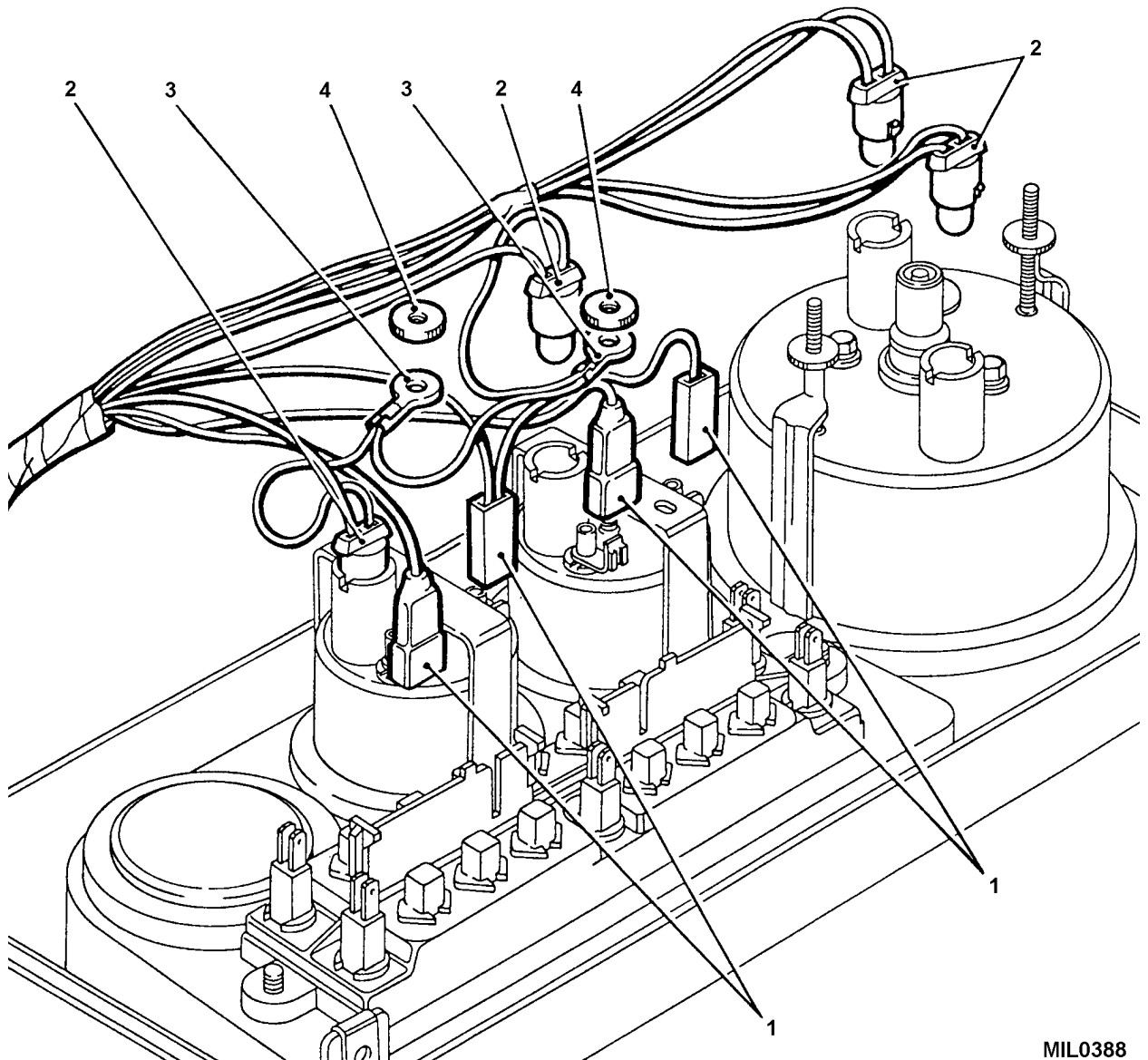
Fig 17 Removing the multiplug connectors

INSTRUMENT REMOVAL

Remove

40 Remove the instrument as follows:

- 40.1 Remove the knurled nuts (Fig 18 (4)) from the instruments and remove the electrical earth connectors (3).
- 40.2 Unplug the electrical instrument connectors (1).
- 40.3 Remove the light bulb holders (2) from the instruments.



MIL0388

1 Electrical instrument connections
2 Light bulb holders

3 Electrical earth connectors
4 Knurled nuts

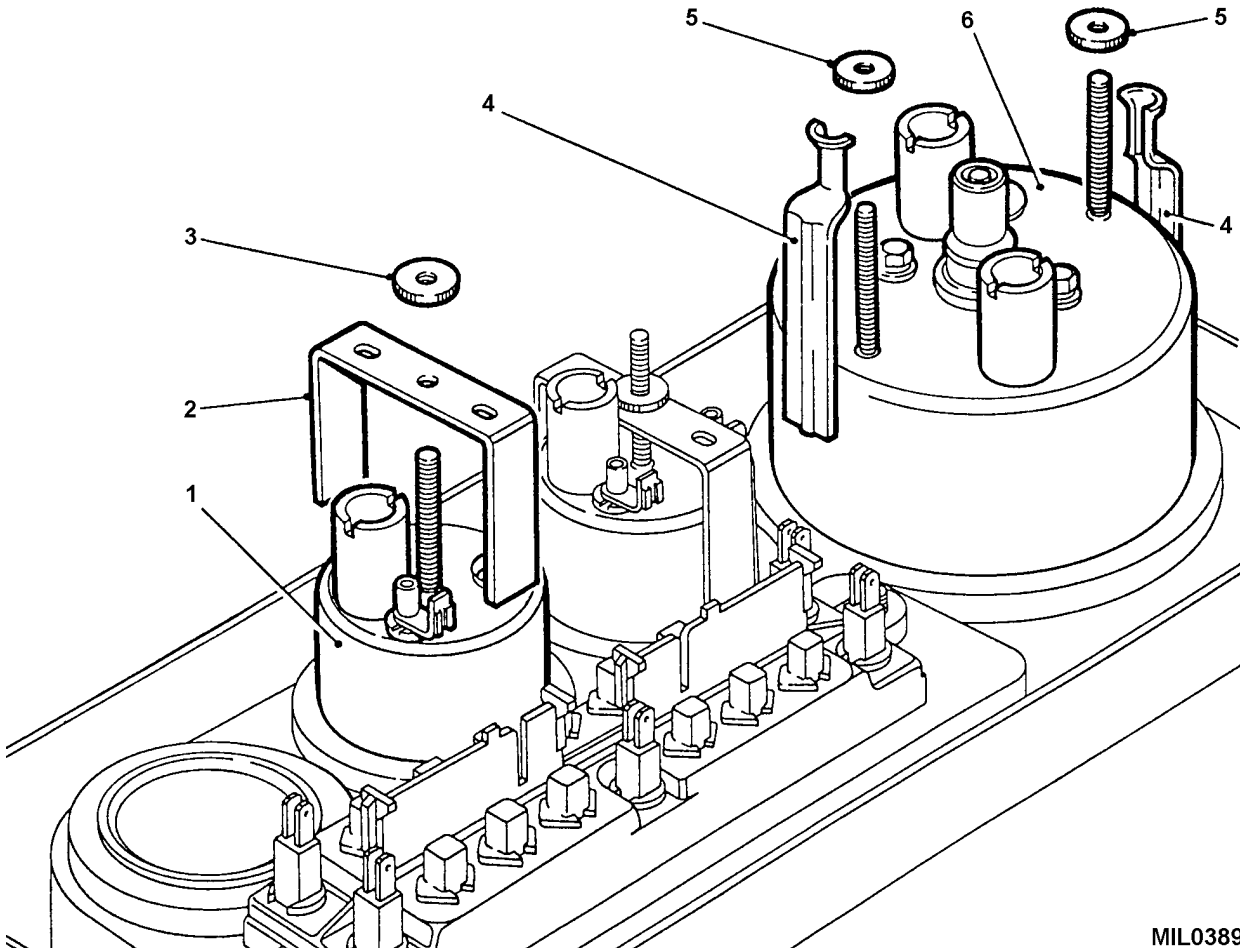
Fig 18 Removing the leads and bulbs

40.4 Remove the one (Fig 19 (3)) or two (5), dependant on the instrument, knurled nuts and remove the bracket(s) (2) (4) holding the instrument(s) (1) (6) and remove.

40.5 From the front, ease the instrument(s) from the panel.

Refit

41 Refit the instruments and panel in reverse order of the removal.



MIL0389

1 Instrument
2 Bracket
3 Knurled nut

4 Bracket
5 Knurled nut
6 Speedometer

Fig 19 Removing the instruments

HAZARD WARNING SWITCH, REAR FOG LIGHT SWITCH AND HEADLAMP LEVELLING SWITCH

Remove

42 Remove the hazard warning switch as follows:

42.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).

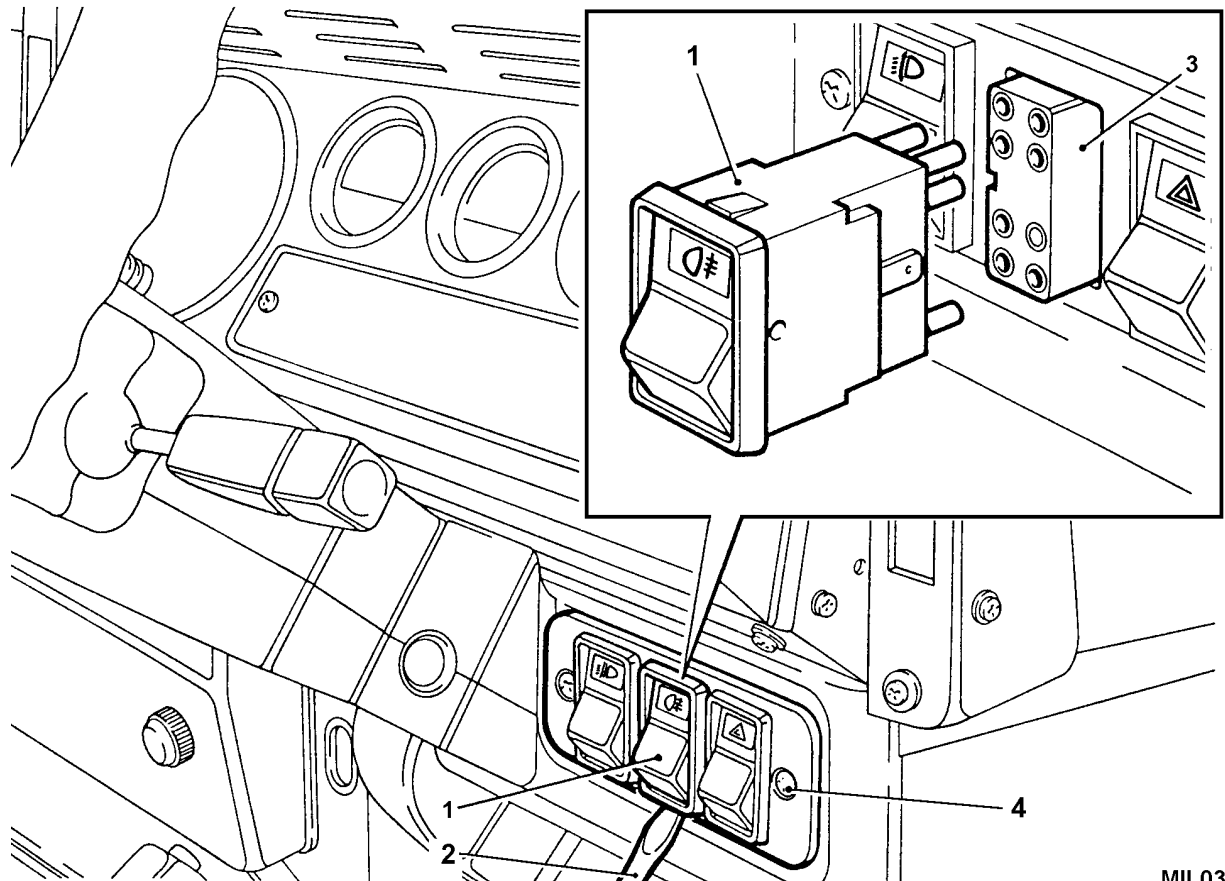
42.2 Remove the two screws (Fig 20 (4)) and ease the panel forward.

42.3 Disconnect the multiplug (3) from the switch unit.

42.4 Press the spring loaded clips inwards then ease the rocker switch (1) out of the panel with the aid of a screwdriver (2).

Refit

43 Refit the rocker switch in the reverse order of the removal.



MIL0390

1 Rocker switch
3 Multiplug

2 Screwdriver
4 Screw

Fig 20 Hazard warning switch, rear fog light switch and headlamp levelling switch

COLUMN SWITCHES AND IGNITION SWITCH.

Remove

44 To remove the steering wheel, instrument panel, steering column and column heater/start switches (refer to Chap 7).

44.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).

44.2 Disconnect the two multiplugs (Fig 21 (1)) from the main harness.

44.3 Remove the screw (2) retaining the switch panel (5) to the column.

44.4 Remove the bolts (4) retaining the wash/wipe switch (3) and remove.

Refit

45 Refit the column switches in reverse order of the removal.

45.1 To refit the steering wheel, instrument panel, steering column, and column heater/start switches. (refer to Chap 7).

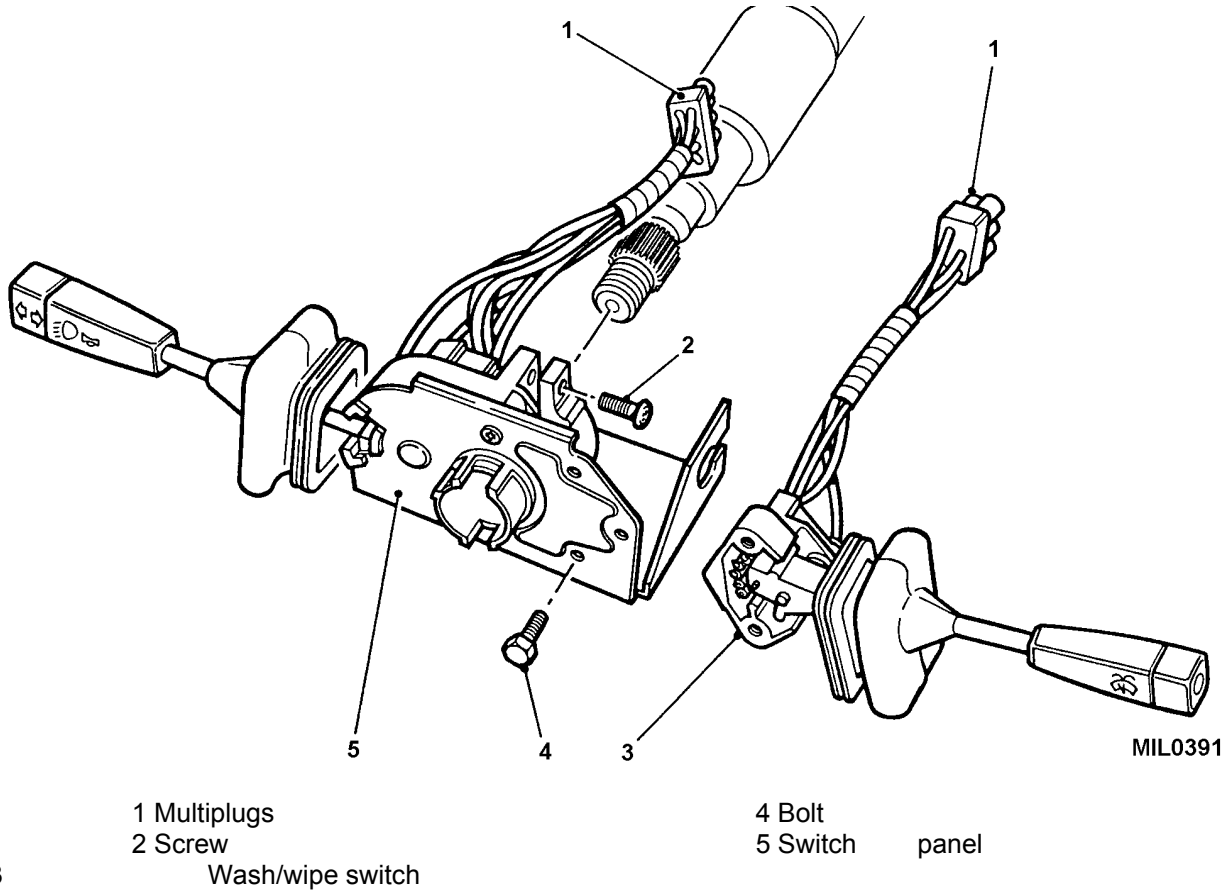


Fig 21 Column switches

WIPER MOTOR AND DRIVE RACK**Remove**

46 Remove the wiper motor and drive rack as follows:

46.1 Disconnect the vehicle batteries (refer to Para 2) and on FFR vehicles the radio batteries (refer to Chap 13-2).

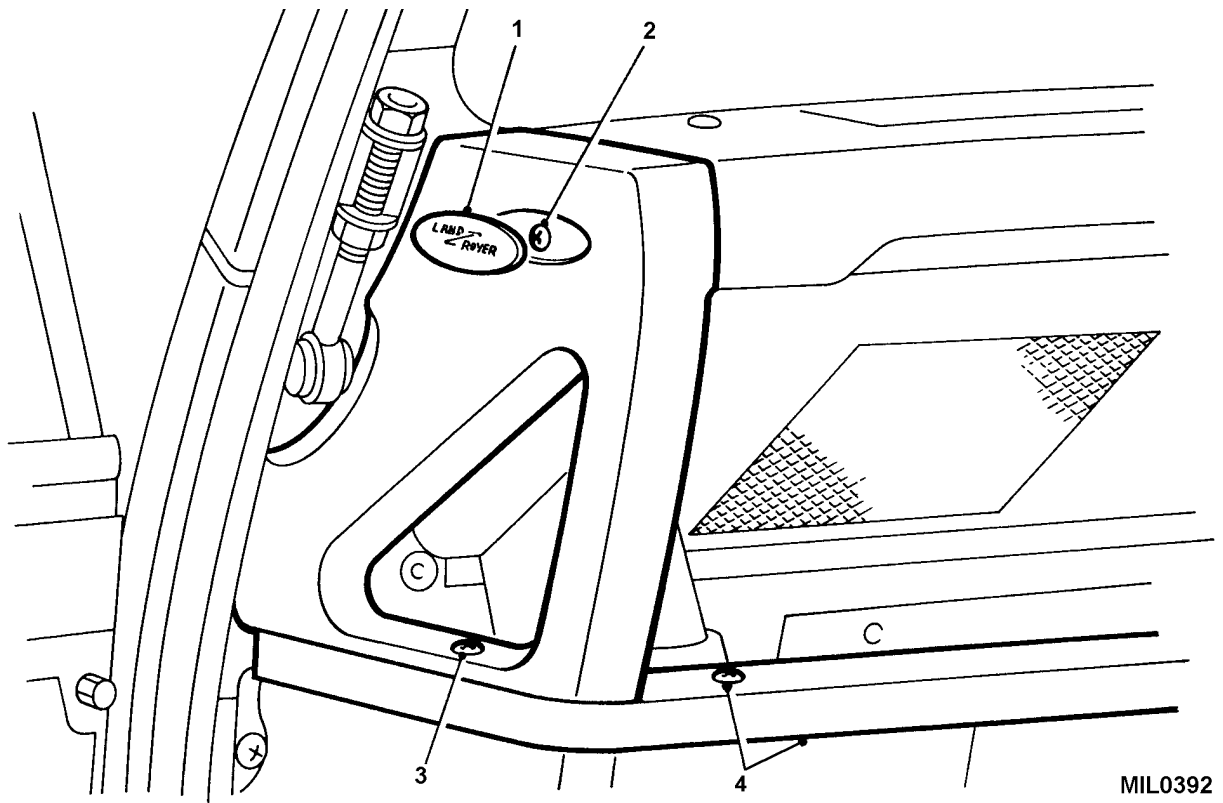
46.2 Remove the wiper arms.

NOTE

The following instructions 46.3 to 46.5 concern right hand drive vehicles only.

46.3 Prise the Land Rover motif (Fig 22 (1)) from the grab handle and remove the screw (2) behind it.

46.4 Remove the screw (3) from inside the handle and withdraw the handle upwards.

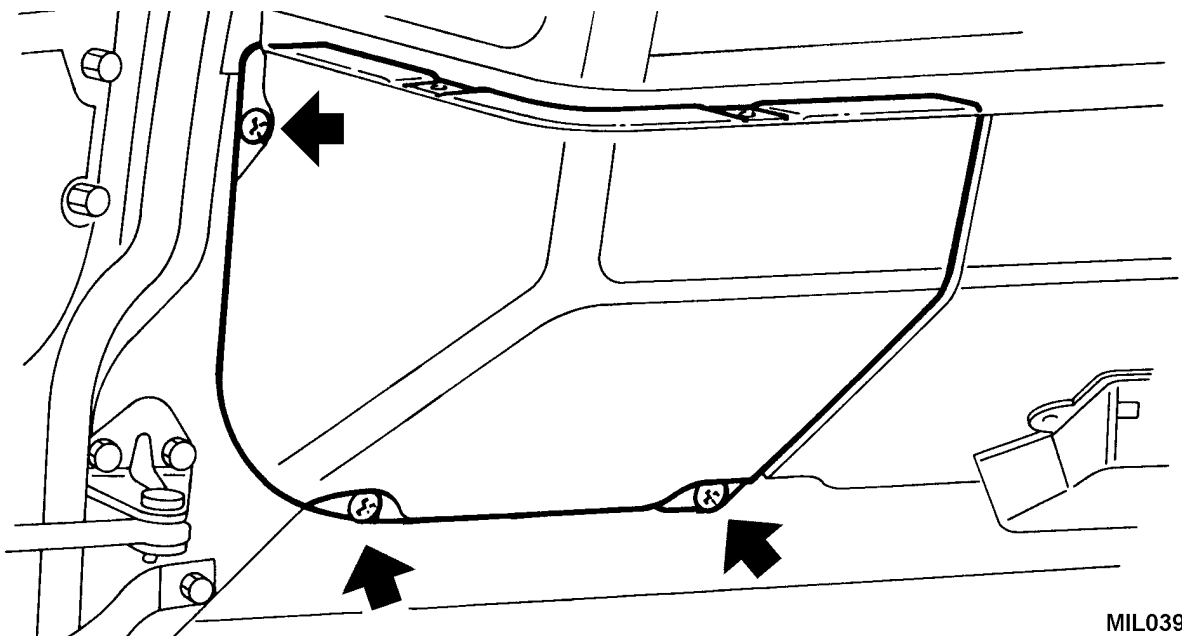


MIL0392

1 Motif
2 Screw

3 Sc rew
4 Retaining screw and finisher

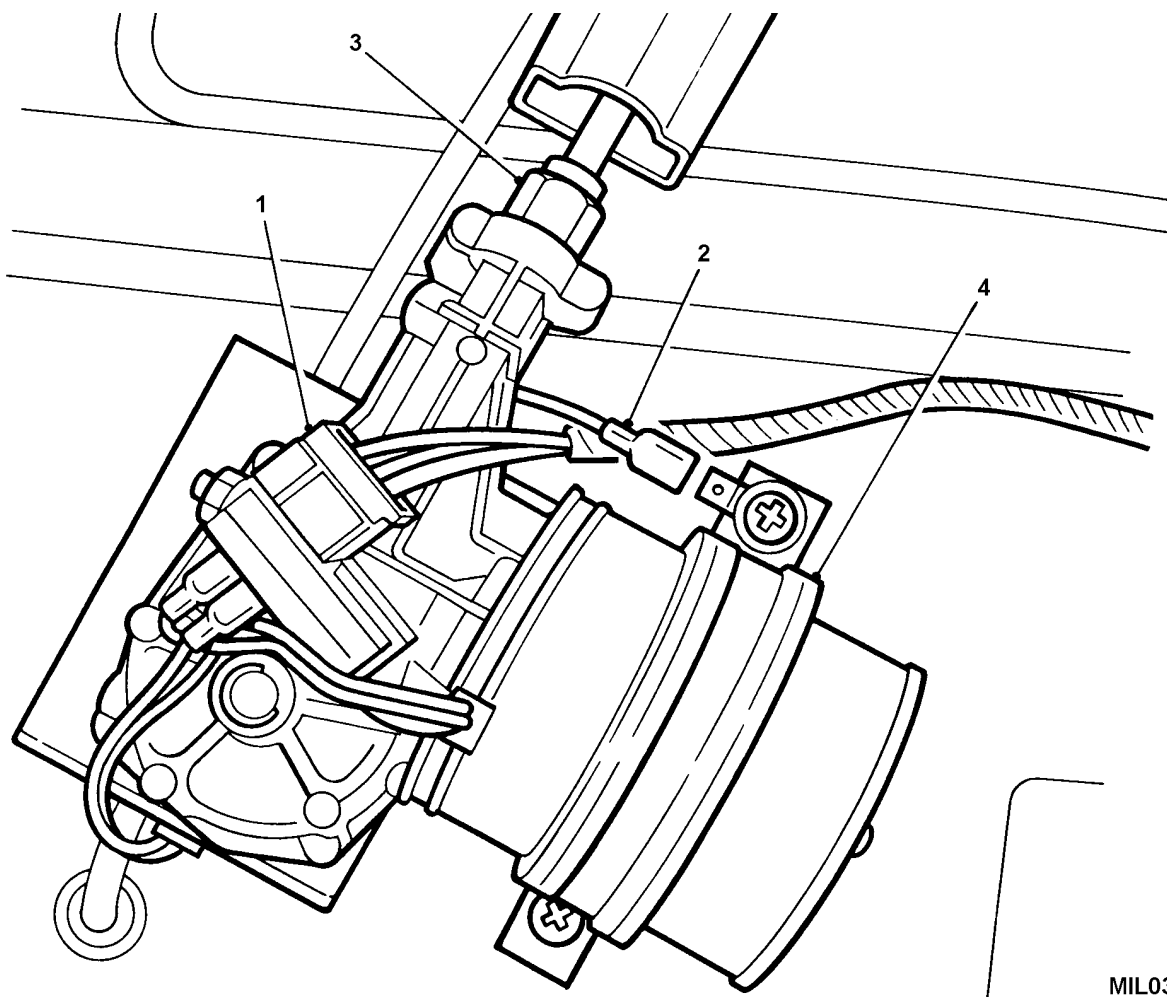
Fig 22 Removing the grab handle



MIL0393

Fig 23 Removing the lower fascia panel

- 46.5 Remove the retaining screws and finisher (4).
- 46.6 Remove the three screws (Fig 23) to release the fascia lower panel to expose the wiper motor.
- 46.7 Disconnect the multi-plug (Fig 24 (1)) from the wiper motor.
- 46.8 Disconnect the wiper motor earth lead (2).
- 46.9 Lift the rubber sleeve and slacken the wiper motor to drive tube nut (3).
- 46.10 Remove two screws to remove the wiper motor retaining strap (4).
- 46.11 Finally, release the tube nut.
- 46.12 Pull the wiper motor and drive rack clear of the tube and retrieve mounting pad and earth tag.



MIL0394

1 Multiplug
2 Earth lead

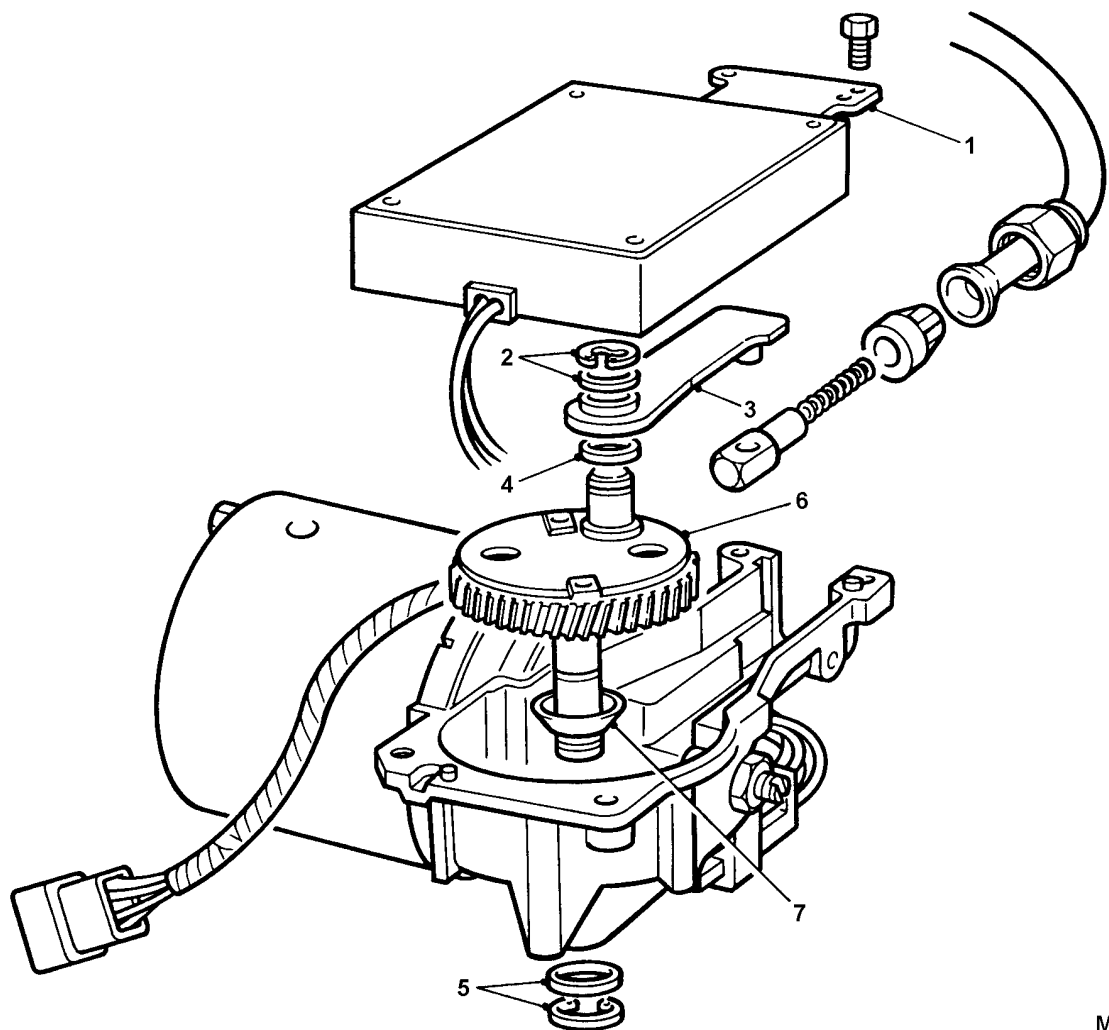
3 Nut
4 Retaining strap

Fig 24 Removing the wiper motor assembly

Dismantle

47 Dismantle the motor assembly as follows:

- 47.1 Remove the wiper motor gearbox cover (Fig 25 (1)).
- 47.2 Remove the circlip and plain washer securing the connecting rod (2).
- 47.3 Withdraw the connecting rod (3).
- 47.4 Withdraw the flat washer (4).
- 47.5 Remove the circlip and washer securing the shaft and gear (5).
- 47.6 Clean any burrs from the gear shaft and withdraw the gear (6).
- 47.7 Withdraw the dished washer (7).



MIL0395

- | | |
|----------------------|----------------------|
| 1 Cover | 5 Circlip and washer |
| 2 Circlip and washer | 6 Gear wheel |
| 3 Connecting rod | 7 Dished washer |
| 4 Washer | |

Fig 25 Wiper motor

Examination

48 A service kit (refer to Table 3 Serial 1) is available for the gear and link only, should it be found upon examination that the motor is excessively worn then the complete wiper motor unit should be renewed.

Assembly

49 Apply grease (refer to Table 2 Serial 1) to the gear wheel teeth, worm gear, connecting rod and pin. Use oil (refer to Table 2 Serial 2) sparingly to lubricate bearing bushes, bearing journals, gear shaft and wheelbox spindles. Thoroughly soak the felt washer in the yoke bearing with oil.

- 49.1 Fit the dished washer beneath the gear wheel with the concave side towards the gearwheel.
- 49.2 Fit the gearwheel to the gearbox.
- 49.3 Secure the gear shaft with the plain washer and circlip.
- 49.4 Fit the connecting rod and secure with smaller plain washer and circlip.
- 49.5 Fit the gearbox cover and secure with the retaining screws.
- 49.6 Connect the electrical leads between the wiper motor and limit switch.
- 49.7 To adjust armature shaft end float, hold the yoke vertically with the adjuster screw uppermost. Carefully screw in the adjuster until resistance is felt, then back-off one quarter turn.

Refit

50 Refit the wiper motor and rack as follows:

- 50.1 Feed the wiper motor drive rack into the tube until fully seated.
- 50.2 Loosely fit the drive tube securing nut.
- 50.3 Fit the wiper motor securing strap, earth tag and mounting pad. Align motor and tighten fixing screws.
- 50.4 Tighten the tube nut and fit the rubber sleeve.
- 50.5 Connect the earth lead and multiplug.
- 50.6 Before fitting panels, fit the wiper blades, connect the vehicle batteries and test operate the wiper motor/drive and adjust the position of the wiper blades if necessary.
- 50.7 Fit fascia lower panel.
- 50.8 Fit the finisher and grab handle.
- 50.9 Reconnect the vehicle batteries (refer to Para 3) and on FFR vehicles the radio batteries (refer to Chap 13-2).

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KEY TO FIG 26

1	Vehicle batteries	46	RH side lamp
2	Vehicle alternator	47	LH side lamp
3	Starter motor	48	Stop lamp LH
4	Starter solenoid	49	Stop lamp RH
5	Resistor	50	Reverse lamp
6	Ignition switch	51	Convoy lamp
7	Map lamp switch	52	Rear fog switch
8	Map lamp	53	Spare
9	Inspection socket	54	Horn/di/dip switch
10	Radio	55	Horn
11	Blower motor	56	RH headlamp level motor
12	Blower switch	57	LH headlamp level motor
13	Coolant temp sensor	58	Hazard warning switch
14	Water gauge	59	Hazard warning lamp
15	Fuel sender unit	60	Indicator switch
16	Fuel gauge	61	Indicator warning lamp
17	Front wash/wipe switch	62	Hazard warning relay
18	Windscreen wiper motor	63	Trailer warning lamp
19	Windscreen washer motor	64	Speedometer illumination
20	Wiper delay unit	65	Speedometer illumination
21	Glow plug timer	66	Fuel gauge illumination
22	Glow plugs	67	Water gauge illumination
23	6 way light switch	68	LH tail lamp
24	Glow plug warning lamp	69	RH tail lamp
25	Header joint	70	No. plate lamp
26	Alternator warning light	71	Ammeter illumination
27	Diode alternator warning light	72	Rear fog lamp LH
28	Radio alternator FFR	73	Rear fog lamp RH
29	Oil pressure warning lamp	74	Rear fog warning lamp
30	Diff lock warning lamp	75	Main beam warning lamp
31	Ignition warning lamp	76	RH headlamp main beam
32	Brake warning lamp	77	LH headlamp main beam
33	Oil pressure switch	78	Headlamp level switch
34	Diff lock switch	79	RH headlamp dipped beam
35	Diode ignition warning lamp	80	LH headlamp dipped beam
36	Diode brake warning lamp	81	LH repeater lamp
37	Brake fluid switch	82	LH front indicator lamp
38	Fuel shut off solenoid	83	LH rear indicator lamp
39	Twin alternator ECU FFR	84	RH repeater lamp
40	Terminal box	85	RH front indicator lamp
41	Ammeter	86	RH rear indicator lamp
42	Radio batteries FFR	87	Main fuse Box
43	Brake lamp switch	88	20 Way fuse box
44	Reverse lamp switch	89	Fast fuse FFR
45	Side light warning lamp		

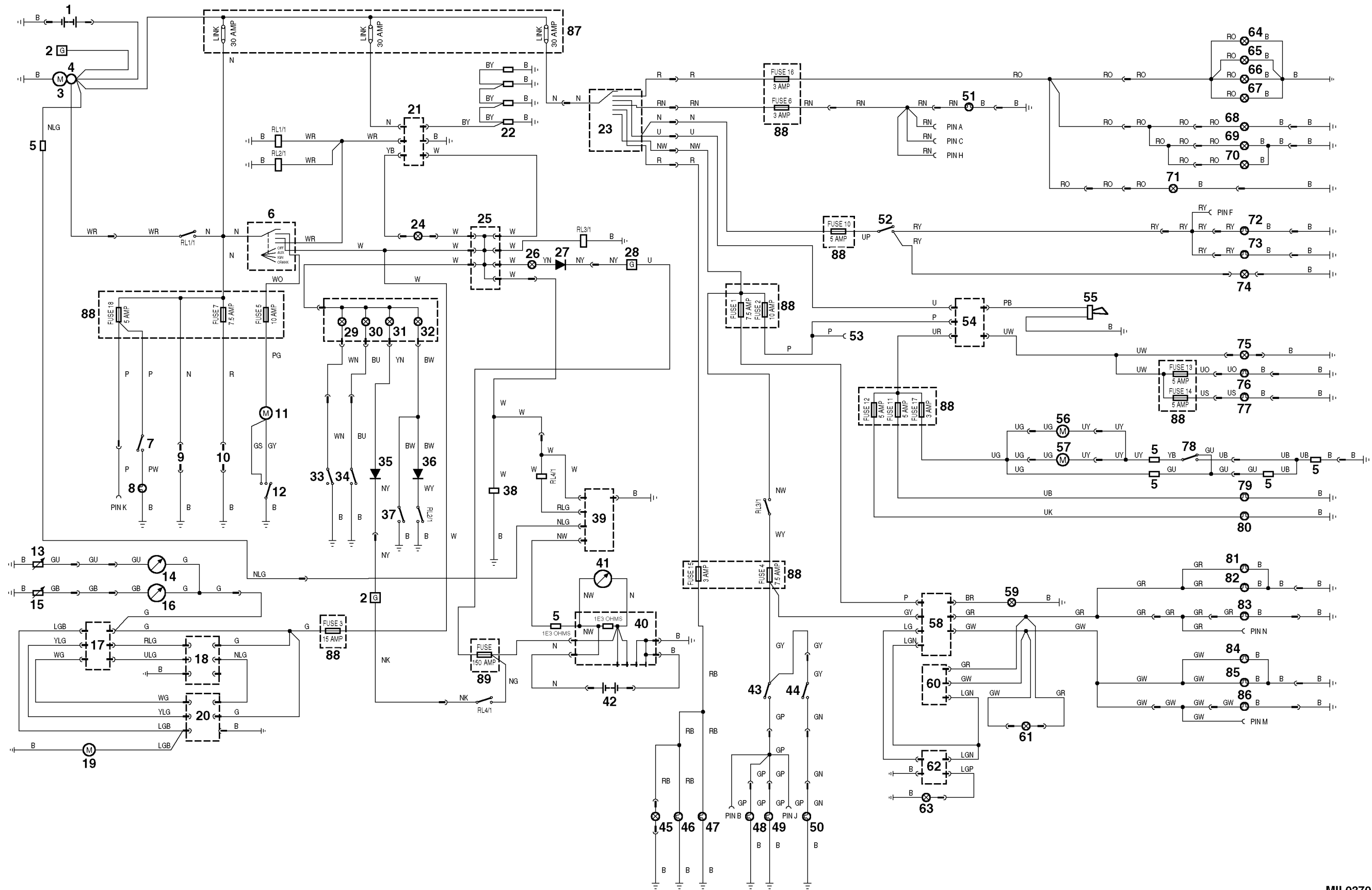


Fig 26 Circuit diagram

MIL0370

CHAPTER 13-2

FITTED FOR RADIO (FFR)

CONTENTS

Para

- 1 Introduction
- 2 Radio battery disconnection (CAUTIONS)
- 3 Disconnection
- 4 Reconnection
- 5 Battery lead stowage post
- 6 Remove
- 7 Refit
- 8 Alternator
- 9 Remove
- 10 Refit
- 11 Electronic Control Unit (ECU) – Radio charging circuit
- 12 Relay - Radio charging circuit
- 13 Ammeter
- 14 Remove
- 15 Refit
- 16 Radio fuse box
- 17 Remove
- 18 Refit
- 19 Auxiliary terminal box
- 20 Remove
- 21 Refit
- 22 Radio table
- 23 Remove
- 24 Refit
- 25 Radio antenna mountings
- 26 TUAAM mountings
- 27 Remove
- 28 Refit
- 29 Battery isolation switch
- 30 Remove
- 31 Refit
- 32 Relay box – Relay
- 33 Remove
- 34 Refit
- 35 Relay box – Circuit breaker
- 36 Remove
- 37 Refit
- 38 Relay box – Fuse Holder
- 39 Remove
- 40 Refit
- 41 Power import/export box – Diode
- 42 Remove
- 43 Refit
- 44 Power import socket – Fuse
- 45 Remove
- 46 Refit
- 47 Warning buzzer harness – buzzer
- 48 Remove
- 49 Refit

CONTENTS (continued)

Para

- 50 Warning buzzer harness – test switch
 51 Remove
 52 Refit

Fig Page

1	Disconnecting the radio batteries	3
2	Removing the upper alternator	6
3	Removing the Ammeter	8
4	Fast fuse	9
5	Terminal box	10
6	Removing the battery isolation switch	12
7	Relay box – removing a relay	13
8	Relay box - removing a circuit breaker	14
9	Relay box – removing the fuse holder	15
10	Power import/export socket – removing the diode	16
11	Power import/export socket – removing the fuse holder	17
12	Removing the buzzer	18
13	Removing the test button and harness	20

INTRODUCTION

1 This chapter details the Unit repairs for Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS Fitted For Radio (FFR) system vehicles.

RADIO BATTERY DISCONNECTION**CAUTIONS**

- (1) Do not let the engine run with the batteries disconnected.
- (2) When using a charger to charge the batteries, they must be disconnected from the vehicles electrical system.
- (3) When installing ensure the batteries are connected in correct polarity.
- (4) Care must be taken when disconnecting the batteries. Ensure the ignition system and all electrical components are switched off.
- (5) Disconnect both the vehicle and the FFR batteries when working on the FFR electrics.

2 The radio batteries are stowed inside the battery stowage box directly under the radio table in the rear of the vehicle.

Disconnection

3 Disconnect the radio batteries as follows:

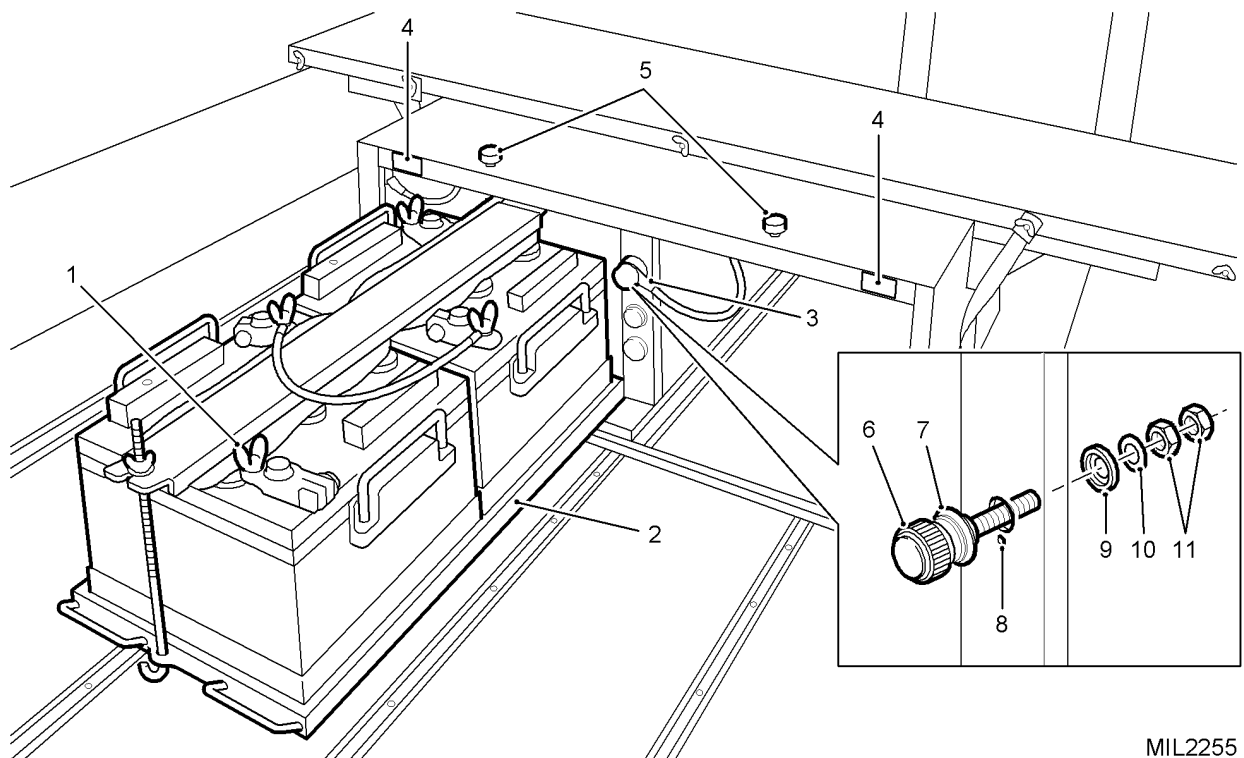
- 3.1 Isolate both vehicle batteries by removing the vehicle battery negative lead. Isolate the radio batteries by removing the battery lead plug from the auxiliary terminal box. Press the battery isolation switch to isolate the Comm's system.

- 3.2 Undo the two retaining screws (Fig 1 (5)) located on top of the box.
- 3.3 Ease the front cover forward then lift out.
- 3.4 Using the handles slide the radio battery trays far enough out of the battery box to access the negative battery leads.

NOTE

Avoid snagging the battery breather tubes and the warning buzzer wiring when removing the battery tray from the radio table.

- 3.5 Disconnect the vehicle Radio battery negative leads from both banks of batteries by loosening the wing nut (1) and unhooking the leads from the battery terminals. The battery clamps should be transferred to new batteries as necessary. Make sure the negative leads are stowed correctly in the clips provided as shown on the negative battery stowage label (4).
- 3.6 Fully slide the battery trays out of the battery box to access the radio battery positive leads. Loosen the wing nuts and unhook the positive leads from the battery clamps. Stow the positive battery leads (3) on the positive lead isolation post (6) provided.
- 3.7 With the battery box empty check all cables for signs of damage, wear or chaffing. Examine the negative battery retention clips for signs of damage. Check the positive isolation posts and other fixings for looseness or damage. Any problems should be rectified as necessary before proceeding.



MIL2255

- | | | | |
|---|-------------------------------------|----|---------------|
| 1 | Battery terminal wing nut | 7 | Insulator |
| 2 | Battery tray | 8 | Location hole |
| 3 | Positive battery lead | 9 | Insulator |
| 4 | Negative battery lead stowage label | 10 | Washer |
| 5 | Retaining screws | 11 | Nut |
| 6 | Positive battery lead stowage post | | |

Fig 1 Disconnecting the radio batteries

Reconnection

4 Reconnect the radio batteries as follows:

4.1 Reconnect the positive leads to the radio batteries. Refit the interconnecting leads and then slide the battery trays into the battery box.

NOTE

Avoid snagging the battery breather tubes and the warning buzzer wiring when removing the battery tray from the radio table.

4.2 Reconnect the negative leads to the radio batteries.

WARNING

IF THE WARNING BUZZER SOUNDS AT THIS STAGE THE BATTERIES HAVE BEEN CONNECTED INCORRECTLY. CHECK BATTERY CONFIGURATION AND RECTIFY.

4.3 If the warning buzzer has not sounded, push the test button, which will result in the warning buzzer sounding to confirm the system is fully operational.

4.4 Reconnect the batteries to the alternator by connecting the battery lead plug to the auxiliary terminal box.

4.5 Replace the front cover and secure with the two retaining screws.

4.6 Reconnect the vehicle battery negative lead.

BATTERY LEAD STOWAGE POST

5 The battery lead stowage post is mounted on the centre post of the battery box in the rear of the vehicle.

Remove

6 Remove the battery lead stowage post as follows:

6.1 Remove nuts (Fig 1 (11)), washer (10) and insulator (9) from the battery lead stowage post (6).

6.2 Remove the battery lead stowage post and insulator (7).

Refit

7 Refit the battery lead stowage post as follows:

7.1 Insert the battery lead stowage post (6) through the hole in the battery box centre post.

7.2 Rotate the battery lead stowage post until the insulator (7) locates in the location hole (8).

7.3 Install the insulator (9) on the battery lead stowage post.

7.4 Install washer (10) and nut (11). Tighten the nut to a torque of 10 Nm, install second nut (11) and lock against first nut.

ALTERNATOR

8 The FFR vehicles have two 50 amp alternators in the charging circuit. The lower alternator is driven by the engine serpentine drive. The upper alternator is driven via an adjuster pulley by a separate drive belt from the crankshaft pulley.

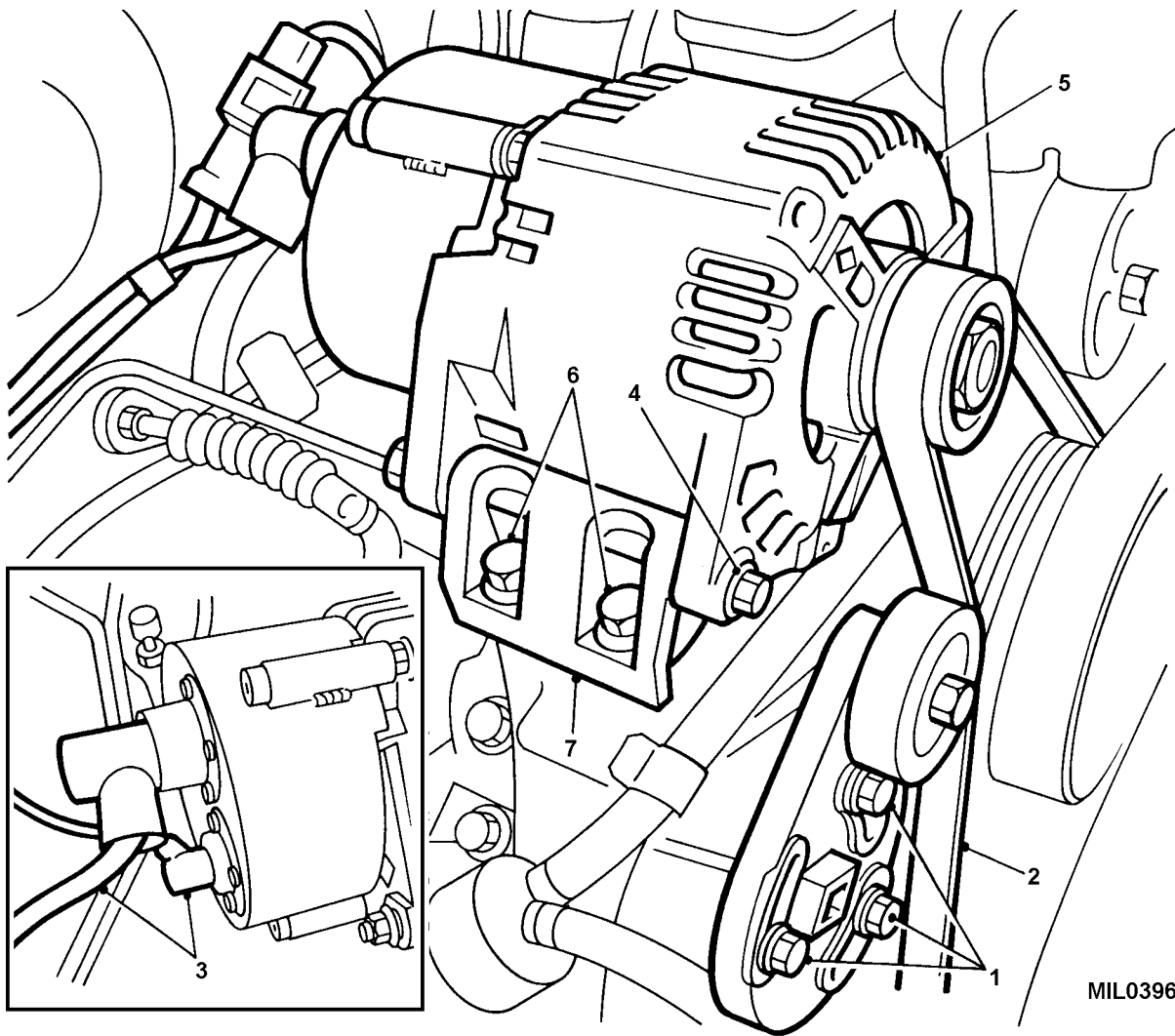
NOTE

The alternator is a non serviceable item and in the event of failure must be replaced.

Remove

9 To remove the upper alternator, proceed as follows:

- 9.1 Disconnect the vehicle batteries (refer to Chapter 13-1) and the radio batteries feed from the side of the terminal box
- 9.2 Slacken the tensioner pulley bolts and retard the tensioner (Fig 2 (1)).
- 9.3 Remove the alternator drive belt (2).
- 9.4 Disconnect the electrical connections from the rear of the alternator (3).
- 9.5 Remove the two bolts (4) securing the alternator to the mounting bracket and withdraw the alternator (5).
- 9.6 If required remove the four bolts (6) securing the mounting bracket (7) to the engine timing cover and lift off the mounting bracket.



MIL0396

1	Tensioner bolts	5	Alternator
2	Drive belt	6	Bolts
3	Electrical connections	7	Mounting brackets
4	Bolts		

Fig 2 Removing the upper alternator

Refit

10 Refit the alternator in the reverse order of the removal.

10.1 Adjust the belt tensioner to give the required deflection (refer to Cat 532 Serial 1) and tighten bolts to 22-28 Nm (16 - 21 lbf ft).

ELECTRONIC CONTROL UNIT (ECU) - RADIO CHARGING CIRCUIT

11 The radio charging circuit ECU is located on the bulkhead behind the left-hand seat and is located by a single screw fixing through the bulkhead. A single multiplug connects the unit to the interlink harness.

11.1 The ECU is a non-repairable item and if found faulty should be replaced with a new one.

RELAY - RADIO CHARGING CIRCUIT

12 The FFR charging relay is mounted on the engine bulkhead under the bonnet. It is fixed to the bulkhead by a single screw fixing and is attached to the charging interlink harness by three bayonet clips.

12.1 The relay is a non-repairable item and if found faulty should be replaced with a new one.

AMMETER

13 The ammeter is situated in a panel below the main lighting switch.

Remove

14 To remove the ammeter carry out the following:

14.1 Disconnect the vehicle batteries (refer to Chap 13-1) and the radio batteries feed from the side of the terminal box.

14.2 Remove the two screws (Fig 3 (6)) nuts (10) and washers (7,9) retaining the auxiliary panel (8) and ease forward.

14.3 Remove the nut and washer (5) and remove lamp holder (3) and lamp (4).

14.4 Detach leads from ammeter terminal.

14.5 Remove bracket (2) securing ammeter, withdraw instrument (1) through front of panel.

Refit

15 Refit the ammeter as follows:

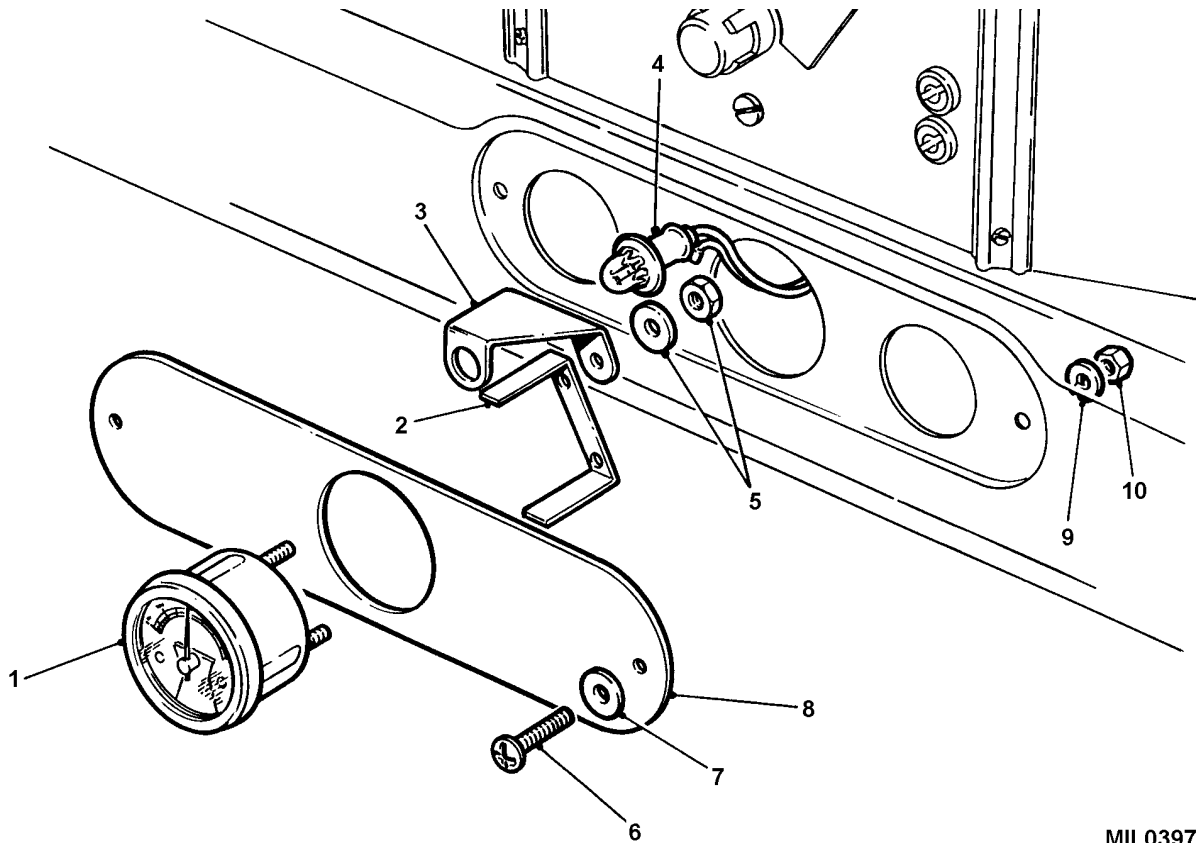
15.1 Insert ammeter through the front of the panel.

15.2 Fit securing bracket and lampholder bracket.

15.3 Fit lampholder and lamp to bracket.

15.4 Refit auxiliary panel to dash.

15.5 Reconnect the vehicle batteries (refer to Chap 13-1) and the radio batteries feed to the side of the terminal box, start engine and check that instrument is functioning.



MIL0397

1	Ammeter	6	Screw
2	Ammeter bracket	7	Plastic washer
3	Light bulb holder bracket	8	Auxiliary panel
4	Bulb holder	9	Washer
5	Nut and washer	10	Nut

Fig 3 Removing the ammeter

RADIO FUSE BOX

16 Vehicles fitted for radio have an additional fuse box fitted to the bulkhead behind the front seats. The box contains a 150 amp fast fuse which protects the alternator circuits in the event accidental reversal of polarity when connecting radio batteries. A spare fuse is contained within the box, should this spare fuse be used a replacement must be obtained at the earliest opportunity.

Remove

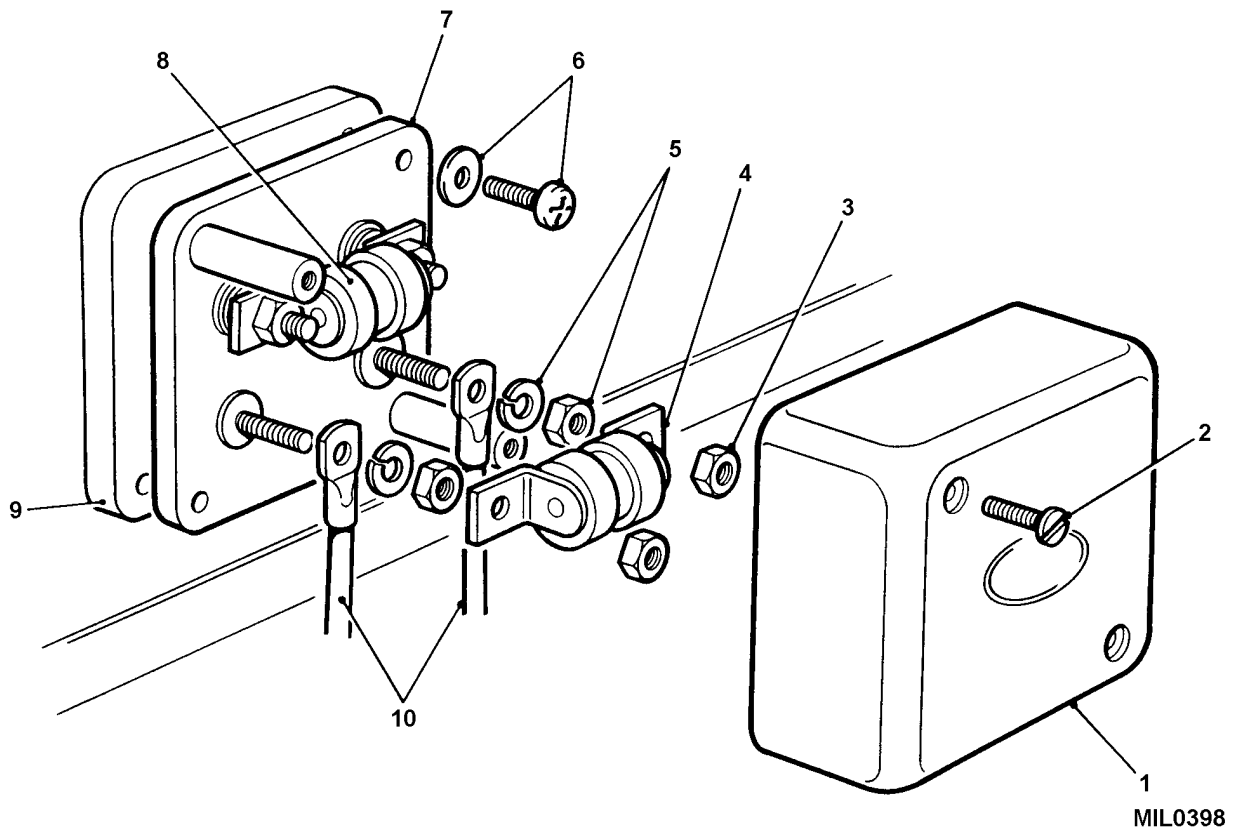
17 Remove the radio fuse box as follows:

17.1 Disconnect the radio batteries feed from the side of the terminal box.

17.2 Remove the screws (Fig 4 (2)) securing the cover and remove (1).

17.3 Remove the two nuts (3) and remove the fuse (4).

17.4 Remove the two nuts and spring washers (5) and disconnect the two leads (10) from the terminals.



1	Fast fuse cover	6	Fixing screw and washer
2	Screw	7	Base plate
3	Nuts	8	Fast fuse spare
4	Fast fuse	9	Mounting plate
5	Nut and spring washer	10	Feed wires

Fig 4 Fast fuse

17.5 Remove the two screws and washers (6) and re move the base plate (7) from the mounting plate.

Refit

18 The refitting of the fast fuse is the reverse procedure of the removal.

AUXILIARY TERMINAL BOX

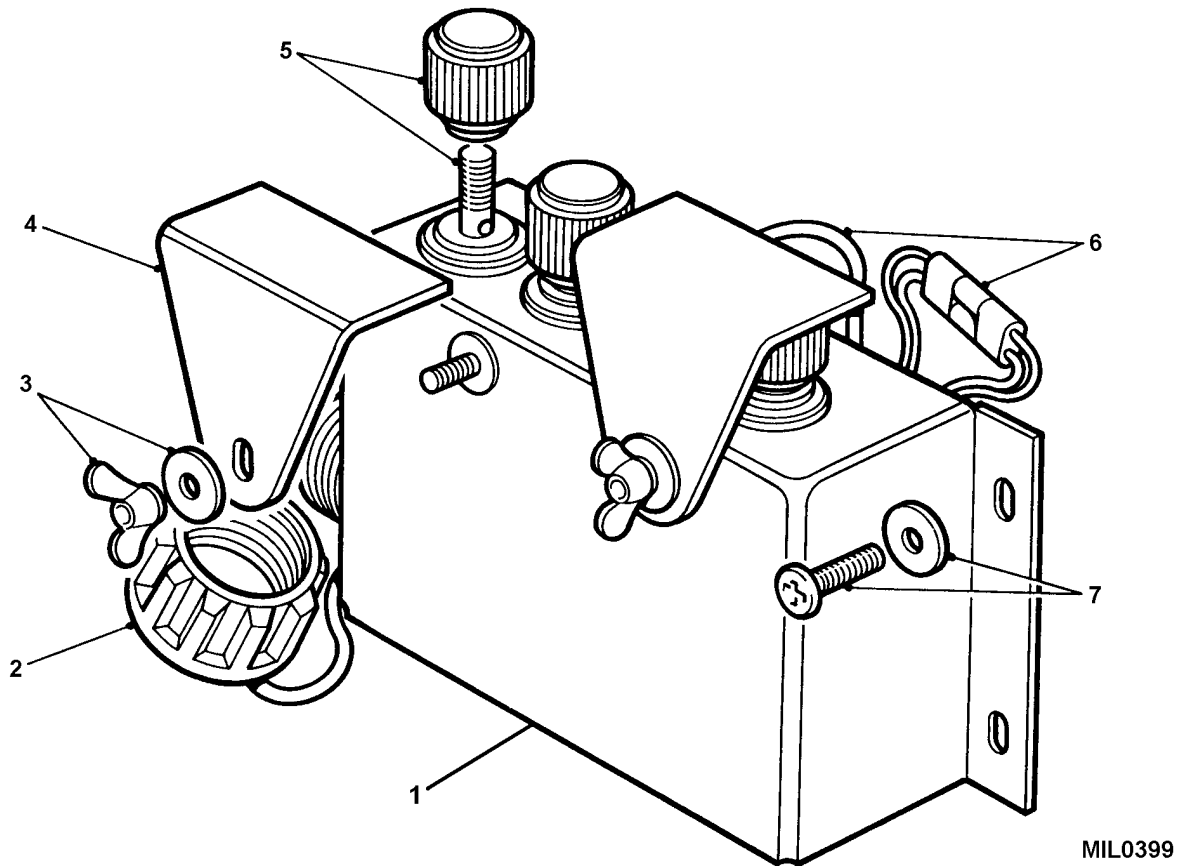
19 The auxiliary terminal box is mounted on the bulk head at the rear of the lefthand seat. A socket is provided on the side of the box for connection of the radio batteries and four terminals situated on top of the box provide the means of operating 24V equipment.

Remove

20 Remove the terminal box as follows:

20.1 Disconnect the vehicle batteries (refer to C hap 13-1) and the radio batteries feed from the side of the terminal box (Fig 5 (1)) if fitted and fit the protective cap (2).

20.2 Remove the wing nut (3) and turn the cover (4) to gain access to any auxiliary terminals, which may be connected.



1	Terminal box	5	Terminal
2	Protection cap	6	Ammeter and feed connection
3	Wing nut and washer	7	Screw and washer
4	Cover		

Fig 5 Terminal box

- 20.3 Disconnect terminals (5) and remove the connections (if fitted).
- 20.4 Remove the retaining screws and washers (7) and ease forward.
- 20.5 Disconnect the ammeter and feed wires (6) from the terminal box.

Refit

- 21 The refitting of the terminal box is the reverse procedure of the removal.

RADIO TABLE

22 The radio table is situated behind the rear bulk head and sits on the floor. The table is supported by the battery box which holds four radio batteries in two trays.

Remove

23 To remove the radio table carry out the following:

23.1 Disconnect radio batteries (refer to Para 3).

23.2 Disconnect the earth straps from the table.

23.3 Remove the fixing screws attaching the table to the battery box and remove the table.

Refit

24 The refitting of the radio table is the reverse procedure of the removal.

NOTE

Before refitting the radio batteries a check should be conducted of all cables, for signs of damage. Any problems should be rectified as necessary before proceeding.

RADIO ANTENNA MOUNTINGS

25 The HF radio antenna mountings are located either side of the vehicle rear body section and are secured by four bolt fixings to brackets and stiffeners. Removal of these items is self evident.

TUAAM MOUNTINGS

26 The VHF TUAAM mountings are located on the top of the front wings.

Remove

27 Remove the mountings as follows:

27.1 From inside the engine compartment remove the support bracket from the top of the wheel arch and TUAAM reinforcement plate.

NOTE

It may be necessary to move aside the coolant reservoir to gain access to one of the TUAAM mountings.

27.2 Remove the remaining fixings securing the TUAAM mountings to the wing and remove the mounting.

Refit

28 Refitting is the reverse procedure of the removal.

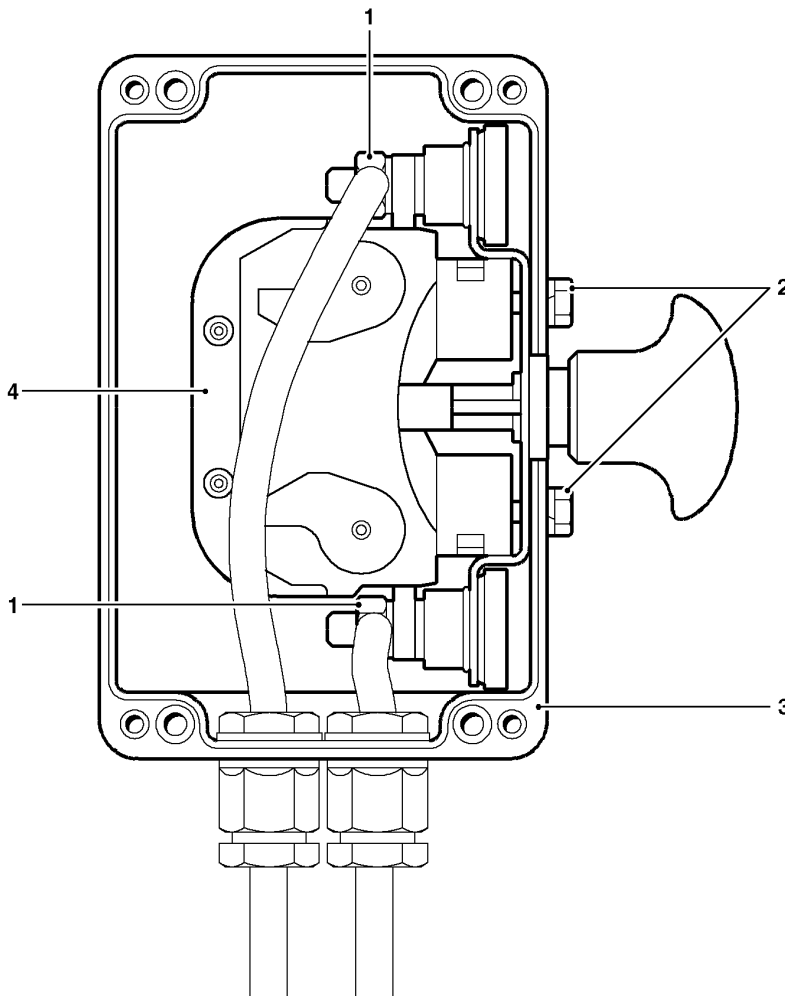
BATTERY ISOLATION SWITCH

29 The Battery isolation switch is located in the rear of the vehicle in the top right hand corner secured to the front roll bar.

Remove

30 To remove the battery isolation switch carryout the following:

- 30.1 Disconnect the vehicle batteries (refer to Chap 13-1).
- 30.2 Disconnect the radio batteries from the terminal box. (refer to Para 17).
- 30.3 Remove the cover from the battery isolation switch box.
- 30.4 Disconnect the terminals (Fig 6 (1)) from the switch inside the box.
- 30.5 Remove the two screws and washers (2) securing the switch (4) to the box (3) and remove the switch.



MIL1907

- | | | | |
|---|--------------------|---|------------|
| 1 | Terminals | 3 | Switch box |
| 2 | Screws and washers | 4 | Switch |

Fig 6 Removing the battery isolation switch

Refit

31 Fit a new isolation switch in the reverse order of removal.

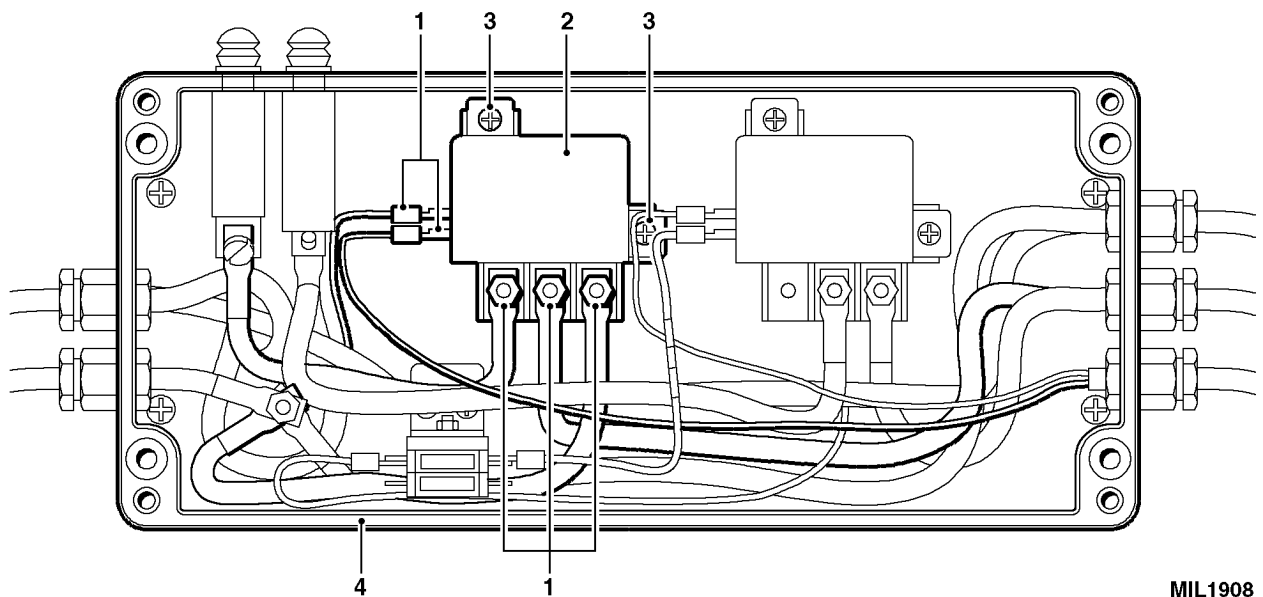
RELAY BOX - RELAY

32 The relay box is mounted on the bulkhead between the driver and passenger seats in the rear of the vehicle.

Remove

33 To remove a failed relay unit carry out the following:

- 33.1 Disconnect the vehicle batteries (Refer to Chap 13-1).
- 33.2 Disconnect the radio batteries from the terminal box. (refer to Para 17).
- 33.3 Remove the cover from the relay box.
- 33.4 Disconnect the terminals (Fig 7 (1)) from the failed relay (2).
- 33.5 Remove the screws (3) securing the relay to the relay box and remove the relay.



1	Terminals	3	Screws
2	Relay	4	Relay box

Fig 7 Relay box – removing a relay

Refit

34 Fit a new relay in the reverse order of the removal.

RELAY BOX – CIRCUIT BREAKER

35 Two circuit breakers, one rated at 100 Amp and the other at 40 Amp are located inside the top of the relay box.

Remove

36 To remove a failed circuit breaker carry out the following:

- 36.1 Disconnect the vehicle batteries (Refer to Chap 13-1).
- 36.2 Disconnect the radio batteries from the terminal box. (refer to Para 17).
- 36.3 Remove the cover from the relay box.
- 36.4 Disconnect the terminals (Fig 8 (1)) from the failed circuit breaker (2).
- 36.5 Remove the splash cover (3) securing the circuit breaker to the relay box and remove the switch.

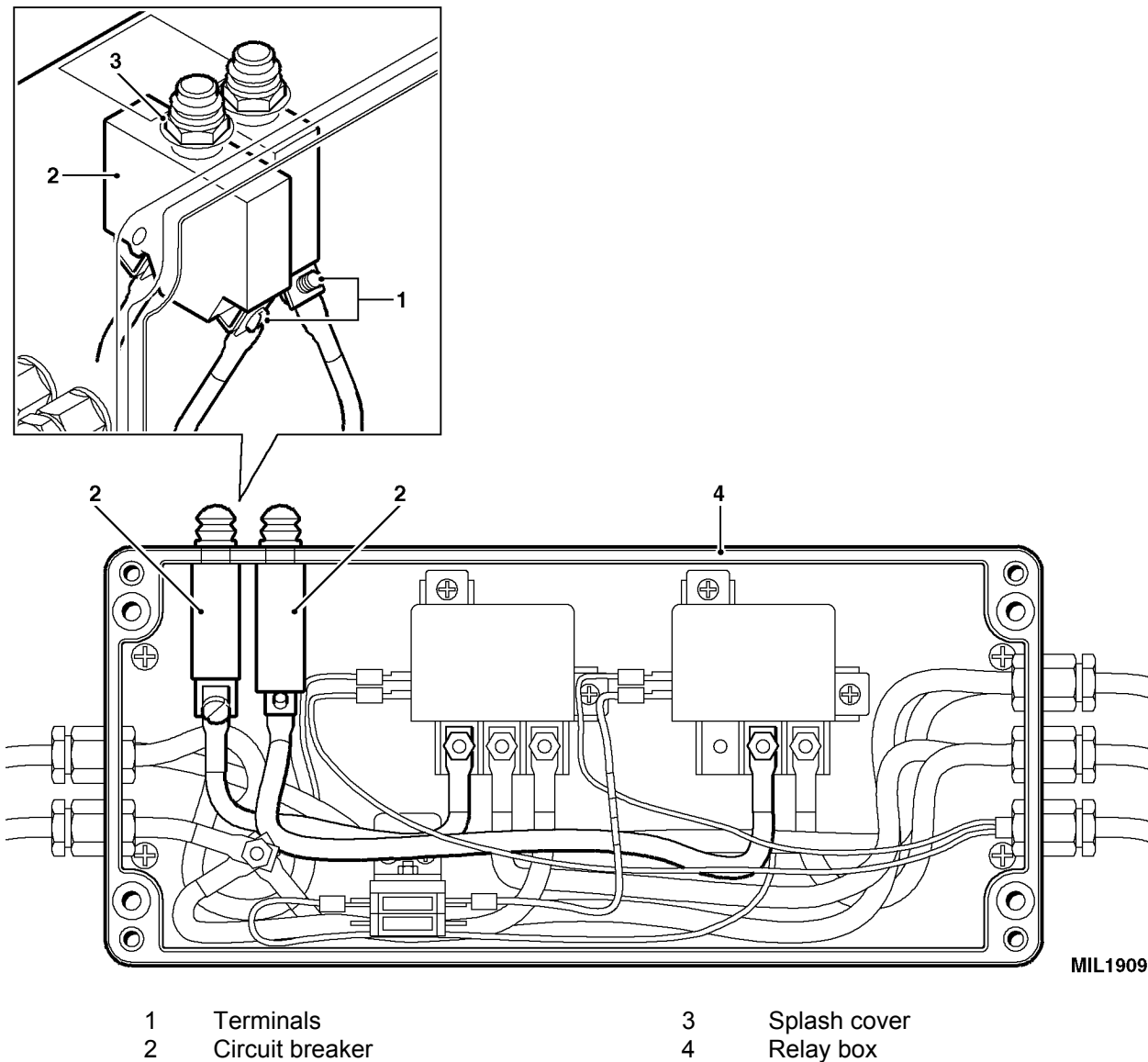


Fig 8 Relay box – removing a circuit breaker

Refit

37 Fit a new circuit breaker in the reverse order of the removal.

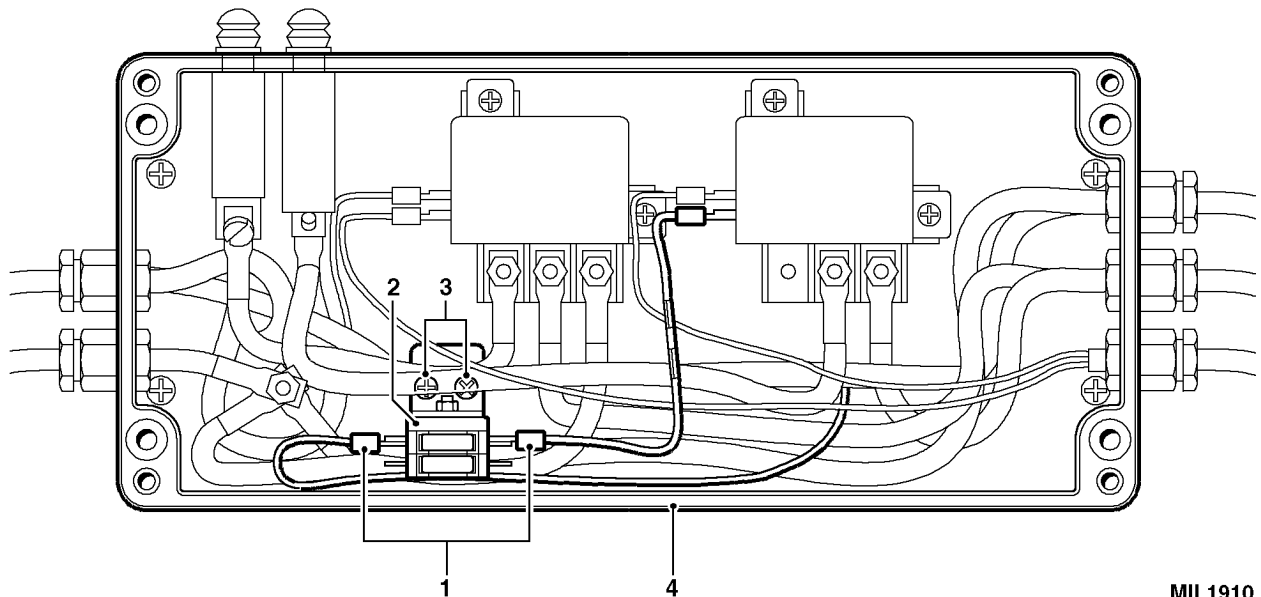
RELAY BOX - FUSE HOLDER

38 There is a single 3 Amp fuse and fuse holder located inside the relay box.

Remove

39 To remove a failed fuse holder carry out the following:

- 39.1 Disconnect the vehicle batteries (Refer to Chap 13-1).
- 39.2 Disconnect the radio batteries from the terminal box. (refer to Para 17).
- 39.3 Remove the cover from the relay box.
- 39.4 Disconnect the terminals (Fig 9 (1)) from the fuse holder (2).
- 39.5 Remove the screws (3) securing the fuse holder to the relay box and remove the fuse holder.



MIL1910

- | | | | |
|---|-------------|---|-----------|
| 1 | Terminals | 3 | Screws |
| 2 | Fuse holder | 4 | Relay box |

Fig 9 Relay box – removing the fuse holder

Refit

40 Fit a new fuse holder in the reverse order of the removal.

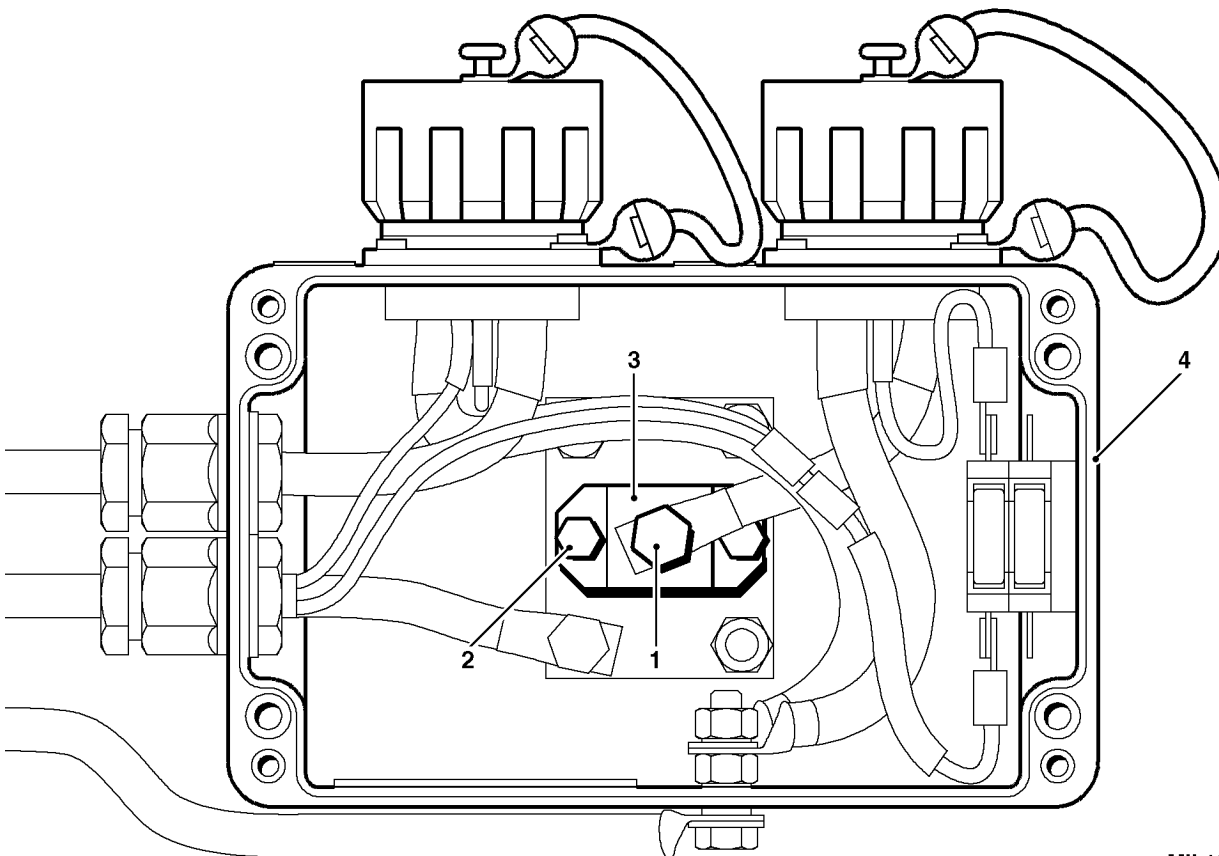
POWER IMPORT/EXPORT BOX - DIODE

41 The import/export socket is located inside the rear right hand side of the vehicle adjacent to the rear tailgate.

Remove

42 To remove a failed diode carry out the following:

- 42.1 Disconnect the vehicle batteries (Refer to Chap 13-1).
- 42.2 Disconnect the radio batteries from the terminal box. (refer to Para 17).
- 42.3 Remove the cover from the relay box.
- 42.4 Disconnect the terminals (Fig 10 (1)) from the failed diode (3).
- 42.5 Remove the screws (2) securing the diode to the import/export power box and remove the diode.



MIL1911

- | | | | |
|---|-----------|---|-------------------------|
| 1 | Terminals | 3 | Diode |
| 2 | Screws | 4 | Power import/export box |

Fig 10 Power import/export box – removing the diode

Refit

43 Fit a new diode in the reverse order of the removal.

POWER IMPORT/EXPORT BOX – FUSE HOLDER

44 There is a single 3 Amp fuse and fuse holder located in the import/export box.

Remove

45 To remove a failed fuse holder carry out the following:

- 45.1 Disconnect the vehicle batteries (Refer to Chap 13-1).
- 45.2 Disconnect the radio batteries from the terminal box. (refer to Para 17).
- 45.3 Remove the cover from the relay box.
- 45.4 Disconnect the terminals (Fig 11 (1)) from the failed fuse holder (3).
- 45.5 Remove the screws (2) securing the fuse holder to the import/export power box and remove the fuse holder.

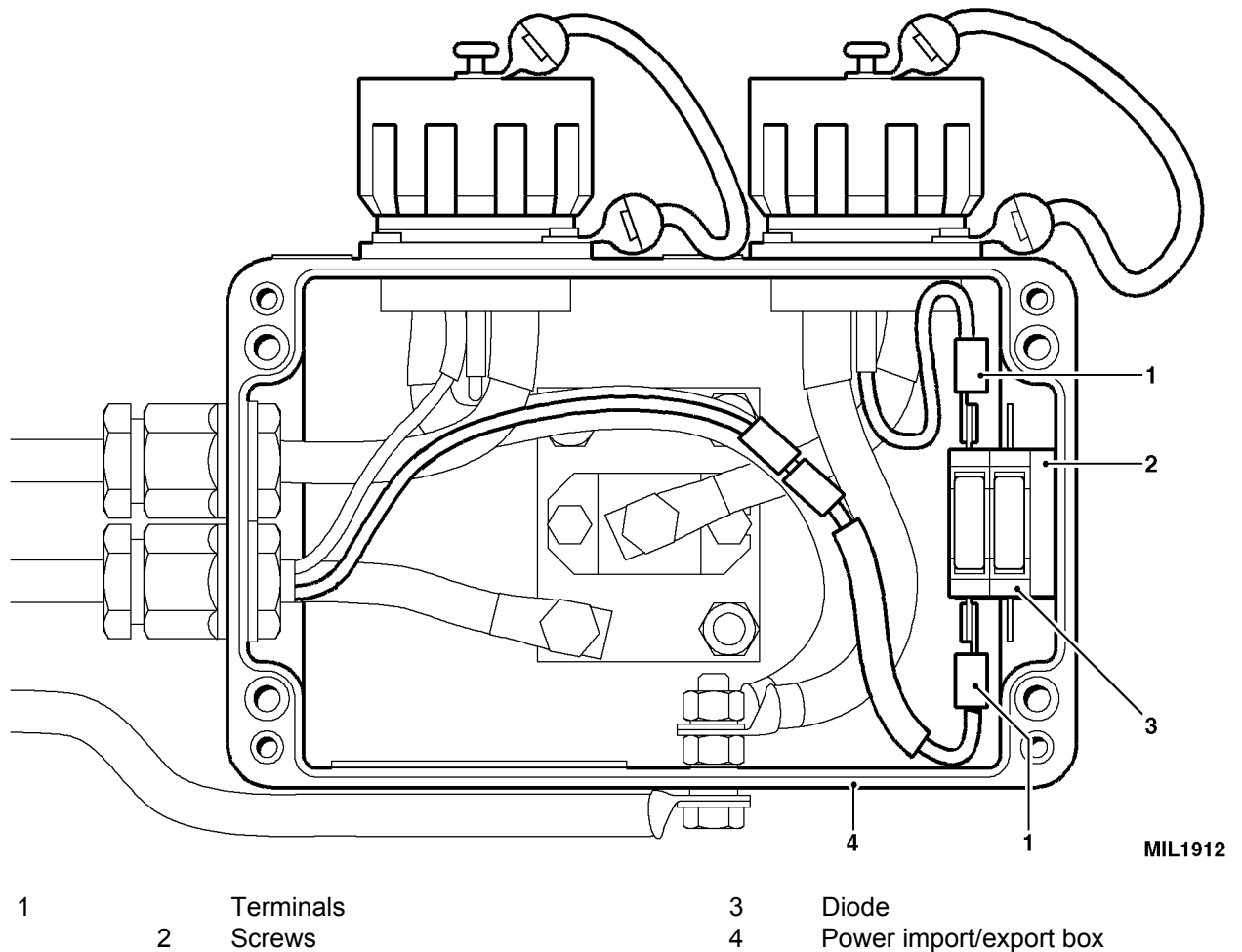


Fig 11 Power import/export box – removing the fuse holder

Refit

46 Fit a new fuse holder in the reverse order of the removal.

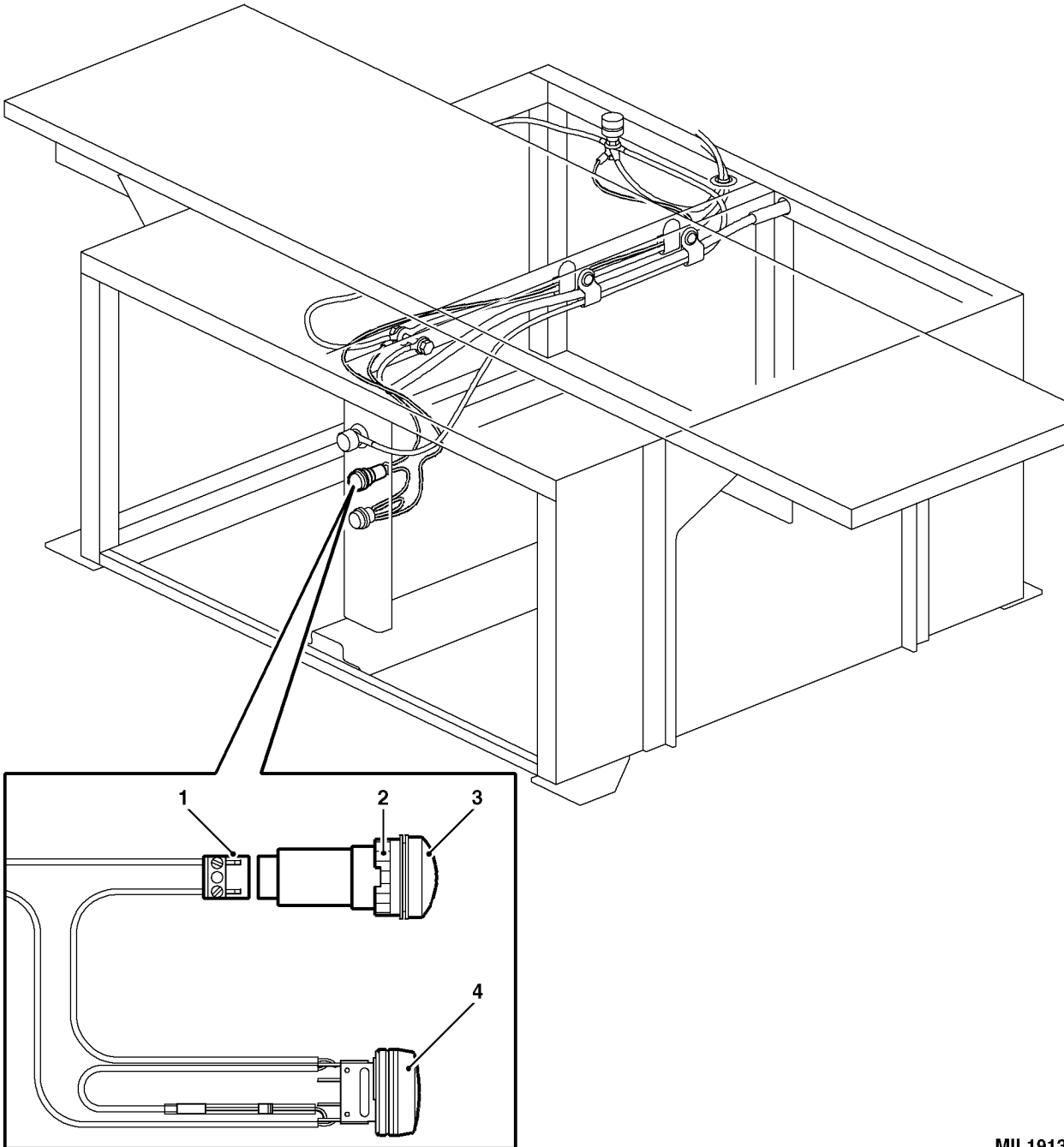
WARNING BUZZER HARNESS - BUZZER

47 The warning buzzer is located in the front of the radio battery table behind the battery cover.

Remove

48 To remove a failed warning buzzer carry out the following:

48.1 Disconnect the radio batteries from the terminal box. (refer to Para 17).



MIL1913

1 Multi-plug
2 Nut

3 Buzzer
4 Radio table

Fig 12 Removing the buzzer

- 48.2 Remove the front cover from the radio battery box.
- 48.3 Disconnect the multi-plug (Fig 12 (1)) from the rear of the failed buzzer (3).
- 48.4 Remove the nut (2) securing the buzzer to the radio table and remove the buzzer.

Refit

- 49 Fit a new buzzer in the reverse order of the removal.

WARNING BUZZER HARNESS – TEST BUTTON

- 50 The test button is located in the front of the radio table just below the warning buzzer.

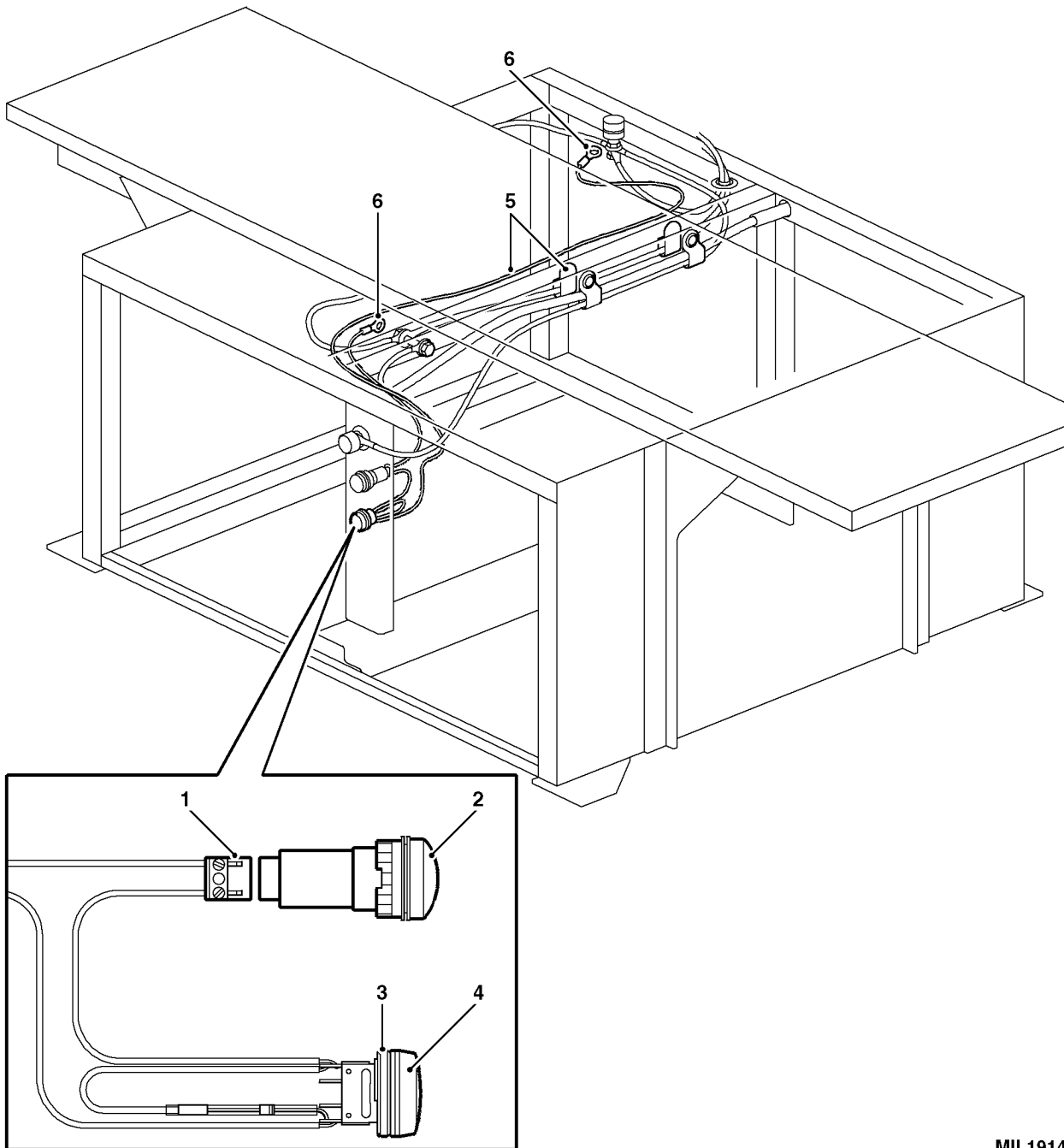
Remove

- 51 To remove a failed test button carry out the following:

- 51.1 Disconnect the radio batteries from the terminal box. (refer to Para 17).
- 51.2 Remove the front cover from the radio battery box.
- 51.3 Disconnect the multi-plug (Fig 13 (1)) from the rear of the buzzer (2).
- 51.4 Remove the nut (3) securing the test button (4) to the radio table.
- 51.5 Disconnect the harness (5) from the respective terminals (6) and remove the test button and harness from the 'P' clips under the radio table.
- 51.6 Withdraw the harness through the test button hole in the front of the radio table.

Refit

- 52 Fit a new test button and harness in the reverse order of the removal.



MIL1914

- | | | | | |
|---|---|------------|---|----------------|
| 2 | 1 | Multi-plug | 4 | Test button |
| 3 | | Buzzer | 5 | Buzzer harness |
| | | Nut | 6 | Terminals |

Fig 13 Removing the test button and harness

CHAPTER 13-3

FIELD AMBULANCE

CONTENTS

Para

1	Introduction
3	General (CAUTIONS)
	Power distribution panel (CAUTION)
4	Remove
5	Refit
	Rotary switch - lighting
6	Remove
7	Refit
	Rotary switch - heater
8	Remove
9	Refit
	Rotary switch - ventilation fan
10	Remove
11	Refit
	Resuscitator socket (12V)
12	Remove
13	Refit
	Resuscitator socket (24V)
14	Remove
15	Refit
	Inspection light socket
16	Remove
17	Refit
	Inspection light switch
18	Remove
19	Refit
	Temperature sensor
20	Remove
21	Refit
	DC/DC converter
22	Remove
23	Refit
	Circuit breaker
24	Remove
25	Refit
	Fluorescent light strips
26	Remove
27	Refit
	Blackout microswitch - rear doors/bulkhead doors
28	Remove
	Refit
	Moonlight
30	Remove
31	Refit
	Heater control unit
32	Remove
33	Refit

(continued)

CONTENTS (continued)

Para		Page
	Glow plug relay	
34	Remove	
35	Refit	
	Through capacitors	
36	Remove	
37	Refit	
	Suppression coil	
38	Remove	
39	Refit	
40	Engine run and buzzer units	
41	Remove	
42	Inline fuses (3 Amp and 15 Amp)	
43	Remove	
	Cab interior light	
44	Remove	
45	Refit	
	Siren	
46	Remove	
47	Refit	
Fig		Page
1	Power distribution panel.....	4
2	Fluorescent light strip removal.....	8
3	Blackout microswitch removal.....	9
4	Moonlight removal.....	10
5	Heater control unit removal.....	11
6	Heater glow plug relay removal.....	12
7	Through capacitors removal.....	13
8	Suppression coil removal.....	14
9	Cab interior light removal.....	16
10	Siren unit removal.....	17/18

INTRODUCTION

- 1 This chapter details the Unit repairs for the electrical components as fitted to the (TUM) Ambulance HS compartment only.
- 2 The information given is applicable to both left and right hand drive vehicles.

GENERAL

- 3 The electrical power to the ambulance compartment is distributed throughout the compartment via the power distribution panel. All components are non serviceable and if found faulty must be renewed.

CAUTIONS

- (1) **BATTERIES.** Before carrying out any work on the electrical circuits inside the ambulance ensure the vehicle batteries are disconnected.
- (2) **LOOSE OR BARE WIRES.** Before reconnecting the vehicle batteries ensure all connections are to their correct terminals and no loose or bare wires exist.

POWER DISTRIBUTION PANEL

CAUTION

WIRE TAGGING. To ensure the correct rewiring of any component removed from the power distribution panel, it is advisable to identify with tags all wires before disconnection.

Remove

4 To remove the Power distribution panel carry out the following:

4.1 Disconnect the vehicle batteries (refer to Chap 13-1).

4.2 Remove the six screws (Fig 1 (1)) securing the distribution panel (2) to the bulkhead and lift away from bulkhead recess.

4.3 Carefully rotate and support the panel to give access to the electrical components and wiring behind the panel.

4.4 Remove and renew faulty component and reconnect the wiring inline with identification tags.

Refit

5 Refit panel to panel to bulkhead and secure with six screws.

ROTARY SWITCH - LIGHTING

Remove

6 To remove the rotary light switch carry out the following:

6.1 Disconnect the vehicle batteries (refer to Chap 13-1).

6.2 Remove screw (Fig 1 (3)) securing knob (4) to switch (8) and remove knob.

6.3 Remove nut (5) securing back plate (6) to power distributor panel and remove back plate.

6.4 Remove distribution panel (Refer to Para 4.2 to 4.3).

6.5 Noting order of connection, disconnect wiring from switch terminals.

6.6 Remove 4 screws (7) securing switch to panel and remove switch.

Refit

7 Refit the switch in the reverse order of removal.

ROTARY SWITCH - HEATER

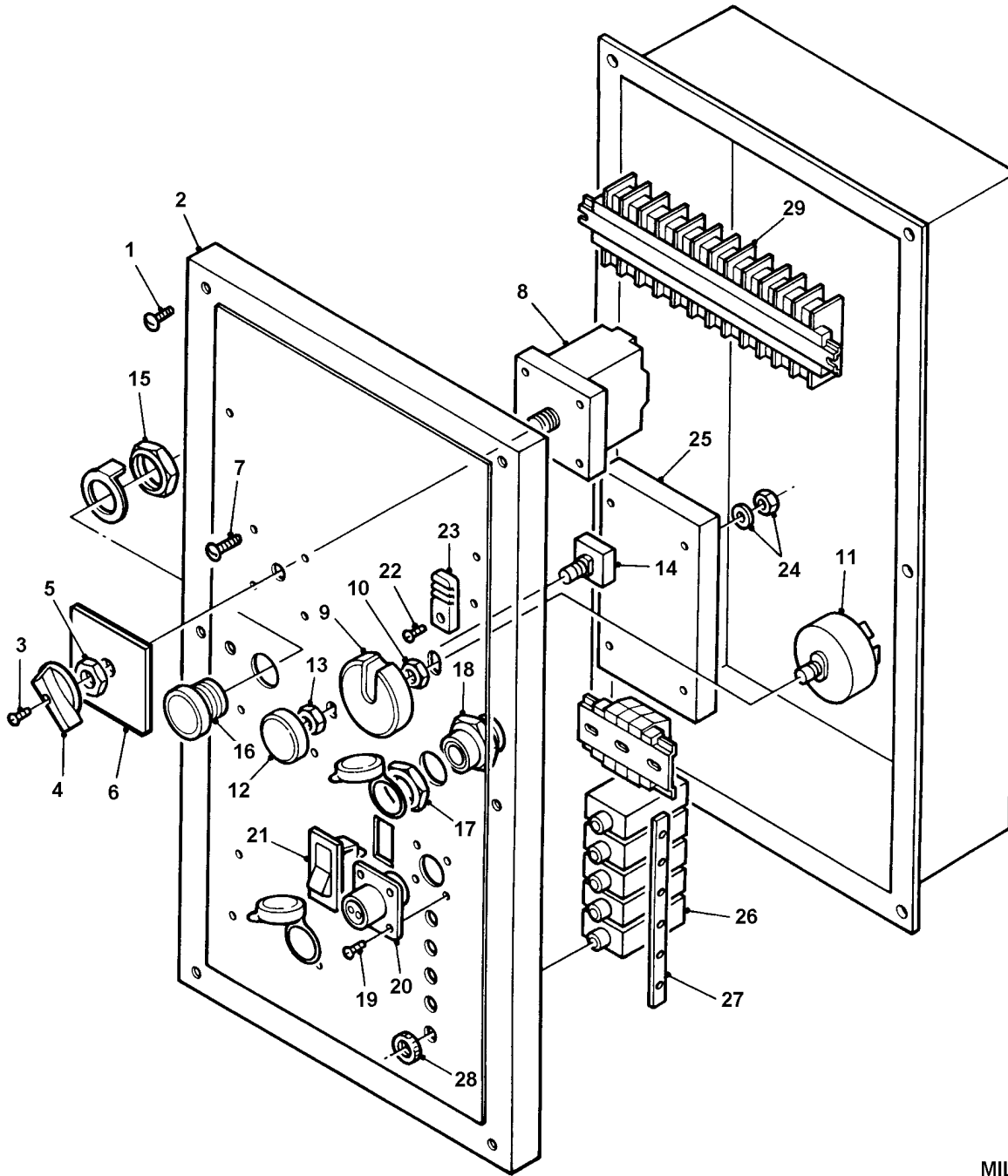
Remove

8 To remove the rotary heater switch carry out the following:

8.1 Disconnect the vehicle batteries (refer to Chap 13-1).

8.2 Prise knob (Fig 1 (9)) from switch on power distributor panel (2).

8.3 Remove panel (2) (refer to Para 4.2 and 4.3).



MIL0450

- | | | | | | |
|----|--------------------|----|----------------------------|----|-------------------------|
| 1 | Screw | 11 | Heater switch | 21 | Inspection light switch |
| 2 | Distribution panel | 12 | Knob | 22 | Screw |
| 3 | Screw | 13 | Nut | 23 | Temperature sensor |
| 4 | Knob | 14 | Ventilation fan switch | 24 | Nut and washer |
| 5 | Nut | 15 | Nut | 25 | DC\DC converter |
| 6 | Back plate | 16 | Resuscitator socket (12 V) | 26 | Circuit breaker |
| 7 | Screw | 17 | Nut | 27 | Bus bar |
| 8 | Lighting switch | 18 | Resuscitator socket (24 V) | 28 | Nut |
| 9 | Knob | 19 | Screw | 29 | Terminal block |
| 10 | Nut | 20 | Inspection light socket | | |

Fig 1 Power distribution panel

8.4 Noting order of disconnection, disconnect wiring from switch terminals.

8.5 Remove nut (10) securing heater switch (11) to panel and remove.

Refit

9 Refit the switch in reverse order of removal

ROTARY SWITCH - VENTILATION FAN

Remove

10 To remove the rotary ventilation fan switch carry out the following:

10.1 Disconnect the vehicle batteries (refer to Chap 13-1).

10.2 Prise knob (Fig 1 (12) from switch on power distributor panel (2).

10.3 Remove panel (2) (refer to Para 4.2 and 4.3).

10.4 Noting order of disconnection, disconnect wiring from switch terminals.

10.5 Remove nut (13) securing ventilation fan switch (14) to panel and remove.

Refit

11 Refit the switch in reverse order of removal.

RESUSCITATOR SOCKET (12 VOLT)

Remove

12 To remove the resuscitator socket carry out the following:

12.1 Disconnect the vehicle batteries (refer to Chap 13-1).

12.2 Remove the power distribution panel (Fig 1 (2)) (refer to Para 4.2 and 4.3).

12.3 Noting the order of connection, disconnect the wiring from the socket terminals.

12.4 Remove the nut (15) securing the resuscitator socket (16) to the distribution panel and remove.

Refit

13 Refit the resuscitator socket in the reverse order of removal.

RESUSCITATOR SOCKET (24 VOLT)

Remove

14 To remove the 24v resuscitator socket carry out the following:

14.1 Disconnect the vehicle batteries (refer to Chap 13-1).

14.2 Remove the power distribution panel (Fig 1 (2)) (refer to Para 4.2 and 4.3).

14.3 Noting the order of connection, remove the cable ties and disconnect the wiring from the circuit breaker 5 (CB5) and terminal block B-2 terminals.

14.4 Remove the nut (17), securing the resuscitator socket (18) to the distribution panel and remove the socket and harness from the panel.

Refit

15 Refit the socket in the reverse order of removal.

INSPECTION LIGHT SOCKET

Remove

16 To remove the inspection light socket, carry out the following:

16.1 Disconnect the vehicle batteries (refer to Chap 13-1).

16.2 Remove the power distribution panel (Fig 1 (2)) (refer to Para 4.2 and 4.3).

16.3 Noting the order of connection, remove the cable ties and disconnect the wiring from the inspection light socket switch and terminal block B-3 terminals.

16.4 Remove the 4 screws (19) securing the inspection light socket (20) to the panel and remove the socket and harness from the panel.

Refit

17 Refit the inspection light socket in the reverse order of removal.

INSPECTION LIGHT SWITCH

18 To remove the inspection light switch, carry out the following:

18.1 Disconnect the vehicle batteries (refer to Chap 13-1).

18.2 Remove the power distribution panel (Fig 1 (2)) (refer to Para 4.2 and 4.3).

18.3 Noting their order of connection, disconnect the wiring from the switch terminals.

18.4 Pinch together the top and bottom sprung retainers on the switch body (21) and push the switch through the front of the distributor panel.

Refit

19 Refit the switch in the reverse order of the removal.

TEMPERATURE SENSOR

Remove

20 To remove the temperature sensor carry out the following:

20.1 Disconnect the vehicle batteries (refer to Chap 13-1).

20.2 Remove the power distribution panel (Fig 1 (2)) (refer to Para 4.2 and 4.3).

20.3 Remove the screw (22) securing the temperature sensor to the panel.

20.4 Noting the order of connection, disconnect the wiring to the sensor at the relevant terminals.

20.5 Remove the temperature sensor (23) from the panel.

Refit

21 Refit the sensor in the reverse order of the removal.

DC/DC CONVERTER

Remove

22 To remove the DC/DC converter carry out the following:

22.1 Disconnect the vehicle batteries (refer to Chap 13-1).

22.2 Remove the power distribution panel (2) (refer to Para 4.2 and 4.3).

22.3 Noting the order of connection, disconnect the terminals to the converter.

22.4 Remove the 4 nuts and washers (24) securing the converter (25) to the panel and remove the converter.

Refit

23 Refit the converter in the reverse order of the removal.

CIRCUIT BREAKERS

Remove

24 To remove a circuit breaker carry out the following:

24.1 Disconnect the vehicle batteries (refer to Chap 13-1).

24.2 Remove the power distribution panel (Fig 1 (2)) (refer to Para 4.2 and 4.3).

24.3 Disconnect the circuit breaker (26) from the bus bar (27) and terminal lead.

24.4 Remove nut (28) securing circuit breaker to panel and remove circuit breaker.

Refit

25 Refit the circuit breaker in the reverse order of the removal.

FLUORESCENT LIGHT STRIPS

Remove

26 To remove a fluorescent light strip unit, carry out the following:

26.1 Disconnect the vehicle batteries (refer to Chap 13-1).

26.2 Remove the light unit cover (Fig 2 (1)).

26.3 Remove the two fluorescent light strips (2).

26.4 Disconnect both positive and negative leads from the connector block (3).

26.5 Remove two screws (4) securing light unit to ceiling, withdraw wiring through holes in unit sides and remove light unit.

Refit

27 Refit the fluorescent light unit in the reverse order of removal.

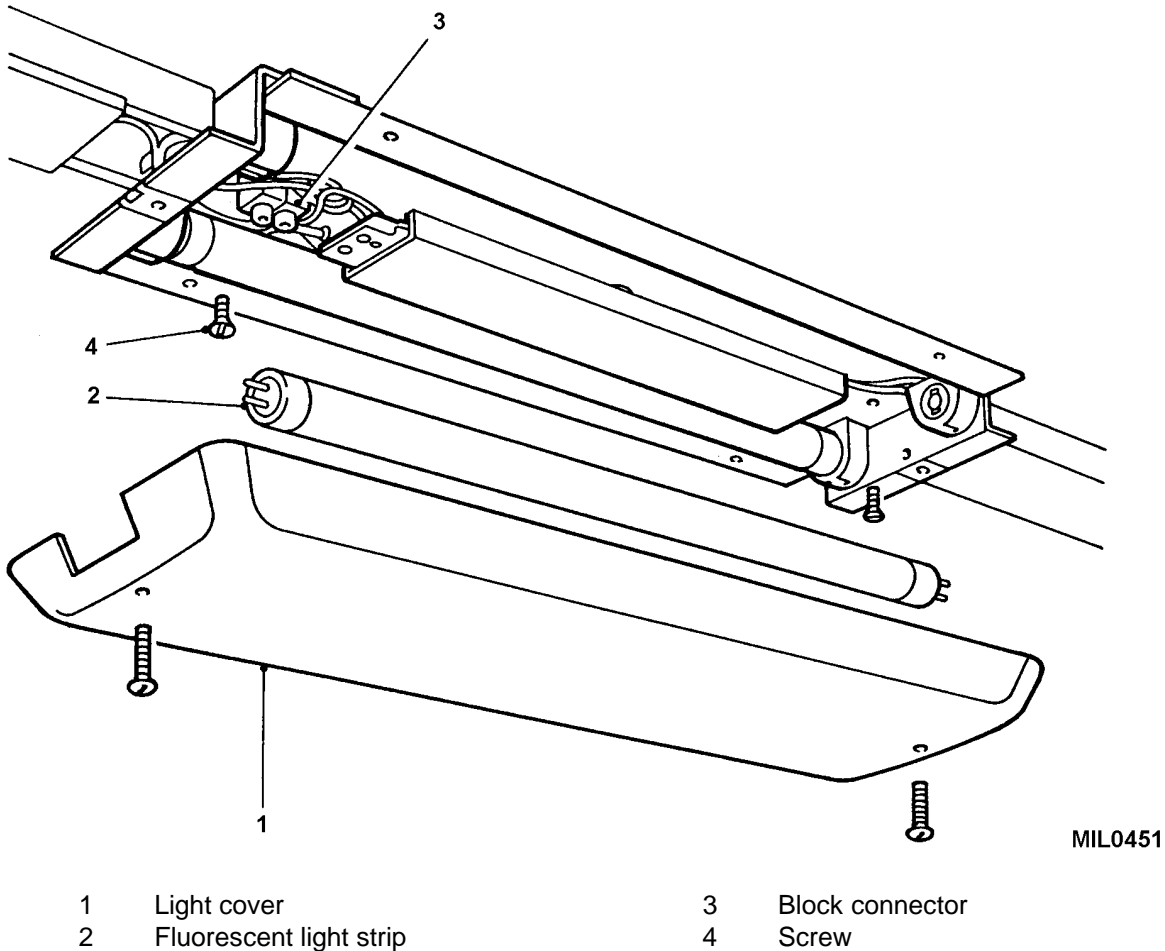


Fig 2 Fluorescent Light strip removal

BLACKOOUT MICROSWITCH - REAR DOORS/BULKHEAD DOOR

Remove

28 To remove a blackout micro switch carry out the following:

- 28.1 Disconnect the vehicle batteries.
- 28.2 Remove the microswitch panel (Fig 3 (1)) from the rear of the switch (4) and disconnect the electrical cables (2).
- 28.3 Remove the two screws (3) securing the switch to the mounting bracket and remove the switch.

Refit

29 Refit the microswitch in the reverse order of removal.

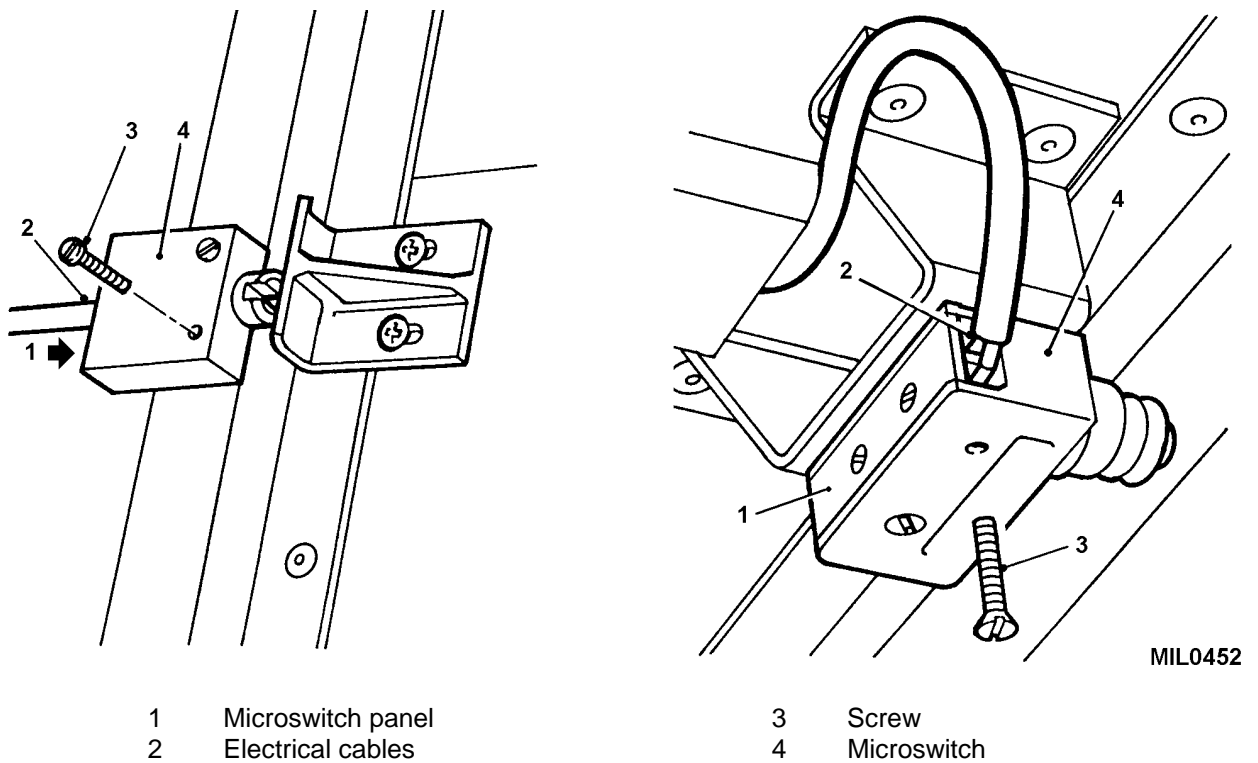


Fig 3 Blackout microswitch removal

MOONLIGHT

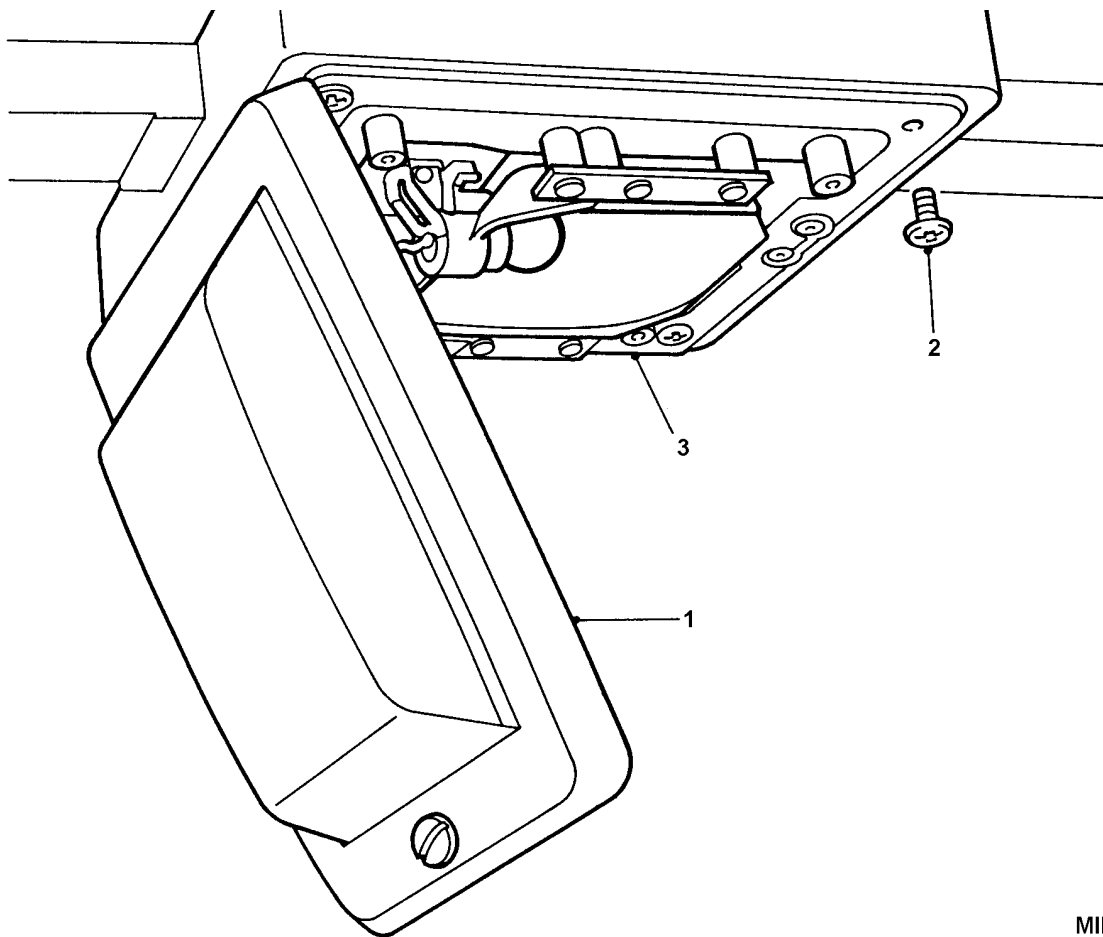
Remove

30 To remove the moon light carry out the following:

- 30.1 Disconnect the vehicle batteries (refer to Chap 13-1).
- 30.2 Open the light cover (Fig 4 (1)).
- 30.3 Remove the four screws (2) securing the light unit to the roof mounting.
- 30.4 Disconnect electrical cables from the terminals and withdraw the light unit (3) from the roof mounting.

Refit

31 Refit the moon light in the reverse order of removal.



MIL0453

1 Light cover
2 Screw

3 Light unit

Fig 4 Moonlight removal

HEATER CONTROL UNIT

NOTE

The heater control unit is located in a fully suppressed compartment on the ambulance floor alongside the heater unit compartment.

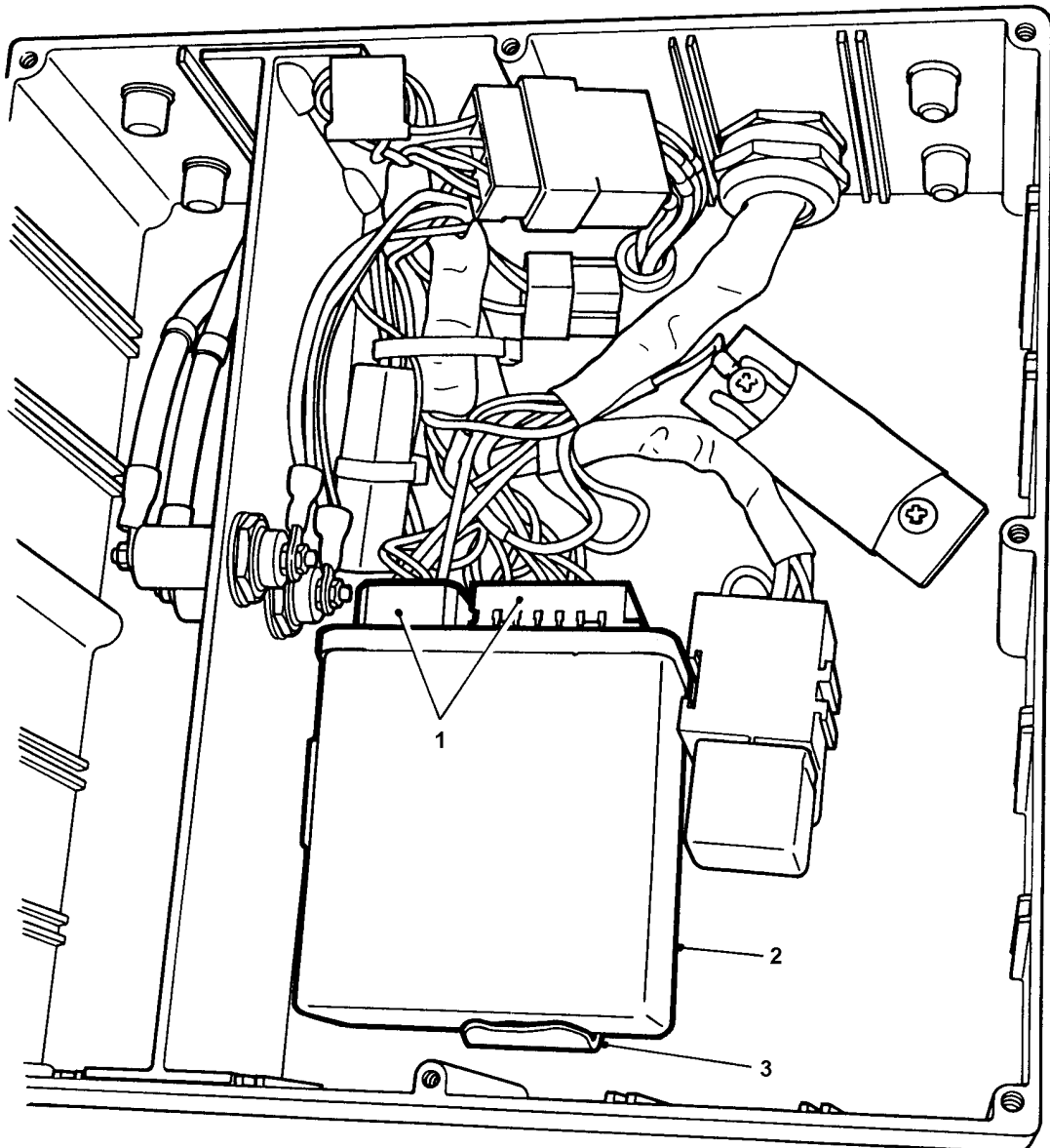
Remove

32 To remove the heater control unit carry out the following:

- 32.1 Disconnect the vehicle batteries (refer to Chap 13-1).
- 32.2 Remove the eight screws securing the compartment cover.
- 32.3 Disconnect the control unit multiplugs (Fig 5 (1)).
- 32.4 Free the control unit (2) from its spring bracket (3) and remove from compartment.

Refit

33 Refit the control unit in the reverse order of removal.



MIL0454

- 1 Multiplugs
- 2 Control unit

- 3 Spring bracket

Fig 5 Heater control unit removal

GLOW PLUG RELAY

NOTE

The glow plug relay is mounted in the same floor compartment as the heater control unit.

Remove

34 To remove the glow plug relay unit carry out the following:

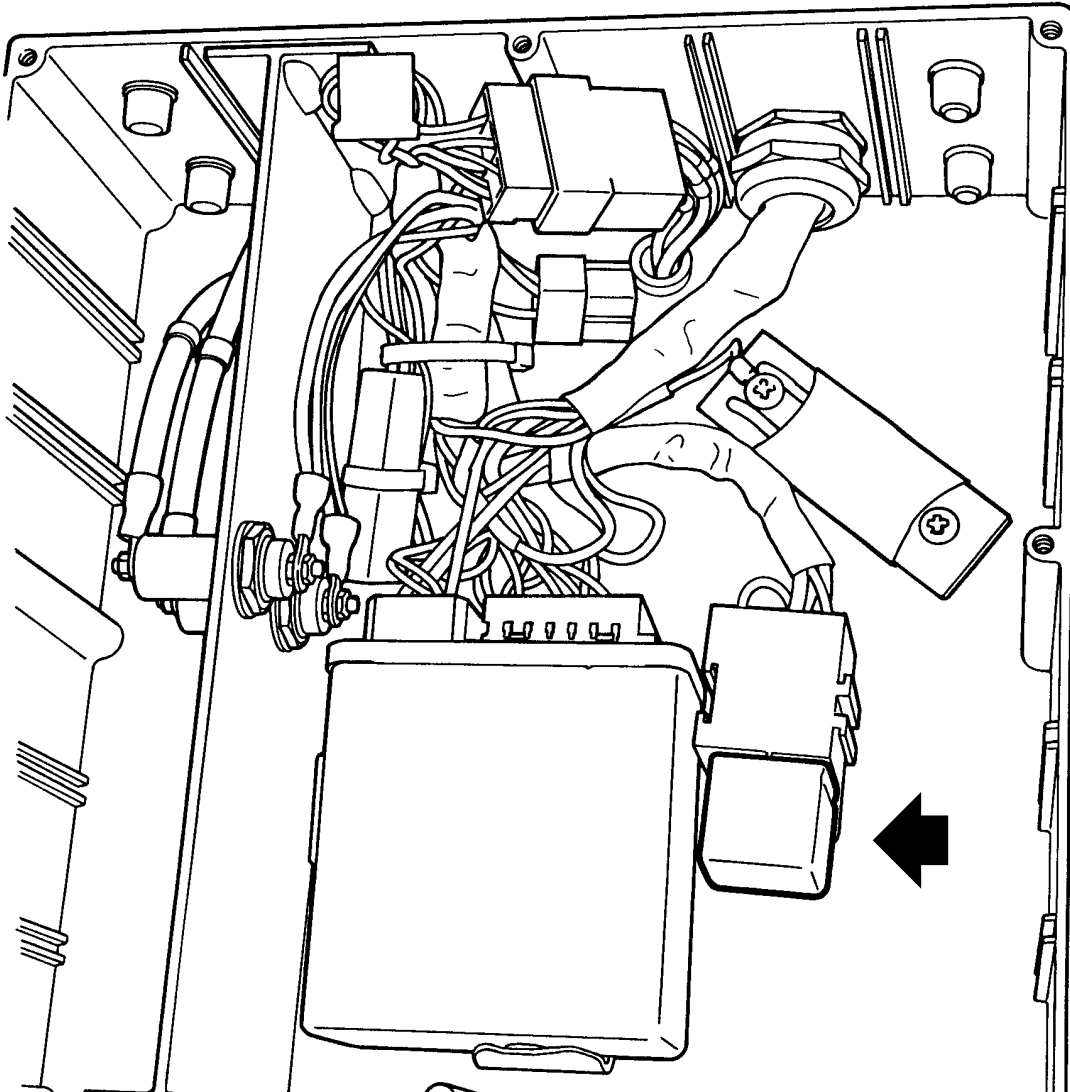
- 34.1 Disconnect the vehicle batteries (refer to Chap 13-1).

34.2 Remove the eight screws securing the compartment cover.

34.3 Locate the relay (Fig 6) and remove from its socket.

Refit

35 Refit the relay in the reverse order of removal.



MIL0455

Fig 6 Heater glow plug relay removal

THROUGH CAPACITORS

Remove

36 To remove the through capacitors carry out the following:

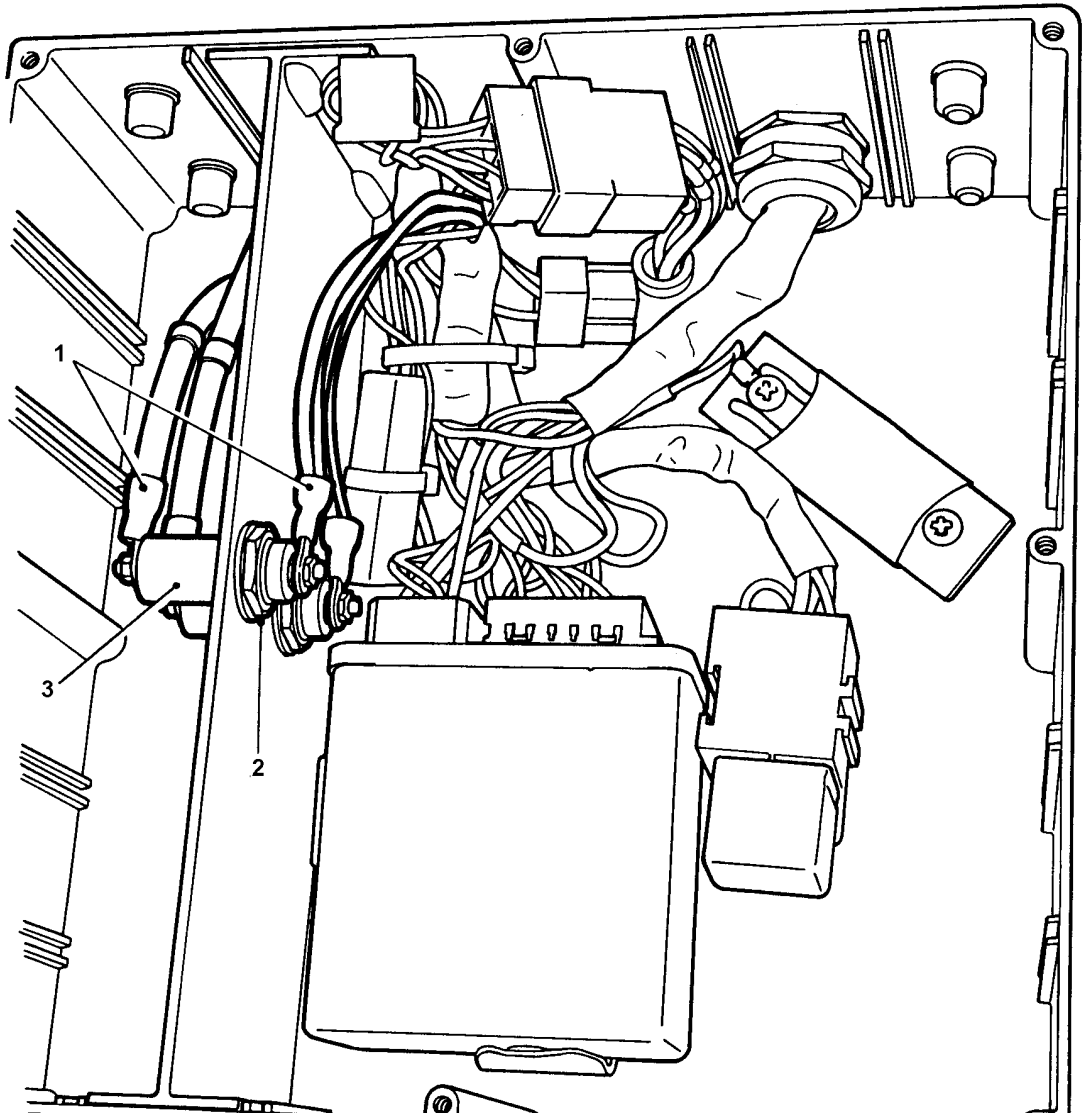
36.1 Disconnect the vehicle batteries (refer to Chap 13-1).

36.2 Remove the eight screws securing the compartment cover and remove the cover.

- 36.3 Disconnect the terminals (Fig 7 (1)).
- 36.4 Remove the nut (2) securing the capacitor to the dividing wall.
- 36.5 Remove the capacitor (3) from the compartment.

Refit

- 37 Refit the capacitor in the reverse order of the removal.



MIL0456

1 Terminals
2 Nut

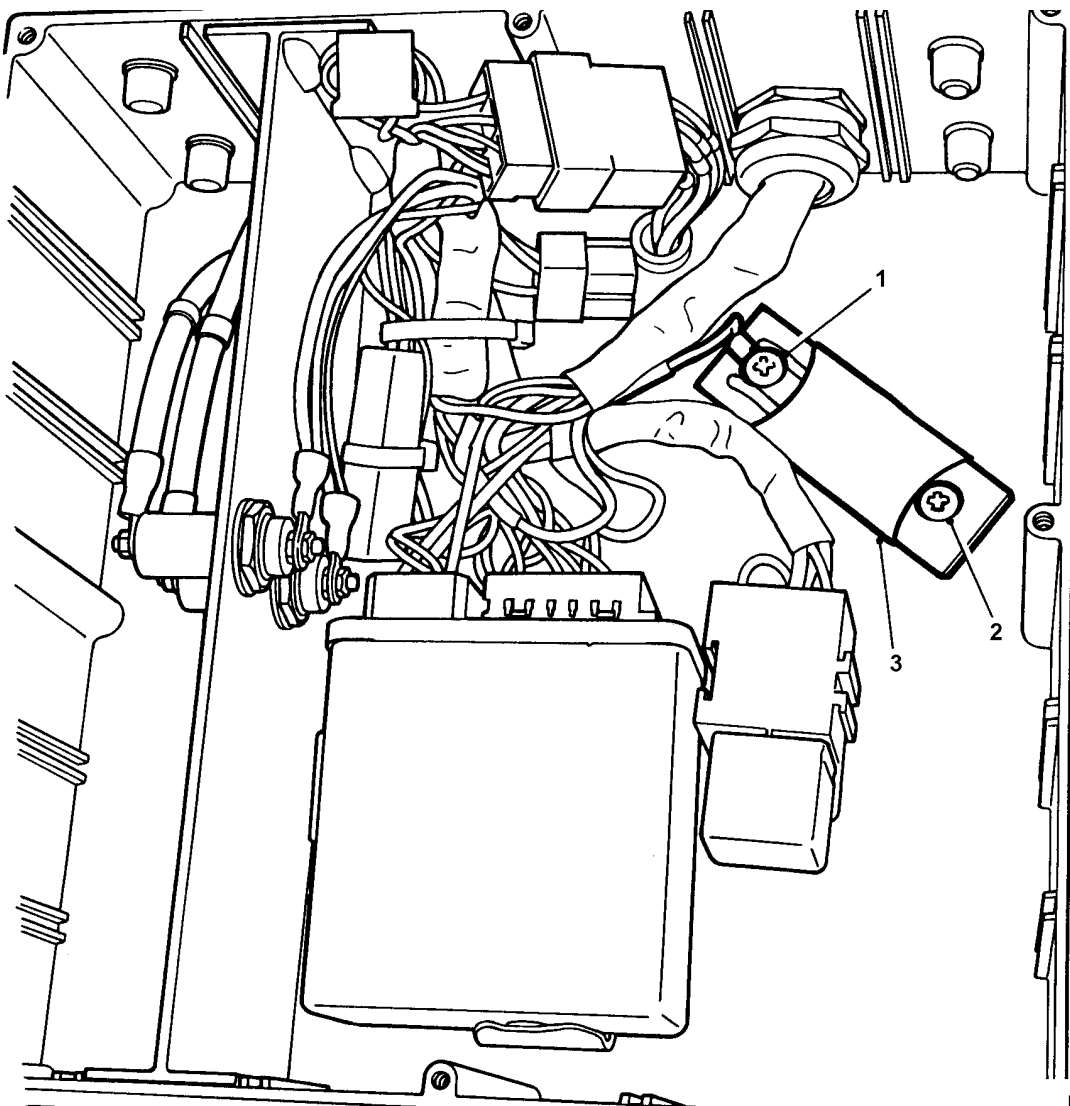
3 Capacitor

Fig 7 Through capacitors removal

SUPPRESSION COIL**Remove**

38 To remove the suppression coil carry out the following:

- 38.1 Disconnect the vehicle batteries (refer to Chap 13-1).
- 38.2 Remove the eight screws securing the compartment cover and remove the cover.
- 38.3 Disconnect the terminal (Fig 8 (1)).
- 38.4 Remove the screw (2) securing the coil (3) to the base of the compartment, and remove the coil.



MIL0457

1 Terminal
2 Screw

3 Suppression coil

Fig 8 Suppression coil removal

Refit

39 Refit the suppression coil in the reverse order of removal.

ENGINE RUN AND BUZZER UNITS

40 The engine run and buzzer units are located behind the instrument panel and are attached to the bulkhead by yellow (engine run unit) and red (buzzer) socket connector blocks.

Remove

41 For removal of the instrument panel (refer to Chap 13-1).

INLINE FUSES (3 AMP AND 15 AMP)

42 Inline fuse for the siren (3 Amp) and beacon relay (15 Amp) are located behind the centre dash panel.

Remove

43 For removal of the centre dash panel (refer to Chap 13-1).

CAB INTERIOR LIGHT

Remove

44 To remove the cab interior light carry out the following:

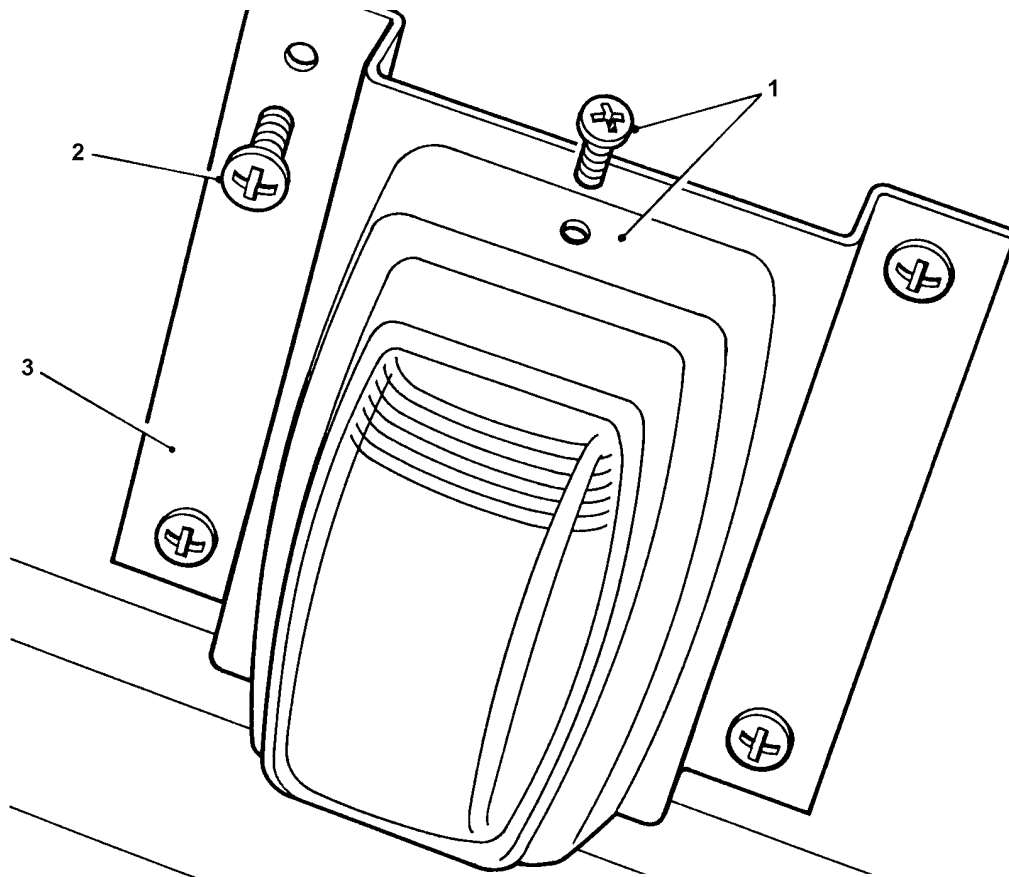
44.1 Disconnect the vehicle batteries (refer to Chap 13-1).

44.2 Remove the lens cover (Fig 9 (1)) and disconnect the terminals.

44.3 Remove the four screws (2) securing the light base (3) to the roof and remove the unit from the vehicle.

Refit

45 Refit the light unit in the reverse order of the removal.



MIL0458

1 Lens cover
2 Screw

3 Light base

Fig 9 Cab interior light removal

SIREN

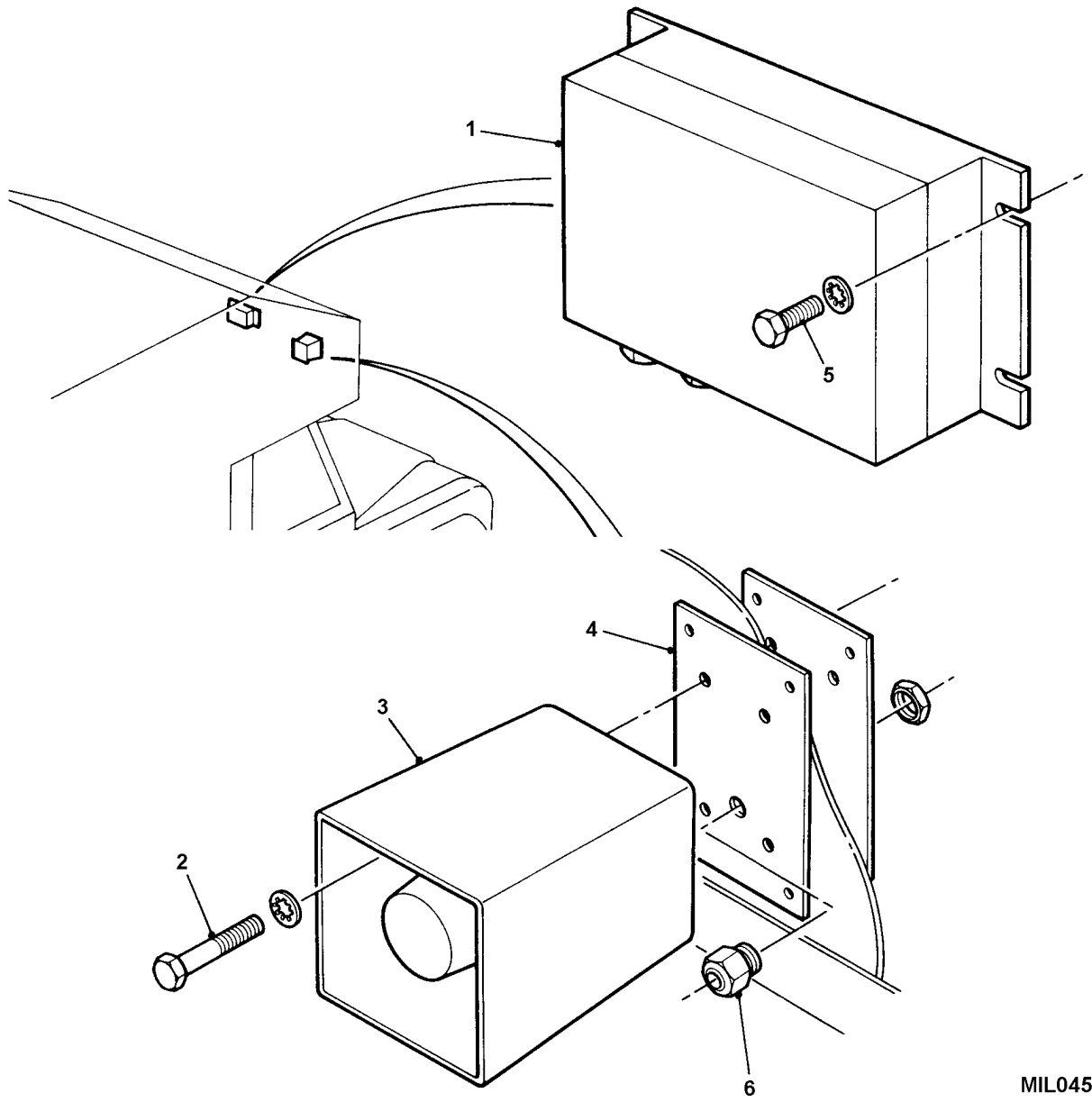
Remove

46 To remove the siren and amplifier carry out the following:

- 46.1 Disconnect the vehicle batteries (refer to Chap 13-1):
- 46.2 From inside the Luton disconnect the terminals to the amplifier (Fig 10 (1)).
- 46.3 Remove gland (6) and withdraw cable.
- 46.4 Support the siren unit and remove the bolts (2) securing the siren (3) to the front of the vehicle and retrieve the mounting plates (4).
- 46.5 Remove siren (3) from vehicle.
- 46.6 Remove bolts (5) securing amplifier to Luton and remove from vehicle.

Refit

Refit the siren and amplifier in the reverse order of removal.



MIL0459

- | | | | |
|---|-----------|---|-----------------|
| 1 | Amplifier | 4 | Mounting plates |
| 2 | Bolt | 5 | Bolt |
| 3 | Siren | 6 | Gland |

Fig 10 Siren unit removal

CHAPTER 13-4

WINTER/WATER

CONTENTS

Para

- 1 Introduction (CAUTIONS)
Battery disconnection (CAUTIONS)
- 2 Disconnection
- 3 Reconnection
- Alternator (CAUTION)
- 4 Remove
- 5 Refit
- Alternator brush renewal
- 6 Remove
- 7 Examination
- 8 Refit (CAUTION)
- Starter motor
- 9 Remove
- 10 Refit
- 11 Control box
- 12 Control box leak test (CAUTION)
- Headlamps
- 18 Remove
- 19 Bulb replacement
- 20 Refit
- Front indicator, tail/stop and side lights
- 21 Remove
- 22 Refit
- Rear indicator, fog and reverse lights
- 23 Remove
- 24 Refit
- Rear number plate light
- 25 Remove
- 26 Bulb replacement
- 27 Refit
- Convoy light
- 28 Removal and dismantling
- 29 Bulb replacement
- 30 Assembly and refit
- Directional side repeater lights
- 31 Remove
- 32 Refit
- Relay renewal
- 33 Remove
- 34 Refit
- Map light, headlamp level, heated rear window, heated front screen,
fog light, and hazard warning switches
- 35 Remove
- 36 Refit
- Warning light panel
- 37 Remove
- 38 Refit

(continued)

CONTENTS (continued)

Para

	Inspection sockets
39	Remove
40	Refit
	Heater switch
41	Remove
42	Refit
	Six Way Main lighting switch
43	Remove
44	Refit
	Seven Way Main lighting switch
45	Remove
46	Refit
	Ignition switch
47	Remove
48	Refit
	Rear wash/wipe switch
49	Remove
50	Refit
	Map reading light
51	Remove
52	Refit
	Centre console fuse box-Fuse removal
53	Remove
54	Refit
	Glow plug timer relay
55	Remove
56	Refit
	Main fuse box-Fuse removal
57	Remove
58	Refit
	Positive stud assembly
59	Remove
60	Refit
	Instrument panel
61	Remove
62	Refit
	Speedometer
63	Remove
64	Refit
	Fuel and temperature gauge
65	Remove
66	Refit
	Centre console and main fuse box
67	Remove
68	Refit
	Steering column switch housing
69	Remove
70	Refit
	Front wiper motor and drive rack
71	Remove
	Front wiper box assembly
72	Dismantle
73	Examination
74	Assembly
75	Refit

(continued)

CONTENTS (continued)

Para

	Front wiper rack tube and wheel box assembly (CAUTION)
76	Remove
77	Refit
	Rear wiper motor
78	Remove
79	Dismantle
80	Examination
81	Assembly
82	Refit
	Terminal box
83	Remove
84	Refit
	Fast fuse
85	Remove
86	Refit
	Terminal post
87	Remove
88	Refit
	Plug socket
89	Remove
90	Refit
	Ammeter
91	Remove
92	Refit

Table

		Page
1	Sealants, adhesives and lubricants	4
2	Service kits	4

Fig

1	Alternator removal.....	6
2	Alternator brush removal.....	8
3	Headlamp assembly	11
4	Front indicator, tail/stop and side lights	13
5	Rear indicator, fog and reverse light.....	14
6	Number plate light.....	16
7	Convoy light	17
8	Directional side repeater light	19
9	Centre console assembly	20
10	Seven Way Main Lighting Switch	23
11	Map reading light removal.....	26
12	Centre console fuse box - fuse removal	27
13	Glow plug timer relay, main fuse and positive stud removal	29
14	Instrument panel removal	31
15	Speedometer removal.....	33
16	Fuel and temperature gauge removal.....	35
17	Centre console and main fuse box removal	37
18	Steering column switch housing removal	39
19	Front wiper motor and wiper rack removal	40
20	Front wiper box assembly	42
21	Front wiper rack tube and wheel box assembly	43
22	Rear wiper motor removal.....	45
23	Terminal box and fast fuse removal.....	47
24	Terminal post and plug socket removal.....	50

INTRODUCTION

1 This chapter details the Unit repairs for Truck Utility Light (TUL) HS, and Truck Utility Medium (TUM) HS winter/water variants fitted with the 24 volt electrical system. The information given is applicable to both left and right hand drive vehicles.

CAUTIONS

- (1) **EQUIPMENT DAMAGE.** The equipment covered in this chapter is designed to remain waterproof during operation and great care must be taken to retain the integrity of the sealed components during maintenance. Only qualified personnel should maintain this equipment.
- (2) **EQUIPMENT DAMAGE.** Do not use inappropriate tools during dismantling.

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	XG 250	6850-99-224-8404	Silicon grease
2	OM 100	9150-99-944-0425	Lubricating oil
3	PX7	9150-99-910-0488	Light grease
4	Celloseal	8030-99-225-0232	Anti-seize grease
5	3M 1602	TBA	Spray sealant

TABLE 2 SERVICE KITS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Service kit (STC 4293)	5920-99-573-6561	Fuse box seal kit
2	Service kit (STC 4296)	2590-99-573-6564	Column switch seal kit
3	Service kit (STC 4295)	2540-99-573-6563	Front wiper seal kit
4	Service kit (STC 4294)	2540-99-573-6562	Rear wiper seal kit
5	Service kit (STC YPF100820)	5940-99-573-6560	Positive stud assembly seal kit
6	Service kit (STC 4368)	TBA	Terminal box assembly seal kit

BATTERY DISCONNECTION**CAUTIONS**

- (1) **EQUIPMENT DAMAGE.** Do not let the engine run with the batteries disconnected.
- (2) **EQUIPMENT DAMAGE.** Do not use a high speed battery charger as a starting aid. When using a charger to charge the batteries, they must be disconnected from the vehicles electrical system.
- (3) **EQUIPMENT DAMAGE.** When installing ensure the batteries are connected in correct polarity.
- (4) **EQUIPMENT DAMAGE.** Care must be taken when disconnecting the batteries. Ensure the ignition system and all electrical components are switched off.

(5) EQUIPMENT DAMAGE. If a new battery is to be installed in the vehicle it should be of the same type and size as the original battery. When fitting ensure that terminals and leads are well clear of the battery clamp assembly.

(6) EQUIPMENT DAMAGE. Ensure the batteries and the area around them is thoroughly dry before attempting to disconnect the terminals.

Disconnection

2 Disconnect the vehicle batteries (refer to chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

Reconnection

3 Reconnect the vehicle batteries (refer to chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

ALTERNATOR

CAUTION

The alternator(s) should be assessed for smoothness of rotation and bearing noise and under no circumstance should the alternator produce a predominant noise over the engine at idling speed.

Remove

4 To remove the alternator carry out the following:

4.1 Disconnect the vehicle batteries (refer to chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

4.2 Release the clip (Fig 1 (2)) securing the air duct to the rear of the alternator and remove the air duct assembly.

4.3 Disconnect the electrical connections (1) at the back of the alternator.

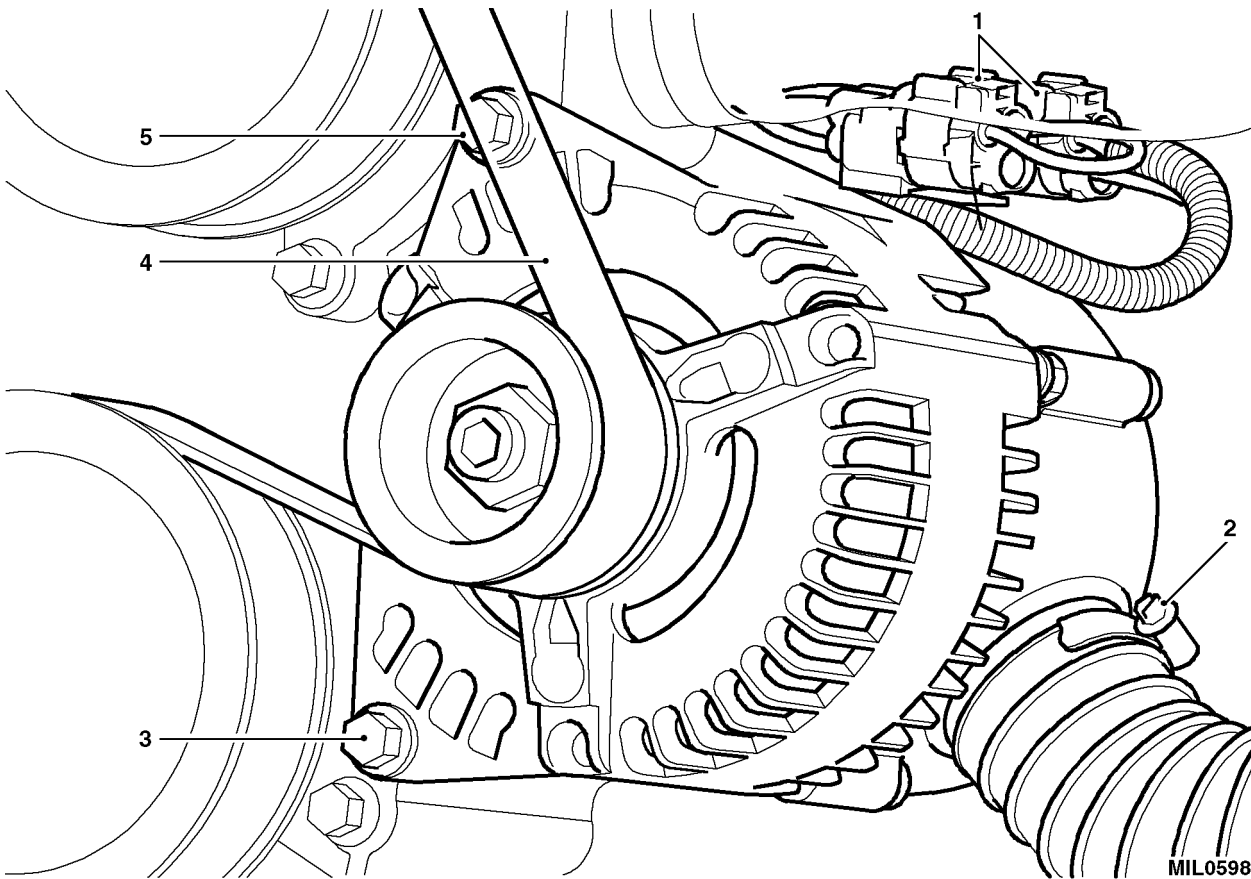
4.4 Remove the drive belt (4) (refer to Chap 12-1).

4.5 Remove securing bolt (3) from bottom of alternator.

4.6 Remove pivot bolt (5) from top fixing and withdraw alternator.

Refit

5 Refit the alternator by reversing the removal procedure and apply grease (refer to Table 1 Serial 1) to the terminals.



- | | | | |
|---|------------------------|---|------------|
| 1 | Electrical connections | 4 | Drive belt |
| 2 | Clip | 5 | Pivot bolt |
| 3 | Securing bolt | | |

Fig 1 Alternator removal

ALTERNATOR BRUSH RENEWAL**Remove**

6 To remove the alternator brushes carry out the following:

NOTE

This procedure also applies to FFR vehicles.

6.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

6.2 Remove the alternator from the vehicle. (refer to Para 4 and on FFR vehicles refer to Chap 13-2).

6.3 With the alternator secured to a suitable work bench remove the three retaining bolts (Fig 2 (6)) securing the rear suppression can assembly (7) to the alternator.

6.4 Separate suppression can assembly from alternator to gain access.

6.5 Remove terminal nuts (5) securing brown lead terminals to rear of alternator (leave other ends secured to cover).

6.6 Remove suppression can (7) and black plastic anti-flash cover (4).

6.7 Remove two nuts (9) securing brush housing and regulator (1).

NOTE

Observe alignment of flag eyelet under nut (8) for re-assembly.

6.8 Remove nut, wavy washer and flag eyelet (8) from centre (D+) terminal.

6.9 Remove nut (10) and screw (3).

6.10 Lift regulator assembly away from slip ring end bracket.

6.11 Press off plastic enclosure (2) from around brushes.

6.12 Remove screws (12) securing brush closures and withdraw the inner and outer brush closure assemblies (11).

Examination

7 Examine the components for signs of wear and water contamination. Clean out the brush holder and regulator assembly and rear of the alternator including all terminal mating faces and stud threads before re-assembly. Clean copper slip ring surfaces of any contamination.

Refit

8 Refit the brushes and regulator as follows:

8.1 Fit new brush assemblies into the brush housing.

NOTE

The brushes are constructed to fit one way only.

8.2 Secure with screws (12). Tighten to a torque of 1.35 to 2 Nm (.88 - 1.5 lbf ft).

8.3 Compress brushes with fingers whilst locating tag over stud (10).

8.4 Release lower brush onto slip ring before locating outer tag over stud (9).

8.5 Release upper brush onto slip ring.

8.6 Fit screw (3) and tighten to a torque of 2 to 2.5 Nm (1.5 to 1.8 lbf ft).

8.7 Fit nut (10) and tighten to 1.1 to 1.6 Nm (.80 to 1.1 lbf ft).

8.8 Fit flag eyelet, wavy washer and nut (8) ensuring correct alignment of flag eyelet (refer to Fig 2 inset) and tighten to 1.7 to 2.3 Nm (1.25 to 1.7 lbf ft).

8.9 Fit nuts (9) and torque to 2.8 to 3.6 Nm (2 to 2.6 lbf ft).

8.10 Refit plastic enclosure (2) to brush housing ensuring it is correctly seated.

CAUTION

SPRAY PROTECTION. Cover the exposed threads and mating surfaces of the alternator terminals before spraying all terminations and connections, which have been reconnected.

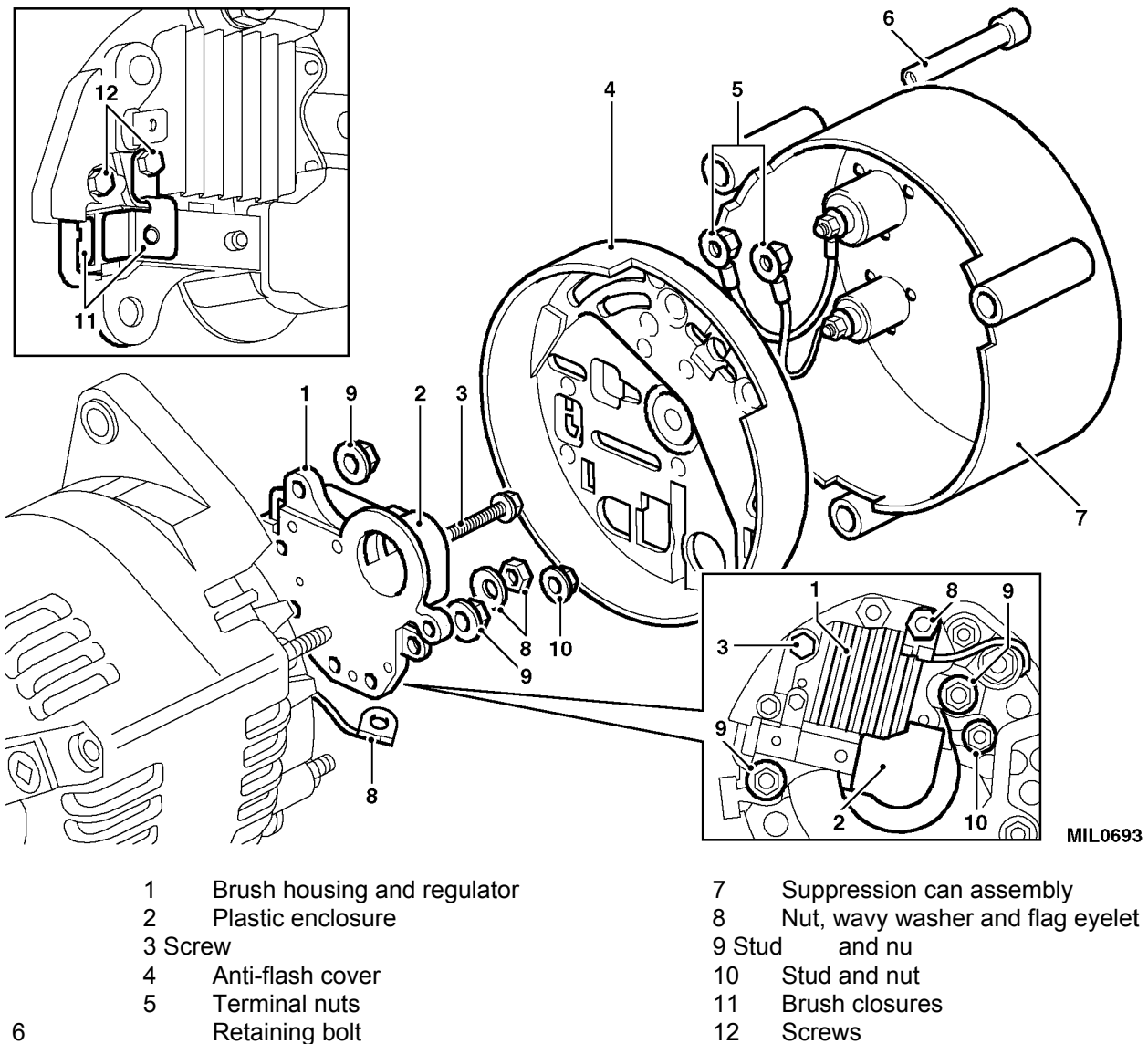


Fig 2 Alternator brush removal

8.11 Using a spray sealant (Table 1, Serial 5) seal the terminations and connections before refitting the anti-flash cover (4).

8.12 Refit brown leads (5) to alternator terminals and torque to 2.7 to 3.3 Nm (2 - 2.4 lbf ft) for the M5 size terminals and 3.6 to 5.1 Nm (2.6 - 3.8 lbf ft) for the M6 size terminals..

8.13 Spray terminals with sealant (refer to Table 1 Serial 1).

8.14 Align and fit suppression can assembly (7) and secure with retaining bolts (6). Torque to 3 to 5 Nm (2.2 - 3.6 lbf ft).

NOTE

Tighten retaining bolt furthest from sliding bush in mounting lug of slip ring end bracket first.

8.15 Fit alternator to vehicle (refer to Para 5).

8.16 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

STARTER MOTOR

NOTE

The starter motor is a non serviceable item, in the event of failure it must be renewed.

Remove

9 To remove the starter motor carry out the following:

9.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

9.2 Remove any sand and dirt which may enter the flywheel housing.

9.3 Disconnect and move aside turbo air intake hose.

9.4 Disconnect the electrical leads to the starter motor and move aside.

9.5 Remove the two bolts and one nut securing the starter motor to the flywheel housing.

9.6 Manoeuvre the starter motor clear of the flywheel housing and remove.

9.7 Remove special waterproof gasket.

Refit

10 Refit the starter motor in the reverse order of removal fitting a new special gasket.

10.1 Apply grease (refer to table 1 Serial 1) to starter motor terminals.

10.2 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

CONTROL BOX

11 The control box is identical to the winterised vehicle (refer to Chap 13-5) for removal and refitting. The exception is the leak test (refer to Para 12) which is for winter/water vehicles only.

CONTROL BOX LEAK TEST

12 The control box is a sealed component and once the integrity of the seal has been compromised by the removal of the cover for diagnostic checks or maintenance, the box must be checked for leakages after it has been re-assembled.

CAUTION

COMPRESSED AIR. Do not use compressed air to pressurise the control box.

13 The control box has a schraeder valve (refer to Chap 13-5) fitted to the underside to enable the following test to be carried out.

13.1 With the control box removed from the vehicle (refer to Chap 13-5) remove the dust cap from the schraeder valve.

13.2 Remove the schraeder valve core from the valve stem using a standard tyre valve core removal tool.

13.3 Connect a length of hose (approx one metre) to the valve stem and secure with a hose clip ensuring a water tight seal.

13.4 Fit a sealing plug to each of the metal electrical connectors to prevent water ingress.

13.5 Submerge the control box and cables in a container of water keeping the open end of the test pipe out of the water.

13.6 Blow into the pipe and observe the following areas for air bubbles.

13.6.1 Box lid.

13.6.2 Plugs.

13.6.3 Cables.

13.6.4 Cable glands.

14 Rectify any leaks and retest.

15 Remove the test pipe and refit the schraeder valve core.

16 Refit the dust cap and dry off the control box.

17 Refit the control box to the vehicle (refer to Para 11).

HEADLAMPS

Remove

NOTE

The headlamps are sealed with a silicone based grease. Wash any sand and/or dirt off the light unit before dismantling to prevent contamination of the seals. Replacement light units have seal components already treated with silicon grease.

18 To remove the headlights, carry out the following:

18.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

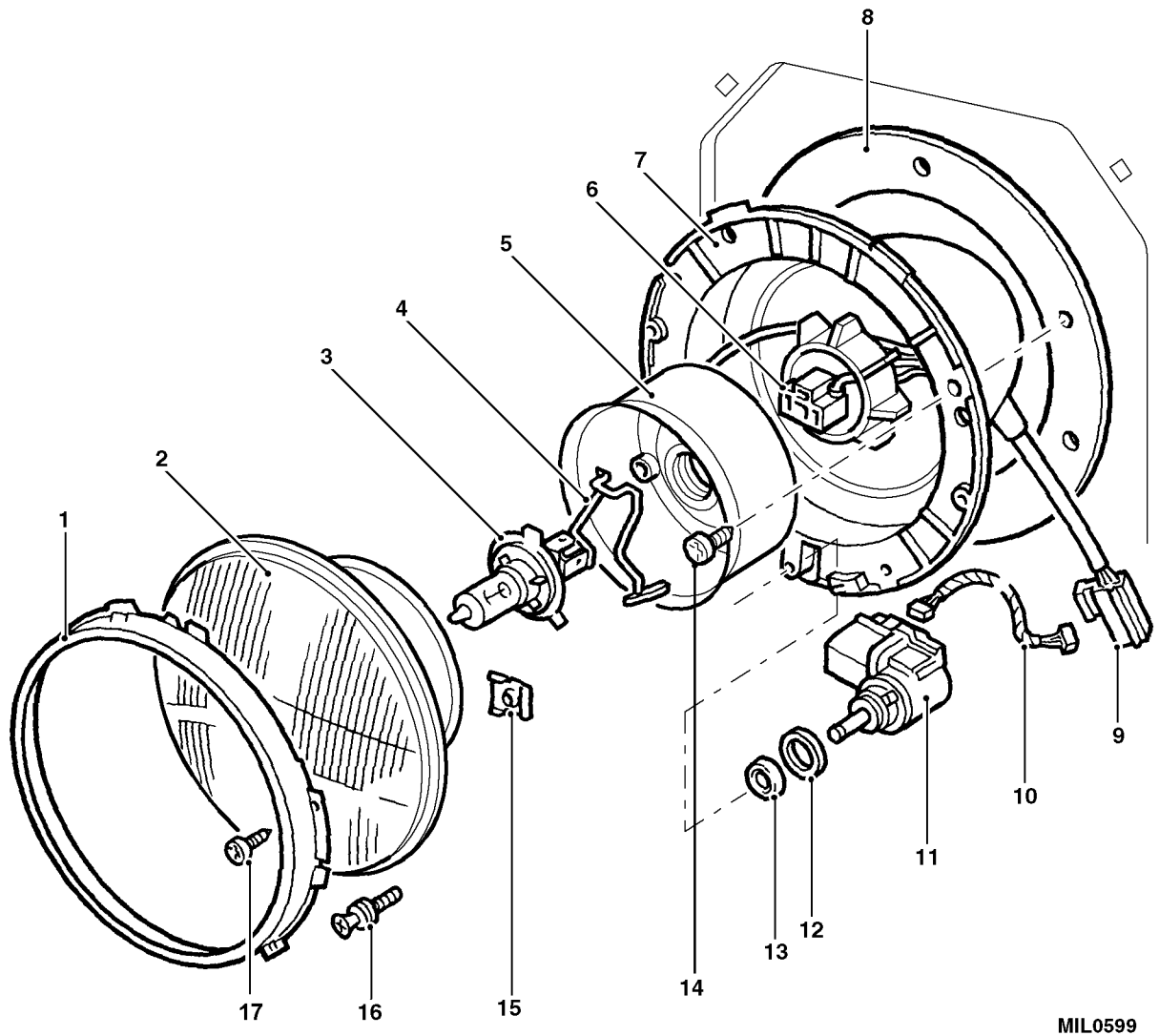
18.2 Unclip lamp guard and drop away.

18.3 Remove the four screws (Fig 3 (14)) securing the headlight assembly to the wing panel.

18.4 Disconnect the headlamp electrical connector (6) and headlamp levelling connector (9) and withdraw the headlight assembly complete with gasket (8) from the wing panel.

18.5 Wash off any sand/dirt with clean water to prevent contamination of the silicone greased seals.

18.6 If required disconnect the link lead (10) and remove the headlamp levelling actuator (11).



MIL0599

1	Headlamp bezel	10	Link lead
2	Lens unit	11	Levelling actuator
3	Bulb	12	Rubber gasket
4	Bulb retaining clip	13	Rubber seal
5	Rubber boot	14	Screw
6	Electrical connector	15	Bezel clamp plate
7	Body	16	Headlight adjustment screw
8	Gasket	17	Bezel screw
9	Electrical connector		

Fig 3 Headlamp assembly

Bulb replacement

19 To replace the bulb proceed as follows:

19.1 Unclip the headlamp bezel (Fig 3 (1)) from the headlight beam adjustment screws (16) and separate the lens unit (2) from the body (7).

19.2 Pull off the electrical connector (6) to the headlight, remove the rubber boot (5) from the lip on the back of the lens unit (2), release the bulb retaining clip (4) and withdraw the bulb (3).

Refit

20 Refit the headlight as follows:

- 20.1 Fit a new bulb (3) and secure with retaining clip (4).
- 20.2 Re-apply silicon grease (Table 1, Serial 1) to disturbed seals.
- 20.3 Refit rubber boot (5) and electrical connector (6).
- 20.4 Refit the light unit by reversing the removal procedure.

NOTE

Care must be taken when refitting the rubber boot to ensure that it is seated properly over the lip on the rear of the light unit.

FRONT INDICATOR, TAIL/STOP AND SIDE LIGHTS**NOTE**

The light units under this heading are all of a similar construction, the removal and refitting procedures are the same for each light. The construction differs only in respect of lens colours and bulb wattage. Replacement light units have seal components already treated with silicon grease.

Remove

21 To remove the light unit carry out the following:

- 21.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 21.2 Remove the two screws (Fig 4 (1)) securing the lens to the wing panel.
- 21.3 Withdraw the unit from the wing, and wash with clean water to remove any sand or dirt to prevent contamination of the silicone greased seals.
- 21.4 Disconnect the electrical connector (5) from the bulb holder (4).
- 21.5 Remove the bulb holder (4) from the lens complete with rubber seal and bulb (3).

Refit

22 Refit the light as follows:

- 22.1 If required fit a new bulb.
- 22.2 Re-apply silicon grease (Table 1 Serial 1) to disturbed seals.
- 22.3 Refit the light unit by reversing the order of removal.
- 22.4 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

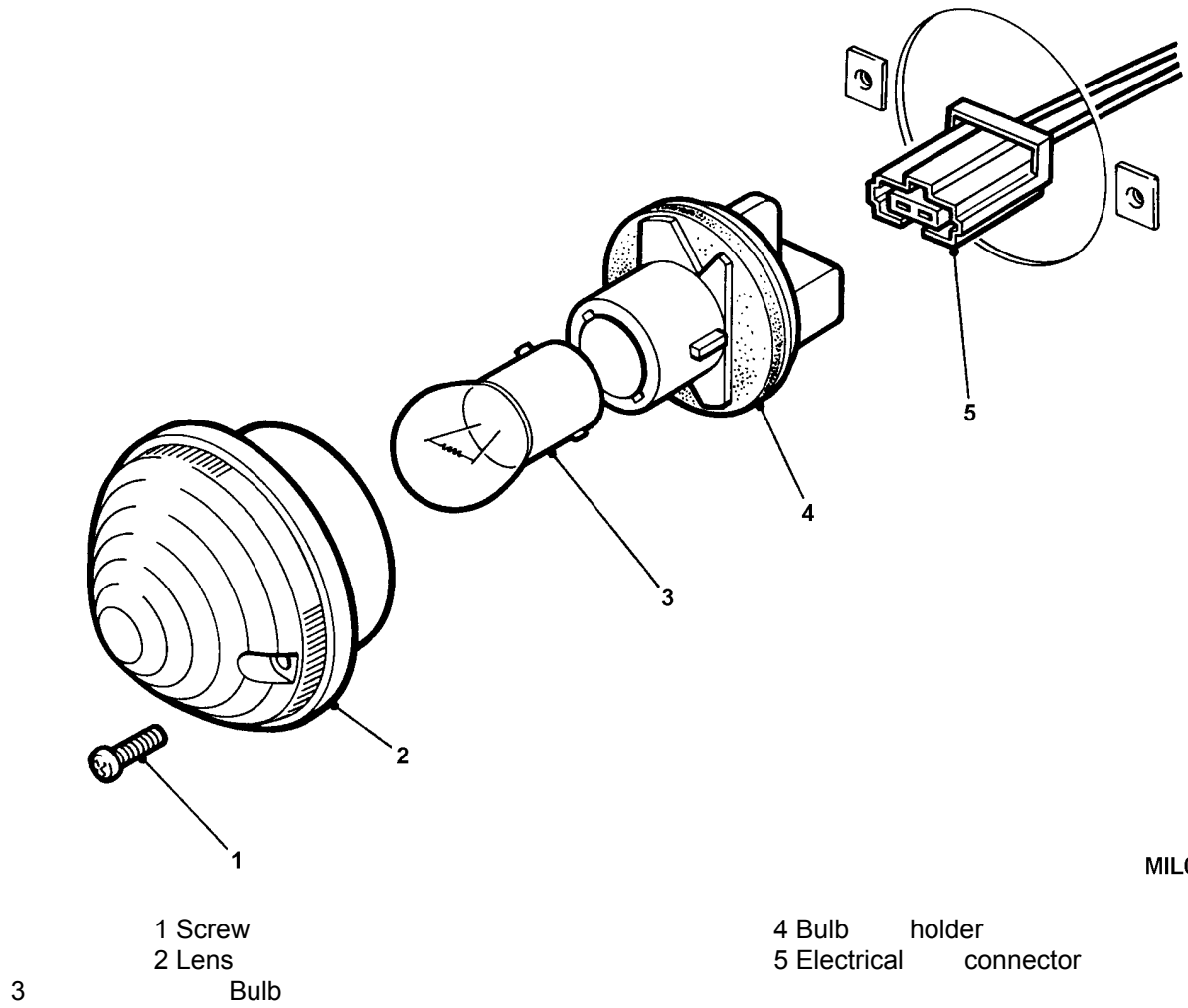
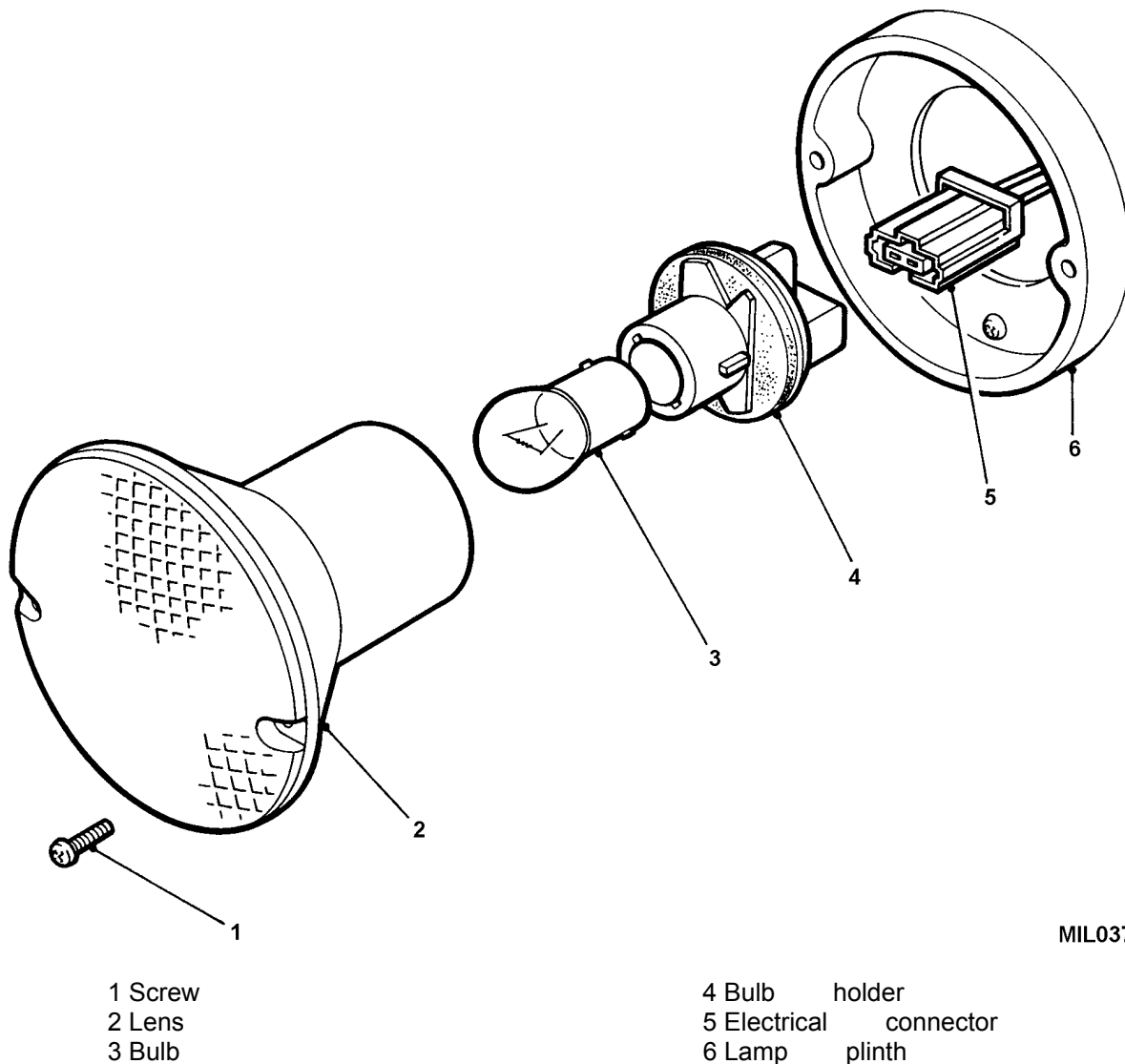


Fig 4 Front indicator, tail/stop and side lights



MIL0377

Fig 5 Rear indicator, fog and reverse light

REAR INDICATOR, FOG AND REVERSE LIGHTS.**NOTE**

The rear indicator, fog and reverse lights are of similar construction and the remove and refitting procedure is the same for each light. The construction differs only in respect of lens colour. Replacement light units have seal components already treated with silicon grease.

Remove

23 To remove the light unit carry out the following:

- 23.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 23.2 Remove the two screws (Fig 5 (1)) securing the lens (2) to the lamp plinth (6).
- 23.3 Withdraw the unit from the rear body and wash with clean water to remove any sand or dirt to prevent contamination of the silicone greased seals.

- 23.4 Disconnect the electrical connector (5) from the bulb holder (4).
- 23.5 Remove the bulb holder (4) from the lens complete with rubber seal and bulb (3).
- 23.6 If necessary, remove the two screws securing the lamp plinth to the body and remove.
- 23.7 Inspect lamp plinth for damage and renew if required.

Refit

24 Refit the light as follows:

- 24.1 If required fit a new bulb.
- 24.2 Re-apply silicon grease (Table 1 Serial 1) to disturbed seals.
- 24.3 Refit the light unit by reversing the order of removal.

REAR NUMBER PLATE LIGHT

Remove

25 To remove the number plate light carry out the following:

- 25.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 25.2 Wash the light unit with clean water to prevent contamination of the silicone seals.
- 25.3 Undo the screw (Fig 6 (4)) securing the lens cover and lens (3) and remove taking care to recover the silicone greased seal (5).
- 25.4 Remove panel from inside the vehicle (refer to Chap 13-1) and disconnect the electrical 2 way connector (1) from inside the vehicle.
- 25.5 Undo the two screws (6), nuts and washers (8) securing the bulb holder and mounting (7) to the vehicle body and remove.

Bulb replacement

26 To replace the bulb carry out the following:

- 26.1 Undo the screw (Fig 6 (4)) securing the lens cover and lens (3) and remove taking care to recover the silicone greased seal (5).
- 26.2 Remove the bulb (2) from the bulb holder and renew.

Refit

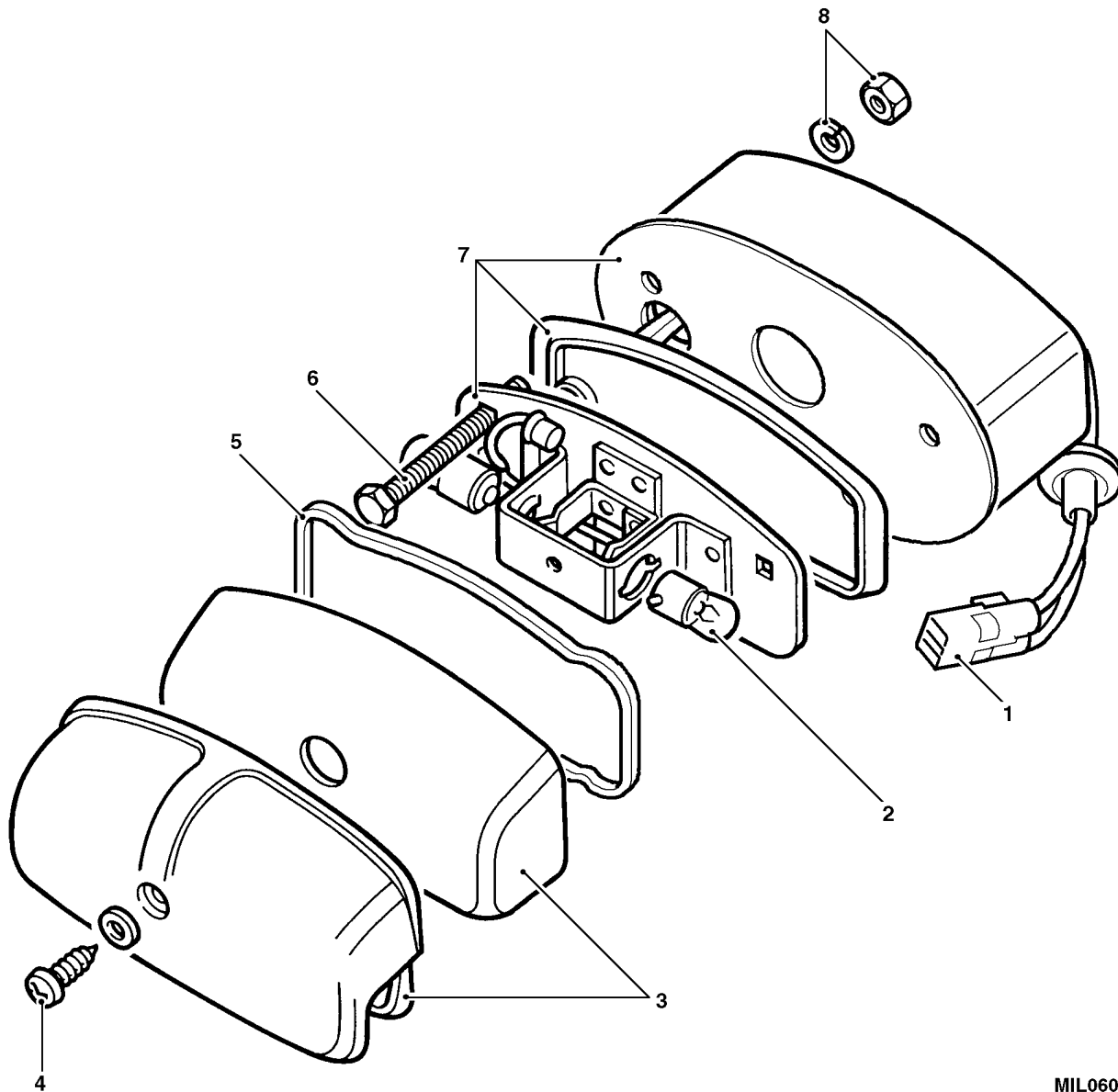
NOTE

Ensure that the silicone greased gasket is seated correctly on the base of the lens.

27 Refit the light as follows:

- 27.1 Re-apply silicon grease (Table 1 Serial 1) to disturbed seals.
- 27.2 Assemble and fit the light in the reverse order of removal.

27.3 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).



MIL0600

- 1 2 way connector
- 2 Bulb
- 3 Lens cover and lens
- 4 Screw

- 5 Silicone greased seal
- 6 Screw
- 7 Bulb holder and mounting
- 8 Nuts and washers

Fig 6 Number plate light

CONVOY LIGHT

NOTE

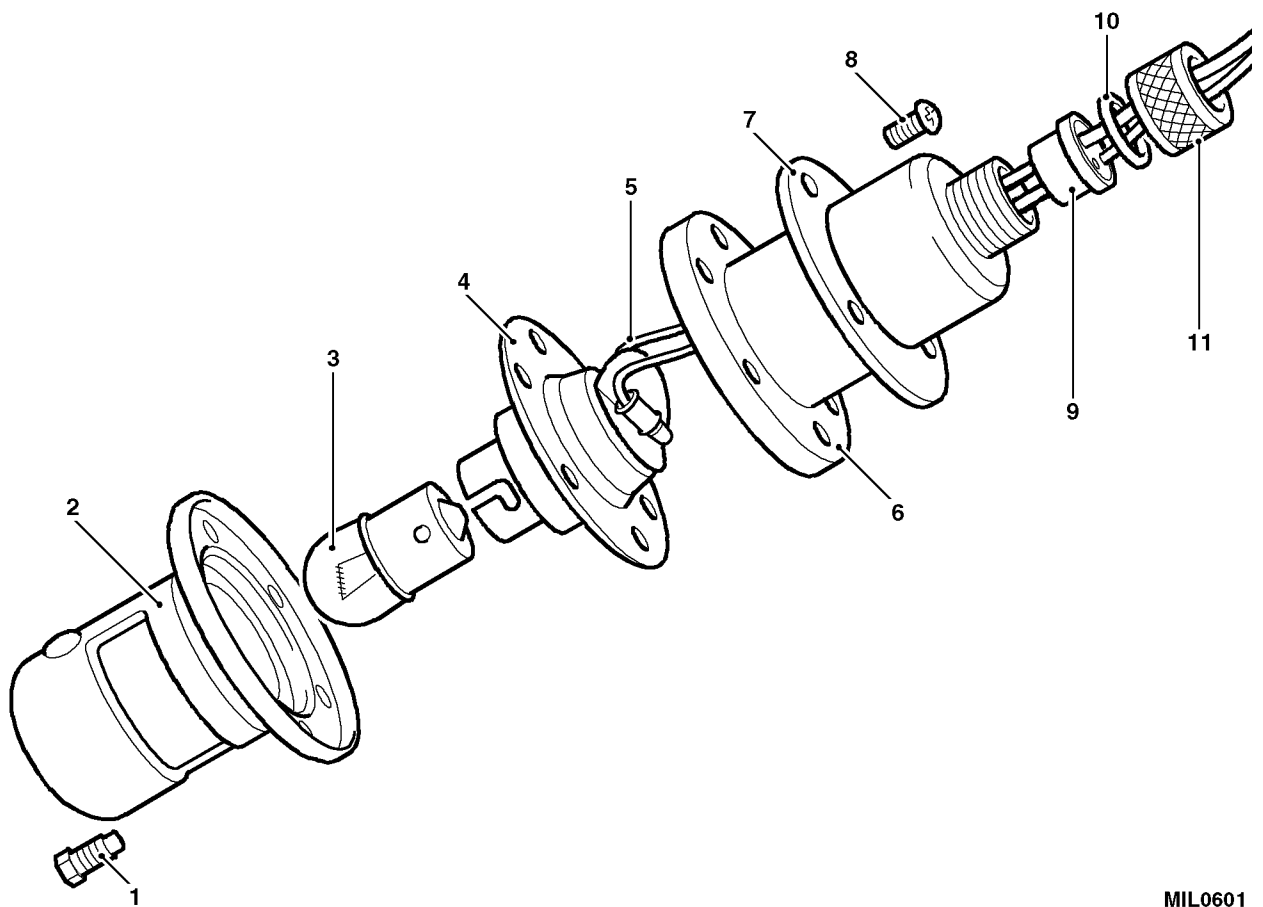
The convoy light is located beneath the vehicle to illuminate an area on a white plate, or a white area on the rear axle. The cover is fitted with a spring loaded light shield which may be rotated on the cover to give full illumination or restricted illumination for use in black-out conditions.

Removal and dismantling

28 To remove and dismantle the convoy light carry out the following:

28.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

28.2 Wash the light assembly with clean water to remove any dirt.



MIL0601

- | | | | |
|---|-------------------|----|------------------|
| 1 | Screw | 7 | Securing plate |
| 2 | Lens cover | 8 | Screws |
| 3 | Bulb | 9 | Rubber insulator |
| 4 | Bulb holder | 10 | Washer |
| 5 | Cable connections | 11 | Knurled nut |
| 6 | Light body | | |

Fig 7 Convoy light

28.3 Remove the three screws (Fig 7 (8)) securing the light assembly to the chassis bracket and remove from the bracket.

- 28.4 Support the light assembly and remove screws (1) securing lens cover (2) to securing plate (7).
- 28.5 Release knurled nut (11) and washer (10) from rear of light and free rubber cable insulator (9) from light body (6).
- 28.6 Release cable connections (5) from bulb holder (4) and withdraw cable through rear of light body.
- 28.7 The lamp can now be removed from the vehicle and cleaned before re-assembly.

Bulb replacement

29 To replace the bulb carry out the following:

- 29.1 Remove the three screws (1) securing the lens cover (2) and remove.
- 29.2 Renew the bulb (3) and refit the lens cover (2).

Assembly and refit

30 Assemble and refit the light in reverse order of removal.

DIRECTIONAL SIDE REPEATER LIGHTS**Remove**

31 To remove the directional side repeater lights carry out the following:

- 31.1 Prise the light unit out of the wing by pushing the unit towards the front of the vehicle and lifting the rear of the light unit out of the wing.
- 31.2 Disconnect the electrical connector (Fig 8 (5) from the rear of the light unit.
- 31.3 Wash the light unit with clean water to remove any sand and dirt to prevent it entering the inside of the unit.
- 31.4 Pull the bulb holder (4) free of the lens and collect the 'O' ring (3).
- 31.5 Renew the bulb (2) if required.

Refit

32 Clean the 'O' ring bulb holder and reassemble and refit the light unit in the reverse order of removal ensuring any disturbed seals are re-coated with silicon grease (Table 1 Serial 1).

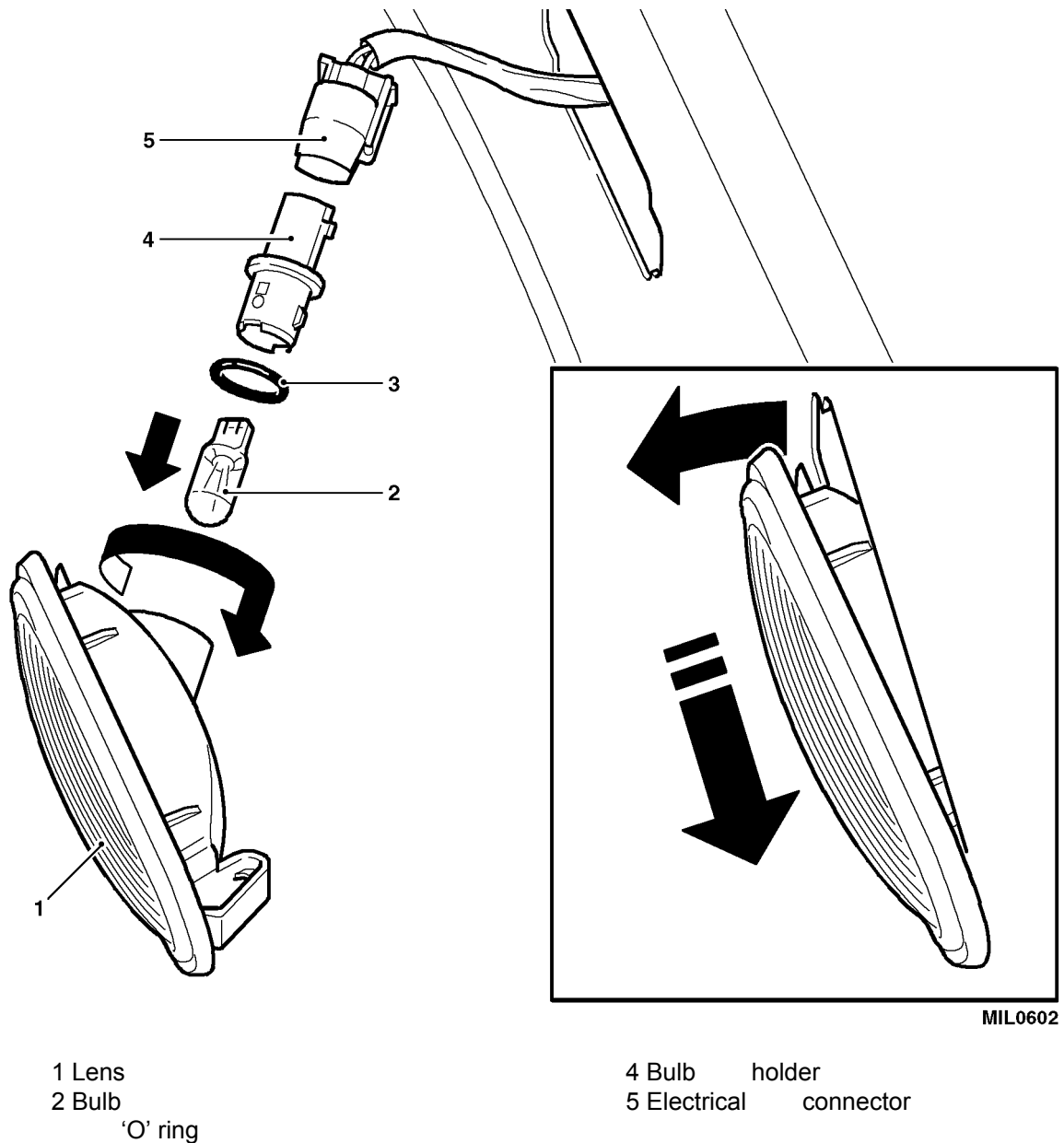


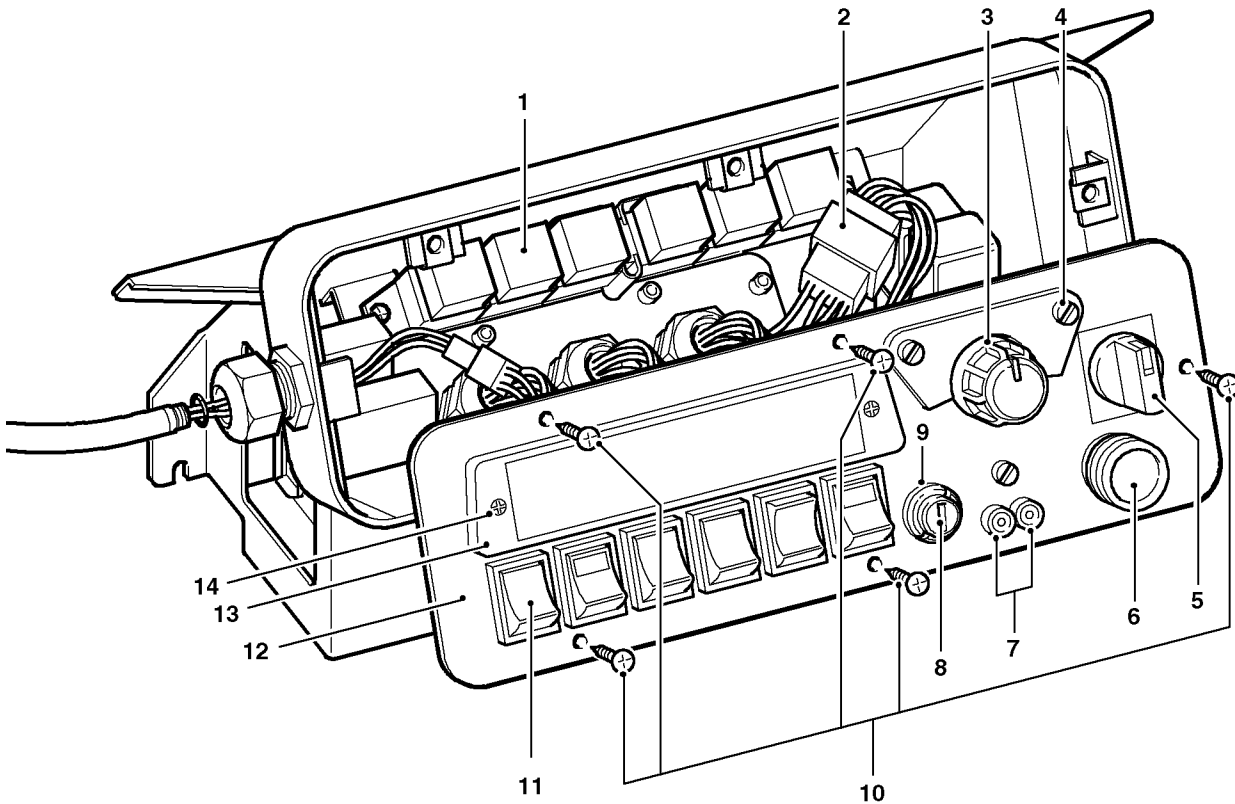
Fig 8 Directional side repeater light removal.

RELAY RENEWAL

Remove

33 To renew the relays inside the centre console carry out the following:

- 33.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 33.2 Remove the five screws (Fig 9 (10)) securing the mounting panel to the centre console assembly.
- 33.3 Ease the mounting panel (12) from the centre console to allow access behind the panel.
- 33.4 Reach inside the box and remove the required relay (1) from its mounting.



MIL0604

1	Relay	8	Ignition switch
2	Multi-plug connector	9	Ignition switch bezel
3	Six Way Main lighting switch	10	Screws
4	Screw	11	Switch
5	Heater switch	12	Mounting panel
6	Rear wash wipe switch	13	Warning light panel
7	Inspection sockets	14	Screws

Fig 9 Centre console assembly

Refit

34 Refit the relay in the reverse order of removal.

MAP LIGHT, HEAD LAMP LEVEL, HEATED REAR WINDOW, HEATED FRONT SCREEN, FOG LIGHT, HAZARD WARNING SWITCHES**Remove**

35 To remove the switch carry out the following:

- 35.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 35.2 Remove five screws (Fig 9 (10) securing mounting panel to the centre console assembly).
- 35.3 Ease the mounting panel (12) from the centre console to allow access behind the panel.

- 35.4 Disconnect electrical connector from rear of switch.
- 35.5 On hazard warning switch only disconnect two separate leads.
- 35.6 Press in spring retainers and withdraw switch (11) from mounting panel.

Refit

- 36 Refit switch in reverse order of removal.

WARNING LIGHT PANEL

Remove

- 37 To remove the warning light panel carry out the following:

- 37.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 37.2 Remove two screws (refer to Fig 9 (14)) and withdraw warning light panel (13).
- 37.3 Disconnect both multi-plug connectors from the rear of the panel.
- 37.4 Disconnect illumination bulb leads.
- 37.5 Remove warning light panel (13).

Refit

- 38 Refit the warning light panel in the reverse order of removal.

INSPECTION SOCKETS

Remove

- 39 Remove the inspection sockets as follows:

- 39.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 39.2 Remove screws (refer to Fig 9 (10)) securing mounting panel to the centre console assembly.
- 39.3 Ease the mounting panel (12) from the centre console to allow access behind the panel.
- 39.4 Disconnect the electrical leads from rear of inspection sockets (7).
- 39.5 Remove nuts securing sockets to the rear of the mounting panel and remove inspection sockets (7).

Refit

- 40 Refit the inspection sockets in the reverse order of removal.

HEATER SWITCH**Remove**

41 Remove the heater switch as follows:

- 41.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 41.2 Pull the knob off the heater switch (refer to Fig 9 (5)).
- 41.3 Remove the five screws (10) securing mounting panel to centre console assembly.
- 41.4 Ease the mounting panel (12) from the centre console to allow access behind the panel.
- 41.5 Disconnect the electrical leads from rear of switch.
- 41.6 Remove nut securing switch to panel.
- 41.7 Remove switch (5) from panel.

Refit

42 Refit the heater switch in the reverse order of removal.

SIX WAY MAIN LIGHTING SWITCH**Remove**

43 To remove the six way main lighting switch, carry out the following:

- 43.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 43.2 Undo retaining screw and remove the control knob from main lighting switch (refer to Fig 9 (3)).
- 43.3 Remove the five screws (10) and ease forward the mounting panel (12) from the centre console.
- 43.4 Disconnect multi-plug connector (2).
- 43.5 Remove the three screws (4) securing switch assembly and indicator plate to panel and withdraw switch and plate.

Refit

44 Refit the lighting switch in the reverse order of removal.

SEVEN WAY MAIN LIGHTING SWITCH**Remove**

45 To remove the seven way main lighting switch, carry out the following:

- 45.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 45.2 Undo retaining screw and remove the control knob (refer to (Fig 10 (6)) from main lighting switch (1).

45.3 Remove the five screws (2) and ease forward the mounting panel (3) from the centre console (4).

45.4 Disconnect the lighting switch multi-plug connectors (5) from the main harness.

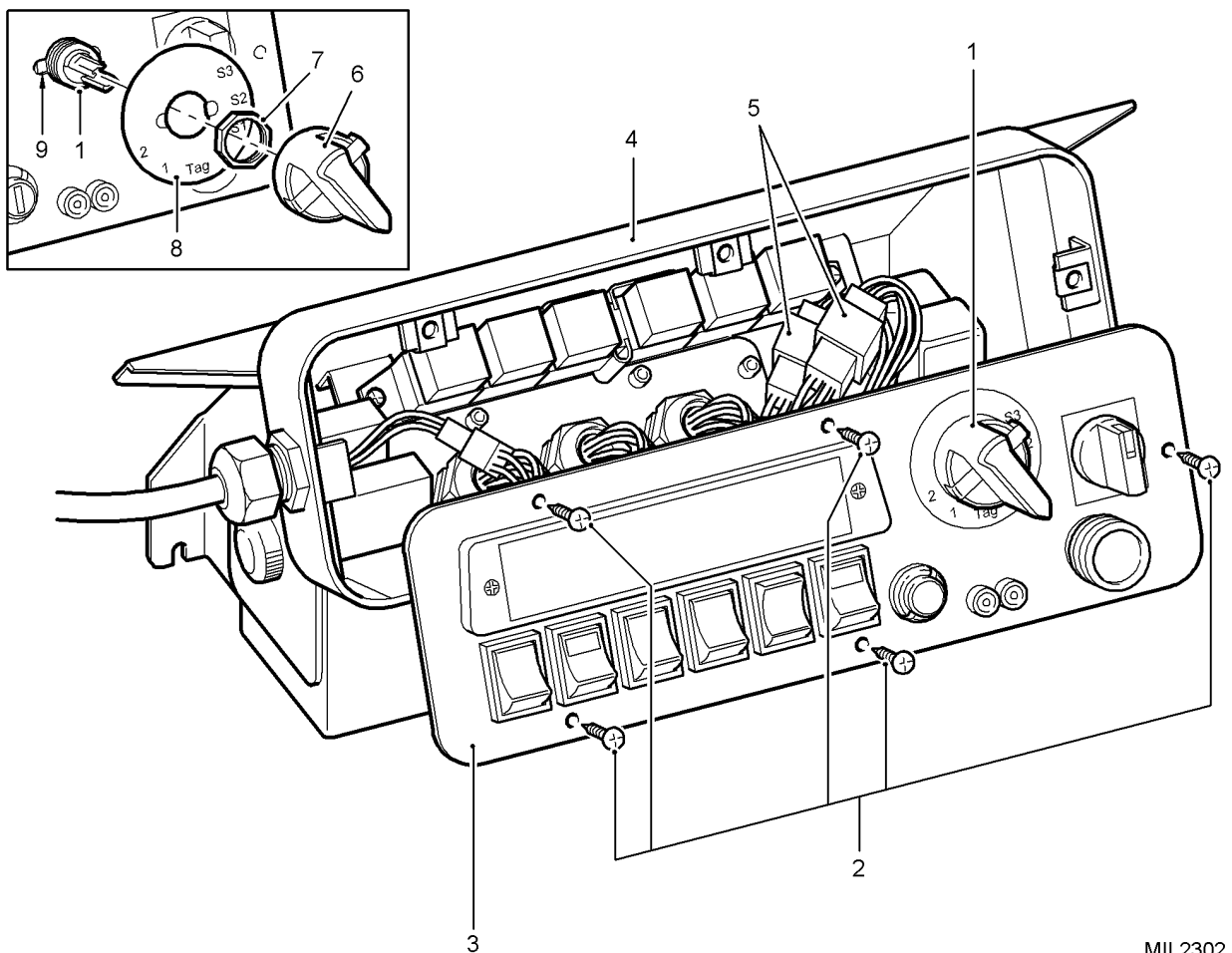
45.5 Remove the large nut (7) securing the switch assembly (1) and indicator plate (8) to panel and withdraw switch and plate.

Refit

46 Refit the lighting switch in the reverse order of removal.

NOTE

Ensure the lock tabs (9) are positioned in the recesses in the switch panel.



MIL2302

- | | | | |
|---|--------------------------------|---|-----------------|
| 1 | Seven Way Main lighting switch | 6 | Knob |
| 2 | Screws | 7 | Nut |
| 3 | Mounting panel | 8 | Indicator plate |
| 4 | Centre console | 9 | Lock tabs |
| 5 | Multi-plug connectors | | |

Fig 10 Seven Way Main Lighting Switch

IGNITION SWITCH**Remove**

47 To remove the ignition switch carry out the following:

- 47.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 47.2 Remove the five screws (refer to Fig 9 (10)) and ease forward the mounting panel (12) from the centre console.
- 47.3 Disconnect electrical connectors from the rear of the switch (8).
- 47.4 Loosen nut at rear of mounting panel and remove front bezel (9).
- 47.5 Remove ignition switch (8) from panel.

Refit

48 Refit ignition switch in reverse order of removal.

REAR WASH /WIPE SWITCH.**Remove**

49 To remove the rear wash wipe switch carry out the following:

- 49.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 49.2 Remove the five screws (refer to Fig 9 (10)) and ease forward the mounting panel (12) from the centre console.
- 49.3 Insert a small screw driver in base of knob on switch (6), press in spring loaded pin and remove knob from switch spindle.
- 49.4 Disconnect electrical connectors from the rear of the switch.
- 49.5 Loosen nut at rear of mounting panel and remove front bezel.
- 49.6 Remove wash wipe switch (6) from panel.

Refit

50 Refit wash/wipe switch in reverse order of removal.

MAP READING LIGHT**Remove**

51 To remove the map reading light carry out the following:

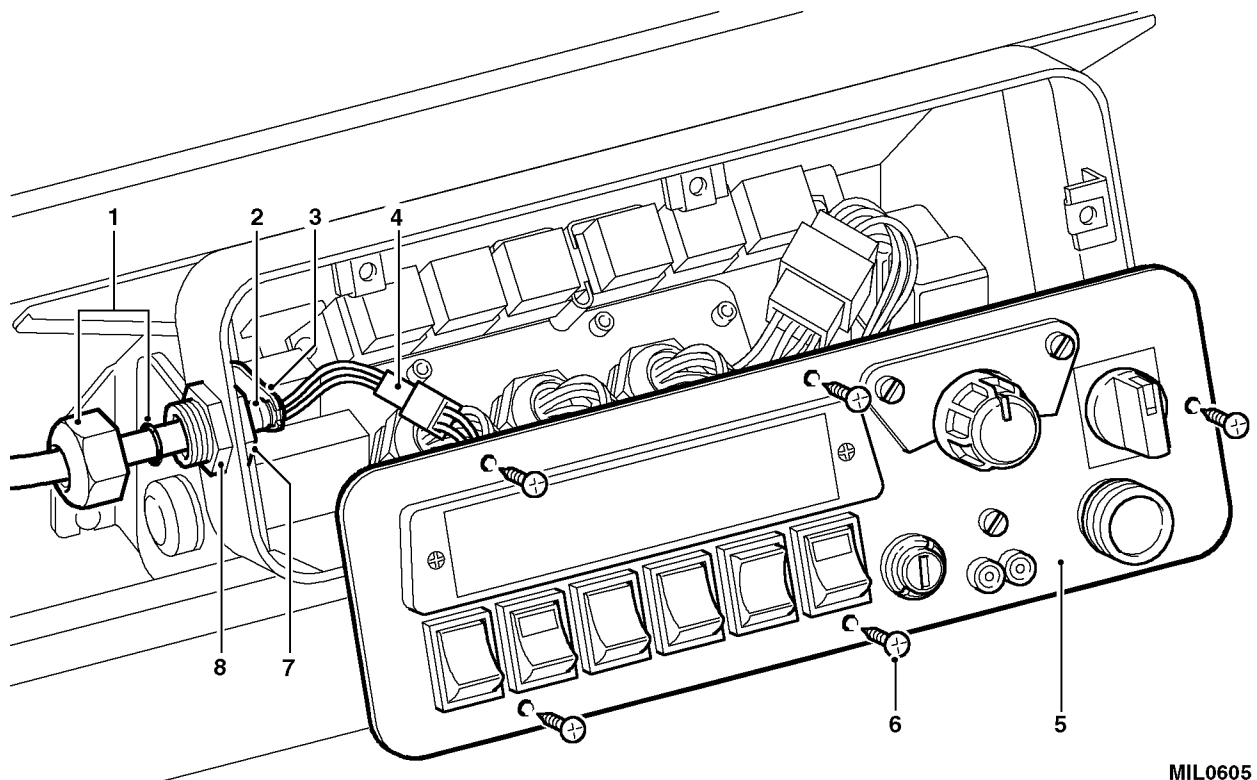
- 51.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 51.2 Remove the five screws (Fig 11 (6)) and ease forward the mounting panel (5) from centre console.
- 51.3 Remove gland nut and slide back 'O' ring (1).

- 51.4 Disconnect electrical connector (4).
- 51.5 Unscrew map lamp (2) from bracket (3) and remove with 'O' ring and gland nut (1).
- 51.6 Withdraw electrical leads through gland (8) and remove map lamp from console.

NOTE

It will be necessary to cut the connector from the electrical leads to enable the leads to be withdrawn through the gland.

- 51.7 Remove plastic nut (7); withdraw gland (8) and bracket (3) from console.



MIL0605

- | | |
|--------------------------|------------------|
| 1 Gland nut and 'O' ring | 5 Mounting panel |
| 2 Map lamp | 6 Screws |
| 3 Bracket | 7 Nut |
| 4 Electrical connector | 8 Gland |

Fig 11 Map reading light removal

Refit

52 Refit the map reading light as follows:

- 52.1 Position gland (8) and bracket (3) into console and secure with nut (7).
- 52.2 Feed electrical leads through gland (8) and screw lamp (2) into bracket ensuring 'O' ring and gland nut (1) are located correctly on the lamp stalk.
- 52.3 Fit electrical connector (4) to electrical leads and reconnect to harness.
- 52.4 Fit gland nut (1) ensuring 'O' ring is located correctly and close gland.

52.5 Refit mounting panel (5) and secure with screws (6).

52.6 Reconnect vehicle batteries.

CENTRE CONSOLE FUSE BOX - Fuse removal

Remove

53 To remove a fuse carry out the following:

53.1 Remove the screw (Fig 12 (1)) from the centre of the fuse box cover and remove the cover (2).

53.2 Remove the required fuse (3) from the fuse box

Refit

54 Renew the fuse ensuring the correct amperage and refit in the reverse order of removal.

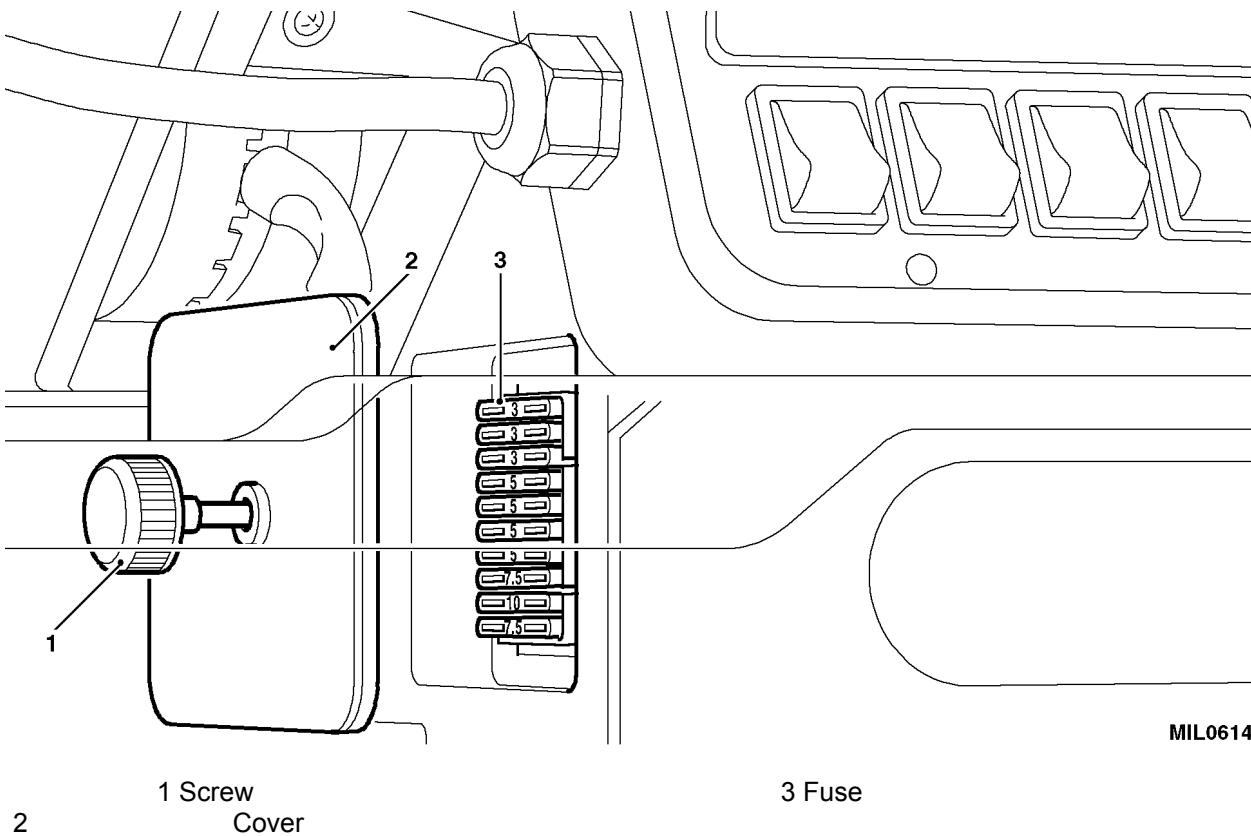


Fig 12 Centre console fuse box fuse removal

GLOW PLUG TIMER RELAY

Remove

55 To remove the glow plug timer relay, carry out the following:

- 55.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 55.2 Remove the 4 screws (Fig 13 (7)) securing the cover (17) and remove the cover complete with seal (6) from the fuse box.
- 55.3 Remove the two screws (18) securing the relay mounting plate to the fuse box base and withdraw the relay assembly from the fuse box.
- 55.4 Remove the relay (5) from the housing.

Refit

56 Refit the glow plug timer relay in the reverse order of removal.

- 56.1 Using the service kit (refer to Table 2, Serial 1) fit a new cover seal and refit the cover.

MAIN FUSE BOX - Fuse removal

Remove

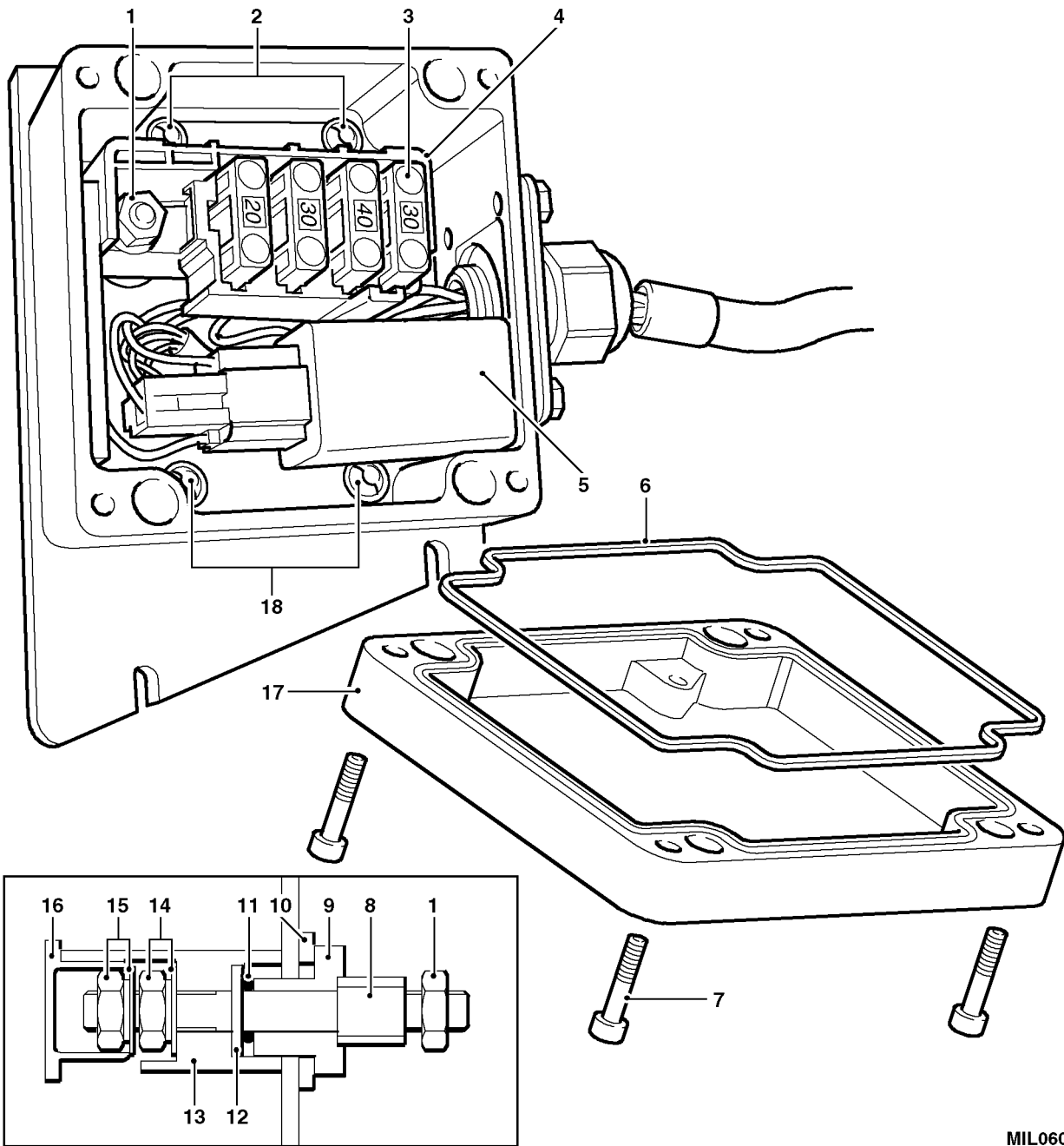
57 To remove a main fuse, carry out the following:

- 57.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 57.2 Remove the four screws (Fig 13 (7)) securing the cover (17) and remove the cover complete with seal (6) from the fuse box.
- 57.3 Remove the required fuse (3) from the fuse box.

Refit

58 Renew the fuse ensuring the correct amperage.

- 58.1 Using the service kit (refer to Table 2, Serial 1) fit a new cover seal and refit the cover.



MIL0606

- | | | | |
|---|-----------------------|----|----------------------|
| 1 | Nut | 10 | Terminal washer |
| 2 | Screws | 11 | 'O' ring |
| 3 | Fuse | 12 | Terminal washer |
| 4 | Fuse housing | 13 | Outer isolation bush |
| 5 | Glow plug timer relay | 14 | Nut and washers |
| 6 | Seal | 15 | Nut and washers |
| 7 | Screws | 16 | Cap |
| 8 | Positive stud | 17 | Cover |
| 9 | Inner isolation bush | 18 | Screws |

Fig 13 Glow plug timer relay, main fuse and positive stud removal

POSITIVE STUD ASSEMBLY

Remove

59 To remove the positive stud assembly carry out the following:

- 59.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 59.2 From under the bonnet remove the red cap (Fig 13 (16)) from the positive stud assembly, remove the nut and washers (15) securing the positive lead connection to the starter motor and disconnect the lead.
- 59.3 Remove the cover (17) and seal (6) from the fuse box.
- 59.4 Remove the nut (1) securing the positive stud assembly to the fuse housing (4).
- 59.5 Remove the two screws (2) securing the fuse housing mounting bracket and pull the fuse housing clear of the positive stud.
- 59.6 Remove the four screws securing the fuse box mounting bracket to the bulk head and remove the fuse box and mounting bracket from the bulkhead (refer to Para 55).
- 59.7 Remove the neoprene gasket from between the mounting bracket and the bulkhead.
- 59.8 Support the fuse box and remove the remaining nut and washers (14) securing the positive stud assembly to the rear of the fuse box.
- 59.9 Withdraw the outer isolation bush (13), terminal washer (12) and 'O' ring (11).
- 59.10 From inside the fuse box withdraw the positive stud (8), terminal washer (10) and inner isolation bush (9).

Refit

60 Using the service kit (Table 2, Serial 5) renew the components and refit the positive stud assembly in the reverse order of the removal.

- 60.1 Refit the fuse box to the bulkhead.
- 60.2 Reconnect the positive lead from the starter motor to the positive stud.
- 60.3 Apply grease (refer to Table 1 Serial 1) to the positive stud terminal and lead and replace the cap.
- 60.4 Reconnect the vehicle batteries and on FFR vehicles the radio batteries.

INSTRUMENT PANEL**Remove**

61 To remove the instrument panel carry out the following:

- 61.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 61.2 Remove four screws (Fig 14 (1)) securing instrument panel (2) to fascia cowl.
- 61.3 From under the bonnet disconnect the speedometer cable connection (3) at the bulkhead.
- 61.4 Pull instrument panel away from fascia and disconnect electrical multi-plug.

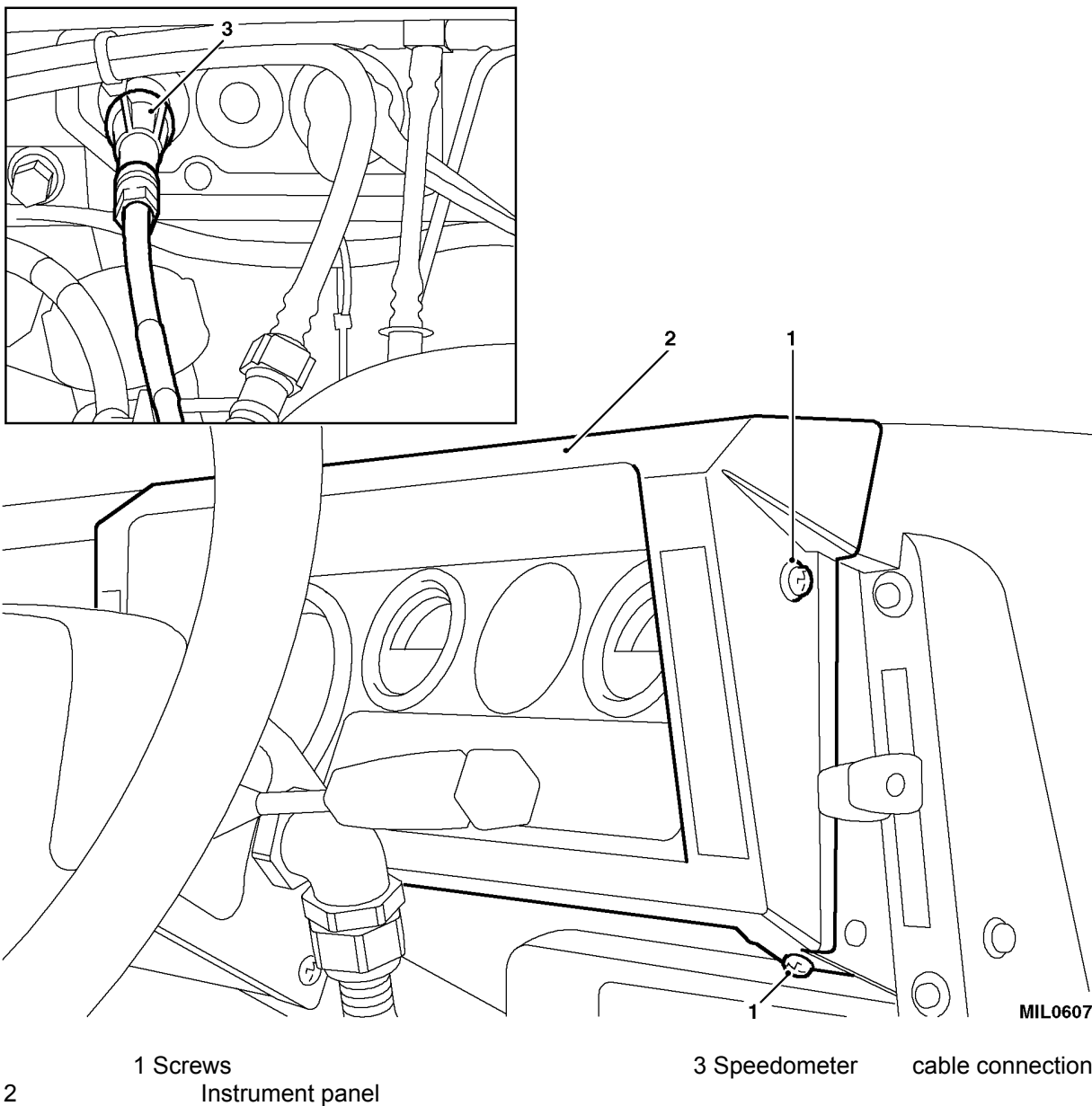


Fig 14 Instrument panel removal

61.5 Withdraw panel complete with instruments and short speedometer cable taking care not to damage the rubber boots fitted over the back of the instruments.

Refit

62 Refit the instrument panel in the reverse order of removal.

SPEEDOMETER

Remove

63 To remove the speedometer, carry out the following:

63.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

63.2 Remove instrument panel (refer to Para 61).

63.3 Remove the clip (Fig 15 (1)) securing the rubber boot (2) to the rear of the speedometer and release the boot.

63.4 Pull back the rubber boot (2), remove two knurled nuts and washers (3) and remove clamping tube (4) securing speedometer (6).

63.5 Release bulb holders (7) from rear of speedometer.

63.6 Withdraw speedometer through front of instrument panel taking care to recover the two 'O' rings (5).

Refit

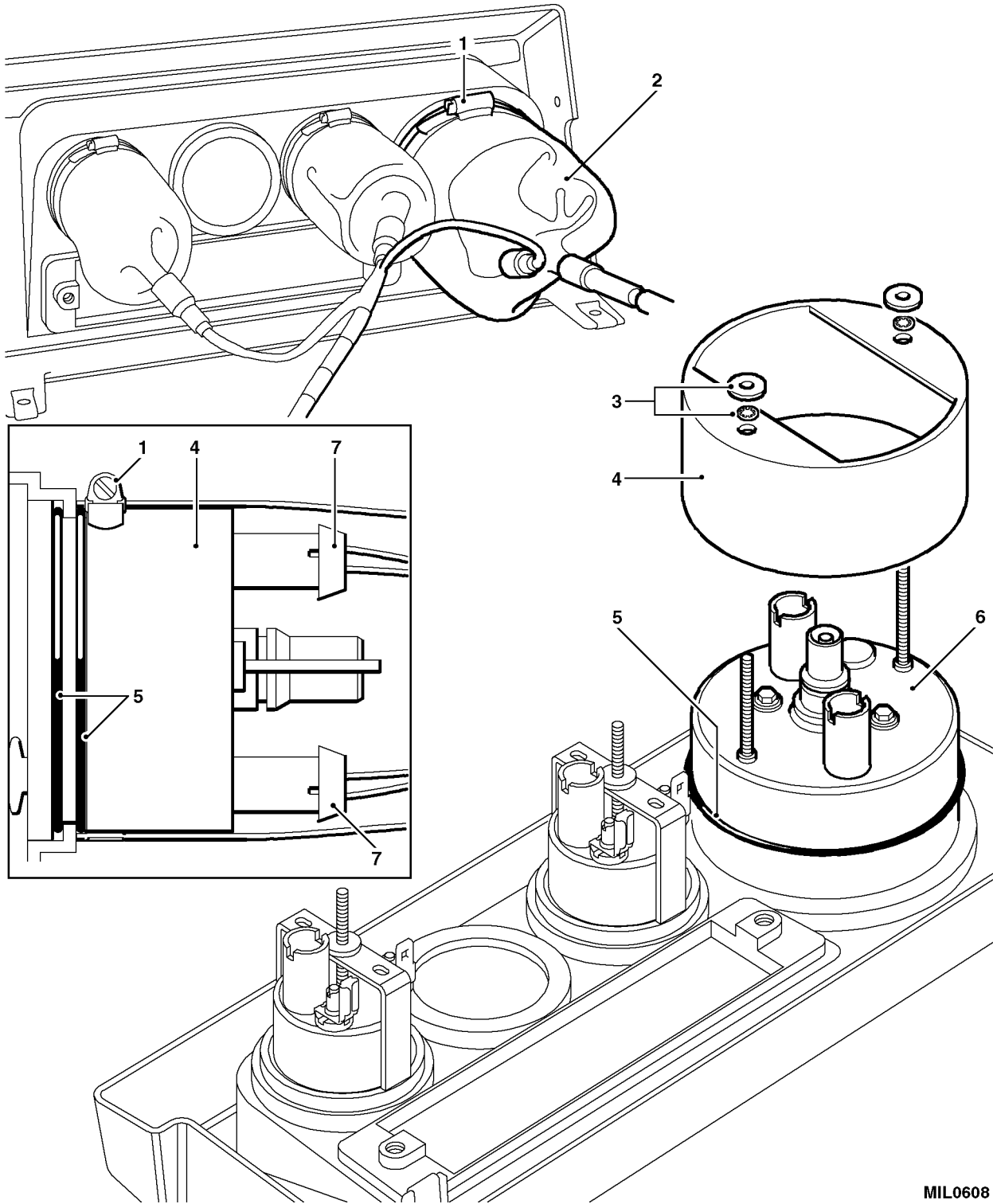
64 Refit the speedometer as follows:

64.1 Fit speedometer into instrument panel and ensuring 'O' rings (5) are fitted correctly either side of the instrument panel.

64.2 Fit bulb holders (7) to speedometer and secure speedometer with clamp tube (4) and knurled nuts and washers (3).

64.3 Fit rubber boot (2) over speedometer tube and secure with a new clip (1). Ensure a uniform and tight fit over speedometer tube.

64.4 Refit instrument panel to fascia (refer to Para 62).



MIL0608

- | | | | |
|---|--------------------------|---|--------------|
| 1 | Clip | 5 | 'O' rings |
| 2 | Rubber boot | 6 | Speedometer |
| 3 | Knurled nuts and washers | 7 | Bulb holders |
| 4 | Clamping tube | | |

Fig 15 Speedometer removal

FUEL AND TEMPERATURE GAUGE

NOTE

The removal procedure for both instrument gauges is identical.

Remove

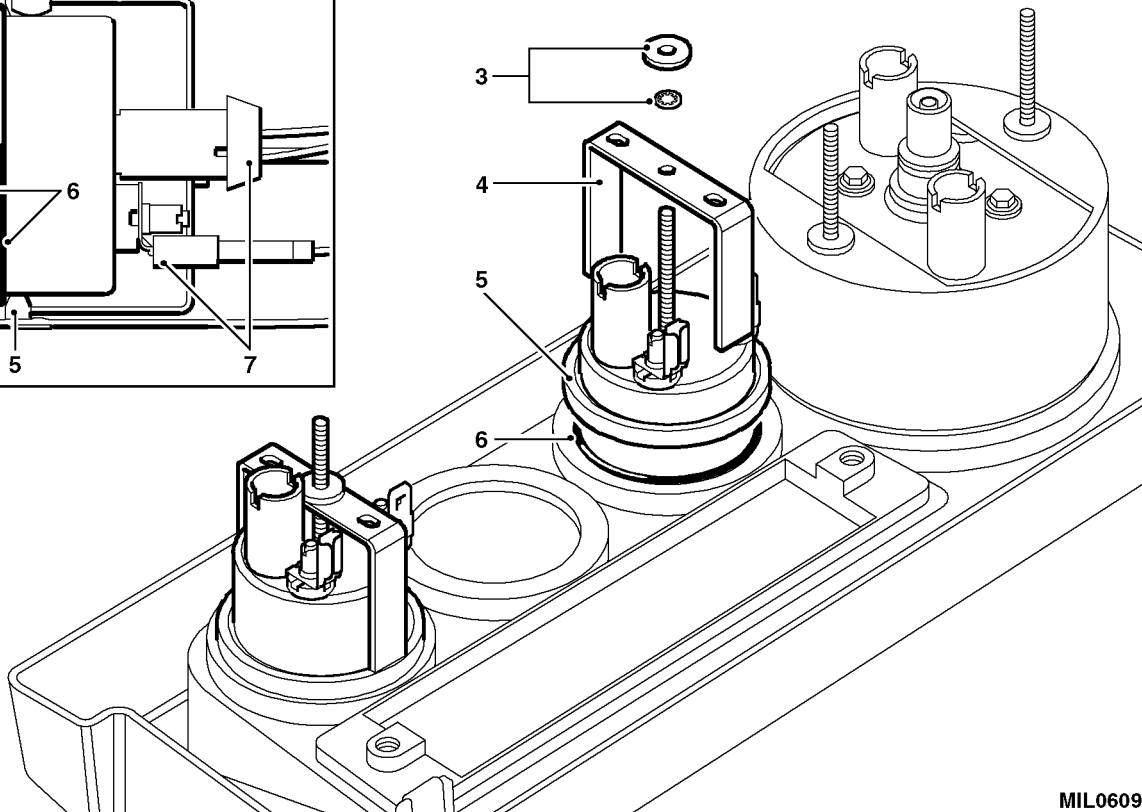
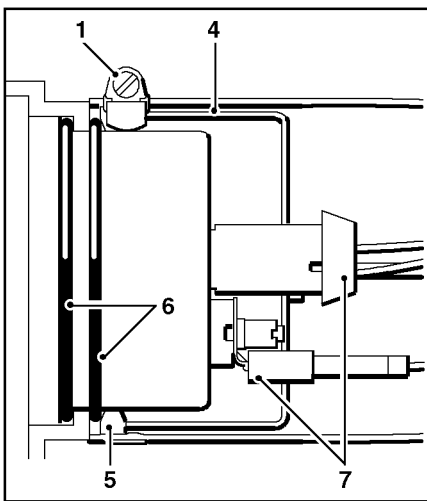
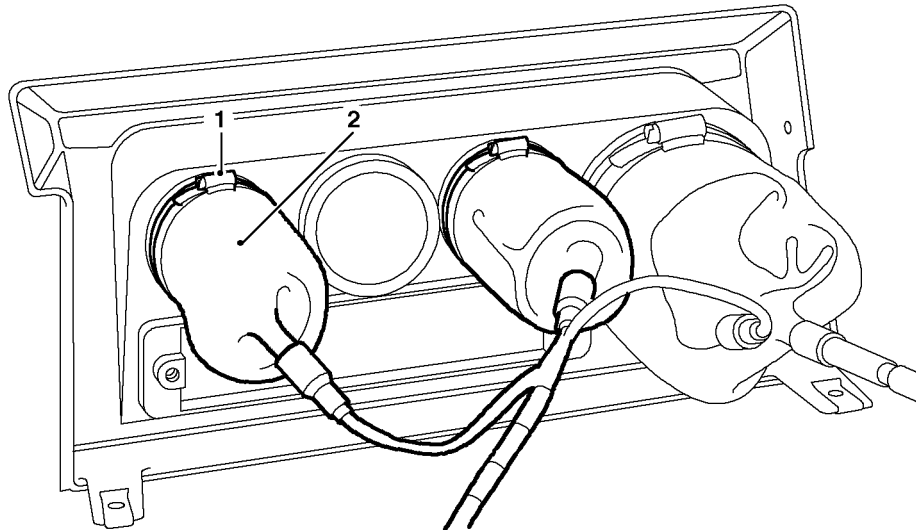
65 To remove the fuel and temperature gauges carry out the following:

- 65.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 65.2 Remove instrument panel (refer to Para 61).
- 65.3 Remove the clip securing the rubber boot (Fig 16 (1)) to the rear of the gauge and release the boot (2).
- 65.4 Pull back the rubber boot (2) and release the illumination bulb holder and electrical lead (7) from gauge.
- 65.5 Remove knurled nut and washer (3) and remove clamp (4) securing speedometer.
- 65.6 Withdraw the clamping ring (5) from the rear of the instrument gauge.
- 65.7 Withdraw gauge through front of instrument panel ensuring the collection of both 'O' rings (6).

Refit

66 Refit the fuel and temperature gauges as follows:

- 66.1 Fit gauge into instrument panel ensuring 'O' rings (6) are fitted correctly either side of the instrument panel and secure with clamping ring (5) and clamp (4).
- 66.2 Fit bulb holders and electrical lead (7).
- 66.3 Fit rubber boot (2) over gauge ensuring the boot is located over clamping ring (5) and secure with a new clip (1).
- 66.4 Refit instrument panel to fascia (Refer to Para 62).



MIL0609

- | | | | |
|---|------------------------|---|---------------------------------|
| 1 | Clip | 5 | Clamping ring |
| 2 | Rubber boot | 6 | 'O' rings |
| 3 | Knurled nut and washer | 7 | Bulb holder and electrical lead |
| 4 | Clamp | | |

Fig 16 Fuel and temperature gauge removal

CENTRE CONSOLE AND MAIN FUSE BOX

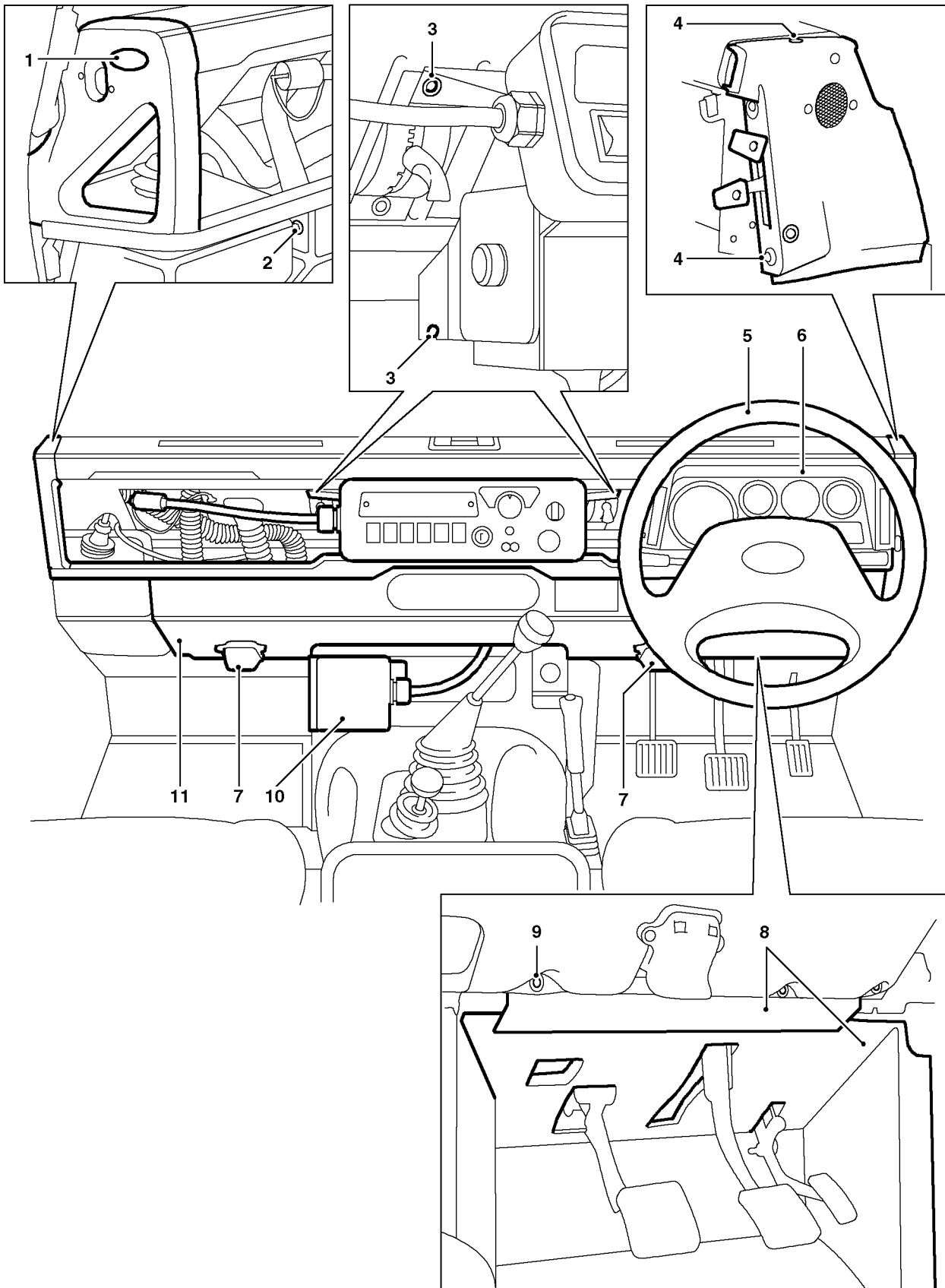
NOTE

The centre console, fuse box and associated harness must be removed as a complete assembly.

Remove

67 To remove the centre console, carry out the following:

- 67.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 67.2 Remove steering wheel (Fig 17 (5)) (refer to Chap 7).
- 67.3 Remove instrument panel (6) (refer to Para 61).
- 67.4 Remove screws securing the heater control fascia end panel (4).
- 67.5 Prise out Land Rover decal (1) and remove screw securing grab handle to crash pad and remove grab handle.
- 67.6 Remove grab handle support bracket fixings (2) from lower fascia panel.
- 67.7 If fitted, remove two screws washers and nuts securing auxiliary switch panel to lower fascia panel (FFR only).
- 67.8 Withdraw switch panel and disconnect electrical leads.
- 67.9 Remove two screws and remove both foot well vents (7) from lower fascia panel.
- 67.10 Remove screws (9) securing lower fascia panel (11) to bulkhead noting position of both foot well cover retaining plates (8).
- 67.11 Remove both retaining plates and lower foot well covers (8).
- 67.12 With assistance, lower fascia panel (11) and remove from vehicle.
- 67.13 From under the bonnet disconnect the main harness from all attached components.
- 67.14 Remove the bulkhead grommet and feed the harness back through the bulkhead.
- 67.15 From under the bonnet, remove cap and disconnect the positive lead from the starter motor to the fuse box terminal.
- 67.16 Remove the four screws securing the fuse box (10) to the bulkhead and support the box.
- 67.17 Remove the four screws (3) securing the centre console assembly to the bulkhead and remove the assembly from the vehicle.



MIL0603

Fig 17 Centre console and main fuse box removal

KEY TO FIG 17

1 Decal	7 Foot well vents
2 Bracket fixings	8 Lower foot well covers and retaining plates
3 Screw	9 Screws
4 Screws	10 Fuse box
5 Steering wheel	11 Lower fascia panel
6 Instrument panel	

Refit

68 Refit the centre console in the reverse order of removal.

68.1 Under the bonnet apply grease (refer to Table 1 Serial 1) to the fuse box positive lead and terminal from the starter motor and refit cap.

68.2 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

STEERING COLUMN SWITCH HOUSING

Remove

69 To remove the water proof steering-column switch housing carry out the following:

69.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

69.2 Remove the steering wheel (refer to Chap 7).

69.3 Release the clips (Fig 18 (2)) securing the waterproof seal (1) to the steering-column and pull the seal free of the housing.

69.4 Remove the screws (6) securing the access cover (4) to the side of the housing, feed the rubber boot (5) through hole in cover and remove the cover.

69.5 Disconnect the harness multi-plug (7).

69.6 Release the clamp (8) and slide the housing assembly off the column ensuring that the components of the waterproof seal are collected.

69.7 Remove 2 screws (3) securing switch assembly to housing, disconnect the electrical connections inside the housing and withdraw the switch assembly through the side of the housing.

69.8 Remove the seal (9) in the top of the switch housing noting the correct way of fitting for re-assembly.

Refit

70 Refit the column switch as follows:

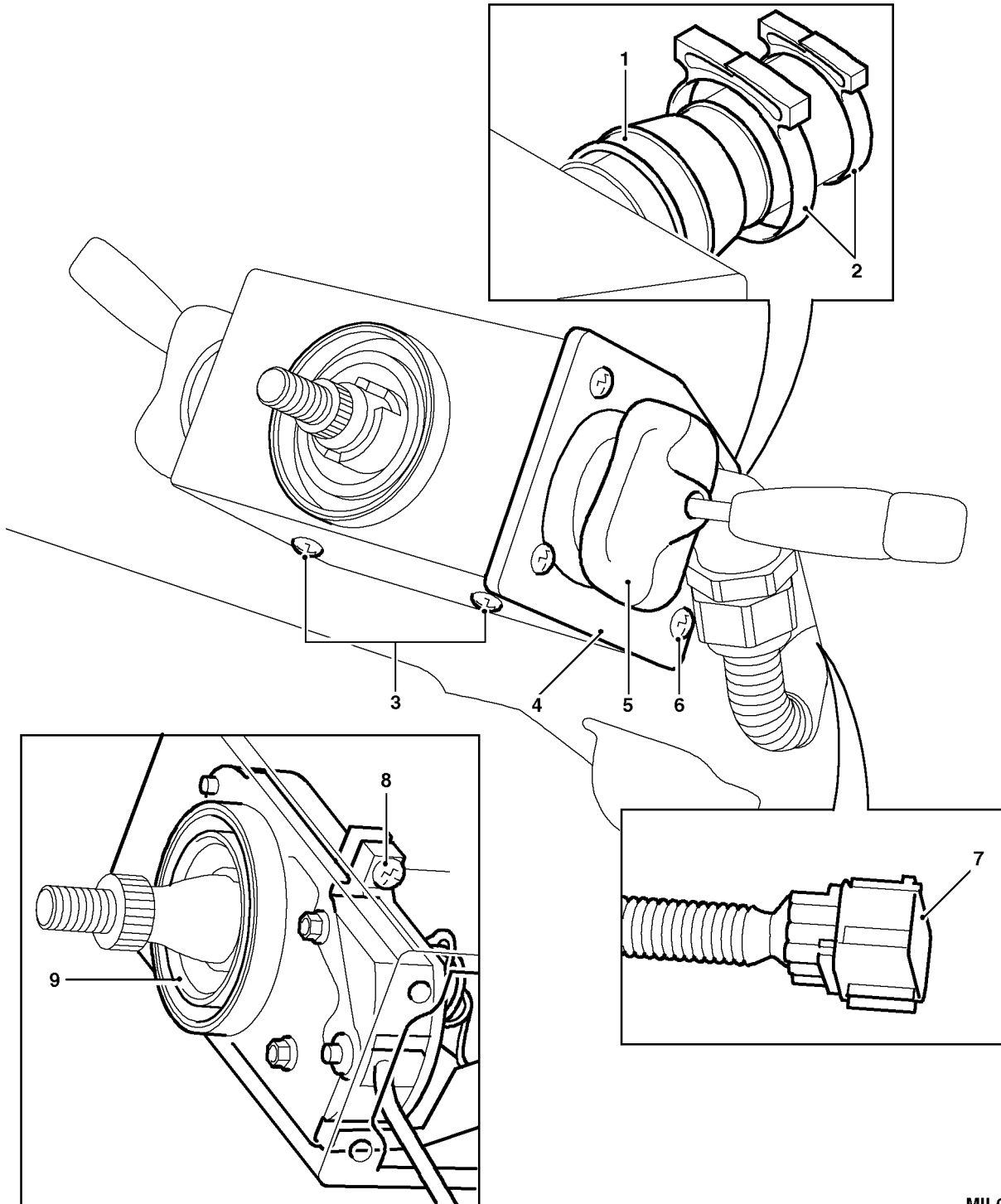
70.1 Using the service kit (refer to Table 2 Serial 2), refit the waterproof housing in the reverse order of removal.

NOTE

Ensure that seal is fitted in the correct way round, with lips facing outwards.

70.2 After fitting the steering wheel pack the area around the retaining nut with grease (refer to Table 1, Serial 4).

70.3 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).



MIL0610

1 Waterproof seal
2 Clips
3 Screws

4 Access cover
5 Rubber boot
6 Screws

7 Multi-plug
8 Clamp
9 Seal

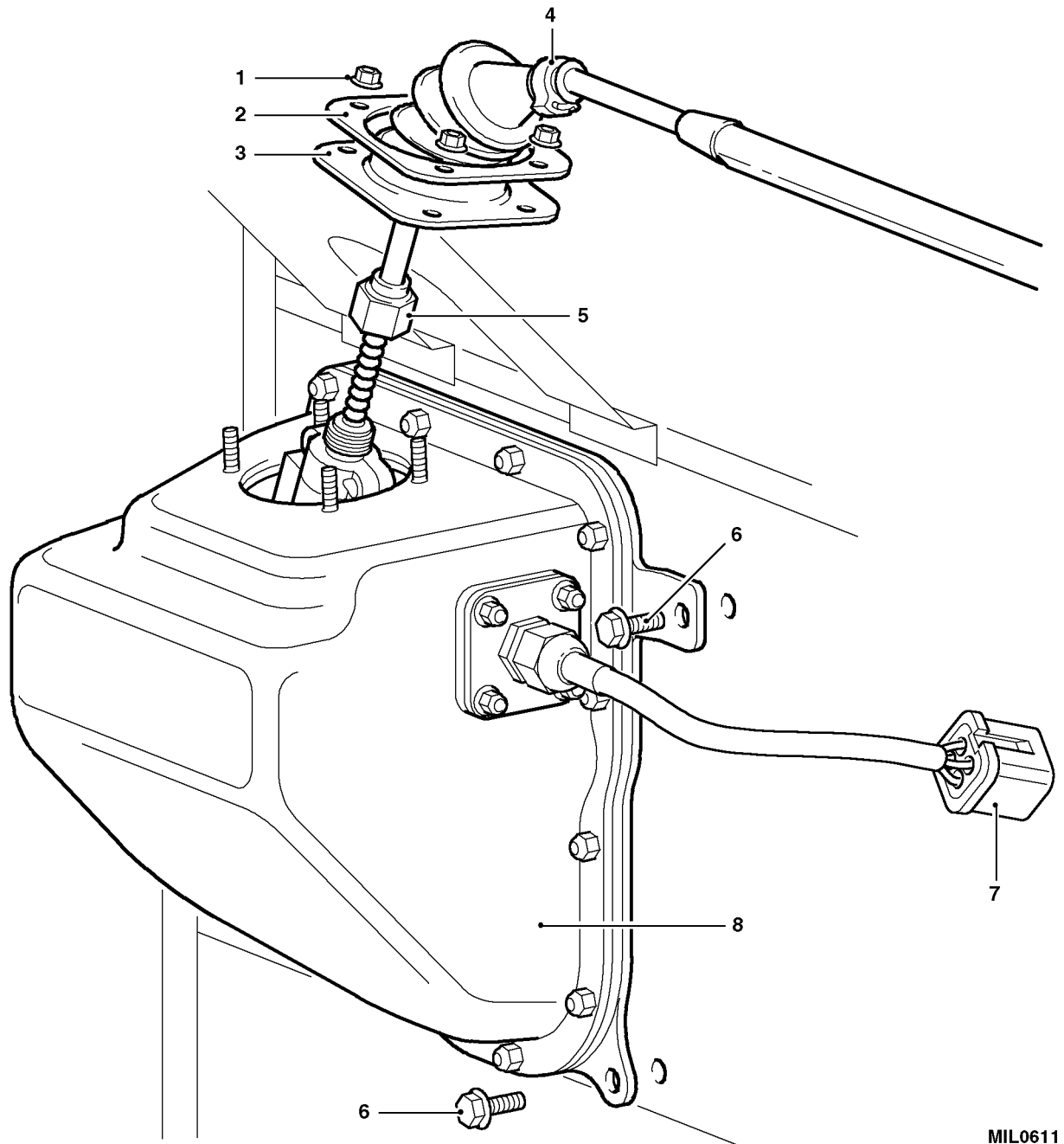
Fig 18 Steering column switch housing removal

FRONT WIPER MOTOR AND DRIVE RACK

Remove

71 To remove the wiper box assembly carry out the following:

71.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).



MIL0611

- | | |
|---------------------|----------------------|
| 1 Nuts | 5 Drive tube nut |
| 2 Gaiter seal plate | 6 Screws |
| 3 Gaiter | 7 Multi-plug |
| 4 Clip | 8 Wiper box assembly |

Fig 19 Front wiper motor and wiper rack removal.

- 71.2 Remove wiper arms.
- 71.3 Prise out Land Rover decal (refer to fig 17) and remove screw securing grab handle to crash pad. Remove grab handle.
- 71.4 Remove fixings securing handle support bracket to lower fascia panel and bulkhead (refer to fig 17).
- 71.5 Remove the clip (Fig 19 (4) securing the gaiter (3) to the wiper drive tube.
- 71.6 Remove four nuts (1) securing gaiter seal plate (2) to wiper box and lift gaiter clear of wiper box.
- 71.7 Release wiper motor to drive tube nut (5).
- 71.8 Disconnect wiper box multi-plug (7).
- 71.9 Remove four screws (6) securing wiper box to bulkhead.
- 71.10 Pull wiper box assembly (8) and drive rack clear of drive tube and remove from vehicle.
- 71.11 Remove gaiter seal plate (2) from gaiter.

FRONT WIPER BOX ASSEMBLY

Dismantle

72 Dismantle the wiper box assembly as follows:

- 72.1 Remove nuts (Fig 20 (1)) securing cover (2) to wiper box back plate (6), remove cover and seal (5).
- 72.2 Disconnect electrical leads (3) and remove cover.
- 72.3 Remove nuts (10) securing wiper motor assembly (9) to back plate (6) and remove the motor assembly. Collect mountings (7,8).
- 72.4 If required remove nuts (11) securing electrical gland (12) and seal (13) to cover (2) and separate gland from cover.

Examination

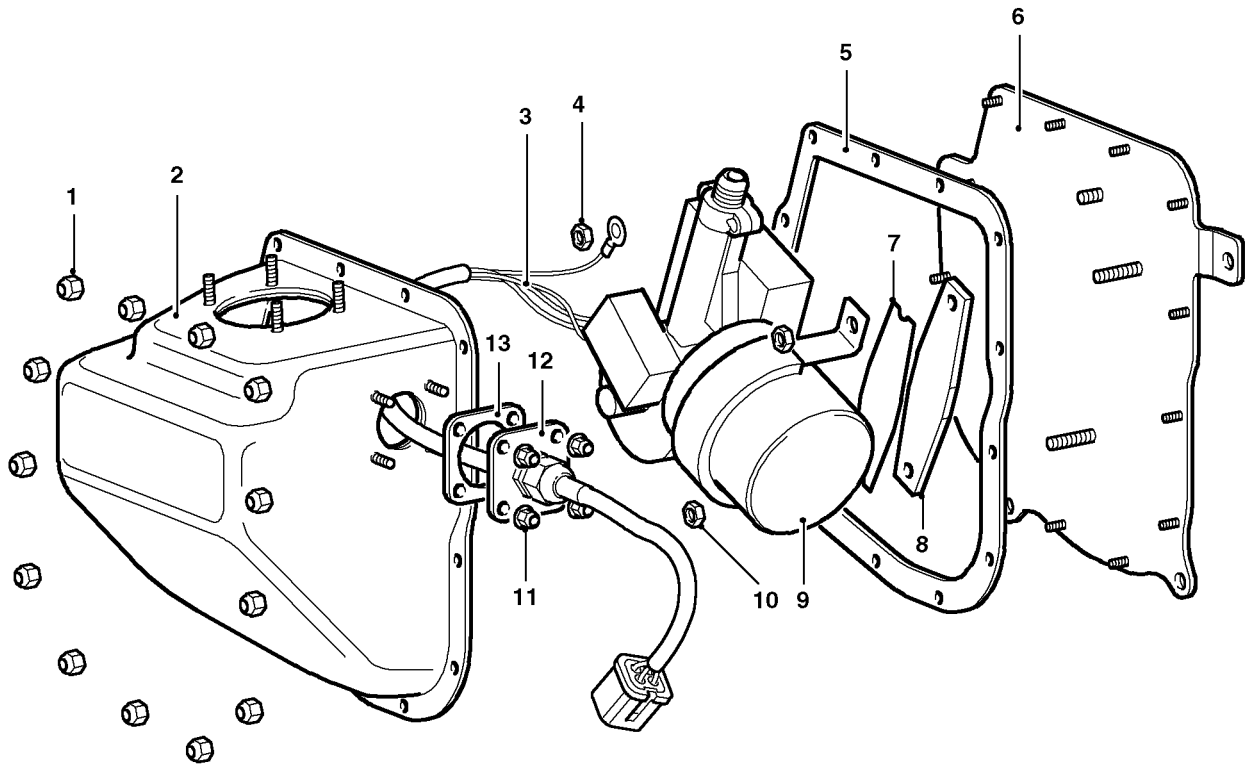
73 Examine the wiper motor assembly for signs of water damage and wear and replace if necessary.

Assembly

74 Using the service kit (refer to Table 2, Serial 3) assemble the wiper box in the reverse order of the dismantle ensuring new seals are fitted.

Refit

75 Refit the wiper box assembly in the reverse order of the removal.



MIL0612

1	Nuts	8	Motor	motor mounting
2	Cover	9	Wiper	wiper motor assembly
3	Electrical leads	10	Nuts	
4	Nut	11	Nuts	
5	Seal	12	Gland	
6	Back plate	13	Seal	
7	Motor mounting			

Fig 20 Front wiper box assembly

FRONT WIPER RACK TUBE AND WHEEL BOX ASSEMBLY

CAUTION

COMPONENT DAMAGE. Care must be taken when refitting the tube assembly not to damage the orange plastic seal encapsulating the rack tube. Damage to this seal will ruin the integrity of the waterproofing of the component and will lead to the failure of the wiper system.

Remove

NOTE

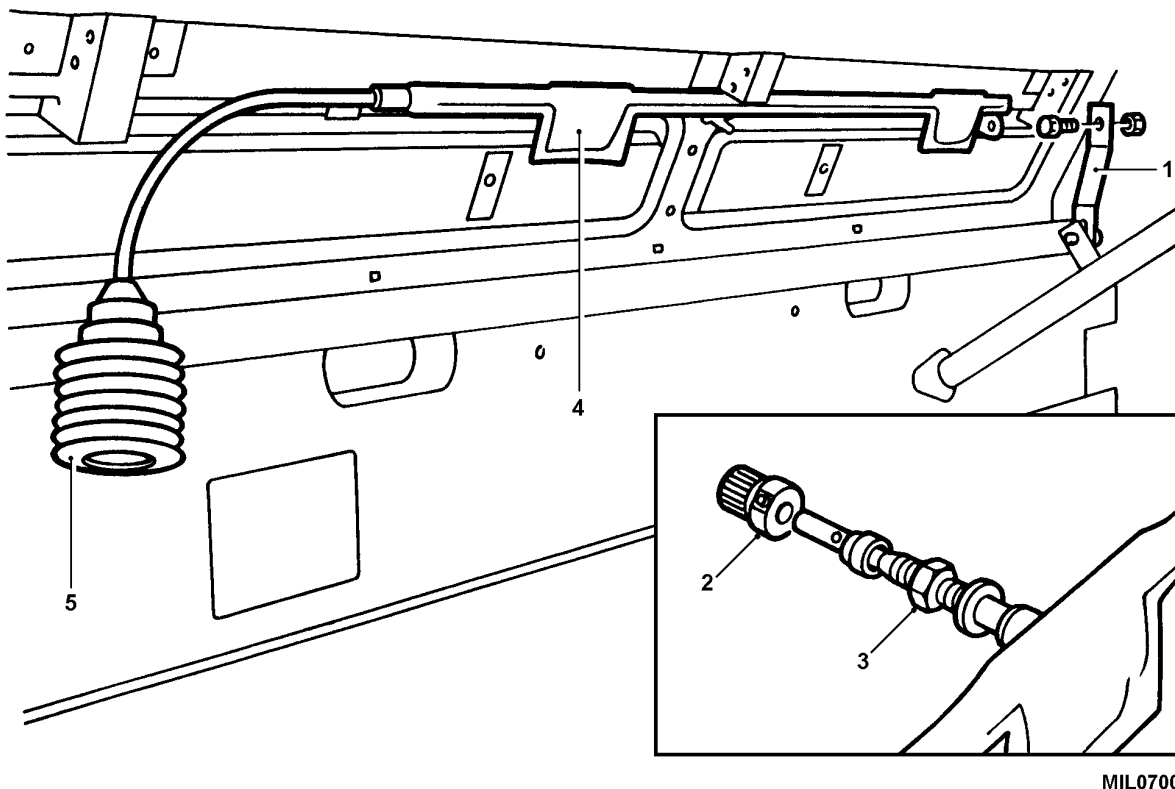
The wiper rack tube and wheel box assembly is a sealed unit and cannot be serviced. In the event of failure the complete assembly must be replaced.

76 To remove the front wiper rack tube and wheel box assembly carry out the following:

76.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

76.2 Remove the front wiper box and drive rack assembly (refer to Para 71).

- 76.3 Remove the centre console and main fuse box assembly (refer to Para 67).
- 76.4 Remove the fascia top crash rail (refer to Chap 16-1).
- 76.5 Remove centre and right hand fascia top crash rail support brackets.
- 76.6 Remove left and right hand demister vents from ducts.
- 76.7 Remove right hand demister vent hose from duct.
- 76.8 Remove right hand vent demister fixing and pivot vent and hose aside.
- 76.9 Remove demister vent top duct.
- 76.10 Release the steering column support (Fig 21 (1)) at the top fixing.
- 76.11 Remove wiper arm splined adapter (2).
- 76.12 Remove nuts (3) securing left and right hand wheel boxes and withdraw the tube assembly (4) from the bulkhead complete with rubber gaiter (5).
- 76.13 Remove clip (refer to Fig 19 (4)), remove and discard rubber gaiter (3).



MIL0700

1 Steering column support
2 Splined adapter
3 Nuts

4 Wiper rack tube assembly
5 Rubber gaiter

Fig 21 Front wiper rack tube and wheel box assembly

Refit

77 To refit the wiper rack tube and wheel box assembly carry out the following:

- 77.1 Using a suitable expander fit a new rubber boot over the nut on the end of the wiper rack tube and secure with a new clip.
- 77.2 Refit the wiper rack tube in the reverse order of removal.
- 77.3 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

REAR WIPER MOTOR

Remove

78 To remove the rear wiper motor carry out the following:

- 78.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 78.2 Remove wiper arm (Fig 22 (2) and nut and washer (3).
- 78.3 Remove the door trim (refer to Chap 16-1).
- 78.4 Remove the two screws (4) securing the wiper motor assembly to the door and remove the assembly from the rear door.

Dismantle

79 Dismantle the wiper box assembly as follows:

- 79.1 Remove the 11 nuts (12) securing the cover (11) to the back plate (5).
- 79.2 Remove the 2 screws (13) securing the electrical leads and remove the cover (11) and seal (7).
- 79.3 Remove the wiring harness seal (10) from the cover.
- 79.4 Remove the nuts (8) securing the wiper motor (9) to the back plate (5) and remove the motor assembly taking care not to damage the grommet (6) in the back plate.
- 79.5 Disconnect the electrical leads to the wiper motor (9).

Examination

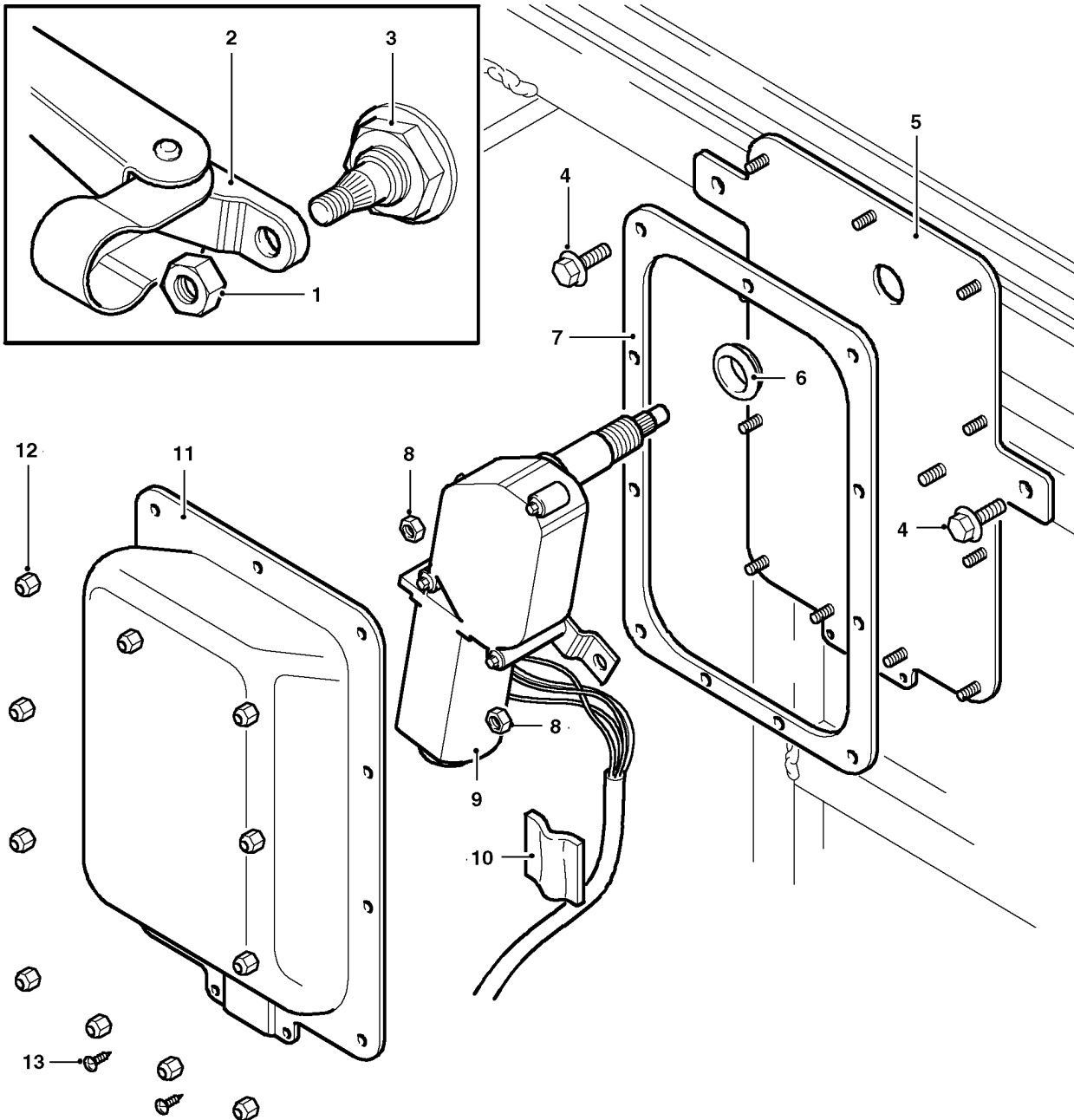
80 Examine the wiper motor assembly for signs of water damage and wear and replace if necessary.

Assembly

81 Using the service kit (refer to Table 2, Serial 4) assemble the wiper box in the reverse order of the dismantle ensuring new seals are fitted.

Refit

82 Refit the rear wiper motor assembly in the reverse order of removal.



MIL0613

- | | |
|------------------|---------------|
| 1 Nut | 8 Nuts |
| 2 Wiper arm | 9 Wiper motor |
| 3 Nut and washer | 10 Seal |
| 4 Screws | 11 Cover |
| 5 Back plate | 12 Nuts |
| 6 Grommet | 13 Screws |
| 7 Seal | |

Fig 22 Rear wiper motor removal

TERMINAL BOX

Remove

83 To remove the terminal box carry out the following:

- 83.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 83.2 Ensure any auxiliary power connections are disconnected from the terminal posts.
- 83.3 Disconnect the electrical multi-plug (Fig 23 (7)) from the back of the terminal box (8).
- 83.4 Remove the two screws (9) and nuts and washers (10) securing the mounting brackets (11) to the top of the bulkhead.
- 83.5 Remove the terminal box (8) from the bulkhead.

Refit

84 Refit the terminal box in the reverse order of removal.

- 84.1 Reconnect the vehicle batteries and on FFR vehicles the radio batteries.

FAST FUSE

Remove

85 To remove the fast fuse carry out the following:

- 85.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 85.2 With the terminal box in situ, remove the four screws (Fig 23 (6)) securing the cover (1) to the terminal box.
- 85.3 Remove the cover (1) and the seal (2).
- 85.4 Remove the two nuts and washers (5) securing the fuse (4) to the terminals and remove the fuse from the terminal box noting the position of the terminal wires for reconnection.

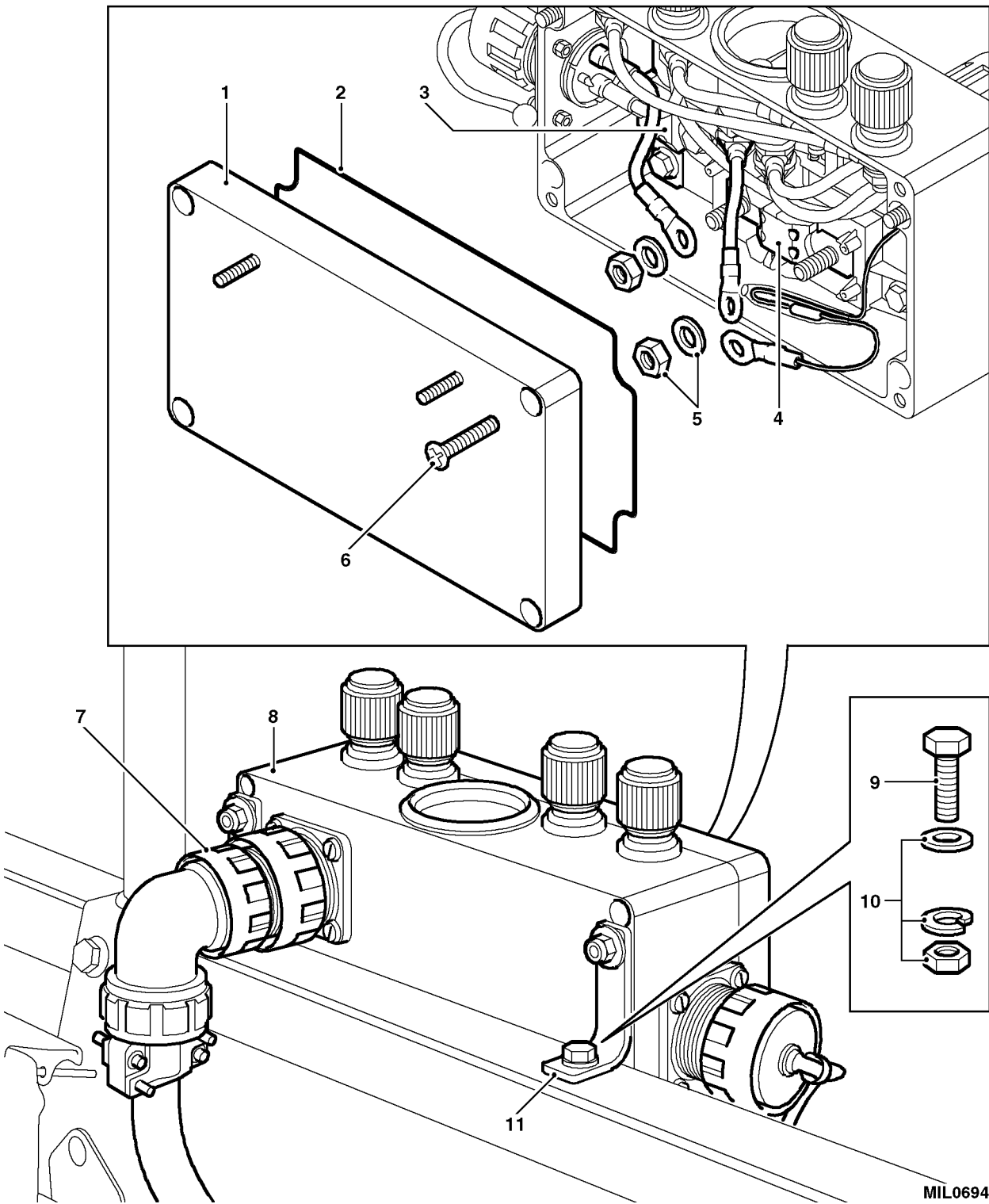
NOTE

A spare fuse (3) is secured to the inside of the terminal box and is for emergency use only. Ensure that the spare is replaced as soon as possible after use.

Refit

86 Refit the fast fuse in the reverse order of removal ensuring the correct fuse rating (150amp) is used.

- 86.1 Fit the seal (2) and refit the cover (1).
- 86.2 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).



- 1 Cover
- 2 Seal
- 3 Spare fuse
- 4 Fast fuse
- 5 Nuts and washers
Screws

- 6
- 7 Multi-plug
- 8 Terminal box
- 9 Screws
- 10 Nuts and washers
- 11 Mounting brackets

MIL0694

Fig 23 Terminal box and fast fuse removal

TERMINAL POST

Remove

87 To remove the terminal post from the terminal box carry out the following:

- 87.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 87.2 Remove the terminal box from the vehicle (refer to Para 83).
- 87.3 Remove the cover (Fig 24 (1)) and seal (2).
- 87.4 Remove the terminal nut (3) and washers (4) and disconnect the electrical leads (8).
- 87.5 Remove the nut (5) securing the terminal post to the box and withdraw the washers (6).
- 87.6 Withdraw the terminal post (10) through the top of the box and retrieve the seal (7).
- 87.7 Clean off sealant from the mating surfaces of the terminal.

Refit

88 Refit the terminal post as follows:

- 88.1 Using the service kit (refer to Table 2 Serial 6) renew all gaskets and seals.
- 88.2 Fit the terminal post through the top of the box and push on a new seal (7) around the threaded post from the inside.
- 88.3 Apply sealant (refer to Table 1 Serial 1) around the seal.
- 88.4 Refit the washers (6) and nut (5) securing the post to the terminal box.
- 88.5 Refit the electrical leads (8) to the terminal post and secure with the washers (4) and nut (3)
- 88.6 Refit the seal (2) and cover (1) and secure with screws (18).
- 88.7 Refit the terminal box to the vehicle (refer to Para 84).
- 88.8 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

PLUG SOCKET

Remove

89 To remove the plug socket carry out the following:

- 89.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).
- 89.2 Remove the terminal box from the vehicle (refer to Para 83).
- 89.3 Remove the cover (Fig 24 (1)) and seal (2).
- 89.4 Disconnect the electrical leads (9) from the terminal posts (10).
- 89.5 Remove the nut, bolt and washers (13) securing the socket (14) to the terminal box.

89.6 Withdraw the socket (14) from the terminal box and recover the gasket (15).

Refit

90 Refit the plug socket as follows:

90.1 Using the service kit (refer to Table 2 Serial 6) fit new gaskets and seals and assemble the terminal box in the reverse order of removal.

90.2 Refit the terminal box to the vehicle.

90.3 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

AMMETER

Remove

91 To remove the ammeter carry out the following:

91.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

91.2 Remove the terminal box from the vehicle (refer to Para 83).

91.3 Remove the cover (Fig 24 (1)) and seal (2).

91.4 Remove the nuts (16) and disconnect the electrical leads to the ammeter.

91.5 Remove the nuts (17) and remove the clamp (12).

91.6 Withdraw the ammeter (11) through the top of the terminal box and retrieve the 'O' ring.

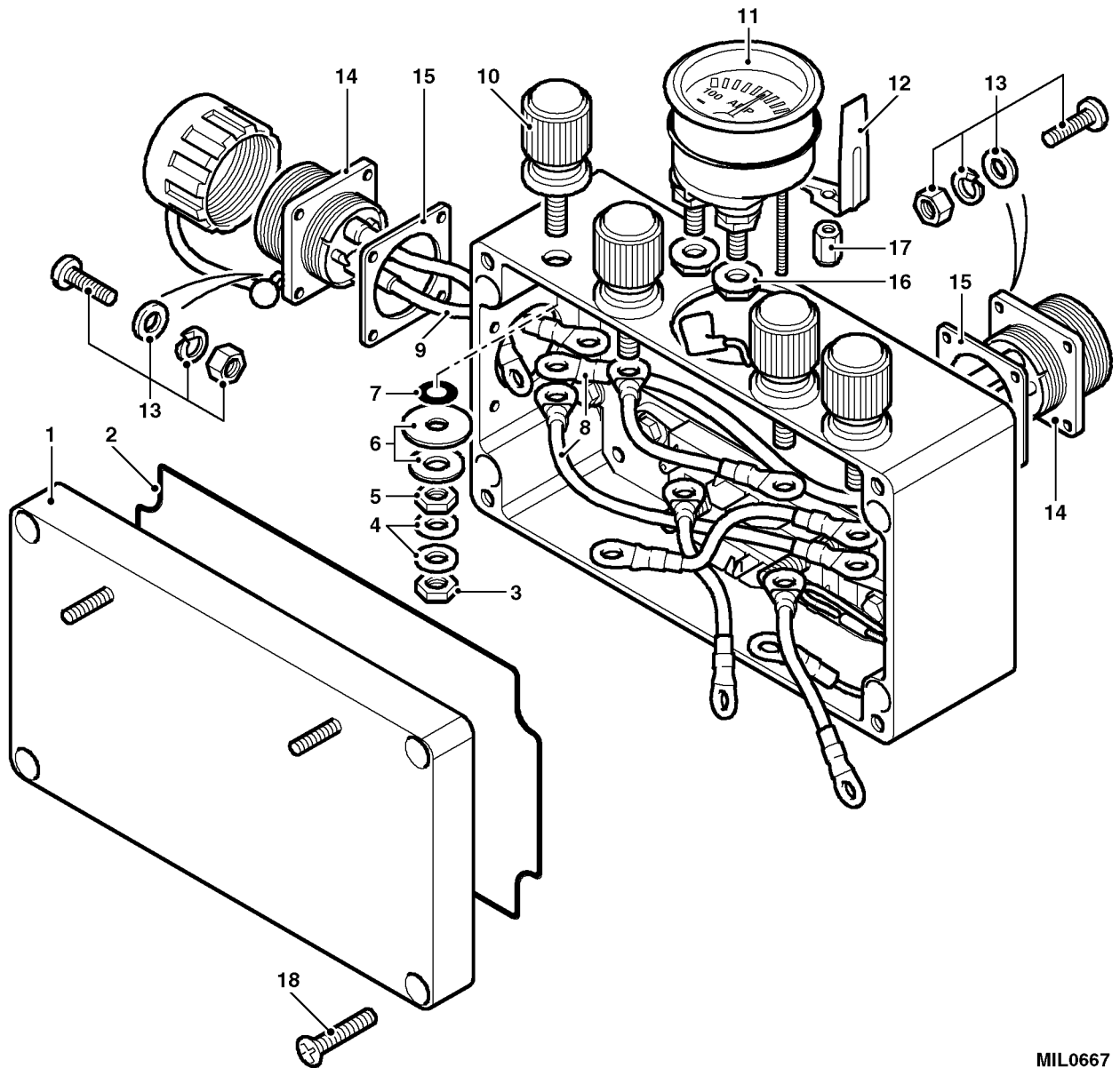
Refit

92 Refit the ammeter as follows:

92.1 Using the service kit (refer to Table 2 Serial 6) fit new seals and assemble the ammeter into the terminal box in the reverse order of removal.

92.2 Refit the terminal box to the vehicle (refer to Para 84).

92.3 Reconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).



MIL0667

- | | | | |
|---|------------------|----|-----------------------|
| 1 | Cover | 10 | Terminal post |
| 2 | Seal | 11 | Ammeter |
| 3 | Nut | 12 | Clamp |
| 4 | Washers | 13 | Nut, bolt and washers |
| 5 | Nut | 14 | Socket |
| 6 | Washers | 15 | Gasket |
| 7 | Seal | 16 | Nut |
| 8 | Electrical leads | 17 | Nut |
| 9 | Electrical leads | 18 | Screw |

Fig 24 Terminal post and plug socket removal

CHAPTER 13-5

WINTERISED

CONTENTS

Para

- 1 Introduction
- 2 General
- WATER HEATER SYSTEM
- 3 Control box
- 4 Remove
- 5 Refit
- 6 Radio Frequency Interference (RFI) filter box
- 7 Remove
- 8 Refit
- Functional Tests
- 9 Temperature sensor resistance check
- 10 Glow pin resistance check
- 11 Flame sensor resistance check
- 12 Combustion air fan test
- 13 Temperature limiter switch reset (CAUTION)
- 14 Diagnostics
- 16 Control box leak test (CAUTION)

Fig

Page

1	Water heater control box removal.....	2
2	Water heater RFI filter box removal.....	4
3	Resetting the temperature limiter switch.....	6
4	Diagnostic lead and test lamp connection	7
5	Circuit diagram.....	11/12

INTRODUCTION

1 This chapter covers the Unit repairs for Truck Utility Light (HS), and Truck Utility Medium (HS) Winterised vehicles fitted with the 24 volt electrical system.

General

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

WATER HEATER SYSTEM

CONTROL BOX

3 The control box for the water heating system is located under the bonnet and bolted to the top of the cab heater unit. The control box is a sealed unit and contains the ECU for the Webasto water heating system.

Remove

4 To remove the control box carry out the following:

- 4.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

4.2 Disconnect the electrical lead (Fig 1 (6)) to the RFI filter box.

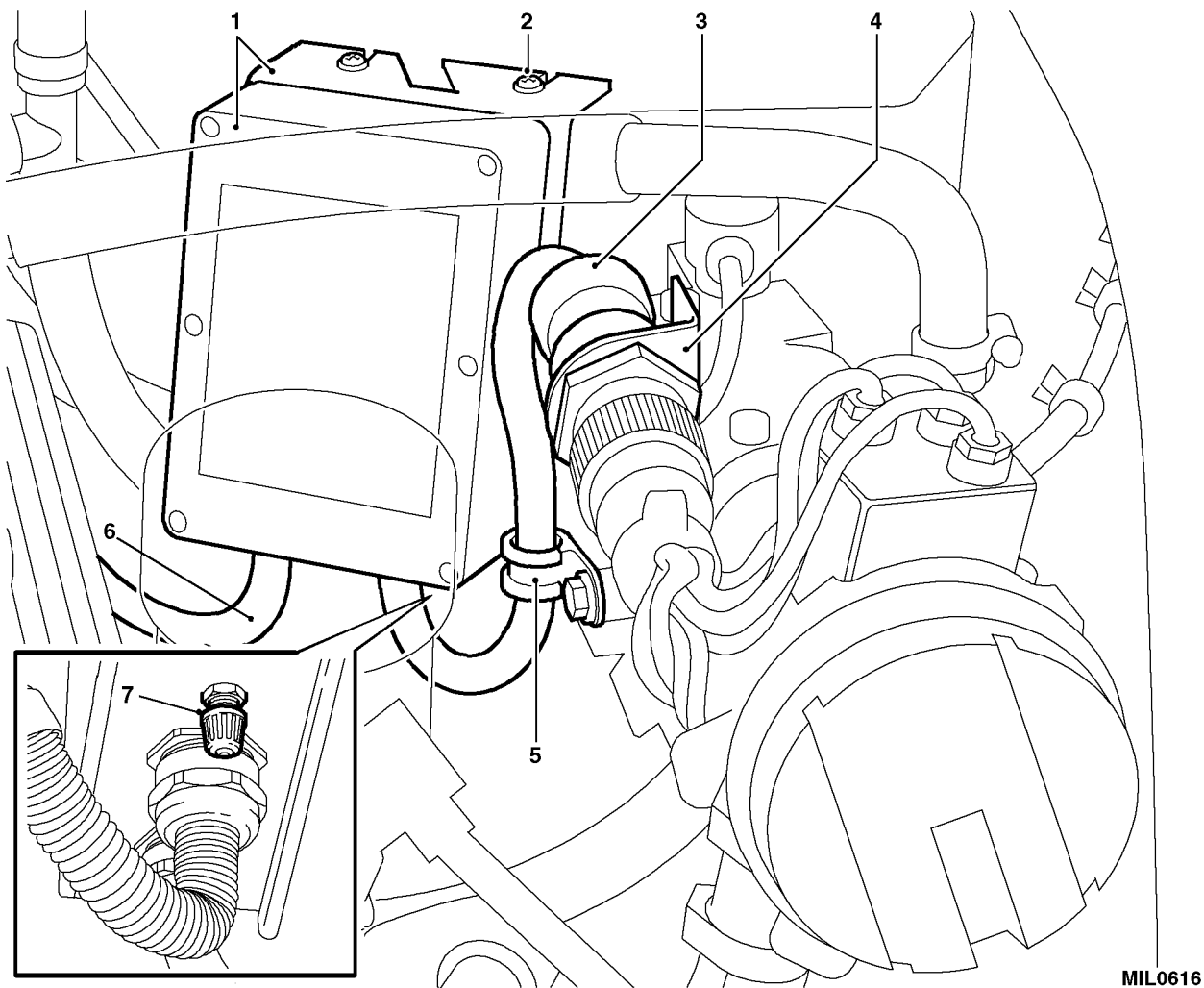
4.3 Disconnect the 14 pin plug (3) to the heater unit and remove the bolt securing plug mounting bracket (4) to the heater unit.

4.4 Remove the 'P' clip (5) securing the harness to the heater unit.

4.5 Remove any other clips or clamps securing the electrical leads to the bodywork.

4.6 Remove the screws (2) securing the control box to the top of the cab heater box and remove the control box (1) from the vehicle complete with mounting bracket.

4.7 If required remove control box from the mounting bracket.



MIL0616

	1	Control box and mounting bracket	5	'P' clip
2		Screws	6	Electrical lead
	3	14 pin plug	7	Schraeder valve
4		Mounting bracket		

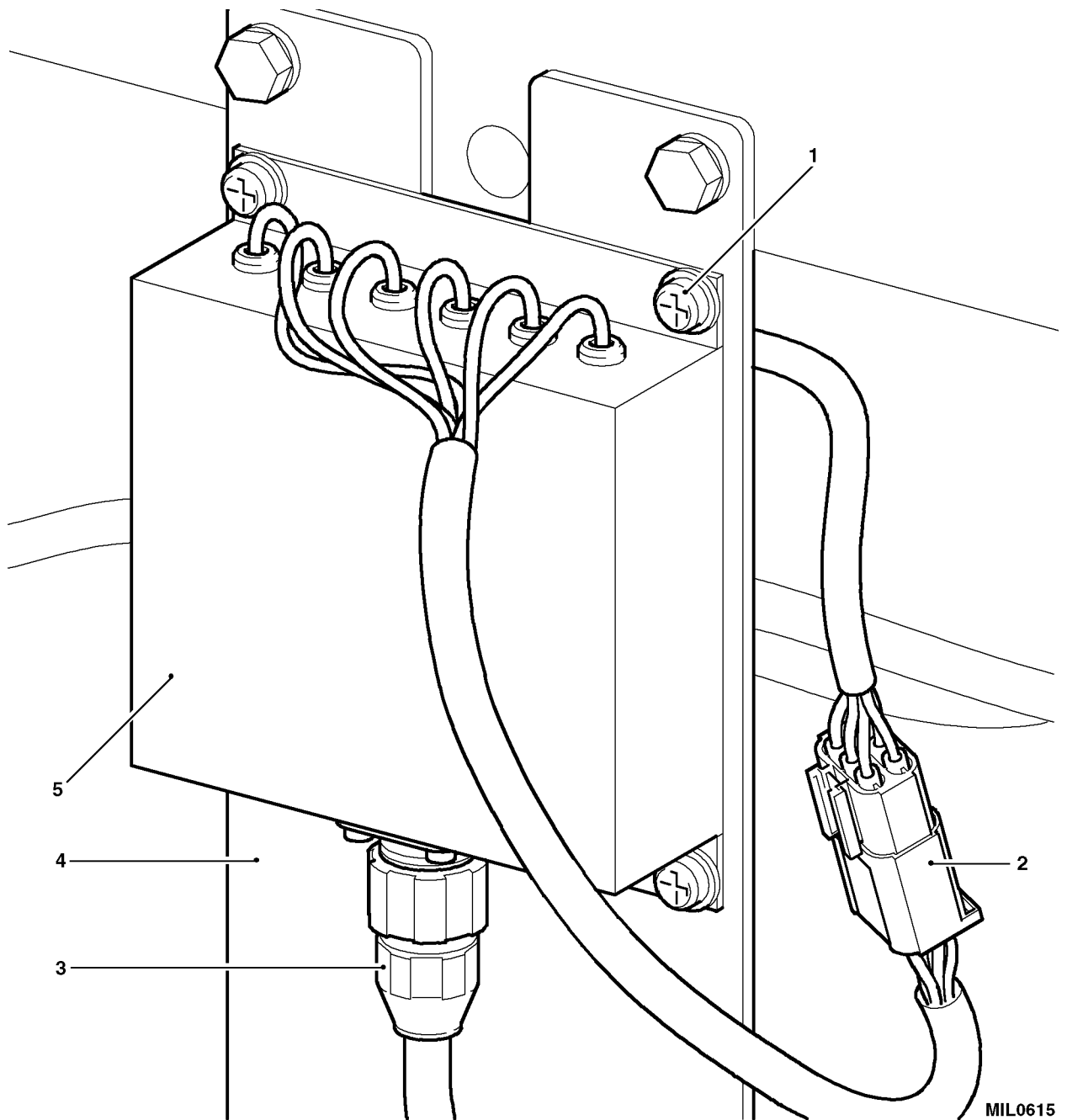
Fig 1 Water heater control box removal

Refit

5 Refit the control box in the reverse order of removal ensuring the foot of the control box mounting bracket is located in the channel on the front of the cab heater unit.

RADIO FREQUENCY INTERFERENCE (RFI) FILTER BOX

6 The Radio Frequency Interference (RFI) filter for the water heater control box is located under the bonnet and is bolted to the bulkhead.



- | | | | |
|---|-----------------|---|------------------|
| 1 | Screws | 4 | Mounting bracket |
| 2 | Multi-plug | 5 | Filter box |
| 3 | Electrical lead | | |

Fig 2 Water heater RFI filter box removal.

Remove

7 To remove the RFI filter box carry out the following:

7.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on FFR vehicles the radio batteries (refer to Chap 13-2).

7.2 Disconnect the multi-plug (Fig 2 (2)) from the vehicle main harness.

7.3 Disconnect the electrical lead (3) to the control box.

7.4 Disconnect the four screws (1) securing the filter box (5) to the bulkhead mounting bracket (4) and remove the filter box from the vehicle.

Refit

8 Refit the filter box in the reverse order of the removal.

FUNCTIONAL TESTS

Temperature sensor resistance check

9 During electrical testing of the temperature sensor using a digital multi-meter, the following readings should be obtained.

9.1 Resistance at 25°C 990 to 1010 ohms

9.2 Test current <1mA

Glow pin resistance check

10 During electrical testing of the glow pin using a digital multi-meter, the following readings should be obtained.

10.1 Glow pin 12 volt (red) 24 volt (green)

10.2 Resistance at 25°C 0.32 to 0.36 ohms 1.3 to 1.44 ohms

10.3 Test current <5mA <5mA

Flame sensor resistance check

11 During testing of the flame sensor using a digital multi-meter, the following readings should be obtained.

11.1 Cold test

11.1.1 Resistance at 25°C 2.6 to 3.4 ohms

11.1.2 Test current <5mA

11.2 Hot test

11.2.1 Resistance at 800°C to 1000°C 12 to 15 ohms

11.2.2 (ceramic rod red hot over a length of approx.20mm)

11.2.3 Test current <5mA

Combustion air fan test

12 The motor speed check must be performed with the heater assembled and within the operating voltage range. During the test listen for worn or damaged bearings.

NOTE

For the motor speed check the cover must be removed. Prior to re-installation the gasket should be renewed.

- | | | | |
|------|---|------------------------|--------|
| 12.1 | Speed in control range min. | 1800 min ⁻¹ | (+-9%) |
| 12.2 | Speed in control range max. | 6100 min ⁻¹ | (+-9%) |
| 12.3 | If speed values are out of tolerance, renew combustion air fan. | | |

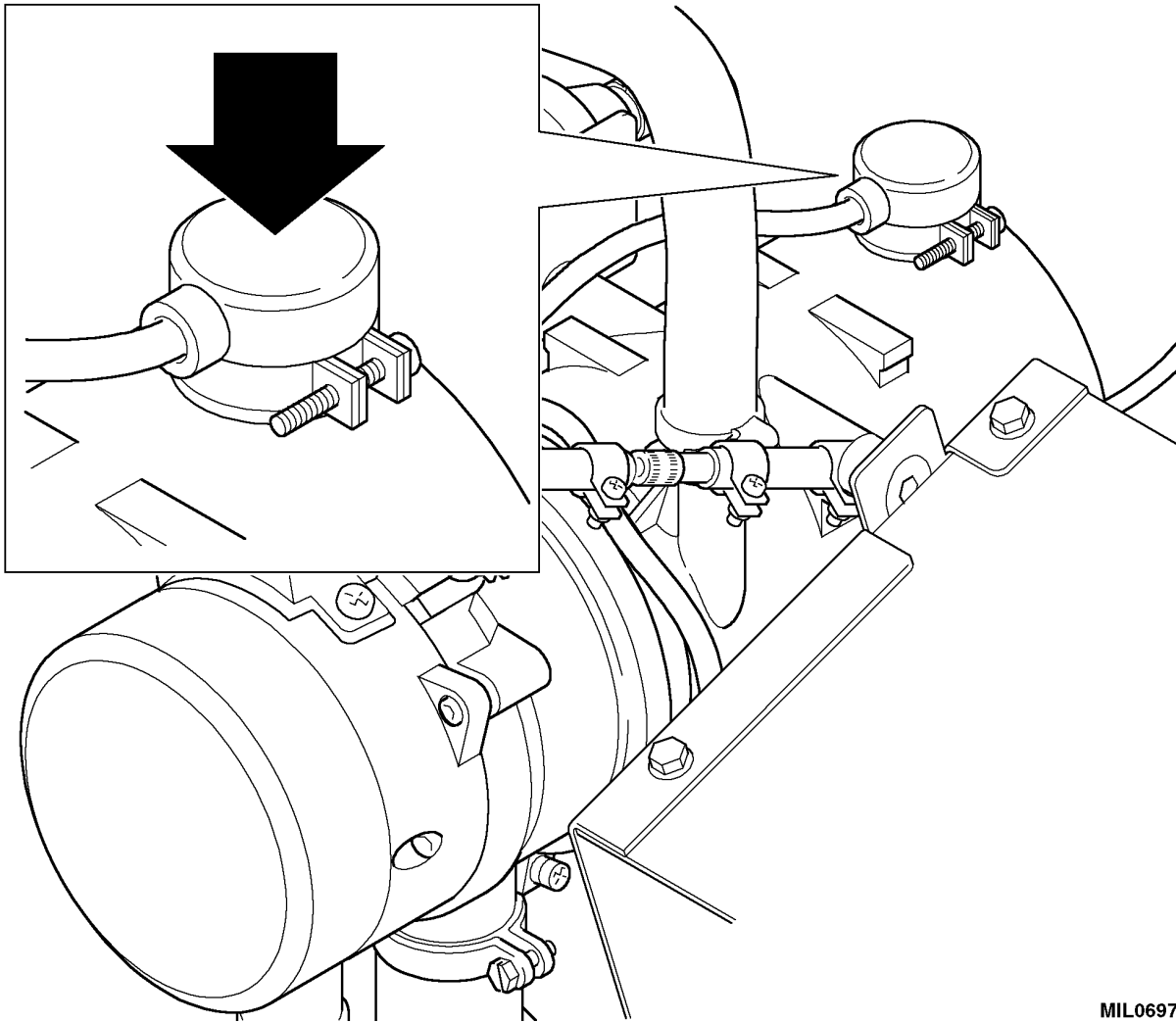
TEMPERATURE LIMITER SWITCH RESET

13 If the heater has shut down due to overheating (refer to Cat 512 Chap 18-3), it will be necessary to reset the temperature limiter switch. The switch is located on the top of the heater unit.

CAUTION

OVERHEAT SWITCH. Do not attempt to reset the overheat switch until the heater unit has cooled down sufficiently. Contact with the heater unit whilst it is still hot could result in serious injury.

- 13.1 Locate the water heater unit in the engine compartment, the switch is located under a rubber cap on top of and towards the rear of the unit. (Fig 3).
- 13.2 Press the top of the rubber cap gently until the push button switch is felt to click and reset.



MIL0697

Fig 3 Resetting the temperature limiter switch.

DIAGNOSTICS

14 In the event of a fault shutdown, the source of the malfunction can be determined by the built-in diagnostics system. This can be checked by using a 24v test lamp (max 2w) connected to a diagnostic lead inside the control box during the after run period of the heater.

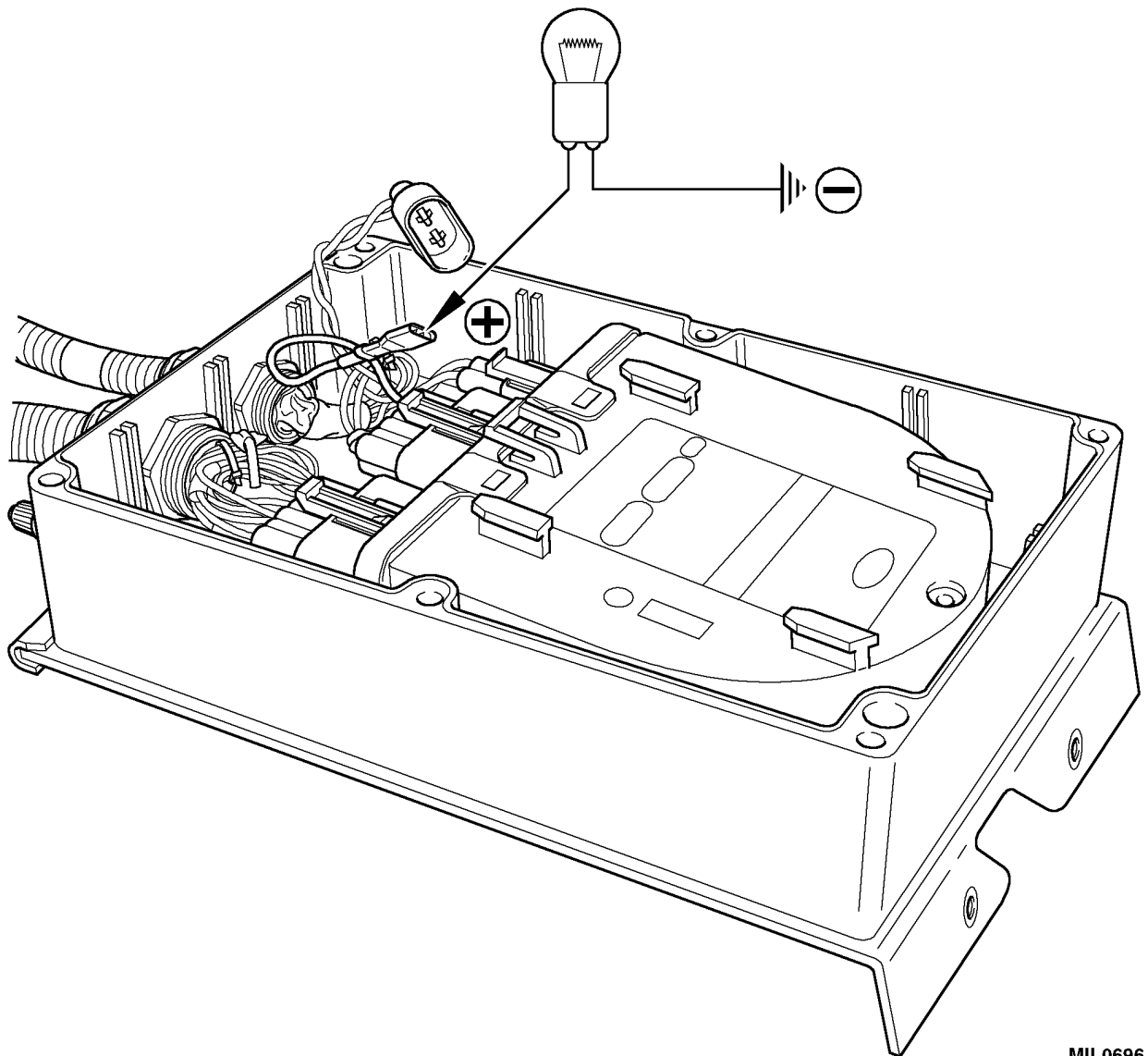
15 To perform a diagnostics check carry out the following:

- 15.1 Remove the control box from its location under the bonnet (refer to Para 3) and place on the wing. Use a suitable material to protect the wing surface.
- 15.2 Remove the cover to the control box to allow access to the ECU and diagnostic connector.
- 15.3 Withdraw the diagnostics connector, this is identified as a short loose blue wire with an insulated socket end located at plug A, pin 6. (refer to Fig 4).

NOTE

The diagnostics lead is a positive feed.

- 15.4 Using a 24v test lamp (2w max), connect the positive probe to the diagnostics connector lead (Plug A, pin 6) and earth the negative lead (refer to Fig 4).



MIL0696

Fig 4 Diagnostics lead and test lamp connection

15.5 After five short signals, count the long flashes. The different types of malfunction are indicated by the following coded flashing signals.

- 15.5.1 1x Start up not successful.
- 15.5.2 2x Flame out after combustion has started.
- 15.5.3 3x Under voltage.
- 15.5.4 4x Flame detector permanently hot.
- 15.5.5 5x Flame detector defective.
- 15.5.6 6x Temperature sensor defective.
- 15.5.7 7x Dosing pump/overheat failure.

- 15.5.8 8x Combustion air fan defective.
- 15.5.9 9x Glow pin defective.
- 15.5.10 10x Overheating.
- 15.5.11 11x Circulation pump open or short circuit.

CONTROL BOX LEAK TEST

16 The control box is a sealed component and once the integrity of the seal has been compromised by the removal of the cover for diagnostic checks or maintenance, the box must be checked for leakages after it has been re-assembled.

CAUTION

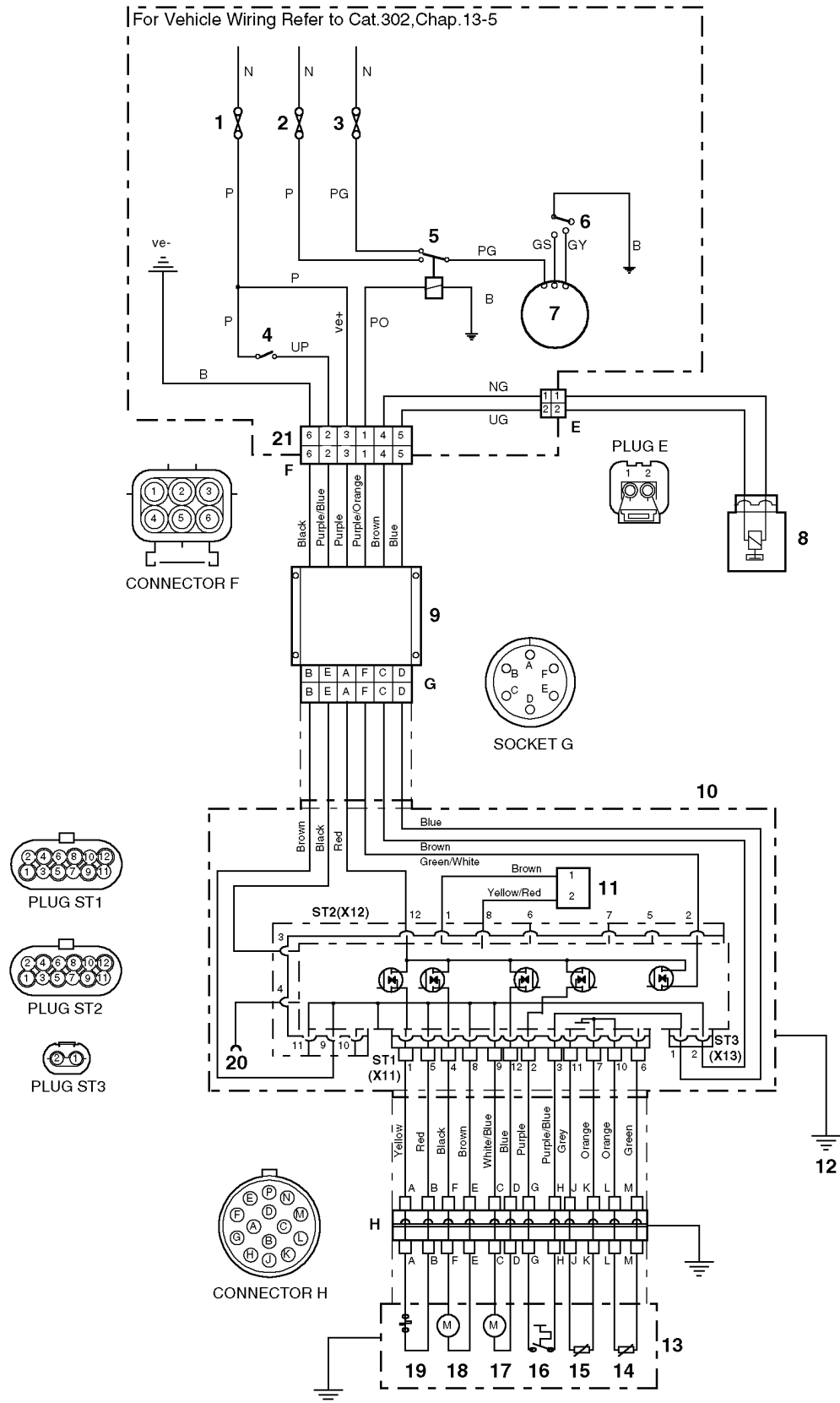
COMPRESSED AIR. Do not use compressed air to pressurise the control box.

- 17 The control box has a schraeder valve (refer to Fig 1 (7)) fitted to the underside to enable the following test to be carried out.
- 17.1 With the control box removed from the vehicle (refer to Para 3) remove the dust cap from the schraeder valve.
 - 17.2 Remove the schraeder valve core from the valve stem using a standard tyre valve core removal tool.
 - 17.3 Connect a length of hose (approx one metre) to the valve stem and secure with a hose clip. Ensure a water tight seal.
 - 17.4 Fit a sealing plug to each of the metal electrical connectors to prevent water ingress.
 - 17.5 Submerge the control box and cables in a container of water keeping the open end of the test pipe out of the water.
 - 17.6 Blow into the pipe and observe the following areas for air bubbles.
 - 17.6.1 Box lid.
 - 17.6.2 Plugs.
 - 17.6.3 Cables.
 - 17.6.4 Cable glands.
- 18 Rectify any leaks and retest.
- 19 Remove the test pipe and refit the schraeder valve core.
- 20 Refit the dust cap and dry off the control box.
- 21 Refit the control box to the vehicle (refer to Para 4).

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KEY TO FIG 5

1	Fuse 20amp
2	Fuse 10 amp
3	Fuse 10amp
4	Heater on/off switch
5	Blower motor relay
6	Blower motor control switch
7	Blower motor
8	Fuel pump
9	RFI filter
10	EMC enclosure
11	P.C diagnostics plug
12	Control box earth strap
13	Water heater
14	Temperature sensor
15	Flame detector
16	Overheat switch
17	Combustion air fan
18	Water pump
19	Glow pin
20	Diagnostics plug



MIL0698

Fig 5 Circuit diagram

CHAPTER 13-6

TROPICALISED

CONTENTS

Para

- 1 Introduction
Blower control switch
- 2 Remove
- 3 Refit
- Thermostatic control switch
- 4 Remove
- 5 Examination
- 6 Refit
- 7 Control relay
- 8 Voltage dropper unit
- 9 Remove
- 10 Refit
- Pressure switch
- 11 Remove
- 12 Refit
- Temperature switch
- 13 Remove
- 14 Refit

Fig

Page

1	Blower control switch removal	2
2	Thermostatic control switch removal	4
3	Pressure switch removal	6
4	Temperature switch removal	7/8

INTRODUCTION

1 This chapter details the Unit repairs for the air conditioning control components fitted to the (TUM) Ambulance HS.

BLOWER CONTROL SWITCH

Remove

2 To remove the blower control switch carryout the following:

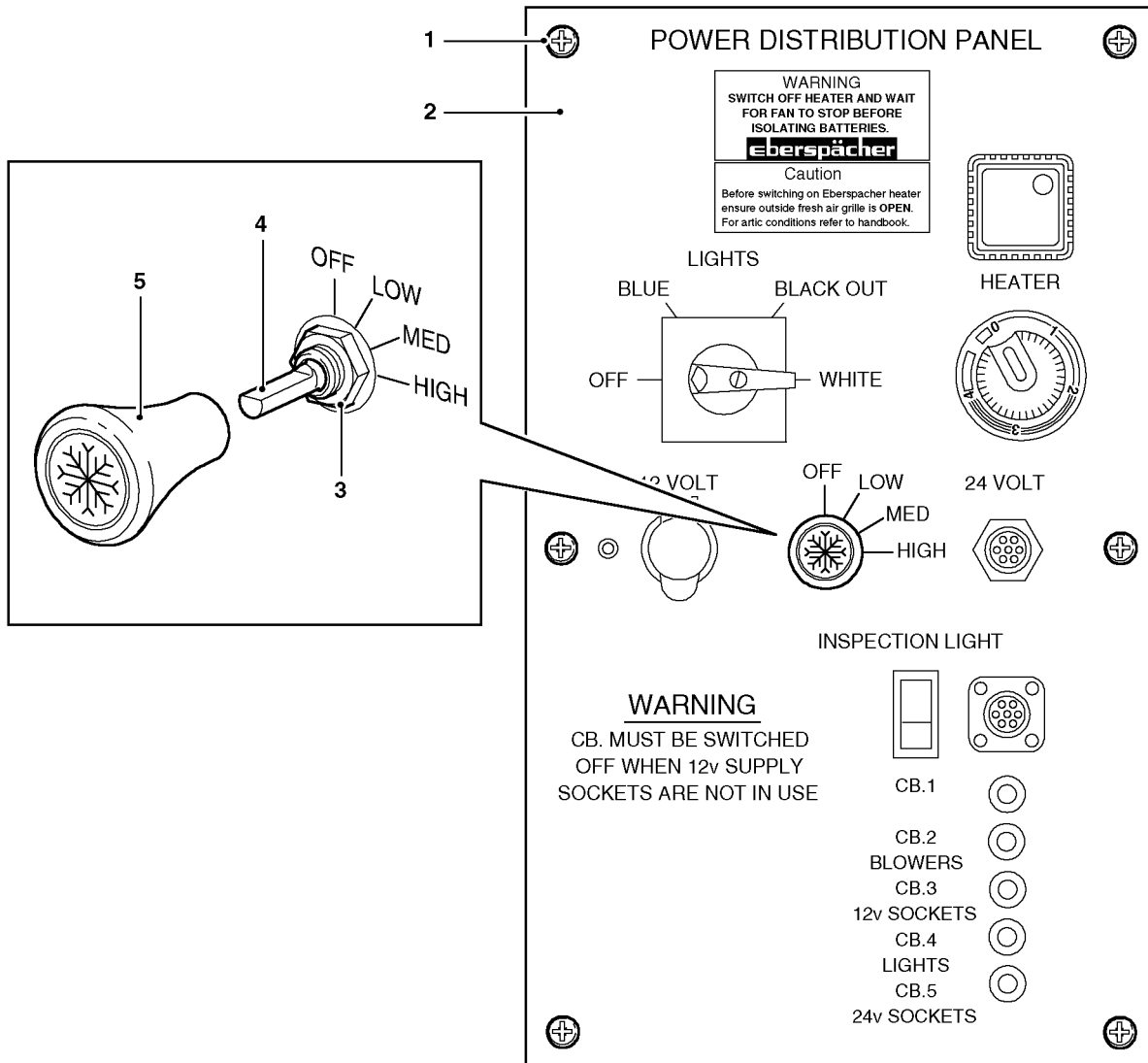
2.1 Disconnect the vehicle batteries (refer to Chap 13-1).

2.2 Remove the six screws (Fig 1 (1) securing the distribution panel (2) to the bulkhead and lift away from bulkhead recess.

2.3 Carefully rotate and support the panel to give access to the electrical components and wiring behind the panel.

2.4 Pull off the control knob (5) on the front of the control panel.

2.5 Remove nut (3) securing switch (4) to control panel, disconnect the electrical connections and remove switch from panel.



MIL0676

- 1 Screw
- 2 Control panel
- 3 Nut
- 4 Switch
- 5 Control knob

Fig 1 Blower control switch removal

Refit

- 3 Refit the switch in the reverse order of removal.

THERMOSTATIC CONTROL SWITCH

Remove

- 4 To remove the thermostatic control switch carry out the following:
 - 4.1 Disconnect the vehicle batteries (Refer to Chap 13-1).
 - 4.2 Pull off the switch control knob (Fig 2 (6))

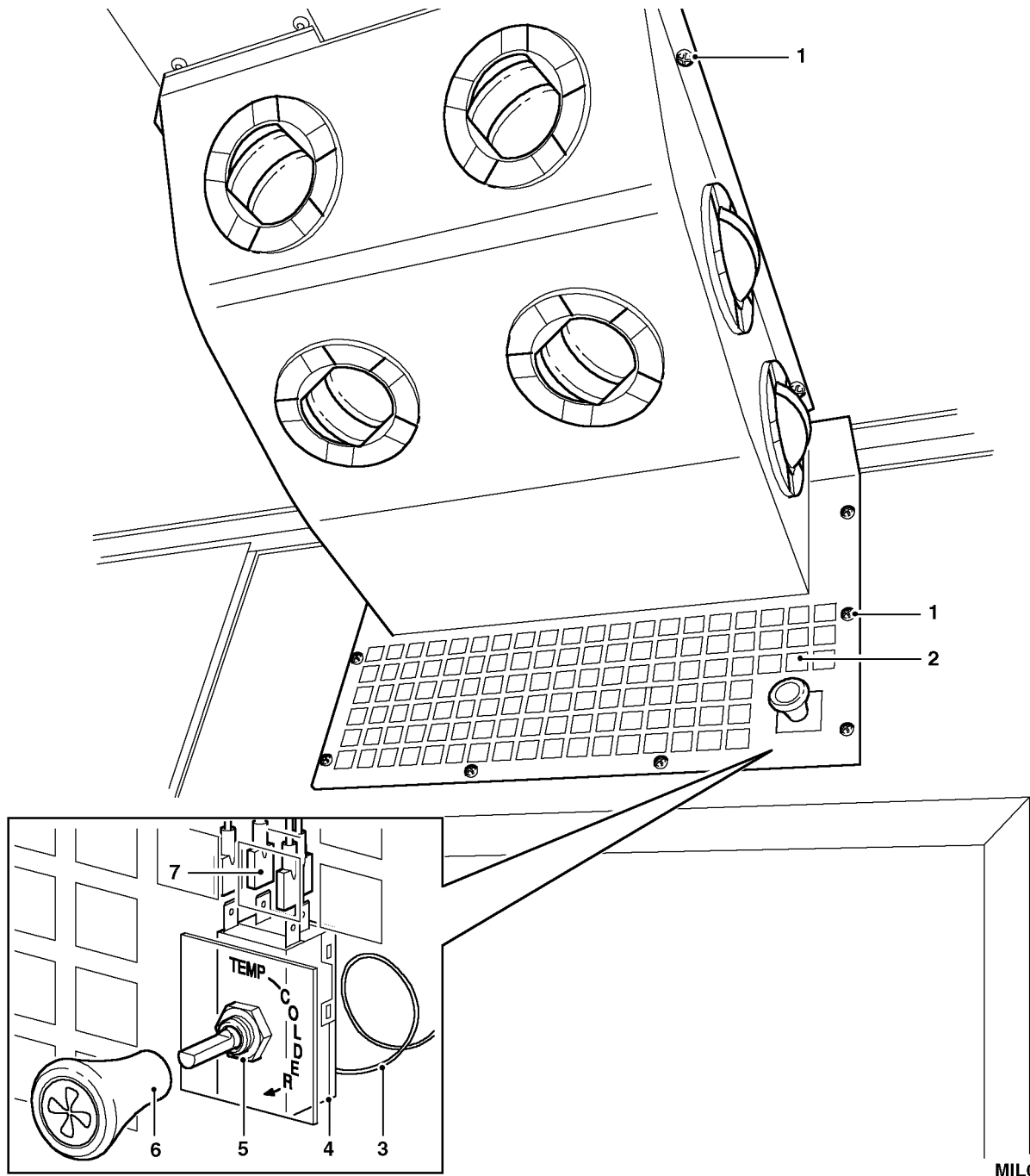
- 4.3 Remove the nut (5) securing the switch (4) to the air distribution duct grille panel (2).
- 4.4 Remove the 14 screws (1) securing the air distribution duct to the bulkhead and roof.
- 4.5 With the aid of an assistant carefully pull the duct away from the roof/bulkhead, remove the switch from the grille panel by pushing the switch back through the hole, and remove the air distribution duct.
- 4.6 Disconnect the electrical connections (7) from the switch and carefully extract the thermostatic probe (3) from the evaporator matrix noting its position for reassembly.
- 4.7 Remove the switch (4) complete with probe.

Examination

- 5 Examine the seals on the air distribution duct between the roof and the bulkhead and replace if necessary.

Refit

- 6 Refit the switch as follows:
 - 6.1 Carefully insert the thermostatic probe (3) into the matrix and reconnect the electrical connections (7).
 - 6.2 With the aid of an assistant, offer up the air distribution duct to the roof/bulkhead.
 - 6.3 Fit the switch into the duct grille panel (2) and secure with the nut (5).
 - 6.4 Fit air distribution duct to roof/bulkhead location and secure with 14 screws (1).
 - 6.5 Fit switch control knob (6).
 - 6.6 Reconnect vehicle batteries (refer to Chap 13-1).



MIL0677

- | | | | |
|---|--------------------|---|------------------------|
| 1 | Screws | 5 | Nut |
| 2 | Grille panel | 6 | Switch control knob |
| 3 | Thermostatic probe | 7 | Electrical connections |
| 4 | Switch | | |

Fig 2 Thermostatic control switch removal

CONTROL RELAY

7 The control relay is mounted behind the control panel in the ambulance. It controls the electrical power to the condenser cooler fans and the compressor. It can be accessed by removing the control panel cover (refer to Para 2). The black relay is mounted between the lighting switch and the heater switch and can be replaced by pulling the relay out of its mounting and inserting a new one.

- 7.1 Before removal ensure the vehicle batteries are disconnected (refer to Chap 13-1).

VOLTAGE DROPPER UNIT

8 The voltage dropper unit for the compressor is located under the front right hand seat in the drivers cab. This is accessed by removing the seat squab and load space cover. The voltage dropper unit is bolted to heel board inside of the load space.

Remove

- 9 To remove the voltage dropper unit carry out the following:
 - 9.1 Disconnect the vehicle batteries (refer to Chap 13-1).
 - 9.2 Access the right hand seat load space area.
 - 9.3 Disconnect the electrical connections to the voltage dropper unit noting the position and colour of each connection for reassembly.
 - 9.4 Undo the four screws securing the cover and remove the cover.
 - 9.5 Disconnect the earth braid.
 - 9.6 Remove the four screws, nuts and washers securing the unit to the heel board and remove the unit from the vehicle.

Refit

- 10 Refit the voltage dropper unit in the reverse order of the removal.
 - 10.1 Reconnect the vehicle batteries (refer to Chap 13-1).

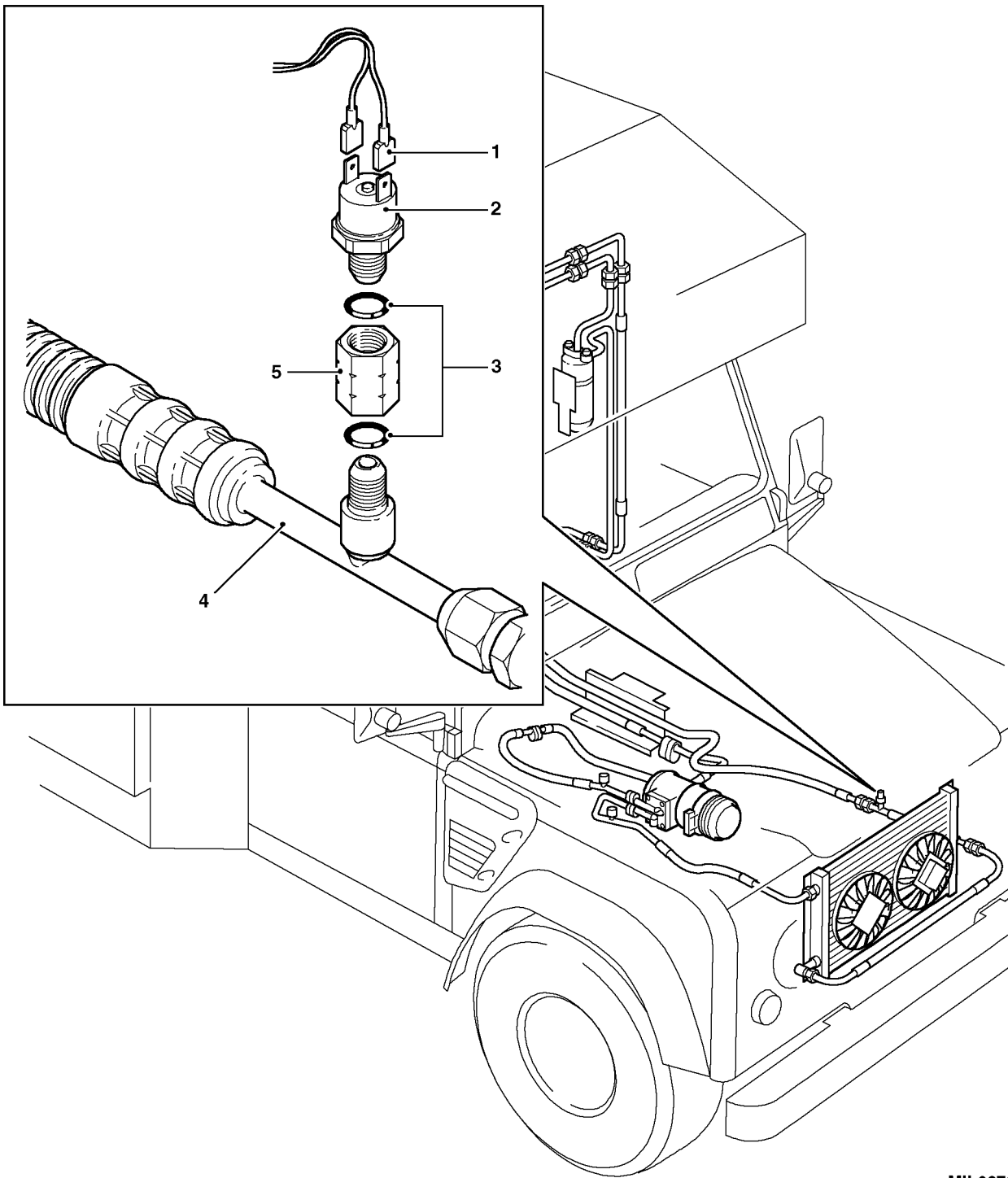
PRESSURE SWITCH

Remove

- 11 To remove the pressure switch carry out the following:
 - 11.1 Disconnect the vehicle batteries (refer to Chap 13-1).
 - 11.2 Recover refrigerant from air conditioning system (refer to Chap 18-5).
 - 11.3 Disconnect the electrical connections (Fig 3 (1)).
 - 11.4 Unscrew the switch (2) from the adapter (5) and retrieve the 'O' rings (3).

Refit

- 12 Refit the pressure switch in the reverse order of removal ensuring a new seal (4) is fitted.
 - 12.1 Recharge the air conditioning system (refer to Chap 18-5).
 - 12.2 Reconnect the vehicle batteries (refer to Chap 13-1).



MIL0678

- 1 Electrical connections
- 2 Switch
- 3 'O' ring

- 4 High pressure pipe
- 5 Adapter

3

Fig 3 Pressure switch removal

TEMPERATURE SWITCH

Remove

13 To remove the temperature switch carry out the following:

13.1 Disconnect the vehicle batteries (refer to Chap 13-1)

13.2 Partially drain the cooling system (refer to Chap 12-2), until coolant level is below thermostat housing.

13.3 Disconnect the electrical connection (Fig 4 (3)).

13.4 Unscrew the temperature switch (2) from the elbow and retrieve the compression washer (1).

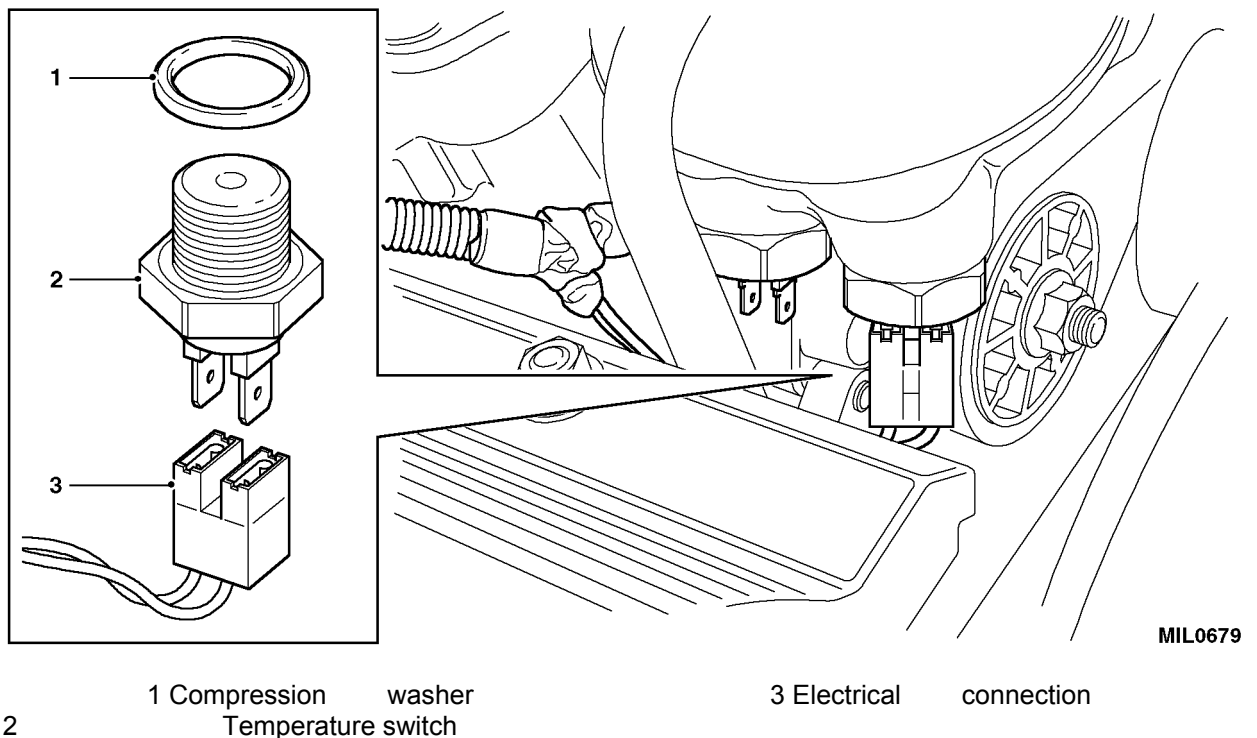


Fig 4 Temperature switch removal

Refit

14 Refit the temperature switch in reverse order of removal ensuring a new compression washer (1) is fitted.

14.1 Top up the cooling system (refer to Chap 12-2).

14.2 Reconnect the vehicle batteries (refer to Chap 13-1).

CHAPTER 13-7

WINTERISED/WATERPROOFED AMBULANCE

CONTENTS

Para

- 1 Introduction
- 3 Main Harness link
- 4 Chassis Harness link
- 5 Auxiliary pick up link
- 6 Headlamp level link
- 7 Convoy lamp
- 8 Blower link

Fig

	Page
1 Main Harness pin out	3
2 Chassis Harness pin out	4
3 Blower link connections	5
4 Drilling of a 30 mm hole in the centre console	6

Table

	Page
1	1

TABLE 1 ELECTRICAL PARTS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	STC4576		Kit, Comprising of:
2	7165-0118		Seals
3	1500-0105		Terminal
4	6189-0136		Connector
5	6918-0336		Secondary lock
6	6181-0077		Connector
7	6918-0337		Secondary lock
8	7161-9787		Cavity plug
9	6181-0071		Connector
10	6918-0325		Secondary lock
11	347875-1		Seals
12	345806-1		Terminal
13	344267-1		Connector
14	345260-1		Secondary lock
15	348461-1		Cavity plug
16	6189-019		Connector
	6918-0322		Secondary lock

INTRODUCTION

- 1 This chapter details the Unit repairs for the Winterised/Waterproof Ambulance vehicles.
- 2 The electrical harnesses fitted to the Winter /Water Ambulance were specially modified during production. Any replacement harnesses will be supplied to the standard specification and will require modification before fitting to the vehicle. A kit is available for this purpose (refer to Table 1).
 - 2.1 The following modifications must be performed by a qualified electrician:
 - 2.1.1 Main Harness: Change to single waterproof connector at the Chassis Harness interface, modifications in the centre console to allow incorporation of the auxiliary link for the Blue light and Siren.
 - 2.1.2 Chassis Harness: Change to single waterproof connector at the Main Harness interface and waterproof convoy lamp connection.
 - 2.1.3 Headlamp resistor pack: Change to waterproof connectors (connector shell only).
 - 2.1.4 Wing Harness: Blanking off of side repeater connectors using heat shrink.
 - 2.1.5 Blower link: Change to waterproof connector.

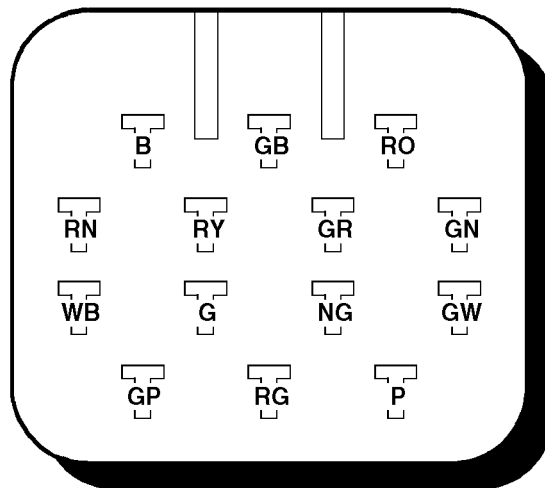
MAIN HARNESS

- 3 This procedure outlines the removal of the existing three connectors at the interface to the chassis harness in the engine bay to replace them with a single 14 way waterproof connector.
 - 3.1 Locate blue four way connector, orange four way connector, grey four way connector and black three way connector in the engine bay, middle of the bulkhead.
 - 3.2 Unpin blue four way connector, orange four way connector and grey four way connector.
 - 3.3 Cut off black three way connector close to the connector.
 - 3.4 Seal, terminate and solder the wires which have just been cut using seals (Table 1 serial 1) and terminals (Table 1 serial 2).

Note

Do not touch the grey 2 way connector.

- 3.5 Plug the terminals into the connector block (Table 1 serial 3), The pin out is shown (Fig 1).
- 3.6 Add secondary lock (Table 1 serial 4) and cavity plugs (Table 1 serial 7) into unused cavities.



MIL1987

Fig 1 Main harness Pin out (as viewed from mating face)

CHASSIS HARNESS

4 This procedure outlines the removal of the three connectors at the interface to the main harness in the engine bay to replace them with a single 14 way waterproof connector.

4.1 Locate the black six way connector, white six way connector and black three way connector situated at the middle of the bulkhead inside the engine bay.

4.2 Unpin the blue four way connector, orange four way connector and grey four way connector.

4.3 Cut off the three way black connector, six way black connector and six way white connector close to each of the connectors.

4.4 Seal, terminate and solder the wires which have just been cut using seals (Table 1 serial 1) and terminals (Table 1 serial 2).

Note

Do not touch the grey two way connector.

4.5 Plug the terminals into the connector block (Table 1 serial 5), The pinout is as shown (Fig 2).

4.6 Add secondary lock (Table 1 serial 6) and cavity plugs (Table 1 serial 7) into unused cavities.

4.7 Plug both 14 way connectors together.

4.8 Plug both two way connectors together.

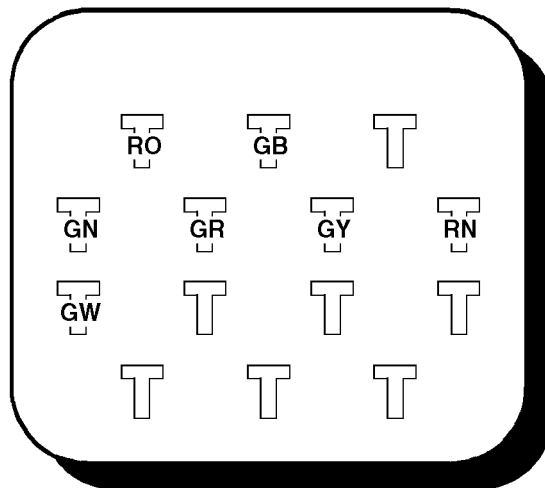


Fig 2 Chassis harness Pin out (as viewed from mating face)

MIL2034

AUXILIARY PICK UP LINK

5 This procedure outlines the splicing in of an auxiliary link into the centre console to provide a power supply for the Blue Light and Siren.

Note

If the centre console is to be renewed a hole 30mm in diameter must be cut into the side of the console to suit the installation (refer to Fig 4) and the existing cable grommet reused.

5.1 Cut the following wires on auxiliary feed to following lengths:

- 5.1.1 Green/Red 1.0 mm 250 mm long,
- 5.1.2 Green/White 1.0 mm 250 mm long,
- 5.1.3 Green 1.0 mm 250 mm long
- 5.1.4 Purple 2.0mm 400 mm long
- 5.1.5 Purple/Black 1.0 mm 500 mm long.

5.2 Seal, terminate and solder using seals (Table 1 serial 10) and terminals (Table 1 serial 11).

5.3 Plug the terminals into Amp connector block (Table 1 serial 12),

5.4 Add secondary lock (Table 1 serial 13) and cavity plugs (Table 1 serial 14) into unused cavities.

5.5 Splice GR/G/GW onto respective colours on Hazard switch and P onto interior light switch using Splice clips, solder and splice tape.

5.6 Feed PB wire through gland nut of new harness and break into fascia harness splicing into PB on fascia harness using splice clip, solder and splice tape.

HEADLAMP LEVEL LINK

6 Modify headlamp level link as follows:

6.1 Take yellow resistor pack and cut off black 3 way econoseal close to connector.

6.2 Seal, terminate and solder using seals (Table 1 serial 1) and terminals (Table 1 serial 2).

6.3 Plug the terminals into the connector block which can be stripped from existing connector, The pin out can be obtained by checking the mating half (part of vehicle).

6.4 Add secondary lock from existing connector.

6.5 Plug new link into waterproof harness.

CONVOY LAMP

7 Modify the Convoy Lamp link as follows:

7.1 Cut off black two way econoseal connector close to connector.

7.2 Seal, terminate and solder using seals (Table 1 serial 1) and terminals (Table 1 serial 2).

7.3 Plug the terminals into the connector block (Table 1 serial 15), The pin out can be obtained by checking the mating half (part of vehicle).

7.4 Add secondary lock (Table 1 serial 16).

BLOWER LINK

8 Modify the Blower link as follows:

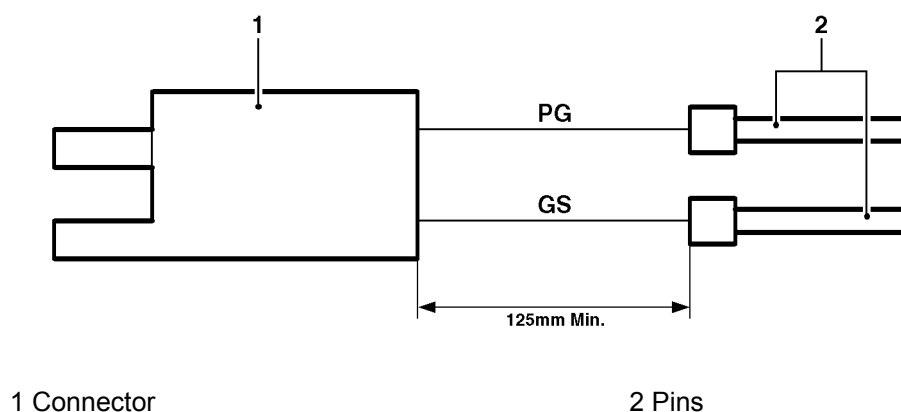
8.1 Take Blower link and cut off black 3 way econoseal close to the connector.

8.2 Seal, terminate and solder the wires which have just been cut using seals (Table 1 serial 1) and terminals (Table 1 serial 2).

8.3 Plug the terminals into the connector block (Table 1 serial 8), The pin out can be obtained by checking the mating half (part of vehicle).

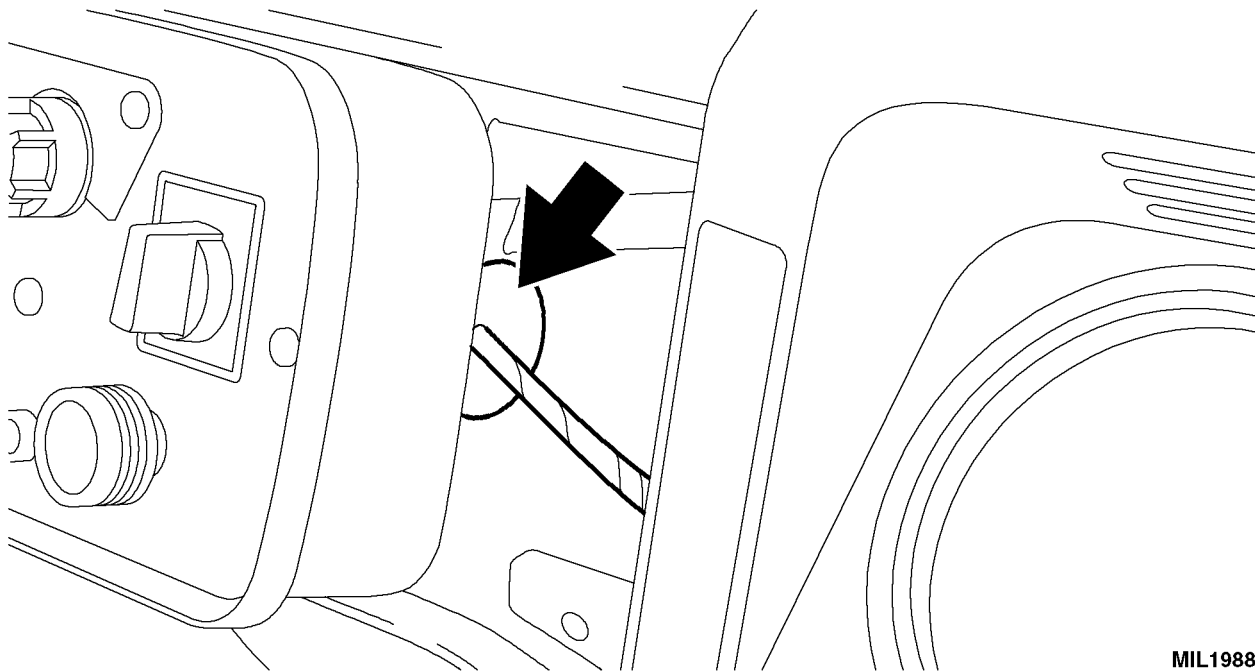
8.4 Add secondary lock (Table 1 serial 9) and cavity plugs (Table 1 serial 7) into unused cavities.

8.5 Plug new link into waterproof harness.



MIL2033

Fig 3 Blower link connections



MIL1988

Fig 4 Drilling of a 30mm dia hole in the centre console for the auxiliary link.

CHAPTER 15

CHASSIS

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

1 This chapter covers the Unit repairs for Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicle chassis.

General

2 This chapter has been sub-chaptered to allow for various types of repair as detailed below.

Chapter 15-1 Frame Alignment TUL/TUM and Field Ambulance

Chapter 15-2 Chassis Repair TUL/TUM

Chapter 15-3 GRP Hood Repair TUL/TUM

CHAPTER 15-1

FRAME ALIGNMENT TUL/TUM AND FIELD AMBULANCE

CONTENTS

Para

- 1 Introduction
- 2 General
- 3 Frame alignment (TUL/TUM vehicles)
- 4 Frame alignment (Field Ambulance)
- 5 Chassis dimensions
 - Front bumper
- 6 Removal
- 7 Refitting
 - Rear bumper (TUL/TUM vehicles)
- 8 Removal
- 9 Refitting
 - Front protection plate (TUL/TUM vehicles)
- 10 Removal
- 11 Refitting

Fig

Page

1	TUL/TUM chassis frame diagonal measurements	2
2	Field ambulance chassis frame diagonal measurements	3
3	TUL chassis alignment dimensions	5
4	TUM chassis alignment dimensions	7
5	Field ambulance chassis alignment dimensions	9

INTRODUCTION

1 This chapter covers the Unit repairs for Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicle chassis.

General

2 The chassis frame comprises two boxed sections on side members and four cross members on TUL vehicles, six cross members on TUM vehicles and seven cross members on Field ambulance. On all vehicle types all of the cross members are welded to the side members, except for the inner member situated beneath the gearbox which is bolted to the side members to allow removal of the cross member when carrying out gearbox removal. Additional supports for road springs, fuel tanks and body retention are welded to the side members.

FRAME ALIGNMENT (TUL/TUM VEHICLES)

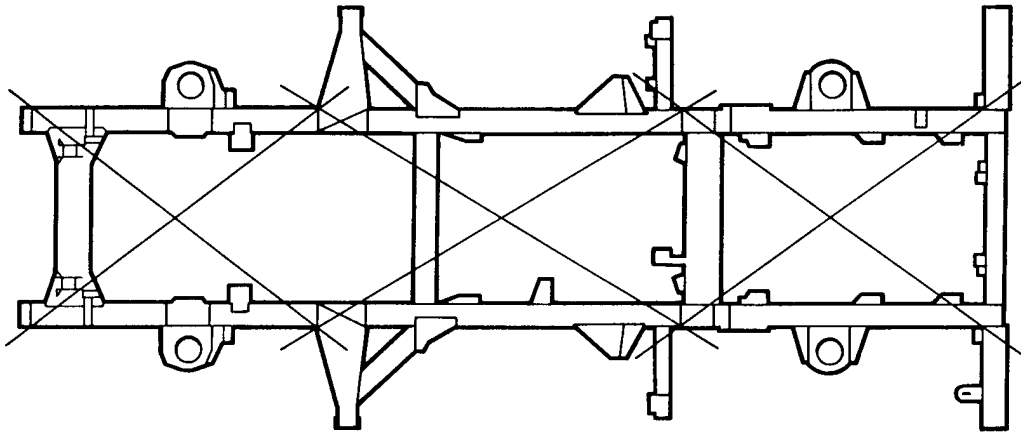
3 With the vehicle assembled, a check for chassis alignment can be made as follows:

3.1 Place the vehicle on a level floor.

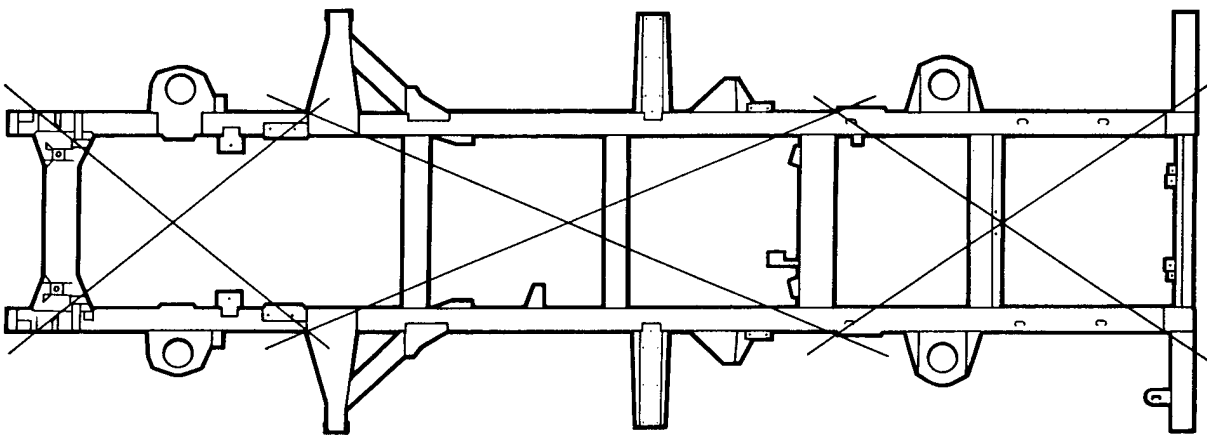
3.2 Mark measuring points at the locations (refer to Fig 1) ensuring that the marks are exactly opposite on each side of the chassis frame.

3.3 Hold a plumb line against each of the measuring points in turn and mark the floor directly beneath the plumb-bob.

3.4 Move the vehicle and measure diagonally between the marks made on the floor, if the chassis is square the diagonals between the related measuring points should agree within 9.50 mm (0.375 in.).



Truck Utility Light



MIL0404

Truck Utility Medium

Fig 1 TUL/TUM chassis frame diagonal measurements

FRAME ALIGNMENT (FIELD AMBULANCE)

- 4 With the vehicle assembled, a check for chassis alignment can be made as follows:
 - 4.1 Place the vehicle on a level floor.
 - 4.2 Mark measuring points at the locations (refer to Fig 2) ensuring that the marks are exactly opposite on each side of the chassis frame.
 - 4.3 Hold a plumb line against each of the measuring points in turn and mark the floor directly beneath the plumb-bob.

4.4 Move the vehicle and measure diagonally between the marks made on the floor, if the chassis is square the diagonals between the related measuring points should agree within 9.50mm (0.375in).

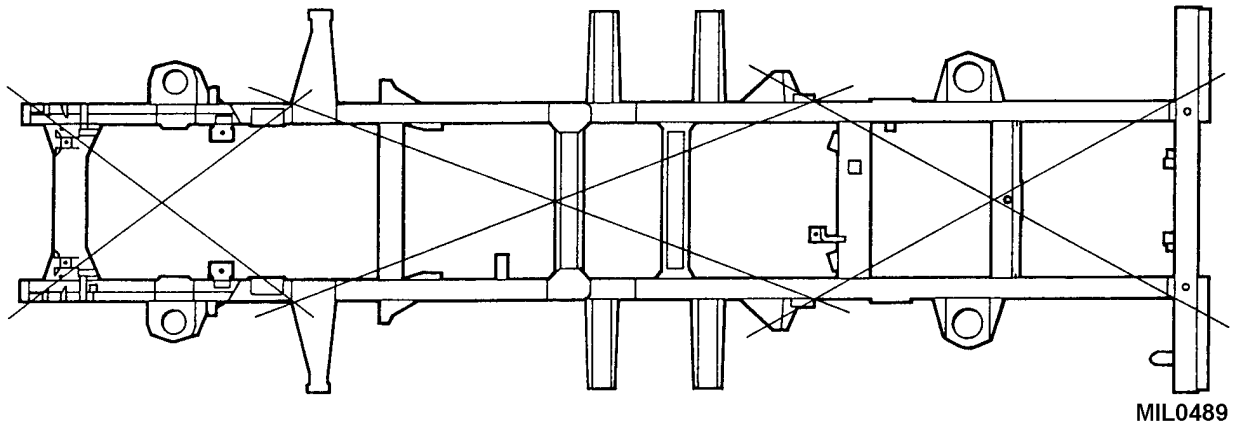


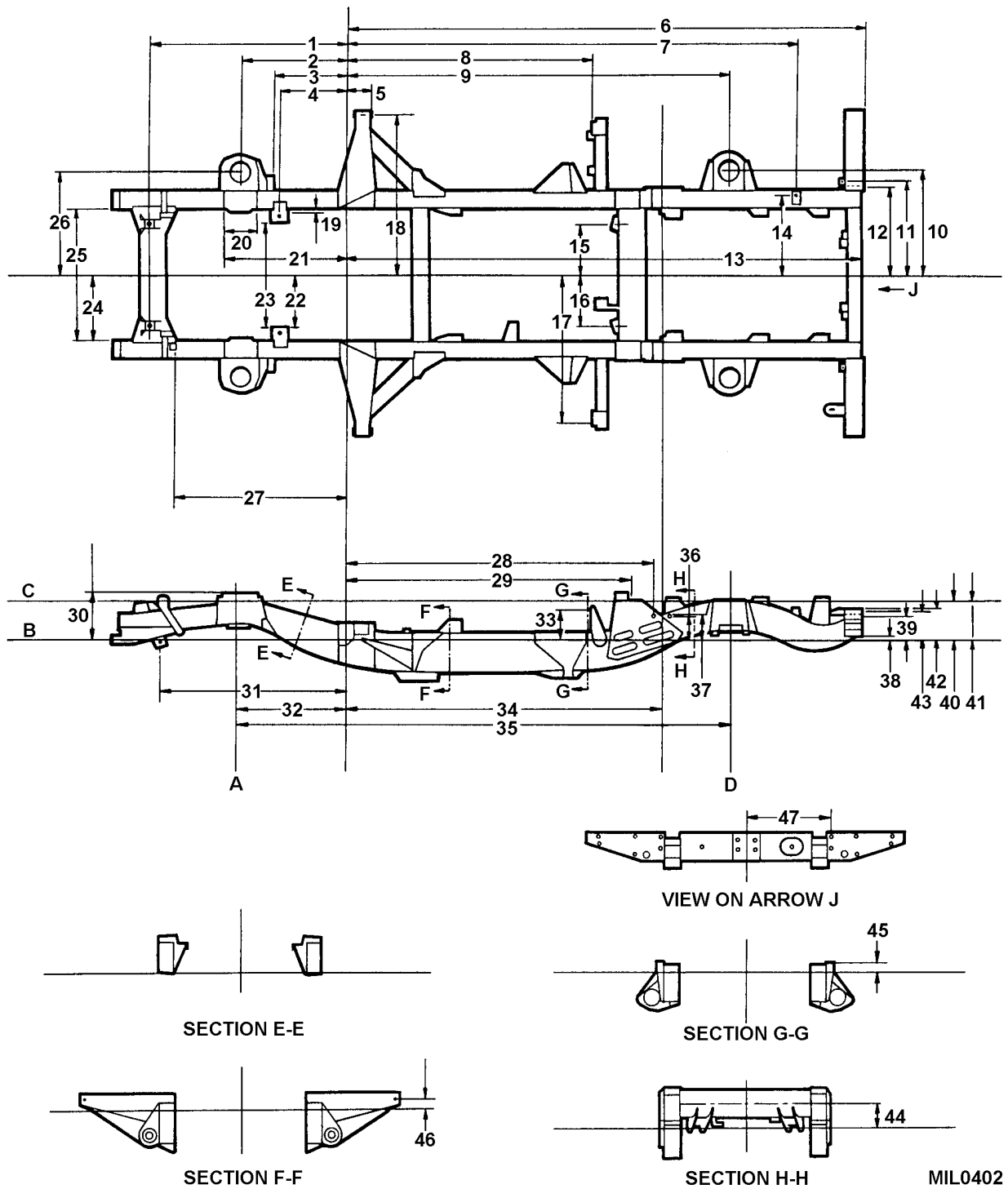
Fig 2 Field ambulance chassis frame diagonal measurements

CHASSIS DIMENSIONS

5 Chassis frame dimensional checks can be made with the vehicle upper structure removed, referring to the applicable illustration (Fig 3, 4 or 5) and their associated key.

KEY TO FIG 3**(All dimensions in millimetres)**

	A	Front axle	C	Body Datum
	B	Chassis Datum	D	Rear axle
1		940	25	634-636
2		504	26	483-488
3		347	27	816-820
4		317.4	28	1468.6-1472.6
5		111.7-115.7	29	1366.5
6		2474.1-2478.1	30	220-224
7		2155.6-2159.6	31	884
8		1178	32	519.9
9		1832.3	33	141-142
	10	486-491	34	1510.75
	11	436.25-440.25	35	2360
	12	410.5-411.5	36	113.2-114.2
	13	2474.1-2478.1	37	121.3
	14	372.3	38	15.5
	15	237.2-238.2	39	111.7-112.7
	16	241.2-242.2	40	186.9
	17	705	41	188.2-192.2
	18	748.8-752.8	42	148.5-149.5
	19	12.5	43	141.2
	20	156.5-158.5	44	113.2-114.2
	21	584-585	45	41-43
	22	248.5	46	52.8
	23	497	47	410.5-411.5
24		317-318		



MIL0402

Fig 3 TUL chassis alignment dimensions

KEY TO FIG 4**(All dimensions in millimetres)**

A	Front axle	C	Chassis datum
B	Body datum	D	Rear axle
1	584 - 585	21	816 - 820
2	503 - 505	22	316.4 - 318.4
3	3191 - 3195	23	220 - 224
4	2843 - 2845	24	186.9
5	2265.3 - 2267.3	25	519.9
6	1563.5 - 1565.5	26	883 - 885
7	1180.5 - 1182.5	27	800
8	495 - 500	28	1076.75
9	732.4 - 734.5	29	1510.75
10	366.2 - 367.2	30	2794
11	640	31	120.3 - 122.3
12	483 - 488	32	159.7 - 162.7
13	634 - 636	33	188.2 - 192.2
14	317 - 318	34	207.8 - 210.8
15	25 - 27	35	410.5 - 411.5
16	157 - 158	36	113.2 - 114.2
17	1799.5 - 1801.5	37	41 - 43
18	2471 - 2473	38	33 - 56
19	1903.6 - 1905.6	39	34 - 35
20	939 - 941	40	52.8

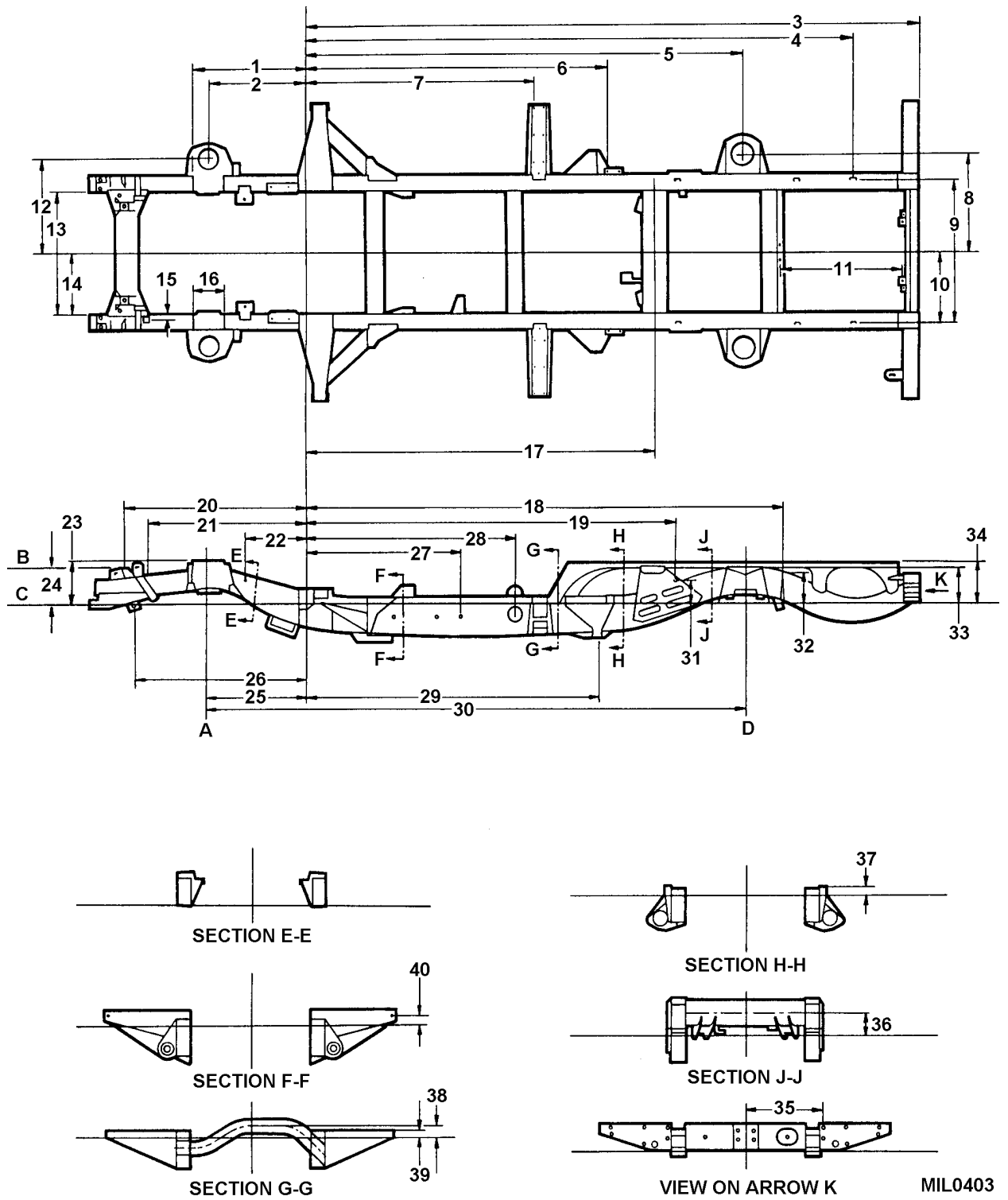


Fig 4 TUM chassis alignment dimensions

FRONT BUMPER**Removal**

- 6 To remove the front bumper carry out the following;
- 6.1 Remove the 4 bolts securing the front bumper to the chassis.
- 6.2 Remove the bumper from the chassis.

Refitting

- 7 The refitting of the bumper is the reversal of the removal procedure.

REAR BUMPER (TUL/TUM VEHICLES)**Removal**

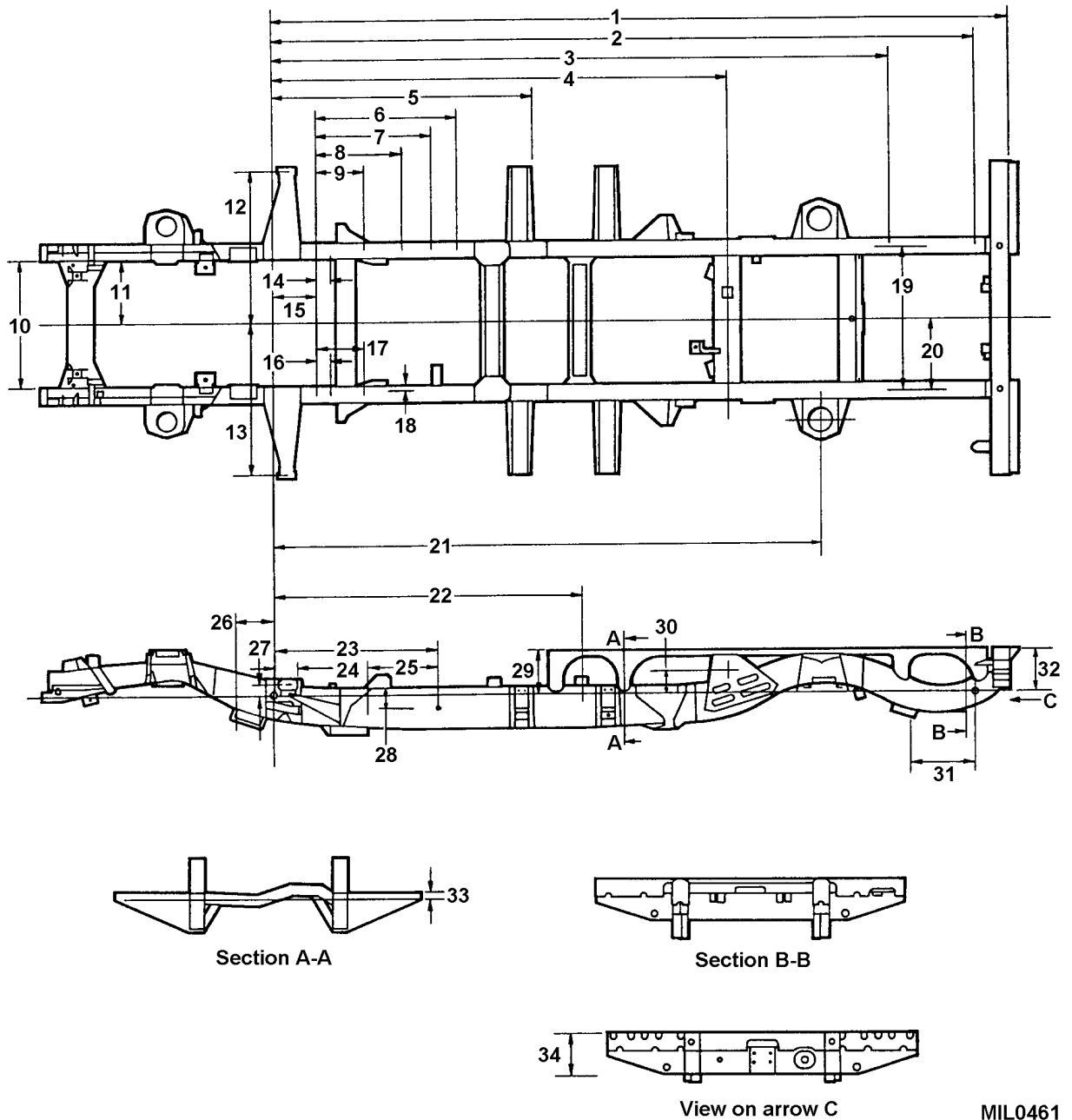
- 8 To remove the rear bumper carry out the following;
- 8.1 Remove the four bolts securing the rotating towing hook to the bumper remove.
- 8.2 Remove the trailer socket (refer to Chap 13-1)
- 8.3 Undo the four bolts securing the two bumperettes to the rear bumper and remove.
- 8.4 From underneath the bumper at each end, remove the two bolts securing the body mounting brackets to the bumper.
- 8.5 Check all fixings are removed and slide bumper pressing out from between the body and chassis.

Refitting

- 9 The refitting of the rear bumper is the reversal of the removal.

KEY TO FIG 5**(All dimensions in millimetres)**

A	Front axle	C	Body Datum
B	Chassis Datum	D	Rear axle
1	3624.8 - 3628.8	18	18
2	3452.8	19	710 - 712
3	3035 - 3037	20	355 - 356
4	2231.3 - 2233.3	21	2697.1 - 2699.1
5	1064 - 1065	22	1503.9 - 1505.9
6	694 - 695	23	799.5 - 800.5
7	567 - 568	24	111.7 - 115.7
8	423 - 424	25	349.5 - 350.5
9	232 - 233	26	177.5 - 179.5
10	634 - 637	27	52.3 - 53.3
11	317 - 318	28	65 - 66
12	750.4 - 751.4	29	207.8 - 210.8
13	750.4 - 751.4	30	113.2 - 114.2
14	72 - 73	31	314 - 316
15	207 - 208	32	207.8 - 210.8
16	72 - 73	33	34 - 35
17	232 - 233	34	207.8 - 210.8



MIL0461

Fig 5 Field ambulance chassis alignment dimensions

FRONT PROTECTION PLATE (TUL/TUM VEHICLES)

Removal

10 To remove the front protection plate carry out the following;

10.1 With the aid of a second fitter to support the protection plate remove the four bolts securing the protection plate to the side plates and lower the protection plate away from the vehicle.

10.2 If necessary, remove the side plates by removing the bolts securing them to the chassis and retrieve the spacers.

NOTE

On the one side the plate shares the same fixings as the panhard rod mounting arm and care must be taken to secure the mounting arm should the vehicle be moved for any reason.

Refitting

11 The refitting of the protection plate is the reverse of the removal.

CHAPTER 15-2

CHASSIS REPAIR TUL/TUM

CONTENTS

Para

	Introduction
1	Research Vehicle
2	Tools and Equipment
3	Methods and Techniques
15	Combination Times
20	Paint Refinishing
21	Painting
	Corrosion Protection Material - Chassis Injection Points (WARNINGS)
22	Location 1
23	Location 2
24	Location 3
25	Location 4
26	Location 5
27	Location 6
28	Location 7
29	Location 8
30	Location 9
31	Location 10
32	Location 11
33	Location 12
	Chassis Repair Operations
	Chassis Outriggers
	Outrigger - Front
34	Removal (CAUTION)
35	Replacement
	Outrigger - Rear
36	Removal (CAUTION)
37	Replacement
	Chassis Cross Members
	Number 1 Cross member
38	Removal
39	Replacement
	Number 2 Cross member
40	Removal
41	Replacement
	Number 3 Cross member
42	Removal
43	Replacement
	Number 7 Cross member
44	Removal
45	Replacement
	Chassis Frame
	Front Section Ahead of Number 2 Cross member
46	Removal
47	Replacement
	Front Spring Seat
48	Removal
49	Replacement

	Rear Spring Seat
50	Removal (CAUTION)
51	Replacement
	'C' Spanner Bracket
52	Removal
53	Replacement
	Trailing Link Bracket
54	Removal (CAUTION)
55	Replacement
	Front Quarter Right and Left Hand
56	Removal (CAUTION)
57	Replacement (CAUTION)
	Front Half Right and Left Hand
58	Removal (CAUTION)
59	Replacement (CAUTION)
	Tie-bar Front Body Mount 'C' Spanner Bracket
60	Removal (CAUTION)
61	Replacement

Table		Page
1	Special Tools	3
2	Sealants, adhesives and lubricants	3
3	Welding	15
4	Welding	16
5	Welding	20
6	Welding	25
7	Welding	27
8	Welding	29
9	Welding	31
10	Welding	33
11	Welding	35
12	Welding	38
13	Welding	41
14	Welding	43

Fig		Page
1	Corrosion Protection - Chassis Injection Points	8
2	Corrosion Protection - Chassis Injection Points	8
3	Corrosion Protection - Chassis Injection Points	9
4	Corrosion Protection - Chassis Injection Points	9
5	Corrosion Protection - Chassis Injection Points	10
6	Corrosion Protection - Chassis Injection Points	10
7	Corrosion Protection - Chassis Injection Points	11
8	Corrosion Protection - Chassis Injection Points	11
9	Corrosion Protection - Chassis Injection Points	12
10	Corrosion Protection - Chassis Injection Points	12
11	Corrosion Protection - Chassis Injection Points	13
12	Corrosion Protection - Chassis Injection Points	13
13	Outrigger - Front - Replacement	17
14	Outrigger - Rear - Replacement	18
15	Number 1 Cross member - Replacement	19
16	Number 2 Cross member - Replacement	21
17	Number 3 Cross member - Replacement	23
18	Number 7 Cross member - Replacement	26
19	Front Section Ahead of Number 2 Cross member - Replacement	28
20	Front Spring Seat - Replacement	30
21	Rear Spring Seat - Replacement	32
22	'C' Spanner Bracket - Replacement	34

23	Trailing Link Bracket - Replacement.....	36
24	Front Quarter Right and Left Hand - Replacement.....	39
25	Front Half Right and Left Hand - Replacement	42
26	Tie-bar Front Body Mount 'C' Spanner Bracket - Replacement	44
27	Rear Spring Seat Alignment Jig Attachment	45/46

INTRODUCTION

Research Vehicle

1 The schedule times shown on the following pages were obtained under Thatcham workshop conditions using methods developed in conjunction with Land Rover. The manual has been based on methods and times derived from a basic 110 specification Defender. Variations from this basic specification may require the adjustment of time values. Complete chassis frame replacement is approximately 33.5hrs.

Tools and Equipment

2 The tools and equipment used are those readily available to the accident repair trade. The following table, whilst not exclusive, details those tools used at Thatcham:

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Cengar JP901		Pneumatic Saw
2	CP Tools CP788		Airdrill
3	Mueskinner		Bonded Wire Brush
4	Desoutter M367		Orbital Sander
5	Various		MIG Welder

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Spies Hecker, Z2852		Spies Hecker 2K Paint System comprising:
2	Spies Hecker, 3255		Metal Conditioner
3	Spies Hecker, 5040		Primer
4	Spies Hecker, 257 Series		Undercoat
			Topcoat
			Corrosion protection wax materials
4	Astor Chemicals, DA 3079		Anti-corrosion solution
	Astor Chemicals, DA 3397		Anti-corrosion solution
6	Croda, PG 176		Anti-corrosion solution
	Croda, PW 110		Anti-corrosion solution
7	EMS Togo, PP 101		Anti-corrosion solution

8	Valvoline - Tectyl, 544-PC	Anti-corrosion solution
9	Edgar Vaughan, RB 8468	Anti-corrosion solution

NOTE:

The corrosion protection wax materials (refer to Table 2 Serial 5 to 9) are approved to BLS22 CP05 for use in corrosion protection operations after repairs.

Methods and Techniques

3 The methods and techniques employed in this manual are based on those developed by Thatcham over many years of practical experience, modified in conjunction with Land Rover for application to repairs on the Defender chassis.

Chassis

4 A welded chassis frame replacement method is shown and detailed in the individual chassis replacement notes in the Chassis Repair Operations section (refer Para 34). Where appropriate, details of bolted components have also been included.

M.E.T. & Body

5 The Operation Times include an allowance for the removal and replacement of M.E.T. items and body components necessary to gain repair access to the chassis frame. These times allow for the removal and replacement of assemblies such as headlamps and suspension units, but do not allow for unnecessary assembly, overhaul or repair of component parts that may be involved. All items removed and replaced are tested and adjusted to ensure correct function.

Wiring Loom

6 Certain repair operations necessitate the partial withdrawal of the wiring loom to avoid the risk of burning using a draw cord that must be left in position to facilitate subsequent replacement. In such operations the loom must be withdrawn from the front to the rear of the vehicle with the exception of the Number 7 Cross member, where the loom is withdrawn from rear to front.

Fuel Tank

7 Removal and replacement of the fuel tank has also been included in the M.E.T. times where its removal is necessary to carry out chassis repairs.

8 In addition a separate time for the fuel tank is shown to allow for cases where it is desirable to treat it in isolation for safety purposes.

9 Where it is necessary to remove the fuel tank an allowance has been made in the Operation Times for draining and refilling with 2 gallons of fuel.

Steering Alignment

10 In those chassis repair operations where it is necessary to carry out a steering alignment check, the Operation Time includes a time for setting up the relevant equipment on the vehicle and conducting a data check only. The time does not include carrying out adjustments. A computerised alignment system was used for this purpose on the research vehicle.

11 M.E.T. and body allowances relate only to the work carried out on a basic specification 110 Defender and may need to be adjusted where a different model version is undergoing repair.

Paint

12 The Operation Times include an allowance for refinishing of the chassis in a two-pack synthetic paint system (refer to Para 21 for further details). The use of alternative paint systems may require adjustment to published times.

Corrosion Protection

13 Published Operation Times include an allowance for the internal wax treatment of welded areas in order to enhance corrosion resistance.

14 The corrosion protection wax materials (refer to Table 2 Serial 5 to 9) are approved to BLS22 CP05 for use in corrosion protection operations after repairs.

Combination Times

15 Where an Operation Time is required for a job incorporating two or more of the published single Operation Times, a guide time can be established by adding single Operation Times together and making the following adjustments:

M.E.T. & Body:

16 It is not possible to establish Operation Times for the M.E.T. in combinations of repair operations due to the complexity of areas of overlap. Such allowances will need to be estimated using the published information as a guide.

Chassis:

17 Because the chassis repairs in each operation are treated separately no deduction for overlap needs to be made.

Paint:

18 Some elements such as mixing materials, cleaning spray guns etc. are common to a paint operation. It is therefore necessary to deduct 0.7hrs. for each additional repair used.

Corrosion Protection:

19 A deduction of 0.2hrs. for each additional repair used should be made for common elements such as setting up and cleaning equipment.

PAINT REFINISHING

20 Refinishing System used: Spies Hecker 2K system comprising Z2852 Metal Conditioner, 3255 Primer, 5040 Undercoat and 257 Series Topcoat.

Painting

21 Number of coats: 1 of Primer, 2 of Undercoat and 2 of Topcoat.

21.1 Prepare affected area of chassis for refinishing.

21.2 Prepare metal conditioner.

21.3 Apply metal conditioner to bare metal.

21.4 Wash and dry affected area of chassis.

21.5 Clean brush.

- 21.6 Solvent wipe affected area of chassis.
- 21.7 Apply masking tape and protective covering sheets.
- 21.8 Move vehicle into booth.
- 21.9 Fit wheel covers as required.
- 21.10 Solvent wipe paint area.
- 21.11 Prepare primer.
- 21.12 Apply 1 primer coat using spray gun.
- 21.13 Clean spray gun.
- 21.14 Prepare undercoat.
- 21.15 Spray on undercoat.
- 21.16 Wash out and clean spray gun.
- 21.17 Prepare top coat paint material.
- 21.18 Spray on top coat.
- 21.19 Wash out and clean spray gun.
- 21.20 Remove masking tape and protective covering sheets.
- 21.21 Allow paint to cure.
- 21.22 Move vehicle out of booth.

CORROSION PROTECTION MATERIAL - CHASSIS INJECTION POINTS

WARNINGS

- (1) INGESTION. THE SWALLOWING OF ANTI-CORROSION MATERIAL CAN CAUSE VOMITING AND ABDOMINAL PAIN. IF INGESTED MEDICAL ATTENTION MUST BE SOUGHT IMMEDIATELY**
- (2) INHALATION. INHALATION OF ANTI-CORROSION MATERIAL CAN CAUSE IRRITATION OF THE NOSE, THROAT AND RESPIRATOR TRACT, DROWSINESS AND HEADACHE. GOOD VENTILATION AND A FILTER TYPE RESPIRATOR MUST BE USED AT ALL TIMES. IF INHALATED THE SUBJECT MUST BE REMOVED FROM EXPOSURE AND MEDICAL ATTENTION SOUGHT IMMEDIATELY.**
- (3) EYE CONTACT. ANTI-CORROSION LIQUID, MIST OR VAPOUR WILL CAUSE CONJUNCTIVAL IRRITATION. CONTACT LENSES SHOULD BE REMOVED, AND IF CONTACT MADE, IRRIGATE WITH CLEAN FRESH WATER FOR AT LEAST 10 MINUTES HOLDING EYELIDS APART. SEEK MEDICAL ATTENTION IMMEDIATELY.**
- (4) SKIN CONTACT. PROLONGED CONTACT WITH THE SKIN SHOULD BE AVOIDED AS IT CAN LEAD TO DEGREASING OF THE SKIN AND IRRITATION. WASH THOROUGHLY IN SOAP AND WATER OR USE A PROPRIETY SKIN CLEANER. SOLVENTS MUST NOT BE USED TO CLEAN THE SKIN. PROTECT EXPOSED SKIN WITH VASELINE PETROLEUM JELLY.**
- (5) PROTECTIVE CLOTHING. ENSURE SUITABLE PROTECTIVE CLOTHING IS WORN BEFORE USING ANTI-CORROSION MATERIAL. ALWAYS WEAR SUITABLE PROTECTIVE OVERALLS, A FILTER TYPE RESPIRATOR, SAFETY GLASSES, GLOVES AND HEAD PROTECTION.**

NOTE:

Injection points shown for both RH and LH sides where applicable.

Location 1

22 Wiring loom entry point at chassis inner face, directly behind outrigger at 1. Also through hole in top face of outrigger at 2 above tie bar weld.

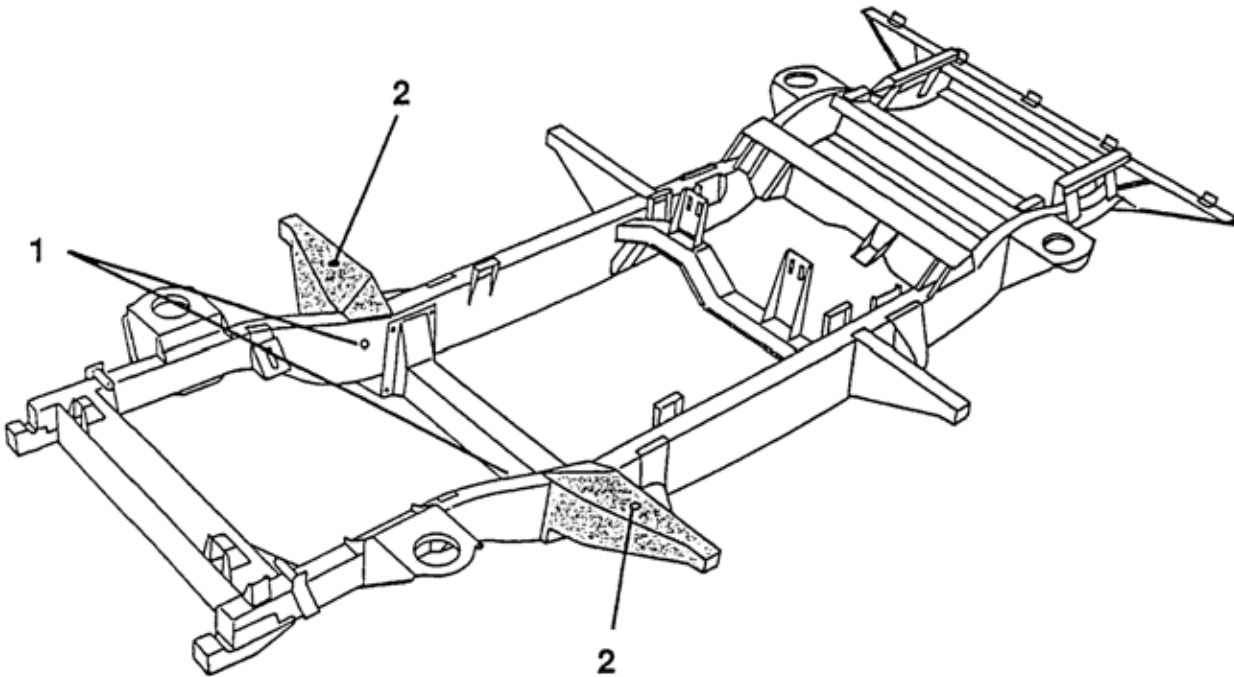


Fig 1 Corrosion Protection - Chassis Injection Points

Location 2

23 Hole on outer face of chassis longitudinal immediately ahead of rear outrigger at 3.

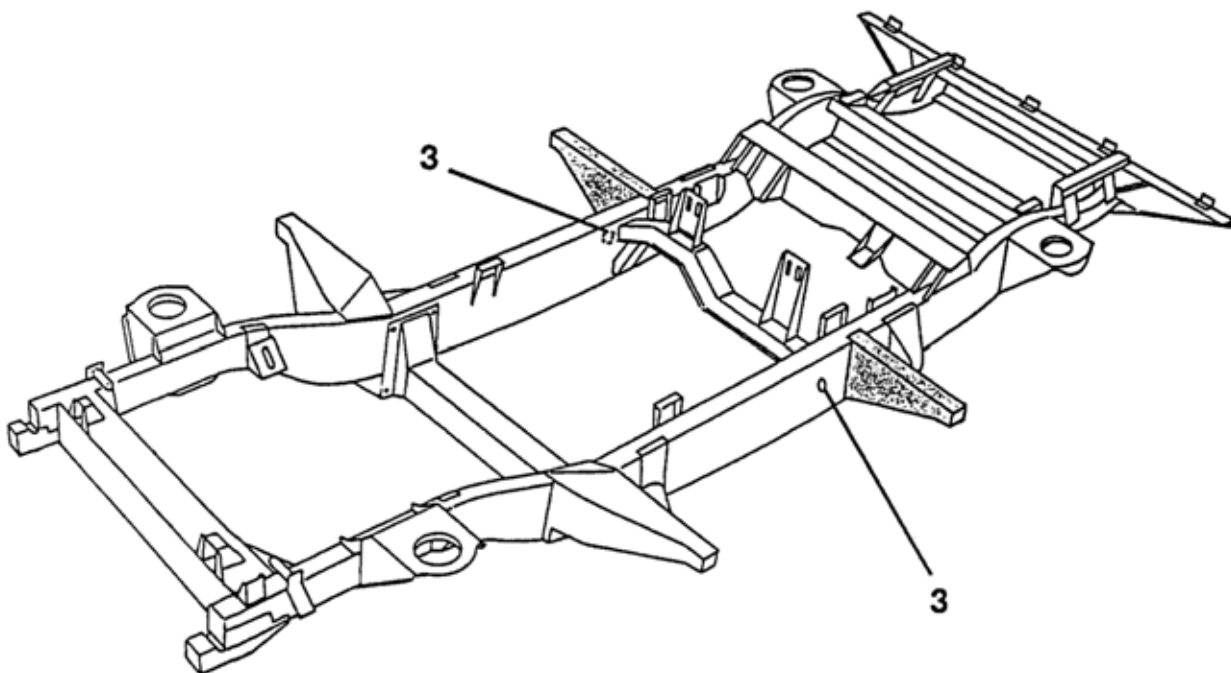


Fig 2 Corrosion Protection - Chassis Injection Points

Location 3

24 Holes at forward face of chassis longitudinal at 4, at corner gusset 7 and rear face of No. 2 cross member 6.

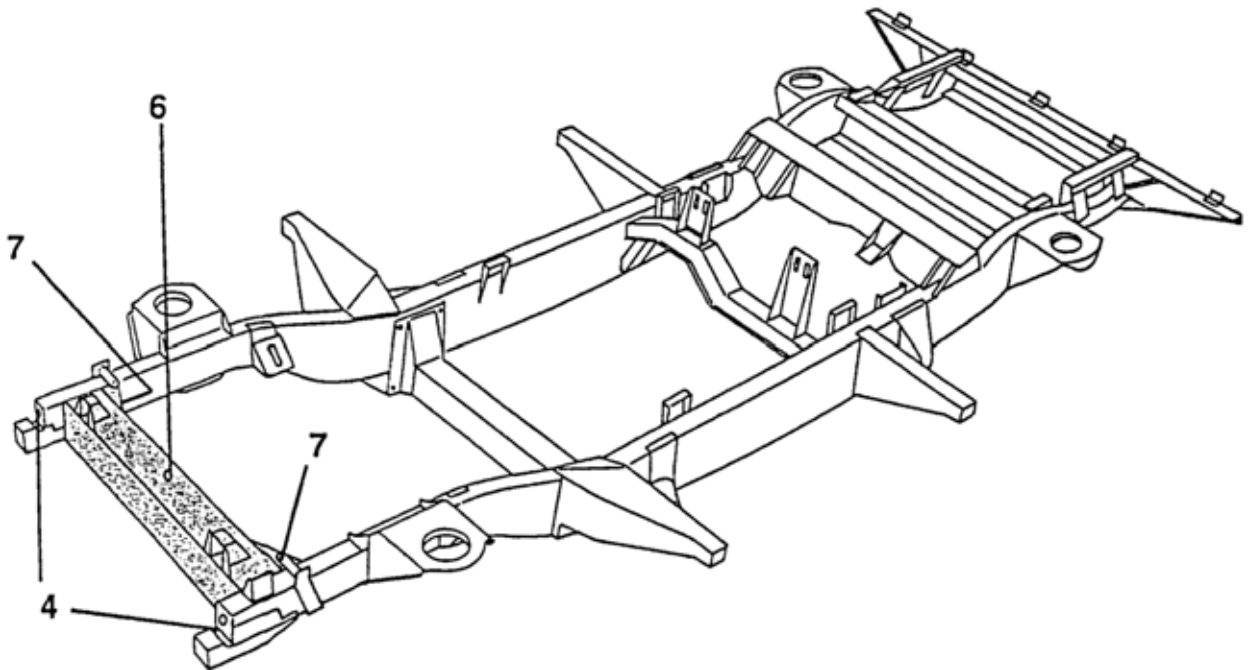


Fig 3 Corrosion Protection - Chassis Injection Points

Location 4

25 Rear wiring loom entry hole at chassis longitudinal 8.

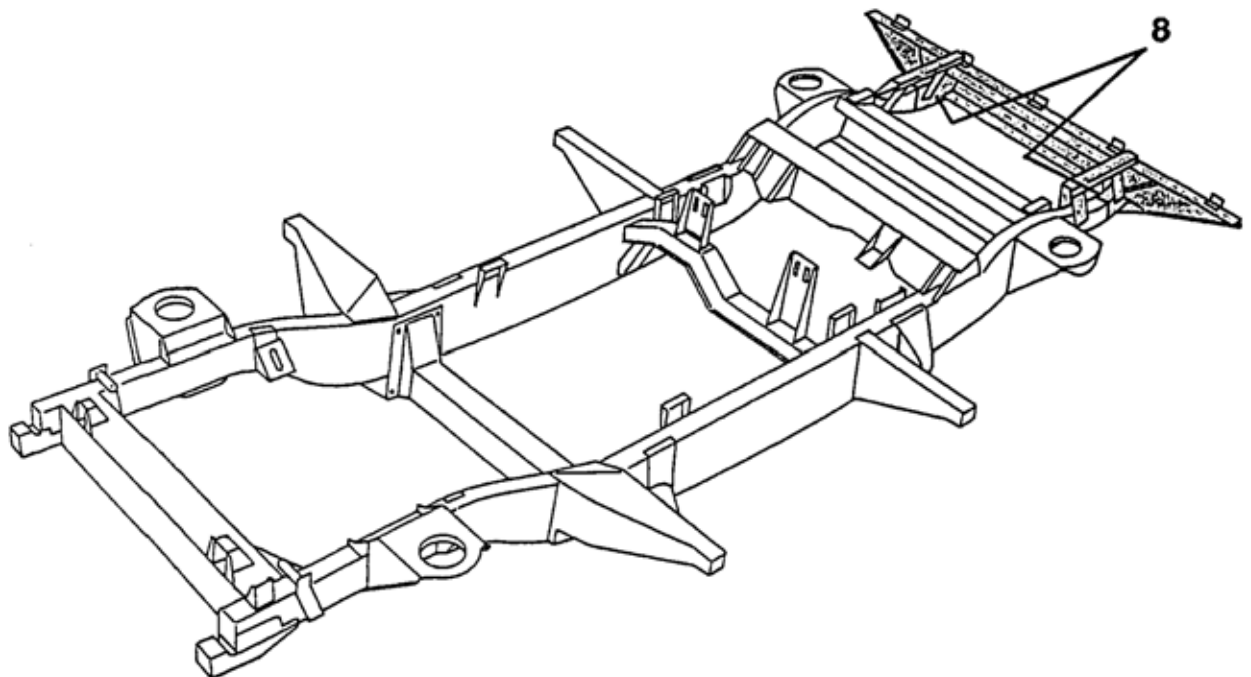


Fig 4 Corrosion Protection - Chassis Injection Points

Location 5

26 Hole at forward face of chassis longitudinal at 4, slot at upper face 5 and hole at rear face of No. 2 cross member 6.

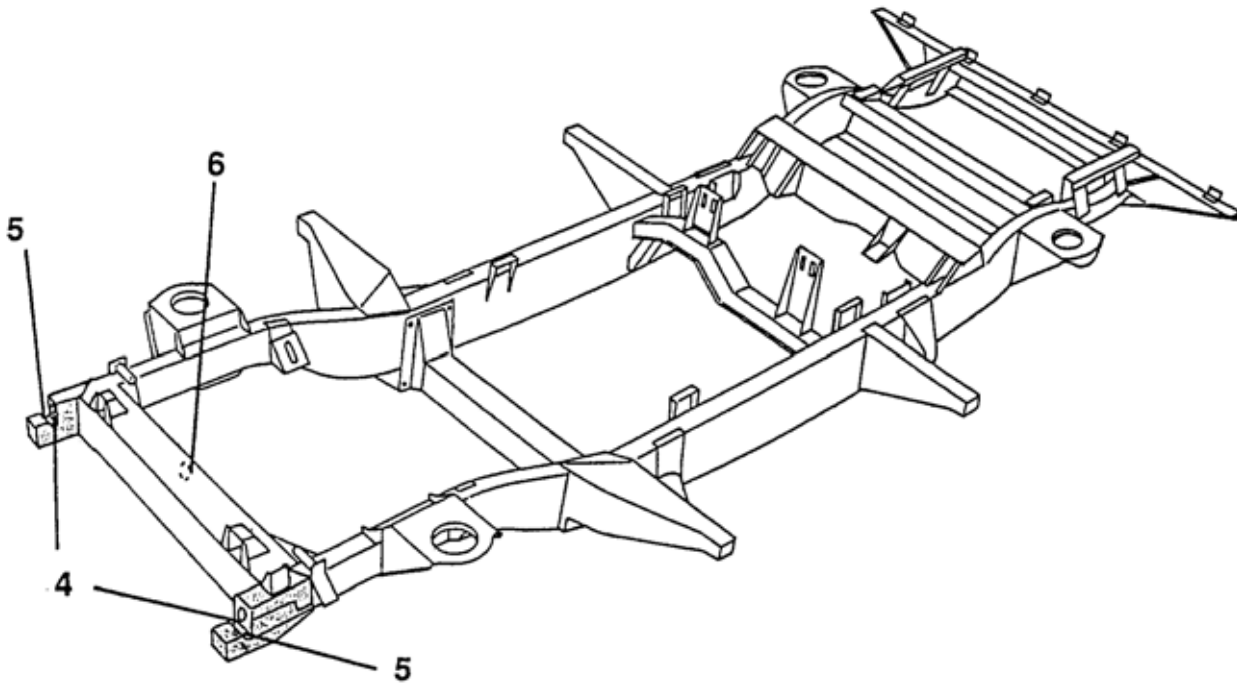


Fig 5 Corrosion Protection - Chassis Injection Points

Location 6

27 Hole at forward face of chassis longitudinal at 4 (using 1 metre metal extension probe).

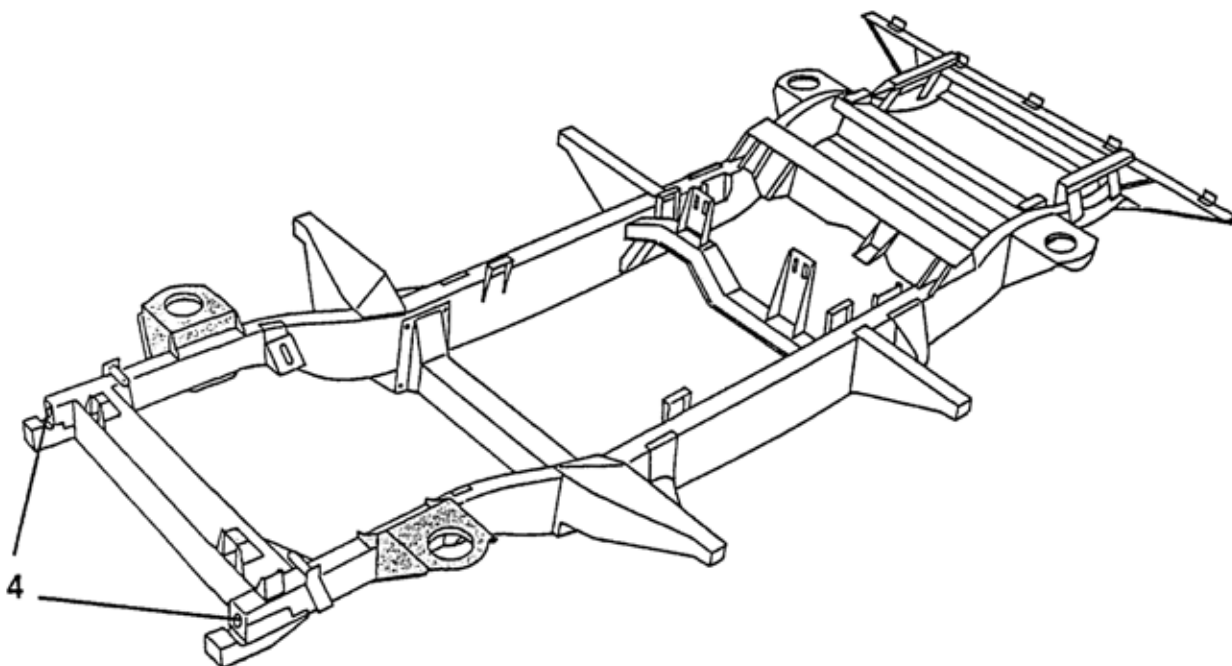


Fig 6 Corrosion Protection - Chassis Injection Points

Location 7

28 Rear wiring loom entry hole at chassis longitudinal 8.

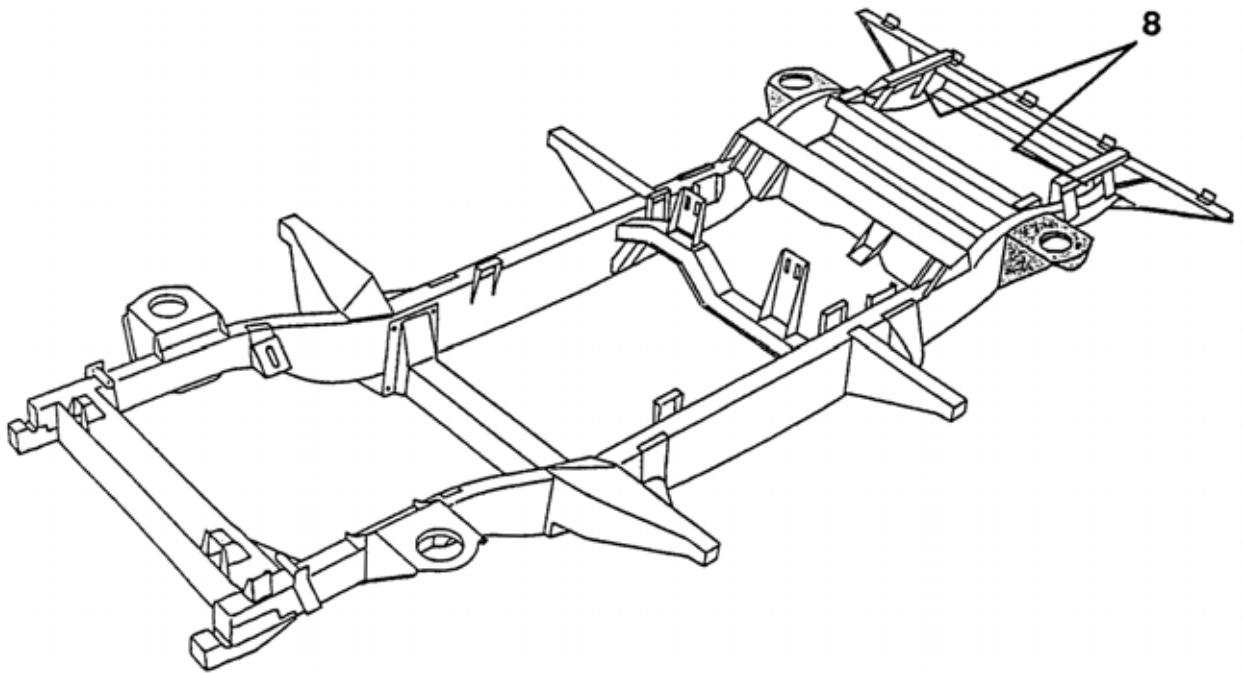


Fig 7 Corrosion Protection - Chassis Injection Points

Location 8

29 Wiring loom entry point at chassis inner face, directly behind outrigger at 1. Also through hole in top face of outrigger above tie bar weld at 2.

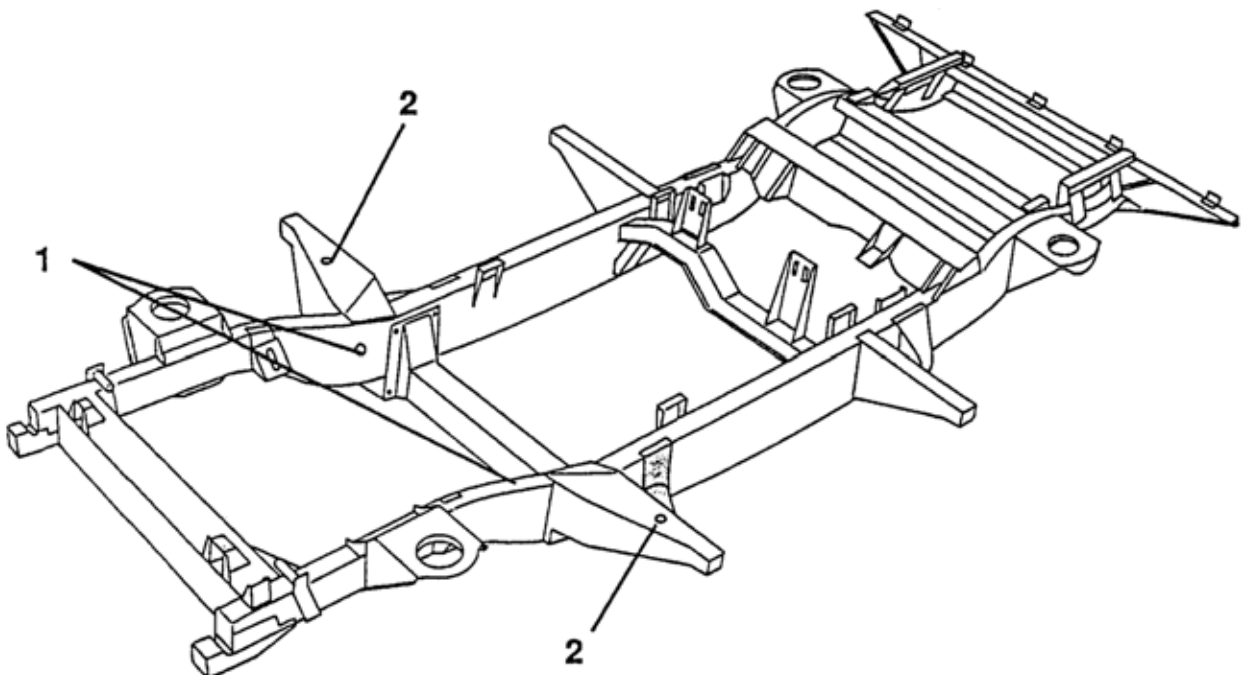


Fig 8 Corrosion Protection - Chassis Injection Points

Location 9

30 Hole at outer face of chassis longitudinal directly ahead of rear outrigger at 9.

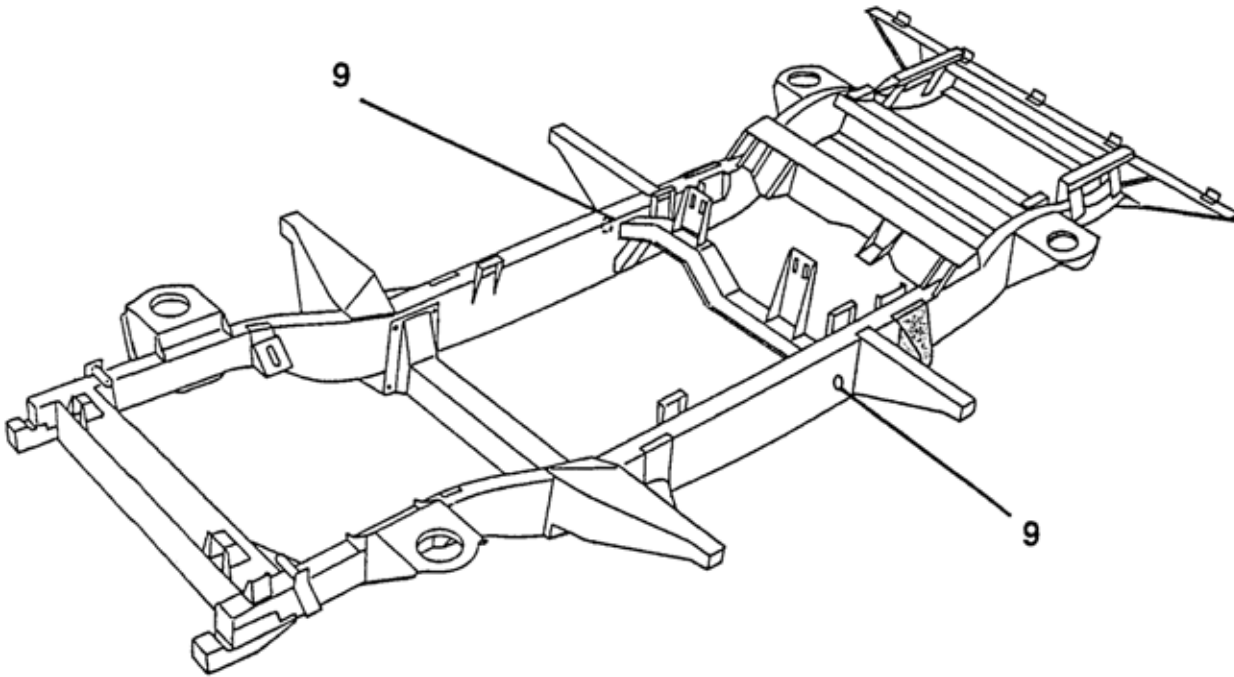


Fig 9 Corrosion Protection - Chassis Injection Points

Location 10

31 Holes at outer and forward faces of chassis longitudinal Nos. 4 and 9, at corner gusset 7 and rear face of No. 2 cross member 6 (injected towards appropriate side).

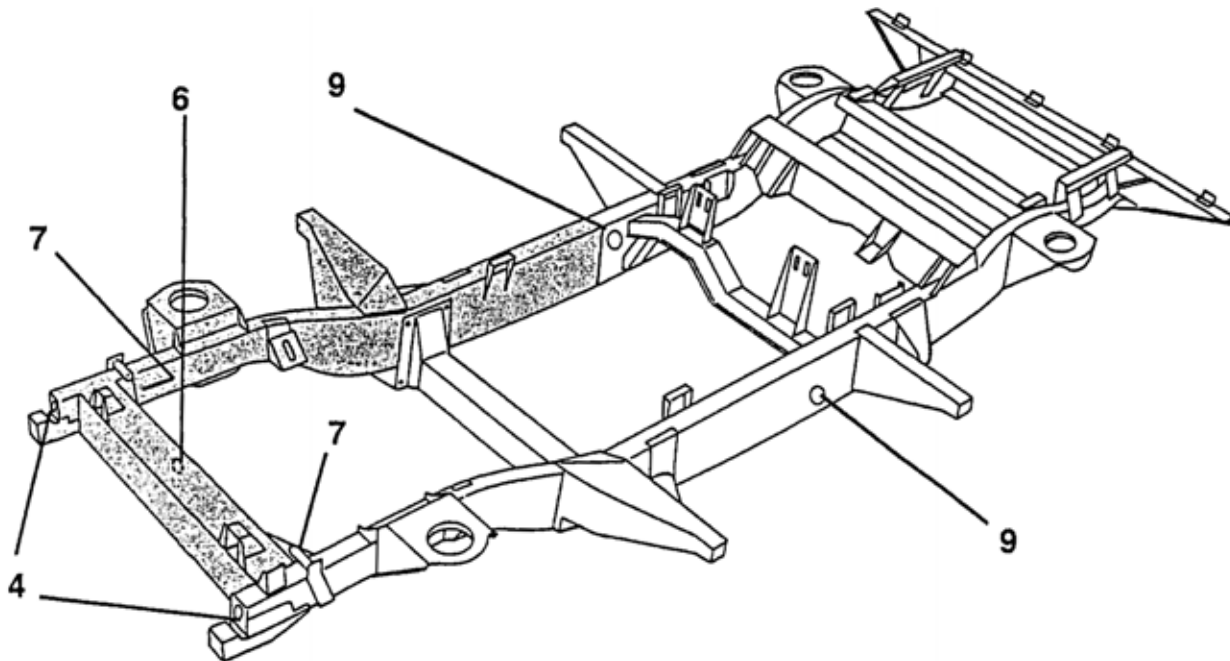


Fig 10 Corrosion Protection - Chassis Injection Points

Location 11

32 Holes at outer and forward faces of chassis longitudinal No. 9.

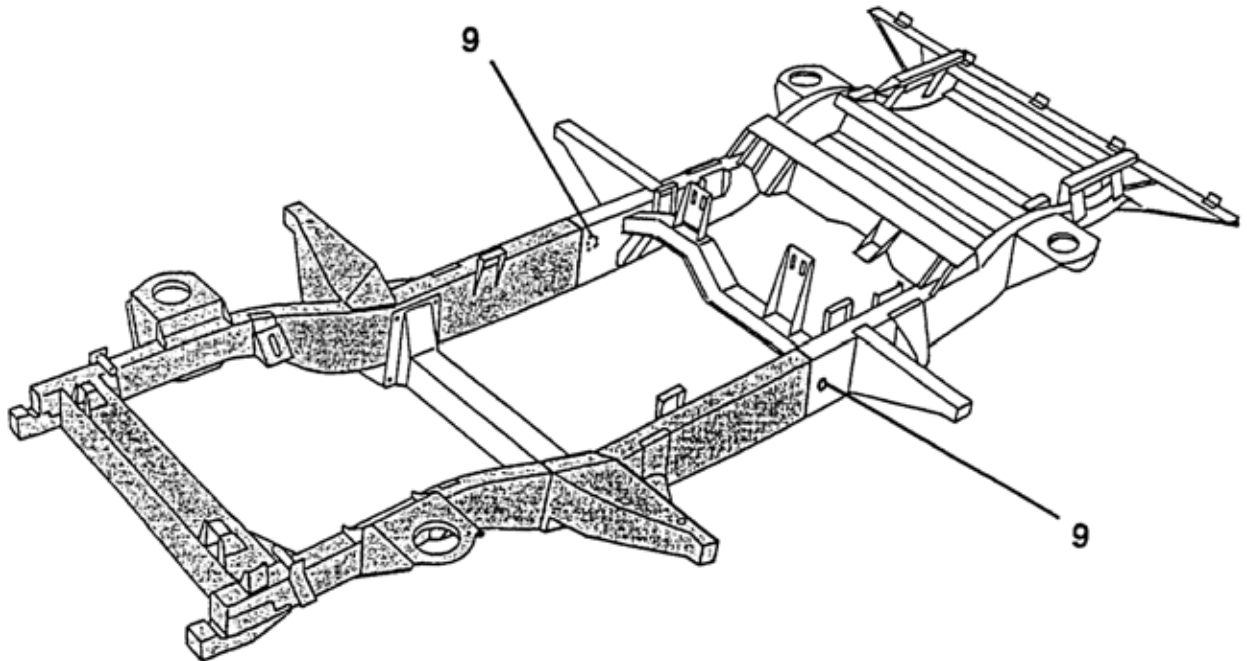


Fig 11 Corrosion Protection - Chassis Injection Points

Location 12

33 Wiring loom point at chassis inner face, directly behind outrigger at 1. Also through hole in top face of outrigger above tie bar weld at 2.

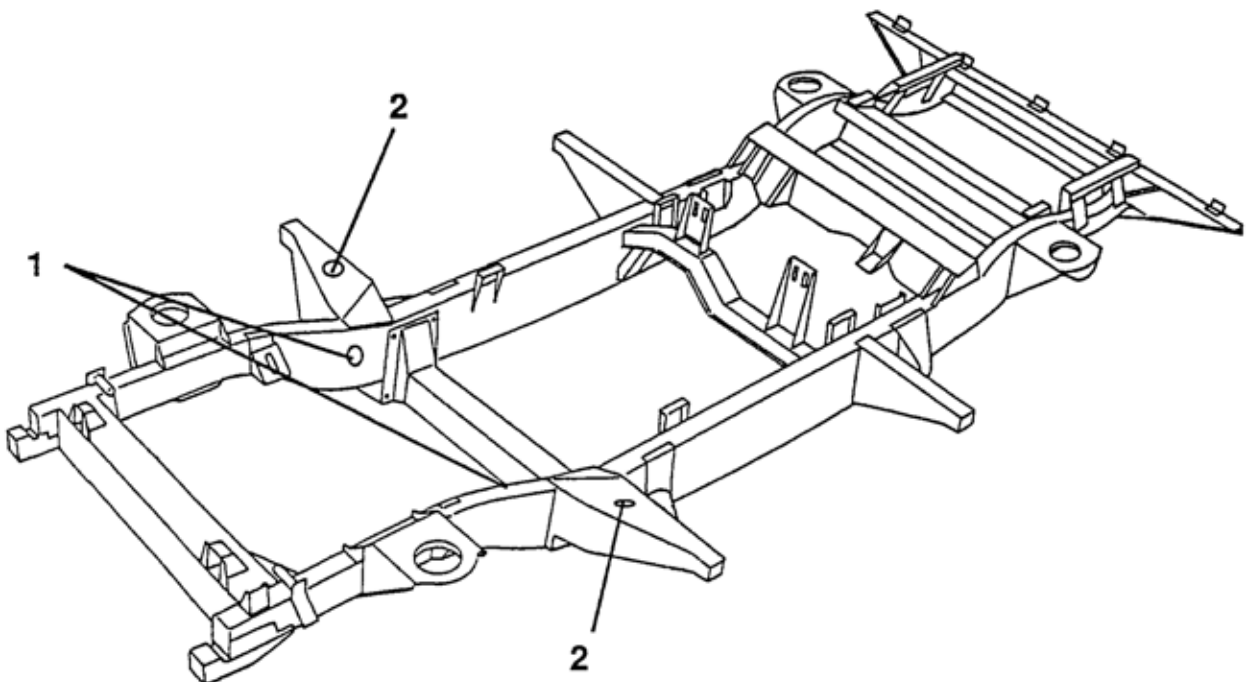


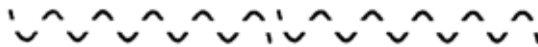
Fig 12 Corrosion Protection - Chassis Injection Points

CHASSIS REPAIR OPERATIONS**Key to symbols**

Visible Saw Cut



Hidden Saw Cut



MIG Seam/Fillet Welds



MIG Plug Welds (Visible)



MIG Plug Welds (Hidden)

**CHASSIS OUTRIGGERS****Outrigger - Front****Removal**

34 Remove the front outrigger as follows:

34.1 Cut outrigger at points A and B in Fig 13.

34.2 Remove outrigger bulk and remove metal remnants from chassis and tie bar.

CAUTION:

Take care to avoid thinning the chassis frame in this area when grinding off the remnants.

34.3 Remove upper mounting bolt at No. 3 cross member as shown at point C.

Associated parts to be removed and replaced

Front Panel.

Front Wing RH and LH.

Cab Unit.

Electrical

The wiring loom must be withdrawn for access when replacing a RH outrigger (refer to Para 6).

Replacement

35 Replacement of the front outrigger is as follows:

35.1 Offer up new front outrigger, mark chassis weld area locations, remove outrigger and dress new and existing joint areas for welding.

35.2 Apply red brown anti-corrosion primer to side face of chassis member at original welded areas.

35.3 Offer up outrigger, MIG seam weld in position at Nos. 1 and 2.

35.4 Check alignment of bolt mounting holes X and re-shape as necessary.

Paint and corrosion protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 3 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To chassis member	1 x 770mm MIG seam weld	1 x 970mm MIG seam weld
2	To tie bar	1 x 330mm MIG seam weld	1 x 330mm MIG seam weld

Time Required

Time 19.8hrs RH
19.6hrs LH

Outrigger - Rear

Removal

36 Remove the rear outrigger as follows:

36.1 Cut outrigger at point C in Fig 14. Remove outrigger bulk and remove metal remnants from chassis.

CAUTION:

Take care to avoid cutting into the reinforcement at the lower section and reducing the thickness of the chassis frame when grinding off the remnants.

Associated parts to be removed and replaced

NOTE:

It is unnecessary to remove any associated panels during this repair operation, although care should be taken to avoid damage to adjacent panel work.

Mechanical, Electrical and Trim

Remove and replace support brackets adjacent to outrigger, lay aside brake pipes/ hoses as necessary.

NOTE:

When replacing a RH outrigger the wiring loom must be withdrawn for access as described in Introduction section (refer to Para 6).

Replacement

37 Replacement of the rear outrigger is as follows:

- 37.1 Offer up new rear outrigger complete with reinforcing plate attached as supplied, mark chassis weld area locations, remove outrigger and dress new and existing joint areas for welding.
- 37.2 Apply red brown anti-corrosion primer to side face of chassis member at original welded areas.
- 37.3 Offer up outrigger, MIG seam weld in position at No. 1.
- 37.4 Dress seam weld.

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 4 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To chassis member	1 x 610mm MIG seam weld	1 x 850mm MIG seam weld

Time Required

Time 6.1hrs RH
5.3hrs LH

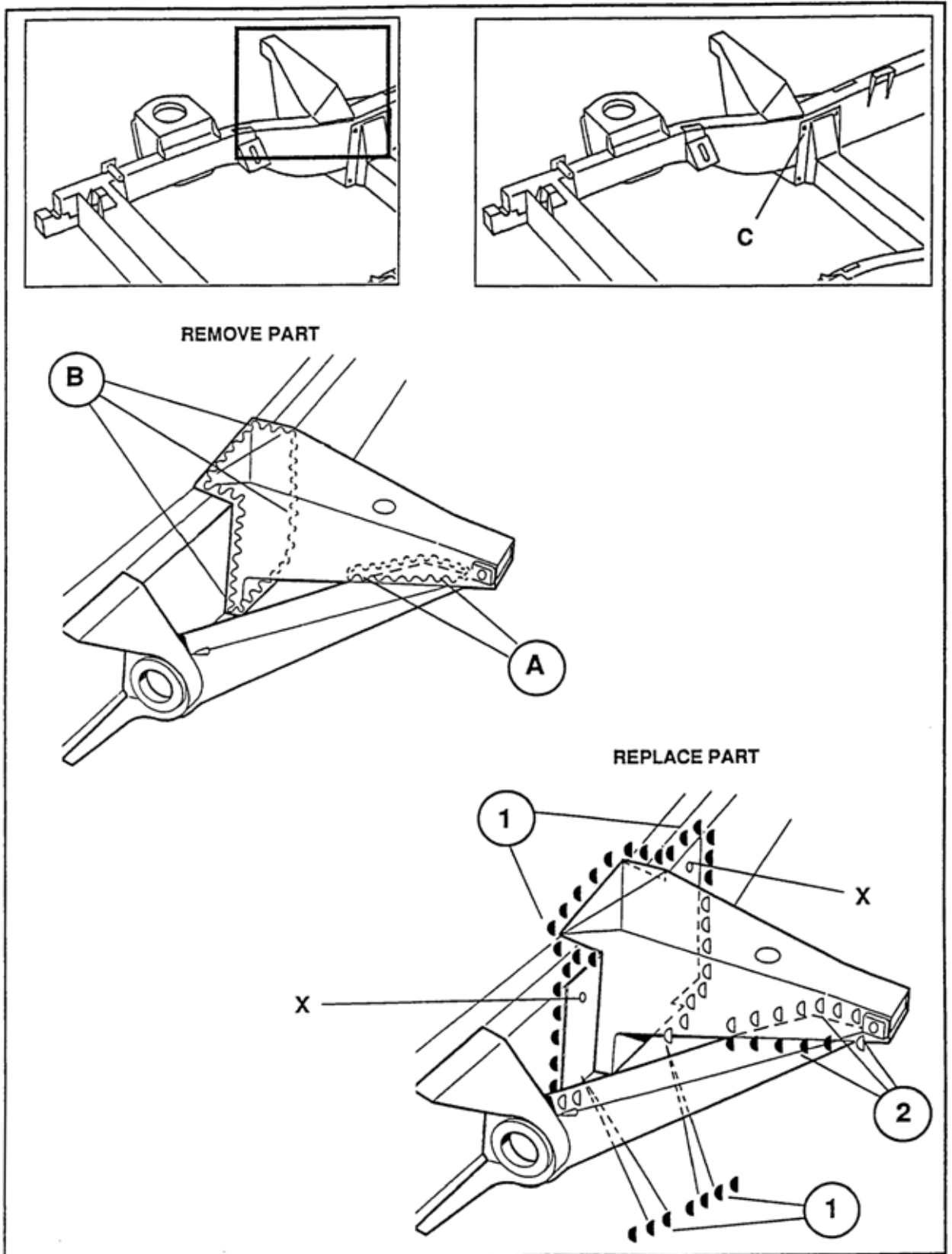


Fig 13 Outrigger - Front - Replacement

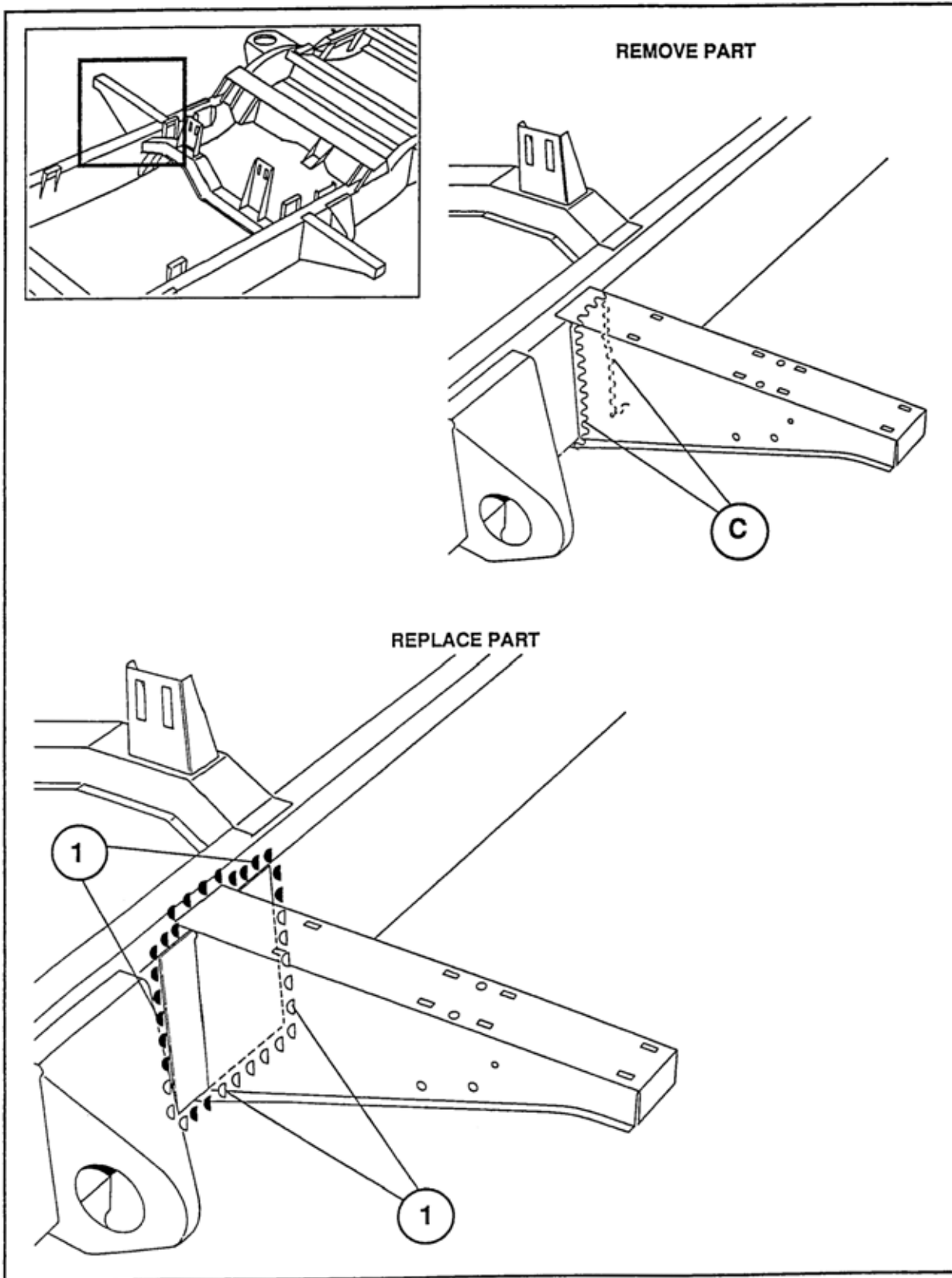


Fig 14 Outrigger - Rear - Replacement

CHASSIS CROSS MEMBERS

NUMBER 1 CROSS MEMBER

Removal

38 Remove the cross member as follows:

38.1 Remove 2 mounting bolts from bracket at cross member upper face RH and LH (see Fig 15).

38.2 Remove cross member from vehicle.

Replacement

39 Replacement of the cross member is as follows:

39.1 Transfer number plate to new cross member, offer up cross member, replace 2 mounting bolts at bracket RH and LH, check alignment and tighten bolts.

Mechanical

Carry out a steering alignment check as necessary observing the points described in Introduction section (refer to Para 10).

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

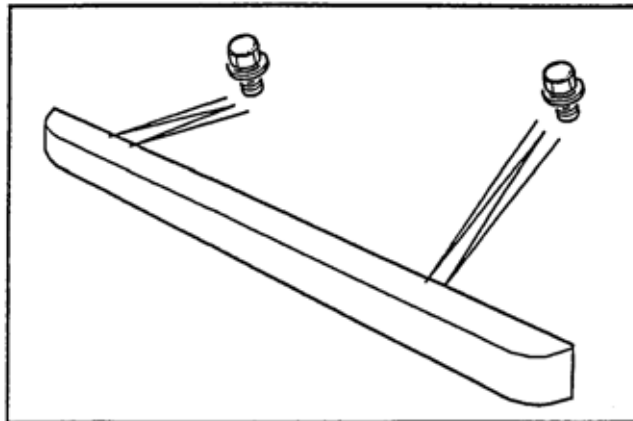


Fig 15 Number 1 Cross member – Replacement

Time Required

Time 0.6hrs

NUMBER 2 CROSS MEMBER**Removal**

40 Remove the cross member as follows:

40.1 Cut cross member and gussets at points D in Fig 16 taking care not to damage the Panhard rod mounting tube at X.

NOTE:

The outer ends of the cross member rear face where they are enclosed by the gussets are not welded in production or subsequent replacement due to insufficient access.

40.2 Remove cross member bulk and metal remnants.

Associated parts to be removed and replaced

No. 1 Cross member front panel, radiator, steering box, lay aside steering damper.

Replacement

41 Replacement of the cross member is as follows:

41.1 Offer up new cross member assembly, mark chassis weld area locations, remove new section and dress new and existing joint areas for welding.

41.2 Offer up cross member assembly, clamp in position and MIG seam weld at No. 1 RH and LH.

41.3 Dress all seam welds.

Mechanical

Carry out a steering alignment check as necessary observing the points described in Introduction section (refer to Para 10).

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 5 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To chassis member RH and LH	1 x 550mm MIG seam weld each side	1 x 550mm MIG seam weld each side

Time Required

Time 9.5hrs

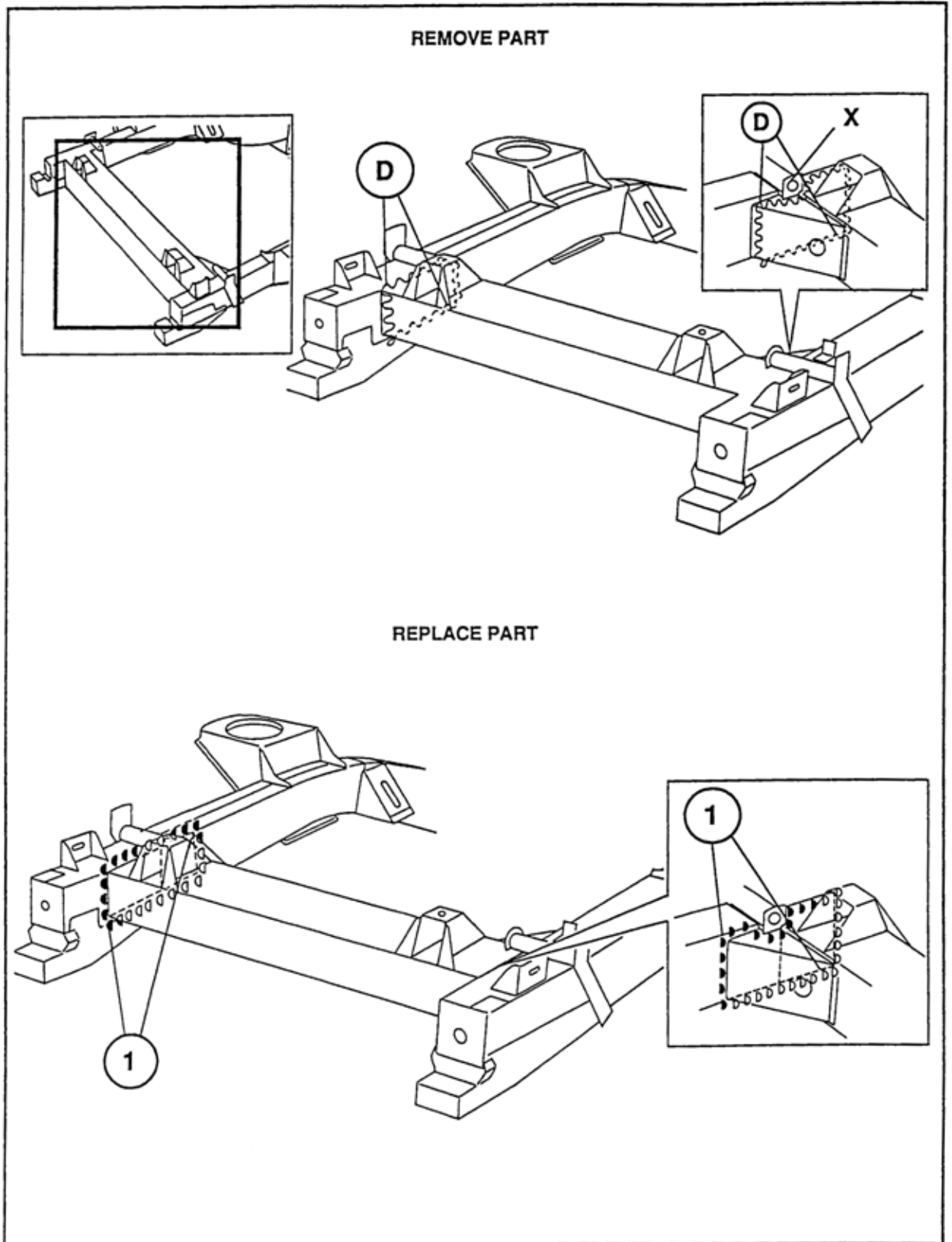


Fig 16 Number 2 Cross member - Replacement

NUMBER 3 CROSS MEMBER**Removal**

42 Remove the cross member as follows:

42.1 Raise vehicle on lift, remove 4 mounting bolts and nuts to chassis member RH and LH as shown in Fig 17, dislodge cross member using a copper-faced mallet or similar, remove cross member from chassis.

NOTE:

Should difficulty be experienced in removing the cross member it may be necessary to use a suitable power-operated chassis spreader to relieve the strains. The Replacement Time Schedules in this Manual do not allow for this operation.

Replacement

43 Replacement of the cross member is as follows:

43.1 Offer up new cross member, replace 4 mounting bolts and nuts to chassis member RH and LH, check alignment and tighten all fasteners, lower vehicle.

NOTE:

Should difficulty be experienced in offering up the cross member it may be necessary to use a suitable power-operated chassis spreader to relieve the strains. The Replacement Time Schedules in this Manual do not allow for this operation.

Time Required

Time 1.1hrs

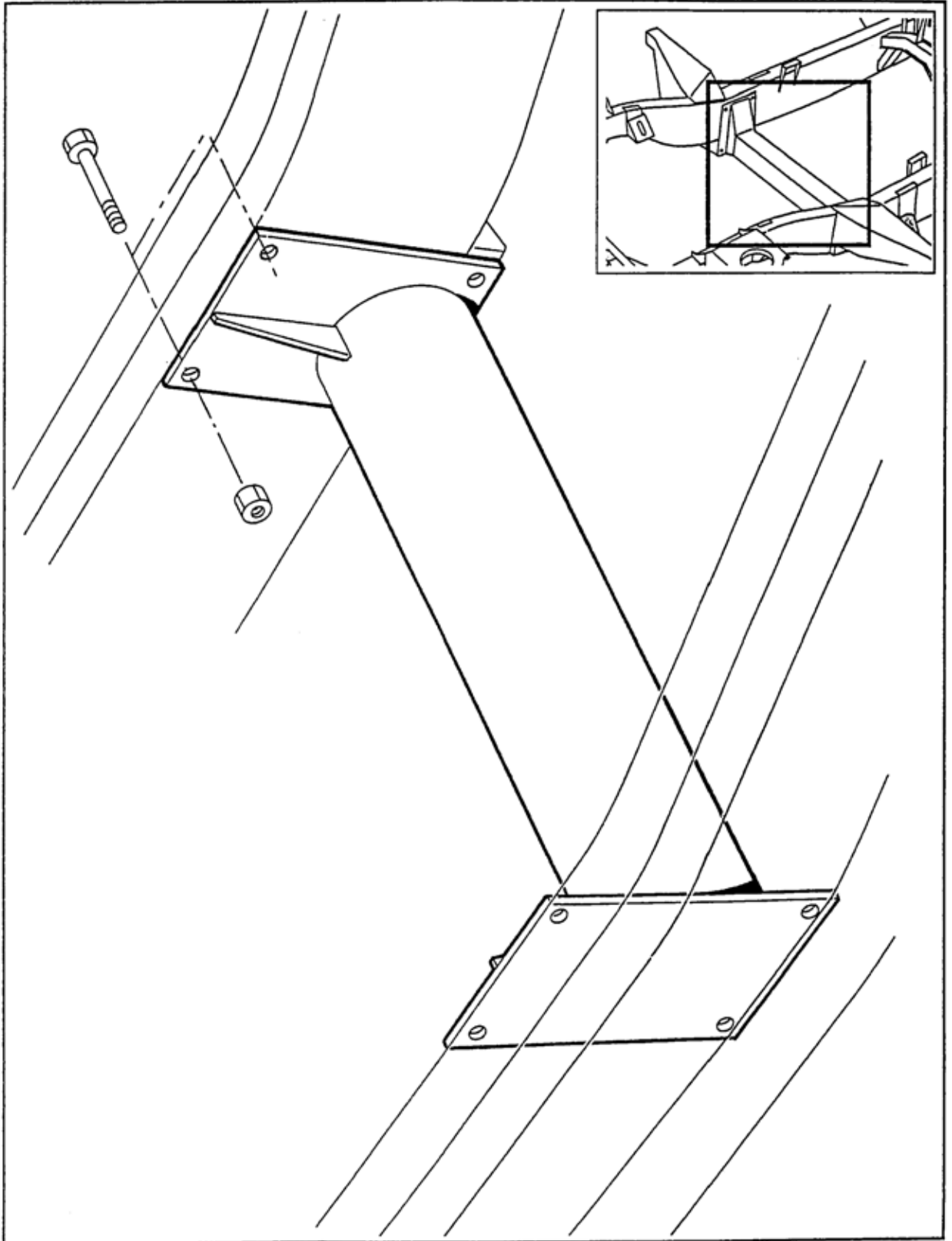


Fig 17 Number 3 Cross member - Replacement

NUMBER 7 CROSS MEMBER**Removal**

44 Remove the cross member as follows:

- 44.1 Measure and mark cutting locations on chassis members approximately 360mm ahead of the rear ends. This is in order to leave at least 10mm surplus on existing chassis members.
- 44.2 Cut chassis members at points E in Fig 18, also body mountings at F (see inset).
- 44.3 Remove cross member bulk leaving alignment jig brackets undisturbed until new cross member assembly is to be fitted.
- 44.4 Remove metal remnants at body support brackets (where applicable).

Associated parts to be removed and replaced

Rear body section, fuel tank, withdraw wiring loom sufficient for access.

Electrical

The wiring loom must be withdrawn on the RH side for access as described in Introduction section (refer to Para 6).

Replacement

45 Replacement of the cross member is as follows:

- 45.1 Transfer fuel tank rear mounting bolts to new cross member assembly, offer up new assembly, measure and mark cutting locations on chassis legs, trim surplus metal from chassis legs to obtain exact alignment.
- 45.2 Ensure jig brackets are locked in position, clean butt joint faces, clamp parts in place, MIG seam weld at Nos. 1 and 2.
- 45.3 Dress seam welds.
- 45.4 Apply red brown anti-corrosion primer to butt joint faces.
- 45.5 Remove alignment jig brackets.
- 45.6 Offer up new upper and lower reinforcement plates to chassis leg joints ensuring that the towing eye mounting holes X and Y are correctly aligned with the corresponding holes on the chassis legs as shown.
- 45.7 Remove reinforcement plates, prepare old and new joint surfaces plates and chassis members for welding.
- 45.8 Seam weld upper reinforcement plates at No. 3, then lower plates into place at No. 4. Also seam/plug weld holes at side faces of upper plates at No. 4.

NOTE:

The mounting holes at X and Y must be left in an unwelded condition.

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 6 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To existing chassis member RH and LH		1 x 400mm MIG seam weld each side
2	Body support bracket to chassis member RH and LH	2 x 90mm MIG seam welds	2 x 90mm MIG seam welds
3	Upper reinforcement plate to chassis member RH and LH		1 x 960mm MIG seam weld each side 6 MIG plug/seam welds each side
4	Lower reinforcement plate to chassis member RH and LH		1 x 540mm MIG seam weld each side

Time Required

Time 22.9hrs

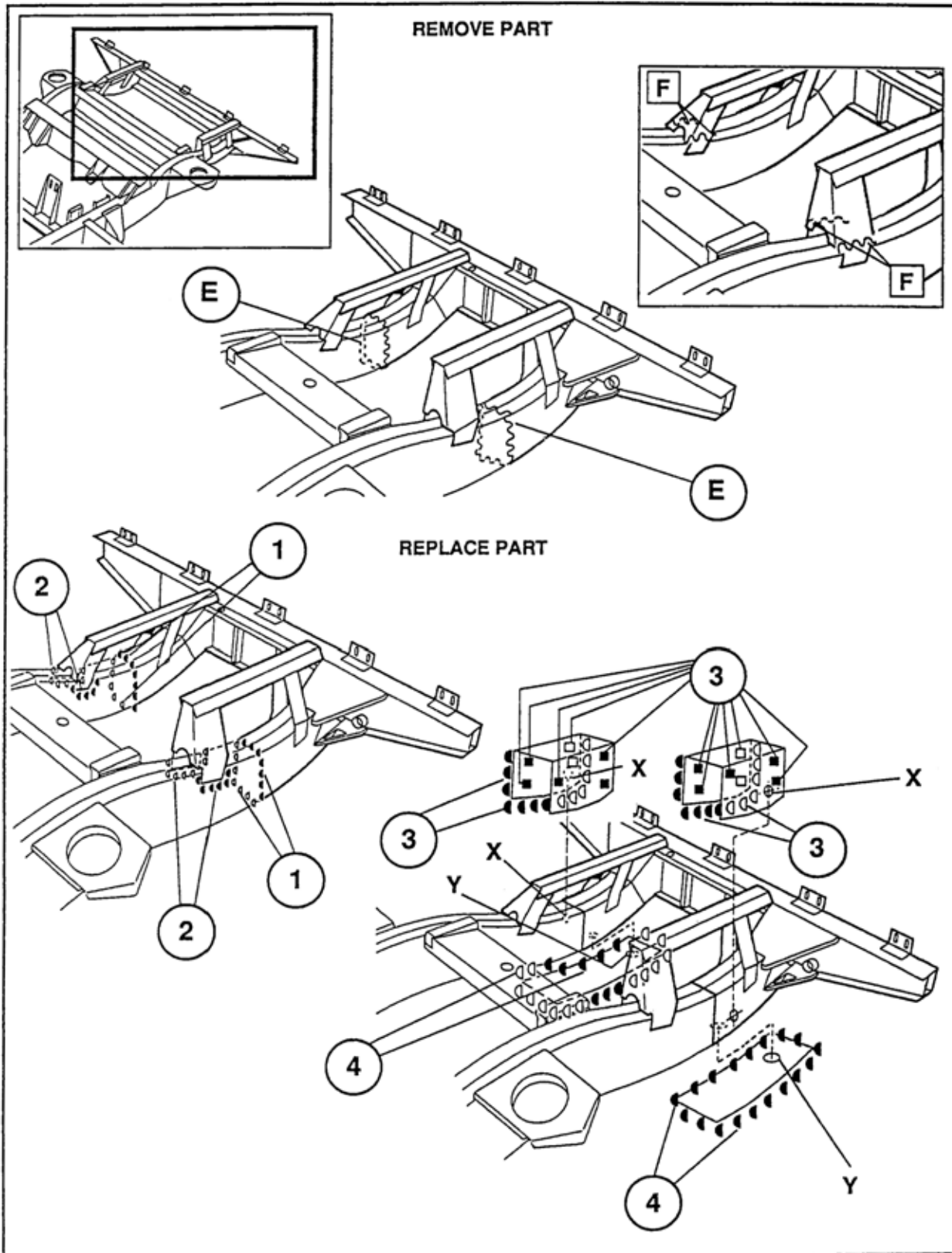


Fig 18 Number 7 Cross member - Replacement

CHASSIS FRAME

FRONT SECTION AHEAD OF NUMBER 2 CROSS MEMBER

Removal

46 Remove the chassis section as follows:

46.1 Mark section to be removed and ensure marks align with new section as supplied.

46.2 Ensure old section is aligned in body jig, cut body mounting bracket at point G in Fig 19 and chassis member at H in that order with the vertical cuts made directly in line with the forward face of the No. 2 cross member.

46.3 Remove chassis section bulk and metal remnants.

Associated parts to be removed and replaced

No. 1 Cross member (refer to Para 38), front panel, front wing.

Replacement

47 Replacement of the chassis section is as follows:

47.1 Offer up new chassis section, mark chassis weld area locations, remove new section and dress new and existing joint areas for welding.

47.2 Offer up chassis section and modify by forming a slot at the inner edge 25mm long to enable the overlapped areas to be separated slightly and offered up over the existing chassis section (see inset X). Dress chassis lower face to facilitate offering up in this area.

47.3 Offer up new chassis section and MIG seam weld in position at Nos. 1, 2 and 3 in that order.

47.4 Dress all seam welds.

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 7 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To existing chassis and cross-member at lower and inner faces		1 x 280mm MIG seam weld
2	To existing chassis at lap joints	1 x 160mm MIG seam weld	1 x 380mm MIG seam weld
3	Body mounting bracket to chassis		1 x 120mm MIG seam weld

Time Required

Time 8.7hrs RH
8.0hrs LH

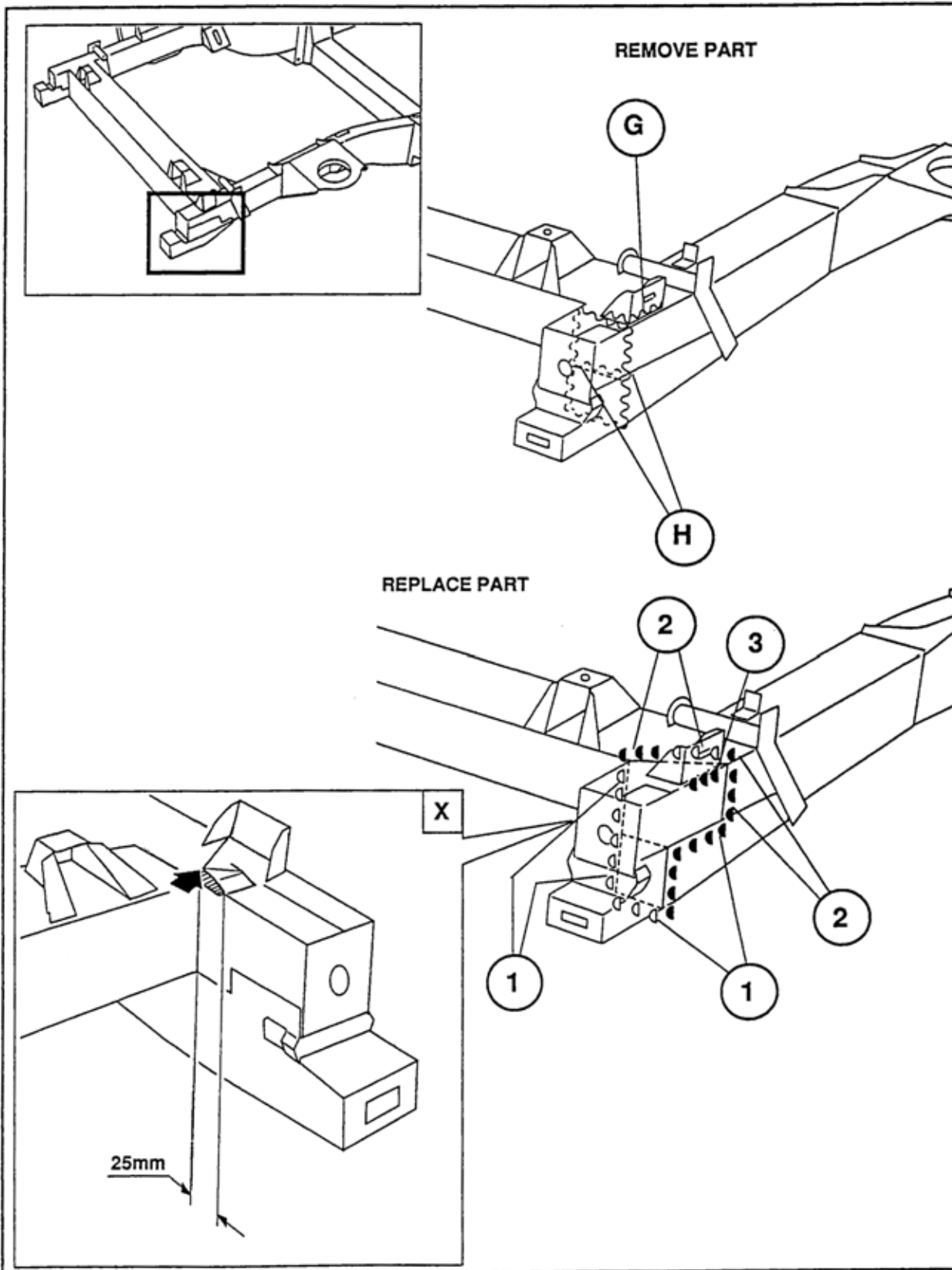


Fig 19 Front Section Ahead of Number 2 Cross member - Replacement

FRONT SPRING SEAT

Removal

48 Remove the front spring seat as follows:

48.1 Cut spring seat at point J in Fig 20, remove bulk and metal remnants at upper support brackets.

Associated parts to be removed and replaced

Front wing, front suspension.

Replacement

49 Replacement of the front spring seat is as follows:

49.1 Dress weld areas.

49.2 Offer up new spring seat to chassis member and support brackets, MIG seam weld at points 1, 2 and 3.

49.3 Offer up lower reinforcement plates as shown at inset X and MIG seam weld into position at Nos. 4 and 5.

Mechanical

Carry out a general steering alignment check as necessary observing the points described in Introduction section (refer to Para 10).

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 8 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To chassis member	1 x 490mm MIG seam weld	1 x 490mm MIG seam weld
2	To front upper support bracket	1 x 50mm MIG seam weld	1 x 50mm MIG seam weld
3	To rear upper support bracket	1 x 50mm MIG seam weld	1 x 50mm MIG seam weld
4	Front lower reinforcement plate to spring seat	1 x 260mm MIG seam weld	1 x 260mm MIG seam weld
5	Rear lower reinforcement plate to spring seat	1 x 380mm MIG seam weld	1 x 380mm MIG seam weld

Time Required

Time 13.4hrs RH
13.2hrs LH

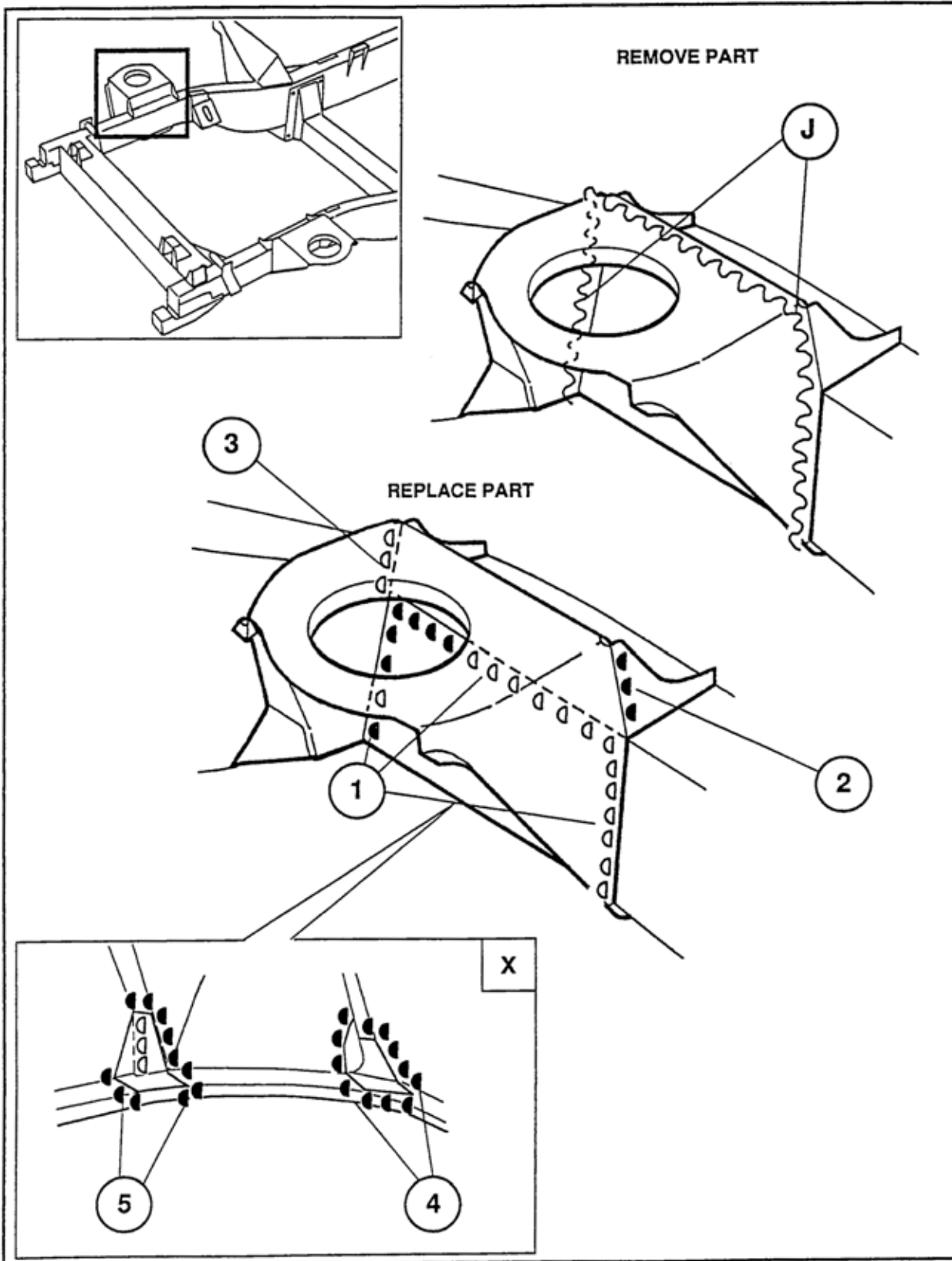


Fig 20 Front Spring Seat - Replacement

REAR SPRING SEAT

Removal

50 Remove the rear spring seat as follows:

50.1 Cut spring seat at point K in Fig 21, remove bulk and metal remnants from chassis member.

CAUTION:

Take care to avoid reducing the thickness of the chassis when grinding off the remnants.

Associated parts to be removed and replaced

Rear body section, rear suspension.

Replacement

51 Replacement of the rear seat is as follows:

51.1 Dress weld areas. Offer up new spring seat to chassis member, check alignment using special location fitting in conjunction with alignment jig (refer to Fig 27).

51.2 MIG seam weld at points 1, 2, 3 and 4.

51.3 Dress seam welds.

Mechanical & Electrical

Carry out a rear suspension alignment check as necessary; also when replacing a RH rear spring seat withdraw the wiring loom (refer to Para 6).

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 9 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To chassis member at front and rear joints	2 x 140mm MIG seam welds	2 x 140mm MIG seam welds
2	To chassis member at upper joint	1 x 170mm MIG seam weld	1 x 170mm MIG seam weld
3	To chassis member lower face at front extension	1 x 140mm MIG seam weld	1 x 140mm MIG seam weld
4	To chassis member lower face at rear extension	1 x 140mm MIG seam weld	1 x 140mm MIG seam weld

Time Required

Time 18.1hrs RH
17.4hrs LH

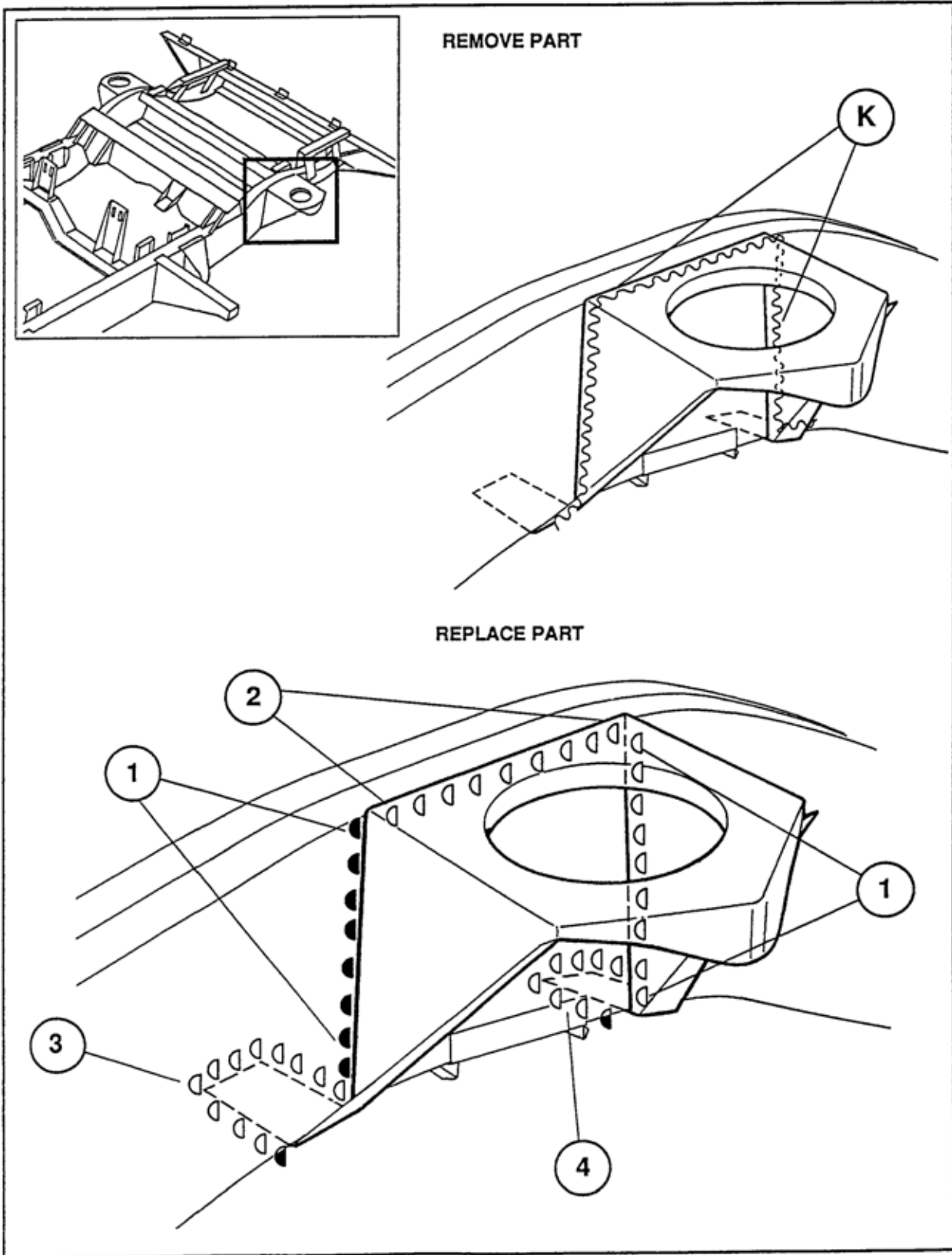


Fig 21 Rear Spring Seat - Replacement

'C' SPANNER BRACKET

Removal

52 Remove the 'C' spanner bracket as follows:

52.1 Cut tie-bar at points L and M in Fig 22, remove bulk, cut 'C' spanner bracket at point N.

52.2 Remove bulk and metal remnants from chassis member.

Associated parts to be removed and replaced

Front suspension link, front floor pan section, lay aside service piping as necessary, remove rear upper mounting bolt from No. 3 cross member.

Replacement

53 Replacement of the 'C' spanner bracket is as follows:

53.1 Dress weld areas. Offer up new 'C' spanner bracket, align and clamp in position on chassis member followed by new tie-bar.

53.2 MIG seam weld at points 1, 2, 3 and 4 making a second row of welds at No. 2 from beneath chassis member.

53.3 Dress seam welds.

Mechanical & Electrical

Carry out a general steering and front suspension alignment (refer to Para 10) check as necessary; also when replacing a RH 'C' spanner bracket and tie-bar withdraw the wiring loom (refer to Para 6).

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 10 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	'C* spanner bracket to chassis member at upper joint	1 x 290mm MIG seam weld	1 x 290mm MIG seam weld
2	'C spanner bracket to chassis member at lower Joint	1 x 300mm MIG seam weld	1 x 300mm MIG seam weld
3	Tie-bar to 'C spanner bracket	1 x 460mm MIG seam weld	1 x 460mm MIG seam weld
4	Tie-bar to front outrigger	1 x 330mm MIG seam weld	1 x 330mm MIG seam weld

Time Required

Time 9.4hrs RH
8.5hrs LH

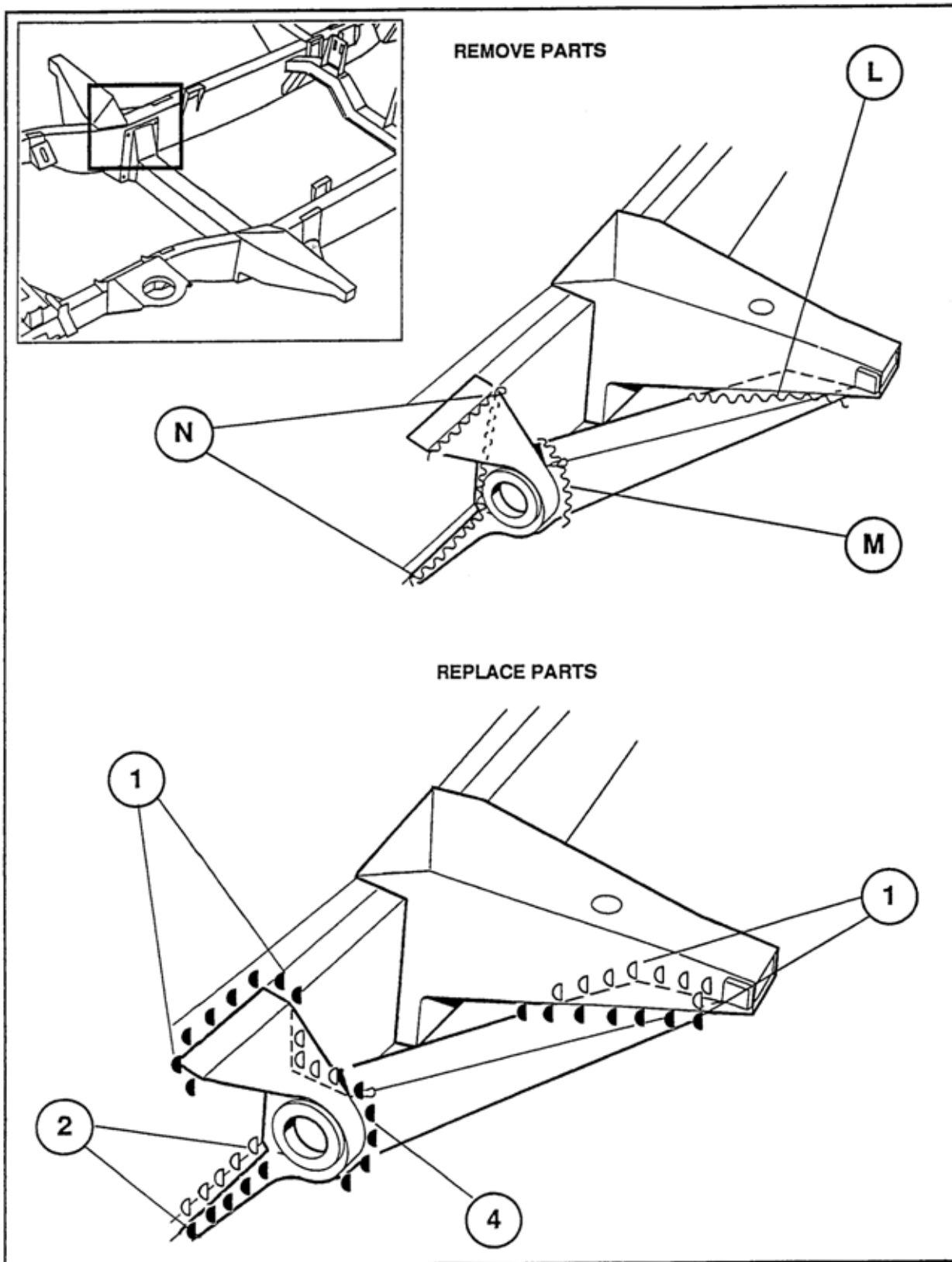


Fig 22 'C' Spanner Bracket – Replacement

TRAILING LINK BRACKET

Removal

54 Remove the trailing link bracket as follows:

54.1 Cut trailing link bracket at point P in Fig 23 and remove bulk. Remove metal remnants at lower and inner faces of chassis member.

CAUTION:

Take care to avoid reducing the thickness of the chassis member when grinding off the metal remnants.

Associated parts to be removed and replaced

Note: it is unnecessary to remove any associated panels during this repair operation, although care should be taken to avoid damage to adjacent panel work.

Replacement

55 Replacement of the trailing link bracket is as follows:

55.1 Dress weld areas. Offer up new trailing link bracket.

55.2 MIG seam weld at points 1 and 2. Dress seam welds.

55.3 Offer up new reinforcing plate and seam weld into position at No. 3.

55.4 Dress seam weld.

Mechanical & Electrical

Carry out a rear suspension alignment check as necessary; also when replacing a RH trailing link bracket withdraw the wiring loom (refer to Para 6).

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 11 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To chassis member at upper joint	1 x 690mm MIG seam weld	1 x 690mm MIG seam weld
2	To chassis member at lower joint	1 x 90mm MIG seam weld	1 x 90mm MIG seam weld
3	Reinforcing plate to chassis member lower and inner faces	1 x 380mm MIG seam weld	1 x 380mm MIG seam weld

Time Required

Time 8.3hrs RH
7.8hrs LH

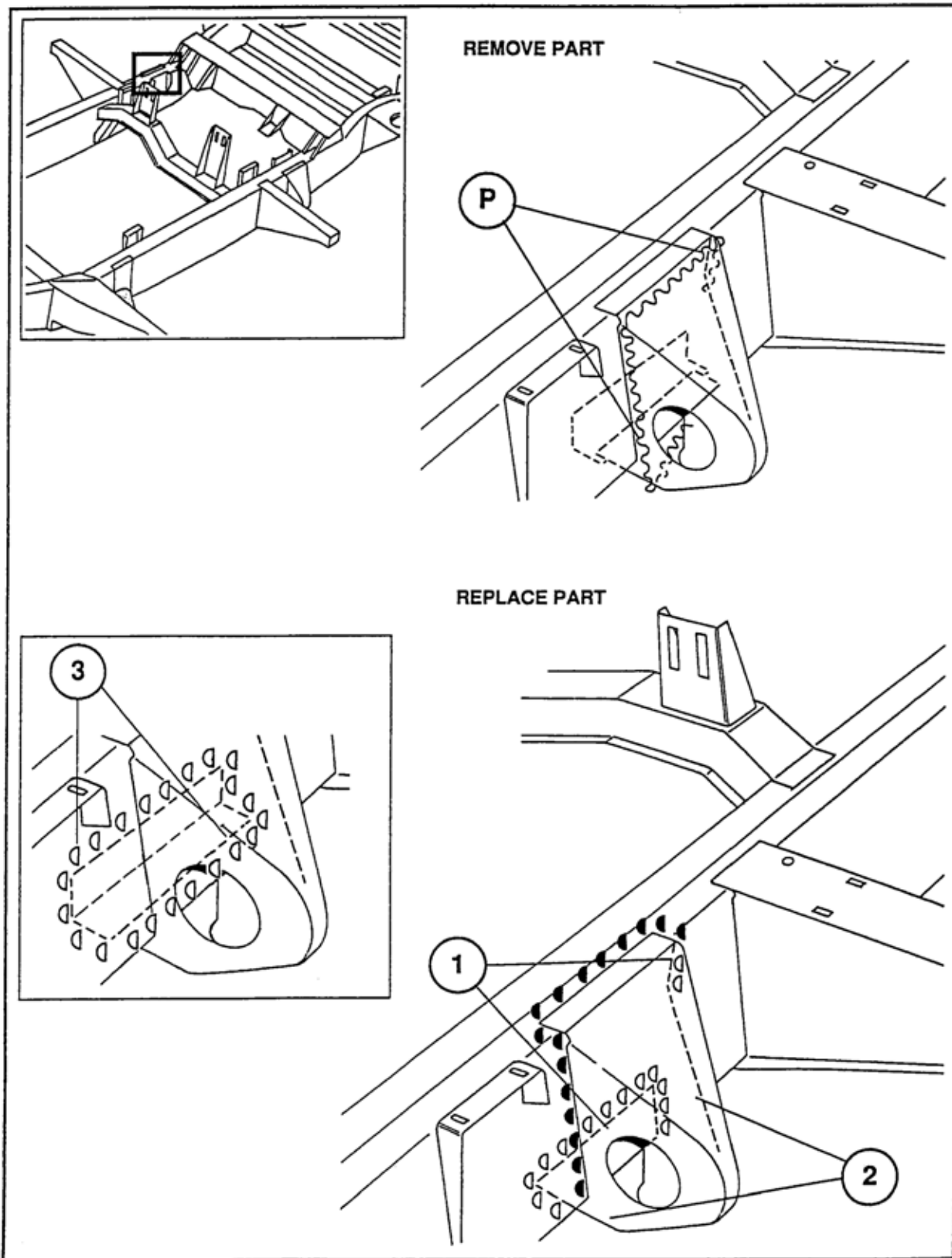


Fig 23 Trailing Link Bracket – Replacement

FRONT QUARTER RIGHT AND LEFT HAND

Removal

56 Removal of the front quarter right and left hand is as follows:

56.1 Check and measure chassis frame for trueness.

56.2 Mark locations approximately 165mm and 220mm to the rear of gearbox upper-rear and lower mounting holes respectively as shown.

56.3 Cut chassis side member at point Q in Fig 24 and No. 2 cross member at R, making cut line Q approximately 5mm ahead of the location mark to leave a metal surplus around the chassis at this point.

CAUTION:

Take care not to damage the Panhard rod mounting tube at X when making the cut at Q.

NOTE:

Note also that the outer end of the cross member rear face where it is enclosed by the gusset is not welded in production or subsequent replacement due to insufficient access.

Associated parts to be removed and replaced

Front wing RH and LH, cab unit, front seats, engine/transmission assembly, front suspension.

Replacement

57 Replacement of the front quarter right and left hand is as follows:

57.1 Offer up new chassis quarter section (2-man operation).

57.2 Dress weld areas, taking extreme care with the measurements when trimming the joint to the existing chassis at No. 1 as this must be exactly aligned with the new section as supplied. Make the final cut line so as to allow a welding gap of 2mm, and trim the lower face of the Panhard rod mounting tube X at No. 4 to enable the new section to be offered up accurately at this point.

57.3 Remove chassis quarter section and dress all weld areas.

57.4 Offer up new chassis quarter section, align, clamp and MIG tack weld in position.

57.5 MIG seam weld at No. 1. Align, clamp and MIG tack weld No. 2 cross member No. 4. MIG seam weld cross member and dress all seam welds.

CAUTION:

Take care to avoid reducing the thickness of the chassis during this operation.

57.6 Apply red brown anti-corrosion primer to butt joint on chassis.

57.7 Offer up the narrower of the two reinforcing plates supplied to chassis inner face, MIG seam weld and plug weld into place at No. 2.

57.8 Dress seam weld, offer up second reinforcing plate to chassis outer face, MIG seam weld and plug weld into place at No. 3.

57.9 Dress seam weld.

Mechanical & Electrical

Carry out a general steering and front suspension alignment check (refer to Para 10) as necessary; also when replacing a RH chassis front quarter section withdraw the wiring loom (refer to Para 6).

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 12 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To existing chassis frame		1 x 550mm MIG seam weld
2	Reinforcing plate to chassis at inner face		1 x 101mm MIG seam weld 4 MIG plug welds
3	Reinforcing plate to chassis at outer face		1 x 960mm MIG seam weld 4 MIG plug welds
4	No. 2 cross member to existing chassis frame	1 x 510mm MIG seam weld	1 x 510mm MIG seam weld

Time Required

Time 31.2hrs RH
30.4hrs LH

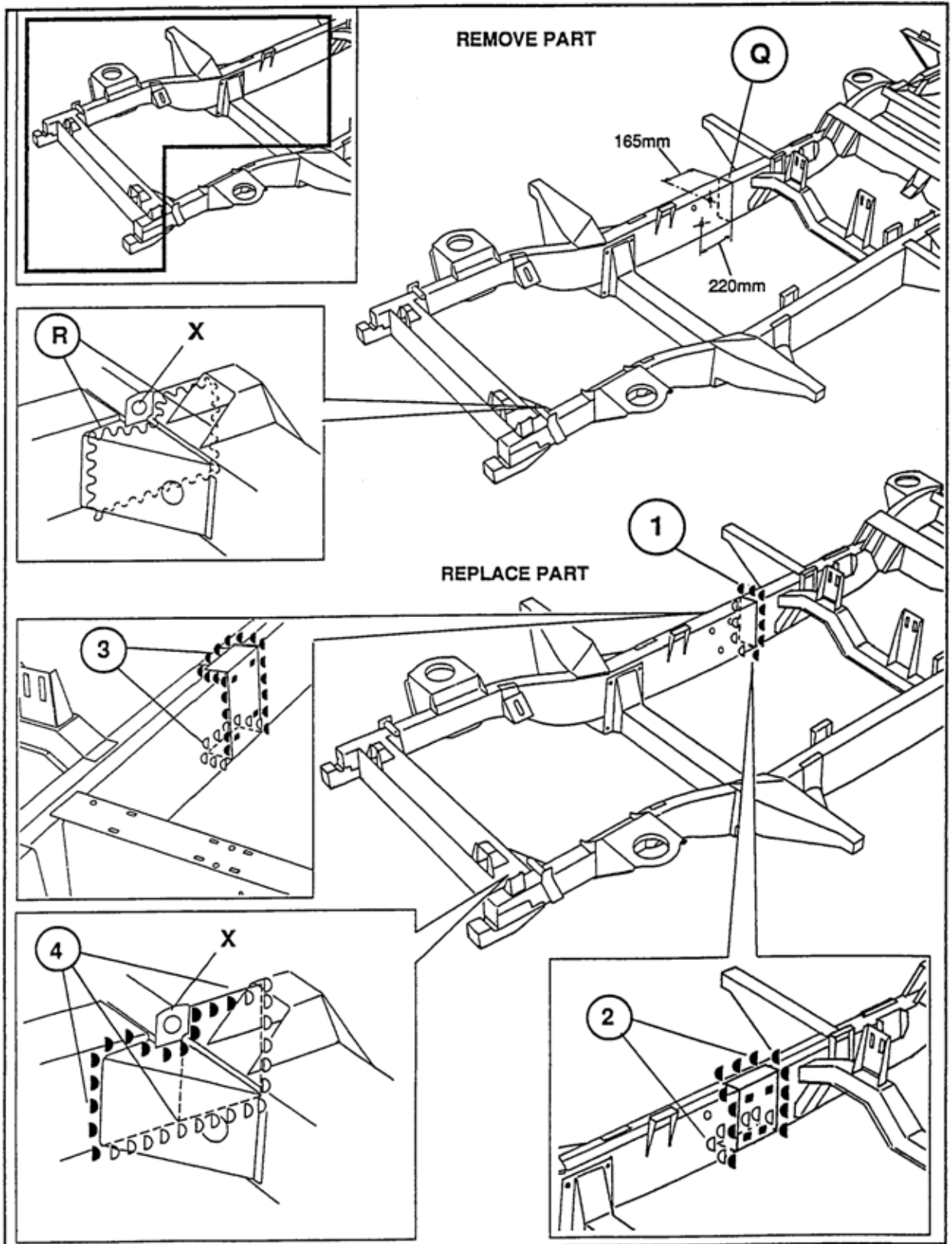


Fig 24 Front Quarter Right and Left Hand - Replacement

FRONT HALF RIGHT AND LEFT HAND**Removal**

58 Remove the front half right and left hand as follows:

58.1 Check and measure chassis frame for trueness.

58.2 Mark locations approximately 165mm and 220mm to the rear of gearbox upper-rear and lower mounting holes respectively as shown.

58.3 Cut chassis side member at point S in Fig 25 each side making the cut line approximately 5mm ahead of the location mark to leave a metal surplus around the chassis at this point.

58.4 Remove 4 mounting bolts to No. 3 cross member, separate bulk of chassis section (2-man operation) and remove metal remnants.

Associated parts to be removed and replaced

Front wing RH and LH, cab unit, front seats, engine/transmission assembly, front suspension.

Replacement

59 Replacement of the front half right and left hand is as follows:

59.1 Offer up new chassis half section (2-man operation).

59.2 Dress weld areas, taking extreme care with the measurements when trimming the joint to the existing chassis at No. 1 as this must be exactly aligned with the new section as supplied. Make the final cut line so as to allow a welding gap of 2mm.

59.3 Remove chassis half section and dress all weld areas.

59.4 Offer up new chassis half section, align, clamp and MIG tack weld in position.

59.5 MIG seam weld at No. 1. Align, clamp and MIG tack weld No. 2 cross member No. 4.

59.6 MIG seam weld cross member and dress all seam welds.

CAUTION:

Take care to avoid reducing the thickness of the chassis during this operation.

59.7 Apply red brown anti-corrosion primer to butt joint on chassis.

59.8 Offer up the narrower of the two reinforcing plates supplied to chassis inner face, MIG seam weld and plug weld into place at No. 2.

59.9 Dress seam weld, offer up second reinforcing plate to chassis outer face, MIG seam weld and plug weld into place at No. 3.

59.10 Dress seam weld.

Mechanical & Electrical

Carry out a general steering and front suspension alignment check (refer to Para 10) as necessary; also when replacing a RH chassis front quarter section withdraw the wiring loom (refer to Para 6).

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M .E.T. operations (refer to Para 12 and Para 13).

TABLE 13 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To existing chassis frame		1 x 550mm MIG seam weld
2	Reinforcing plate to chassis at inner face		1 x 101mm MIG seam weld 4 MIG plug welds
3	Reinforcing plate to chassis at outer face		1 x 960mm MIG seam weld 4 MIG plug welds

Time Required

Time 32.4hrs

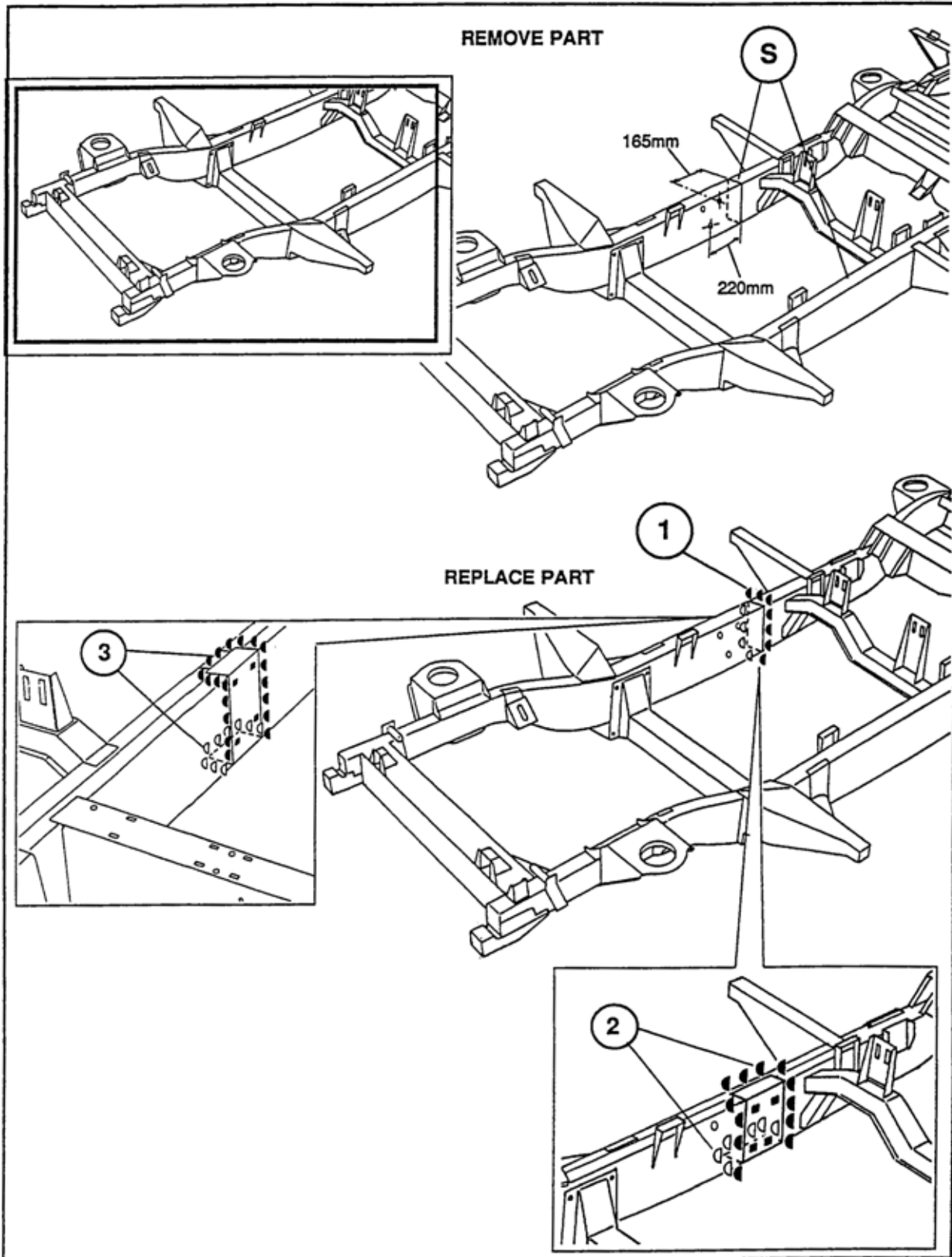


Fig 25 Front Half Right and Left Hand - Replacement

TIE-BAR FRONT BODY MOUNT 'C' SPANNER BRACKET

Removal

60 Remove the Tie-bar Front Body Mount 'C' Spanner Bracket as follows:

60.1 Cut tie-bar at points T and U in Fig 26.

60.2 Remove bulk and metal remnants.

CAUTION:

Take care to avoid damaging the front face of the 'C' spanner bracket during this operation.

Associated parts to be removed and replaced

Front suspension link, front floor pan section, aside service piping as necessary.

Electrical

When replacing a RH tie-bar the wiring loom must be withdrawn for access as described in Introduction section (refer to Para 6).

Replacement

61 Replacement of the Tie-bar Front Body Mount 'C' Spanner Bracket is as follows:

61.1 Dress weld areas.

61.2 Offer up new tie-bar, align and clamp in position.

61.3 MIG seam weld at points 1 and 2.

61.4 Dress seam welds.

Paint and Corrosion Protection

Carry out painting and anti-corrosion application before replacement of associated panels and M.E.T. operations (refer to Para 12 and Para 13).

TABLE 14 WELDING

No. (1)	Location (2)	Remove Factory Joint (3)	Replace Repair Joint (4)
1	To chassis 'C' spanner bracket	1 x 460mm MIG seam weld	1 x 460mm MIG seam weld
2	To front outrigger	1 x 330mm MIG seam weld	1 x 330mm MIG seam weld

Time Required

Time 7.7hrs RH
7.3hrs LH

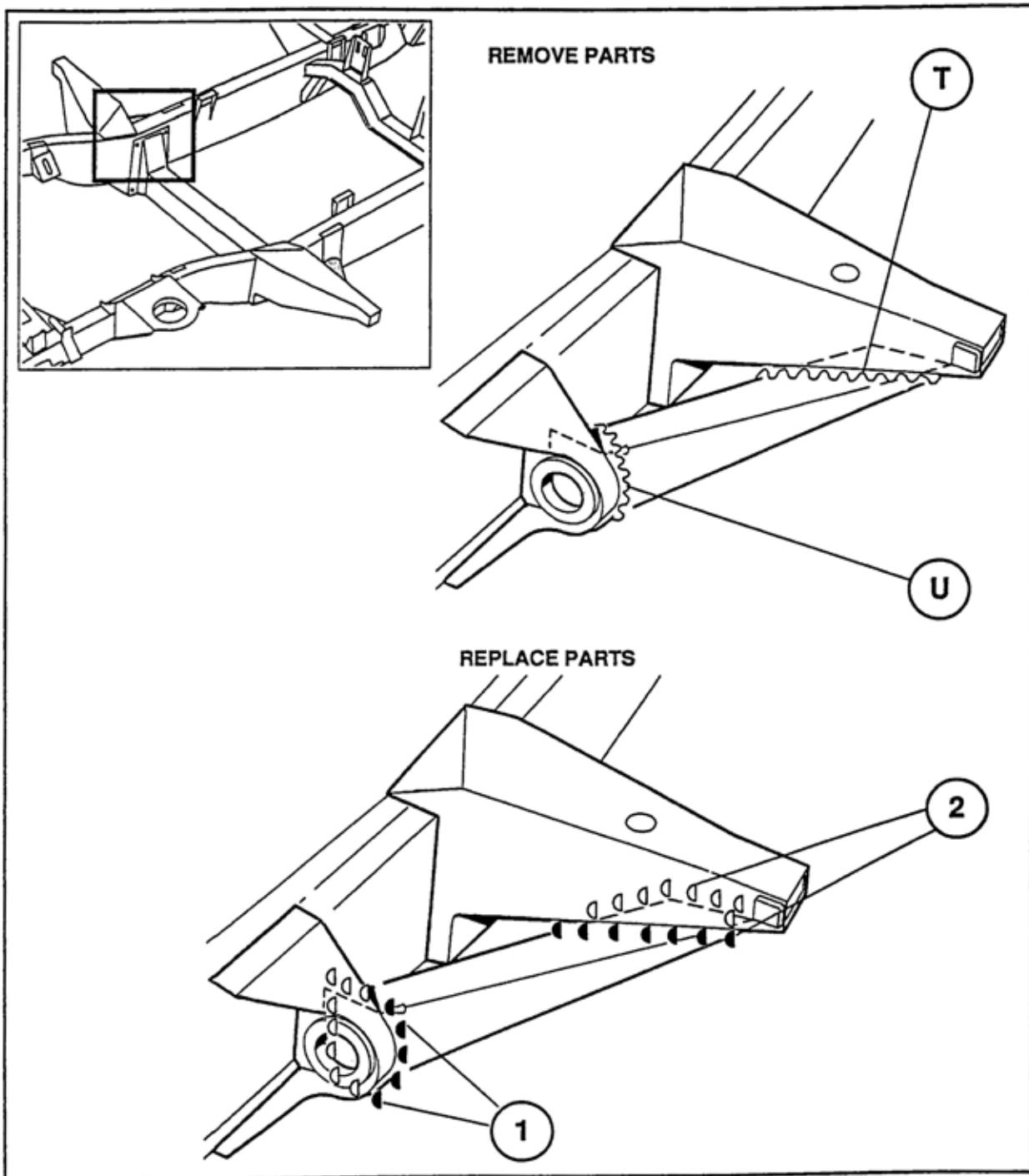


Fig 26 Tie-bar Front Body Mount 'C' Spanner Bracket – Replacement

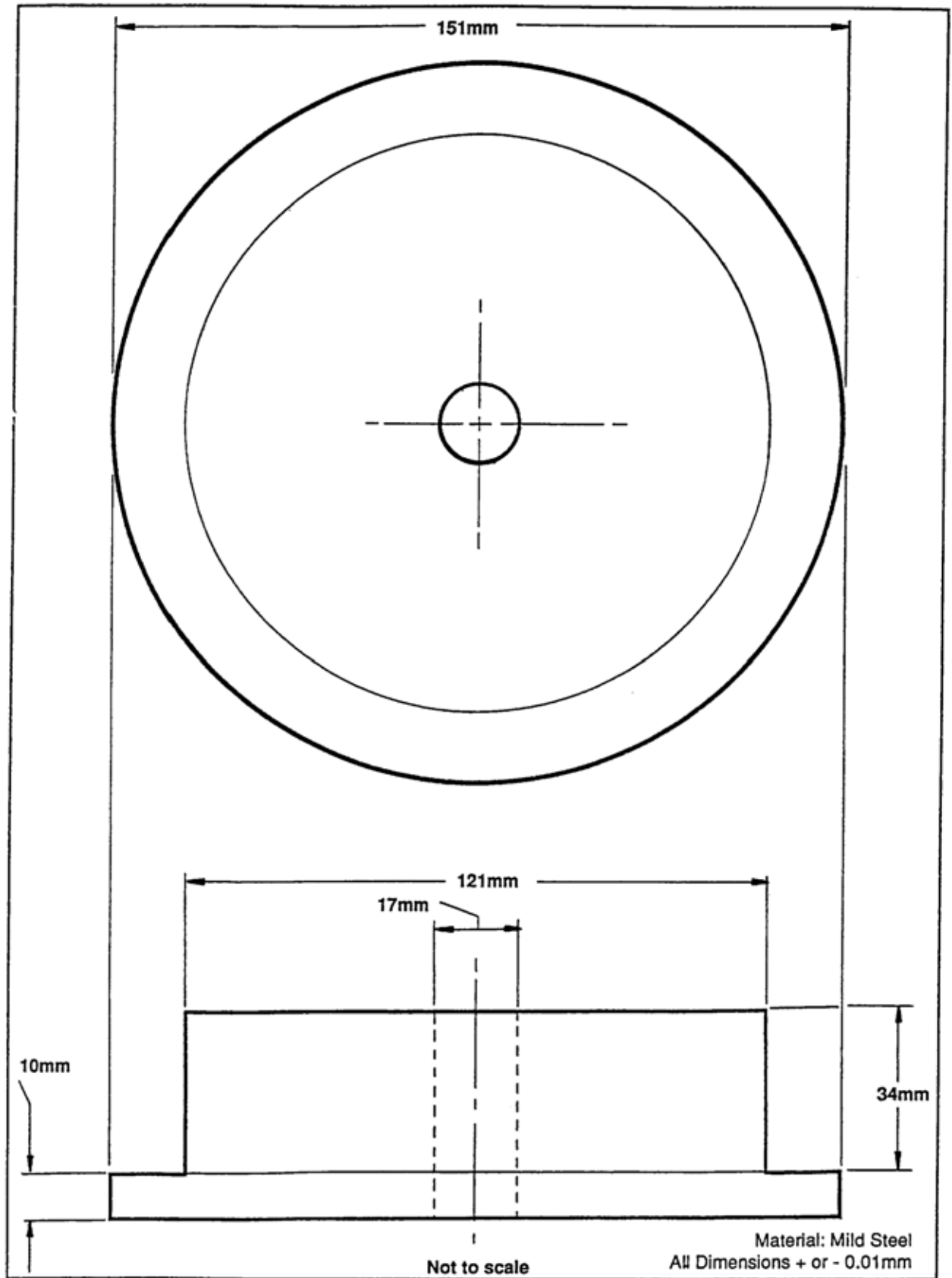


Fig 27 Rear Spring Seat Alignment Jig Attachment

CHAPTER 15-3

GRP HOOD REPAIR

CONTENTS

Para

- 1 Introduction
GRP Hood Aluminium Extrusion
- 2 Removal
- 3 Fitting (WARNING)

Table

		Page
1	Special Tools	1
2	Sealants, adhesives and lubricants	2
3	Service kits.....	2
4	Adhesive handling times	5/6

Fig

		Page
1	Application of Adhesive.....	3
2	Fitting the Aluminium Extrusion to GRP Hood.....	4

INTRODUCTION

1 This chapter details the Unit repairs for the aluminium extrusion fitted to the GRP Hood on Truck Utility Light (TUL) and Truck Utility Medium (TUM) vehicles. The procedures are applicable to both left and right hand drive vehicles.

TABLE 1 SPECIAL TOOLS

Serial (1)	Manufacturers Part Number (2)	NSN/Part Number where applicable (3)	Designation (4)
1	3M 4251 or equivalent		Respirator
2			Clamp
3			Cartridge gun
4			Static Mixing Nozzle
5			Nozzle Collar
6			Scotchbrite Pad
7			P80 Grit Paper

TABLE 2 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1 2	Pliogrip 7400/7655 3M Cleaner/Acetone		Dual Cartridge Adhesive Solvent

TABLE 3 SERVICE KITS

Serial (1)	NSN/Part Number where applicable (2)	Designation (3)
1 2	ASR1129 ASR1130	Aluminium Extrusion, 90 Aluminium Extrusion, 110

NOTE

The aluminium extrusion (refer to Table 3 Serial 1 and 2) must be primed and used within 14 days of the application of the primer.

GRP HOOD ALUMINIUM EXTRUSION**Removal**

- 2 To repair the hood carry out the following:
 - 2.1 If necessary remove the existing aluminium extrusion from the GRP hood.
 - 2.2 Remove any adhesive left by the old aluminium extrusion.

Fitting**WARNING**

SAFETY GLASSES / GOGGLES, GLOVES, OVERALLS AND A RESPIRATOR MUST BE WORN WHEN HANDLING ADHESIVES AND SOLVENTS. ENSURE CLEANLINESS IS OBSERVED THROUGHOUT.

- 3 To fit the aluminium extrusion carry out the following:
 - 3.1 Abrade the area of the hood to be bonded using P80 grit paper.
 - 3.2 Wipe the area with a clean Mutton cloth/paper tissue to remove dust/dirt. Clean an area 75mm around the area to be bonded. Do not use this cloth for applying solvent.
 - 3.3 Apply solvent (refer to Table 2 Serial 2) to the area to be bonded using a clean Scotchbrite pad/Mutton cloth/paper tissue. Immediately wipe the area with a second clean cloth/tissue using the wipe on wipe off method. Repeat as necessary until the surface is free from dust/debris etc.
 - 3.4 Remove the protective tape from the self -adhesive foam pads. The foam pads provide the bond gap and initial fixing for the aluminum extrusion.

3.5 Remove the green cap from the tube of adhesive (refer to Table 2 Serial 2). Fit a clean static mixer nozzle (refer to Table 1 Serial 4) to the tube using a clean collar (refer to Table 1 Serial 5). Insert the tube into the appropriate gun (refer to Table 1 Serial 3).

3.6 Hold cartridge gun, point nozzle upwards and operate trigger to pump adhesive through nozzle. Dispense and discard bead of approximately 10mm diameter. Apply a bead of adhesive approximately 12mm in diameter onto the aluminium extrusion to be bonded, in such a pattern as to ensure no air is trapped as the joint is assembled (Fig 1). Care must be taken not to apply adhesive over or close to the self-adhesive foam pads.

NOTES

- (1) Care must be taken not to apply adhesive over or close to the self-adhesive foam pads. Application of adhesive in these areas would prevent the self-adhesive foam pads sticking to the GRP hood.
- (2) Care must be taken to avoid application of adhesive to the lower seal edge of the extrusion. Application of adhesive to the lower seal edge would prevent the fitting of the rubber seal.
- (3) The static mixer nozzle must be replaced if there is a period of 2 minutes or more between applications.

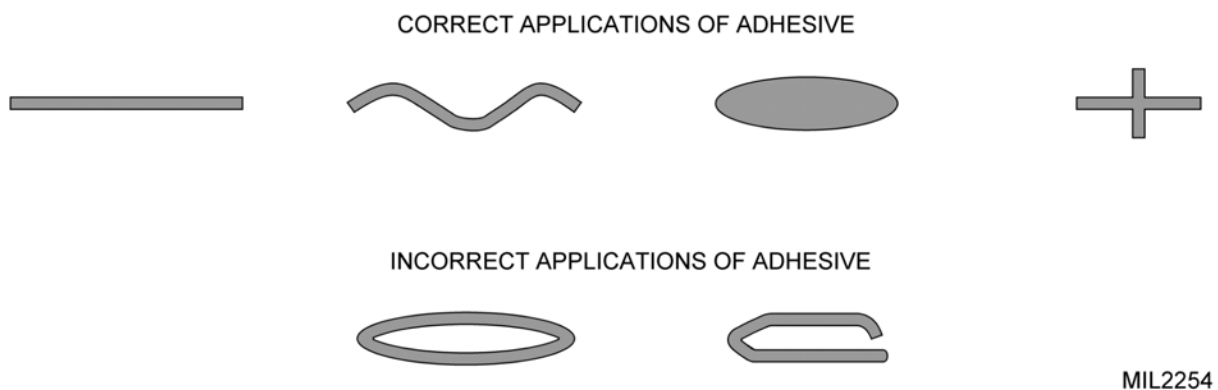


Fig 1 Application of Adhesive

3.7 As soon as the adhesive has been applied align the aluminium extrusion (refer to Table 3 Serial 2) using the internal shape of the hood (5) as a datum. Position the aluminium extrusion approximately 40mm from the end of the hood.

NOTE

The joint must be made within 6 minutes of starting to apply the adhesive.

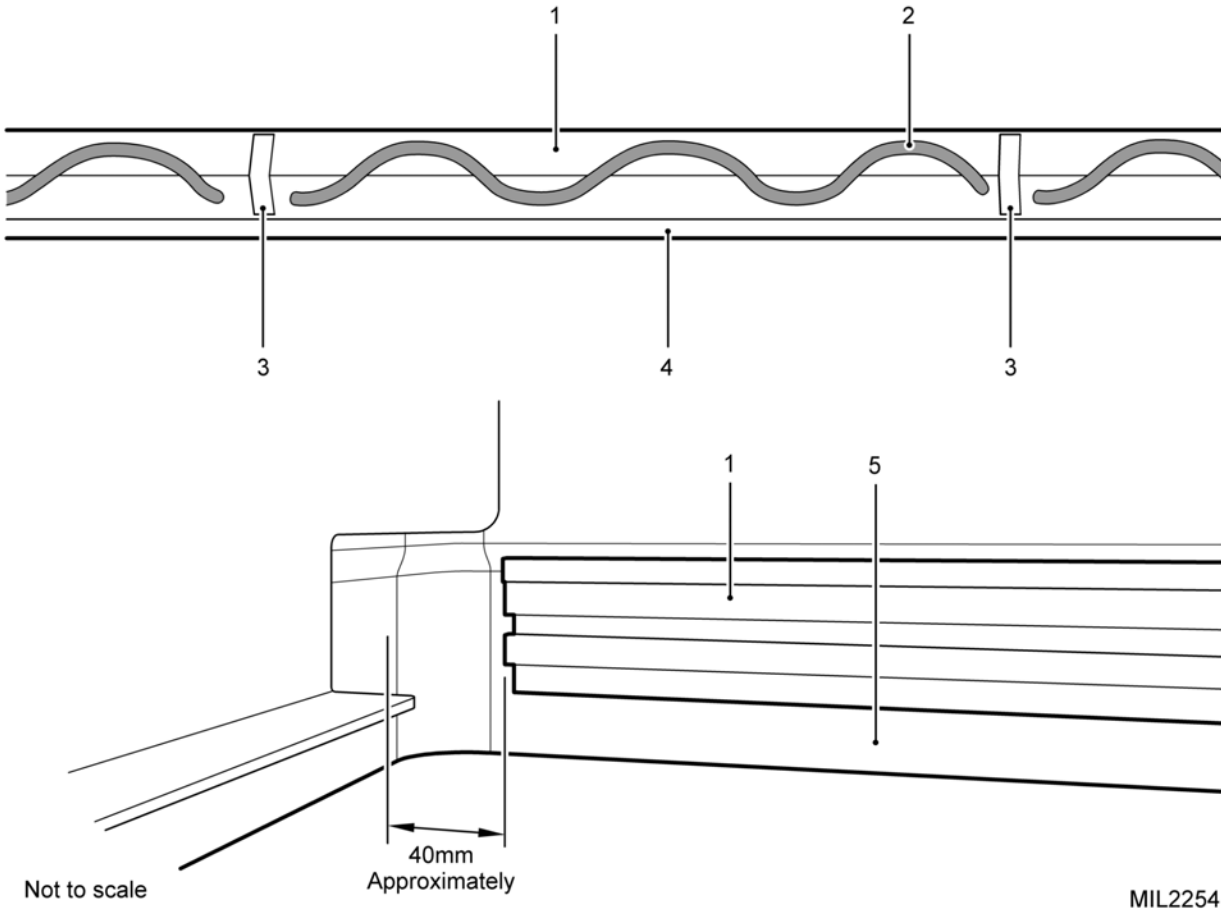
3.8 Using clamps (refer to Table 1 Serial 2) secure the aluminium extrusion in place with a light clamping pressure (clamps to be placed over the self-adhesive foam pads). Leave clamps in position until handling strength is achieved.

3.9 Remove any excessive adhesive carefully with solvent/cloth before it cures.

NOTE

Disturbance of the joint prior to achieving handling strength will reduce bond strength (refer to Table 4).

3.10 Allow the adhesive to cure for 24 hours before moving the vehicle.



- | | |
|---------------------------|-------------------|
| 1 Aluminium Extrusion | 4 Lower Seal Edge |
| 2 Adhesive | 5 GRP Hood |
| 3 Self-Adhesive Foam Pads | |

Fig 2 Fitting the Aluminium Extrusion to GRP Hood

TABLE 4 ADHESIVE HANDLING TIMES

Workshop Temperature (°C)	Handling Times (minutes)
13	60
15	50
18	40
20	35
23	30
25	25

CHAPTER 16

BODY CAB AND FITTINGS

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

1 This chapter gives the Unit repair for the body cab and fittings as fitted to Truck Utility Light (TUL) HS, and Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles.

General

2 This chapter has been sub-chaptered to allow for the various types of vehicle body cab and fittings as detailed below.

- 2.1 Chapter 16-1 TUL/TUM and FFR
- 2.2 Chapter 16-2 Field Ambulance
- 2.3 Chapter 16-3 Winter/water
- 2.4 Chapter 16-4 Winterised
- 2.5 Chapter 16-5 Tropicalised
- 2.6 Chapter 16-6 Helicopter Support Platform

CHAPTER 16-1

TUL/TUM AND FFR

CONTENTS

Para

- 1 Introduction
- 2 Body panels
- 4 Panel beating
- Welding
- 5 Gas welding
- 14 Welding tears and patches
- 18 Electric welding (CAUTION)
- 19 Riveting
- 20 Painting
- Hood repair
- 21 Soft top
- 26 Hard top
- 29 Bodywork

Fig

Page

1	Welding flame jets.....	3	
2	Welding techniques.....	4	
3	Bonnet assembly	9	
4	Front wing scuttle assembly		11
5	Scuttle assembly	13	
6	Dash trim assembly	15	
7	Gearbox tunnel and seat base assembly	17	
8	Side door assembly	19	
9	Lower rear body assembly I (TUL)	21	
10	Lower rear body assembly II (TUL)	23	
11	Lower rear body assembly I (TUM)	25	
12	Lower rear body assembly II (TUM)	27	
13	Tailgate assembly (soft top only).....	29	
14	Soft top assembly (TUL)	31	
15	Soft top assembly (TUM)		33
16	Hard top assembly (TUL).....		35
17	Hard top assembly (TUM).....		37
18	Rear door assembly (Hard top only).....	39	
19	Roll cage assembly (TUL)		40
20	Roll cage assembly (TUM)		43
21	Radio equipment (FFR only).....	45	
22	Antennae and aerial assemblies (FFR only)	47/48	

INTRODUCTION

1 This chapter covers the Unit repairs for Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS vehicle cab and fittings.

BODY PANELS

2 TUL and TUM body panels are manufactured from a special aluminium-alloy known as birmabright'.

3 'Birmabright' melts at a slightly lower temperature than pure aluminium and will not rust or corrode under normal circumstances. It is work hardened, but is easily annealed. Exposed to atmosphere, a hard oxide skin forms on the surface.

PANEL BEATING

4 'Birmabright' panels and wings can be beaten out after accidental damage then must be annealed by the application of heat, followed by slow air cooling; as the melting point is low, heat must be applied slowly and carefully. A practical temperature control is to apply oil to the cleaned surface to be annealed. Play the welding torch on the underside of the cleaned surface and watch for the oil to clear, leaving the surface clean and unmarked; then allow to cool naturally in the air, when the area so treated will again be soft and workable. Do not quench with oil or water. An alternative method is to clean the surface to be annealed and then rub it with a piece of soap. Apply heat beneath the area, as described above, and watch for the soap to clear. Allow to cool as for the oil method. To avoid any risk of locally melting the metal, when applying the heat for annealing, hold the torch some little distance from the metal and keep it moving.

WELDING

Gas welding

5 When carrying out gas welding a small jet must be used, one or two sizes smaller than would be used for welding sheet metal of comparable thickness. For example, use a No 2 nozzle for welding 18 swg (0.048 in.) sheet, and a No 3 for 16 swg (0.064 in.) sheet.

6 The flame should be smooth, quiet, neutral and have a brilliant inner core with a well defined, rounded end. The hottest point of the flame is close to the jet and the flame should have a blue to orange envelope becoming nearly colourless at the end (Fig 1 (A)).

7 A slightly reducing flame may also be used, that is, there may be a slight excess of acetylene. Such a flame will have a brilliant inner core with a feathery white flame and a blue to orange envelope (Fig 1 (B)).

8 Do not use an oxidising flame which has a short pointed inner core bluish white in colour with a bluish envelope (Fig 1 (C)).

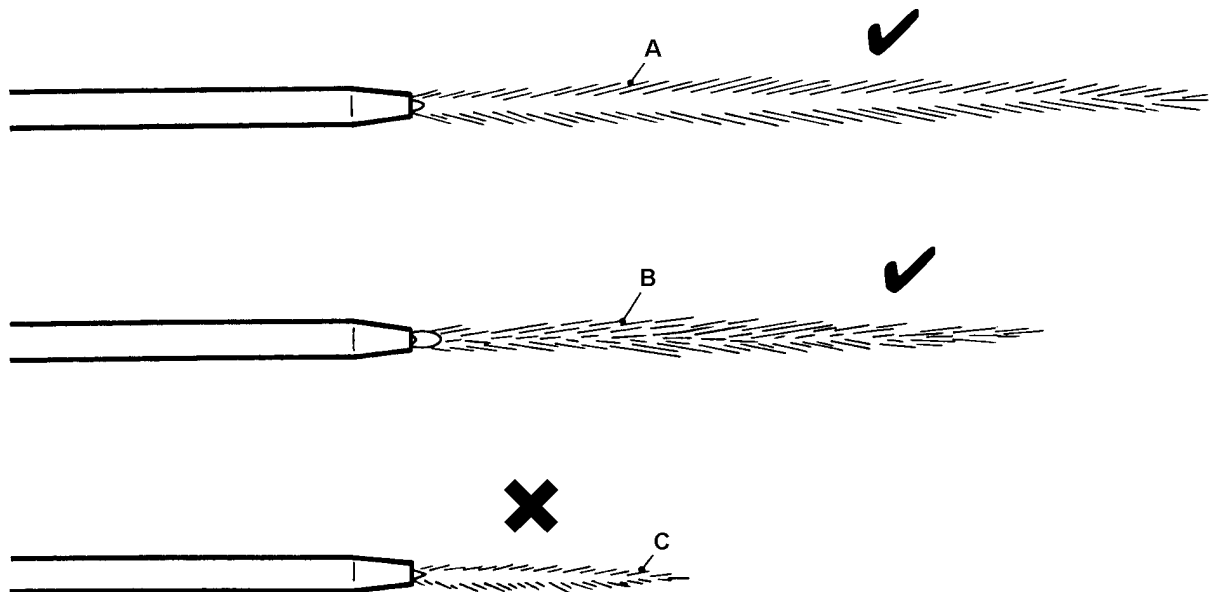
9 To carry out repairs use only 5 per cent magnesium/aluminium welding rod (Fig 2 (1)) (5 Mg/A), (Sifalumin No 27 (MG 5 Alloy) or an off-cut of 'Birmabright' sheet with Sifbronze Special Acid Flux. If using an off-cut, do not use too wide or thick an off-cut or trouble may be experienced in making it melt before the material being welded melts.

10 Prior to welding clean off all grease and paint, dry thoroughly then clean the edges to be welded and an area at least half an inch on either side of the weld, with a stiff wire scratch-brush or wire wool. Also clean the welding rod or cut-off strip with wire wool. Cleanliness is essential to achieve a satisfactory weld.

11 It should be remembered that aluminium and its alloys do not show 'red hot' before melting, so there is nothing to notice about the appearance of the metal to indicate that it has reached welding temperature. A little experience will enable the operator to gauge this point. A useful guide is to sprinkle a few particles of sawdust over the work; this will sparkle and char when the right temperature is approached, alternatively a piece of dry wood rubbed over the hot metal will sparkle at the point of contact if the temperature is correct.

12 The Sifbronze special flux should be used in accordance with the manufacturers instructions, as this flux is highly acid, it is essential to wash it off immediately after the weld has cooled. Very hot soapy water should be used with wire wool or a scratch brush, the alkaline nature of the soap will tend to neutralise the acid.

13 The heat of welding will have softened the metal in the area of the repair, it may be hardened again by peening with a light hammer. Many light blows are preferable to few heavy ones. To avoid denting and deformation, and to make the peening more effective, use a dolly or an anvil behind the work. Filing surplus metal from the weld will also help to harden the work again.



MIL0421

Fig 1 Welding flame jets

Welding tears and patches

14 If a tear extends to the edge of a panel, drill a small hole at the end away from the edge to prevent the crack from spreading. Start the weld where the hole has been drilled and work towards the edge.

15 When welding a long tear, or making a long welded joint, tack the edges to be welded at intervals of 50 to 100 mm (2 to 4 in.) with spots. Melting the metal at the starting end and fusing into it a small amount of filler rod, repeating the process at the suggested intervals does this. After tacking, weld continuously along the joint from right to left (Fig 2), increasing the speed of the weld as the material heats up.

16 When the work has cooled, wash off all traces of flux as described previously, and file off any excess build-up of material.

17 When patching, cut the patch to the correct shape for the hole to be filled, but of such size as to leave a gap of 0.80 mm (0.030 in.) between the patch and the panel, then weld as described above. A repair must never be made by applying an overlay patch.

Electric welding

CAUTION

BATTERY DISCONNECTION. Before commencing electric welding, the battery earth lead must be disconnected otherwise damage to the alternator will occur (refer to Chap 13-1 and/or Chap 13-2).

18 During vehicle manufacture the 'Argon arc' process is used, all atmospheric oxygen being excluded from the weld by the Argon gas shield. For all body repair work carried out at Unit level, the gas welding method is sufficient and quite satisfactory.

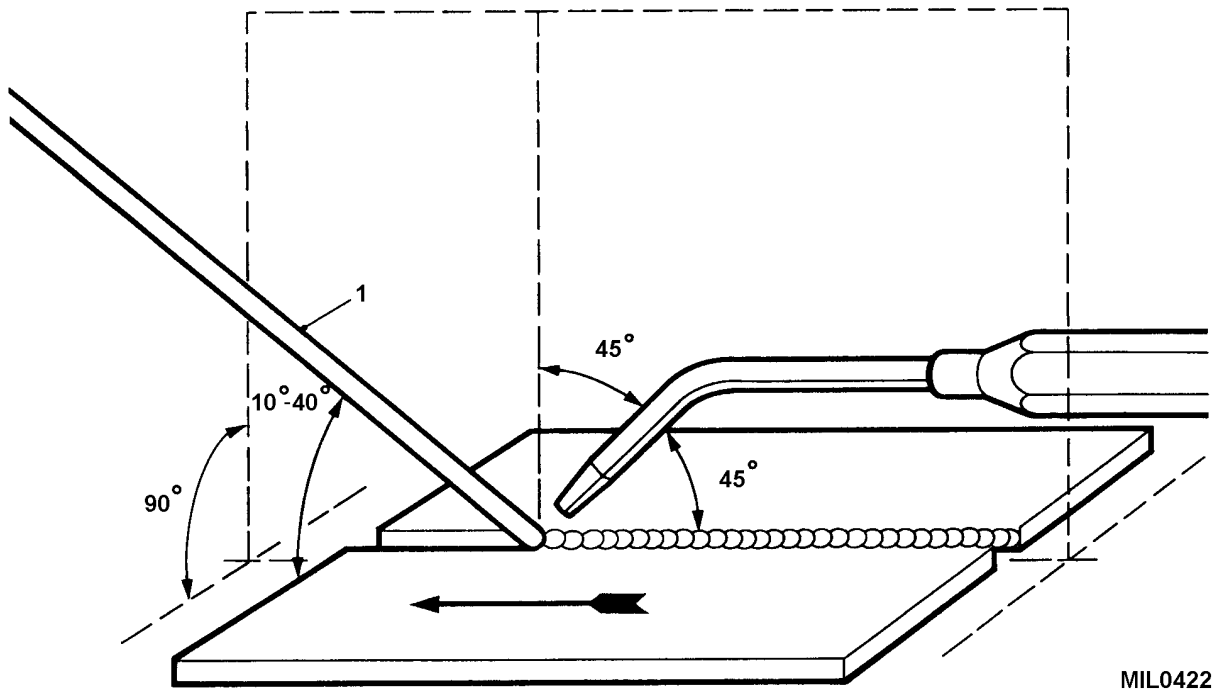


Fig 2 Welding techniques

RIVETING

19 Where both sides of the material are accessible and it is possible to use an anvil or 'dolly', solid aluminium rivets may be used, with a suitable punch or 'pop' to ensure clean rounded heads on the work. For riveting blind holes, 'pop-rivets' must be used.

PAINTING

20 The area to be painted must be flatted to remove the hard oxide skin, which forms on the surface of the alloy when exposed to the atmosphere. Degrease and dry the area, then apply a suitable etch primer. Unless an etch-primer is used, paint is liable to come away as it cannot 'key' into the hard oxide of an untreated alloy surface. It is quick and easy to apply and it prolongs the life of the paint film by ensuring excellent adhesion.

HOOD REPAIR**Soft top**

21 Repair of small holes and tears.

21.1 Small holes and tears can be patched using PVC hood material and adhesive.

22 To repair the hood carry out the following:

22.1 If necessary remove the hood from the vehicle.

22.2 Cut a PVC patch to size allowing sufficient overlap to give good adhesion and round off the corners.

22.3 Rough up the surface of the patch and mating surface of the hood using emery paper.

NOTE

Patch is to be applied to inner surface of the hood.

22.4 Coat both the patch and the damaged area on the hood with adhesive and apply the patch. Press firmly together to ensure a good contact.

22.5 Seal the repair on the outside surface of the hood using clear silicone sealant.

23 Repair of large holes and tears.

23.1 Large holes and tears necessitate the use of either hot air or high frequency welding equipment for the application of repair patches.

24 Straps, Listings and Stitching

24.1 If straps or listings become detached it is possible to sew them back on using an industrial sewing machine and polyester thread. The new stitching will require sealing using "MAXOL" sealant.

25 Elastic straps and ropes

25.1 Replacement elastic straps and ropes are available from LRPE.

Hard top

26 Repair of scratches and surface damage

WARNINGS

(1) SAFETY GLASSES / GOGGLES, GLOVES AND OVERALLS MUST BE WORN WHEN HANDLING RESINS, CATALYSTS AND SOLVENTS. ENSURE CLEANLINESS IS OBSERVED THROUGHOUT.

(2) VENTILATION. ENSURE ALL WORK IS CARRIED OUT IN A WELL VENTILATED AREA.

(3) COMPRESSED AIR. DO NOT DIRECT AIR STREAM AT PERSONNEL AS THIS CAN CAUSE PERSONAL INJURY.

NOTE

Repairs deeper than 2mm must be filled with P 40 (containing glass and filler). For dry mat areas deeper than half moulding thickness carry out a structural repair (refer to para 27).

26.1 Clean the area repair area using mutton cloth and acetone.

NOTE

Make sure that the surface to be repaired is as near to horizontal as possible.

26.2 Rout out the defect to a depth of 1-1.5mm (or to full depth if dry mat) to give a clean edge all round.

26.3 Carefully blow repair clear of dust using an air line.

26.4 Lightly abraid the area up to approx 12mm from edge of repair using P180 grit paper.

26.5 Carefully clean dust from the repair area using an air line.

- 26.6 Prepare a small quantity of catalysed repair mix (following manufacturers instructions).
P40 (or equivalent) for repairs deeper than 2mm
P38 (or equivalent) for repairs up to 2mm deep
- 26.7 Apply filler mix to the routed hole, pushing firmly into the repair. The depth of filler mix should be level with the surrounding surface.
- 26.8 For larger surface defects apply filler to surface using a small blade or plastic screed.
- 26.9 Allow repair to cure for a minimum of 15 to 20 minutes at 15 - 20°C.
- 26.10 Key the repair with P80 paper repeat using P180, P240/320, refill with filler if necessary.

27 Repair of Holes and Gashes

WARNINGS

- (1) SAFETY GLASSES / GOGGLES, GLOVES AND OVERALLS MUST BE WORN WHEN HANDLING RESINS, CATALYSTS AND SOLVENTS. ENSURE CLEANLINESS is OBSERVED THROUGHOUT.**
- (2) VENTILATION. ENSURE ALL WORK IS CARRIED OUT IN A WELL VENTILATED AREA.**
- (3) COMPRESSED AIR. DO NOT DIRECT AIR STREAM AT PERSONNEL AS THIS CAN CAUSE PERSONAL INJURY.**

- 27.1 Secure the split section tightly together using tape or clamps.
- 27.2 Tape over the split on the outer surface.
- 27.3 On the inside surface, abrade approximately 75mm around the split to a depth of at least half the thickness of the moulding gradually 'feathering up' to full thickness at the edges.
- 27.4 Wipe the abraded area free of dust.
- 27.5 Cut pieces of glass mat – 2 x 300g/m² chopped strand mat and 1 x surface tissue to cover the entire repair area, 1 x 300g/m² Ulti approximately 25 –35mm smaller than the chopped strand mat pieces.
- 27.6 Pour sufficient quantity of liquid polyester resin into a mixing bowl. Add catalyst and mix thoroughly following the manufacturers instructions.
- 27.7 Using a 1" brush, apply a thin layer of resin over the repair area. Wet out the 3 layers of mat turn on both sides using a lay up board. Transfer a layer of chopped strand mat to the repair area and dab out with a brush. Locate the Ulti layer centrally and 'dab' out. Transfer the remaining chopped strand mat and tissue layers, 'dab' out and smooth to finish even with the surrounding surface.
- 27.8 Allow to cure for 4-6 hours at room temperature. This may be speeded up by using a hot air gun held approximately 30cm from the repair for at least 5 mins (allow the resin to gel first).
- 27.9 Sand down the repair using P80 paper and a block if necessary.
- 27.10 Fill any porosity in the repaired area (refer to para 28).
- 27.11 Remove the tape from the outside surface.

28 Finishing Procedure

28.1 Carefully rub down the repair using P240/320 paper. Rub in a circular motion (using a block of suitable size to produce a flat surface) ensuring that the rubbing down area is limited to the immediate area of the repair.

28.2 Avoid excessive pressure on the repair to avoid deep scratching of the surface. Repeat for inner face where applicable.

28.3 When the repaired surface is level with the surrounding surface, wipe the repair clean with mutton cloth and check the surface for porosity and smoothness, if necessary, refill with P38 (refer to para 26). Carefully clean using an air line.

28.4 To repair small pinholes or very fine surface scratches use Top Stop. Wipe the filler paste firmly into the affected area and smooth with a firm wiping action. Allow to dry for 15-20 minutes.

28.5 Respray the area using 3077-P-9530 PPG black primer and Nato Green PPG 9150x2023.

BODYWORK

29 The following illustrations show the make up of the TUL and TUM vehicles.

KEY TO FIG 3

1	Bonnet stay	29	Stiffener, Bonnet - LH
2	Bonnet stay mounting plate	30	Windscreen buffer fixings
3	Grommet	31	Spring
4	Bonnet assy	32	Adjusting plate
5	Striker plate fixings	33	Support plate
6	Cleat	34	Bonnet stay mounting plate
7	Safety catch fixings	35	Spare wheel clamp plate
8	Spare wheel retainer	36	Top grille panel fixings
9	Strap plate	37	Pop rivet
10	Rope stowage strap	38	Catch plate fixings
11	Safety catch	39	Catch plate
12	Windscreen buffer	40	Cross brace fixings
13	Tool support bracket	41	Cross brace
14	Spare wheel retainer fixings	42	Pop rivet
15	Bonnet hinge fixings	43	Mounting plate
16	Bonnet hinge	44	Bonnet catch fixings
17	Bush	45	Grille panel fixings
18	Shovel support bracket	46	Grille fixings
19	Shovel support pad	47	Badge
20	Clamp plate fixings	48	Grille
21	Buffer	49	Cross brace
22	Tool support bracket	50	Bonnet catch
23	Tool stowage strap	51	Bonnet striker
24	Tool support bracket	52	Striker plate
25	Buffer fixings	53	Top grille panel
26	Buffer	54	Grille panel
27	Pop rivet	55	Grille panel fixings
28	Bonnet stay clip		

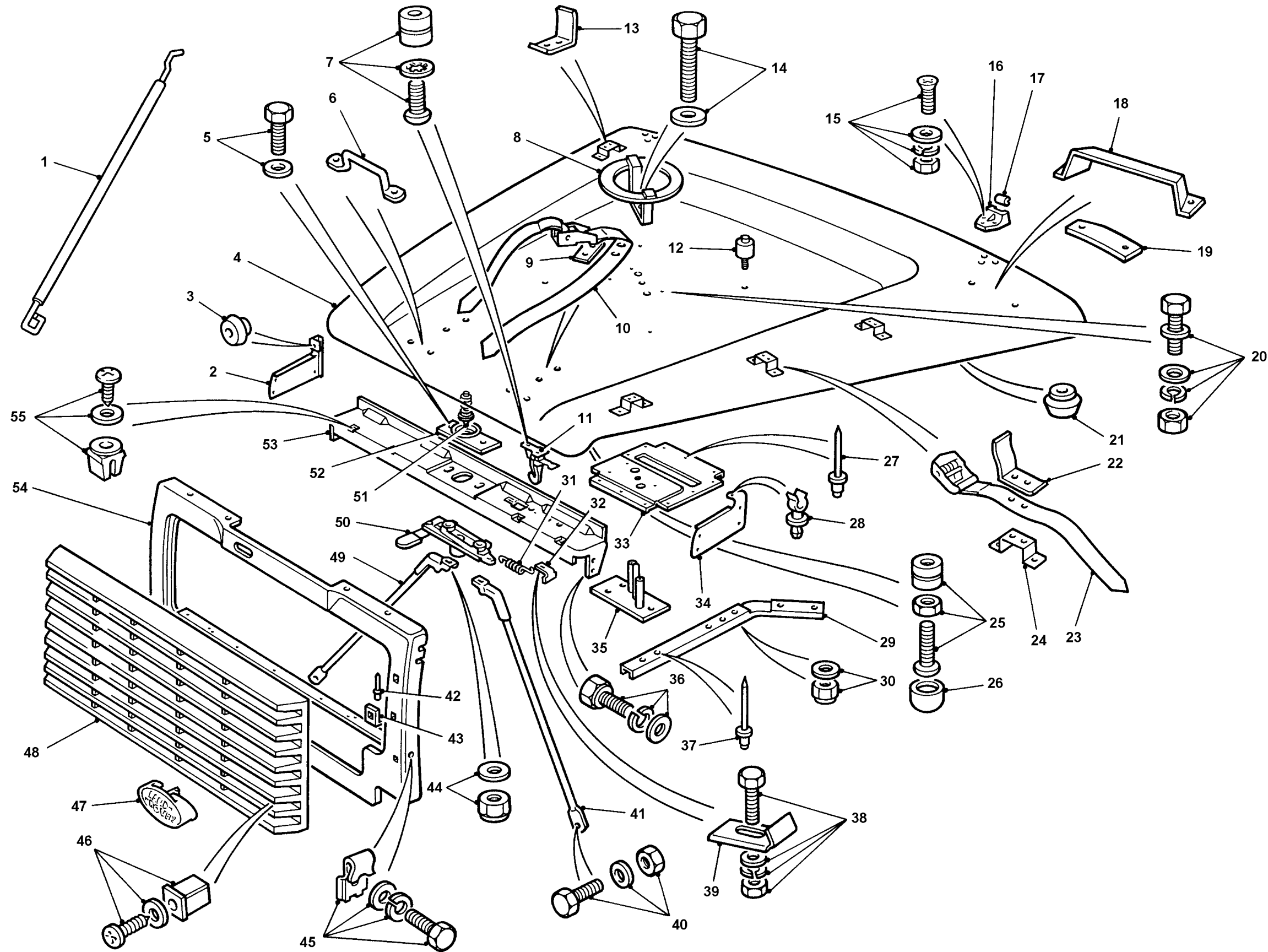
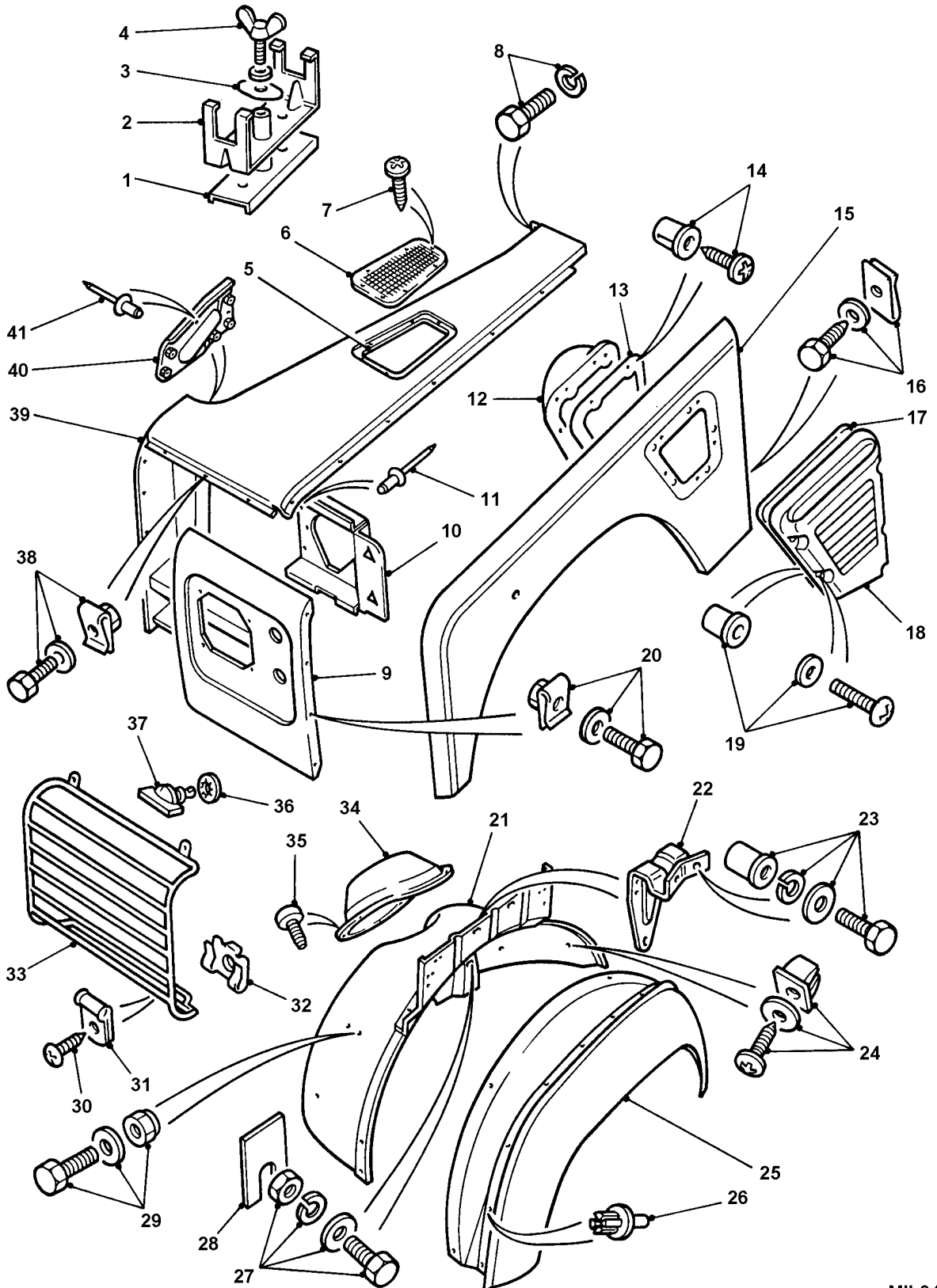


Fig 3 Bonnet assembly

MIL0423

KEY TO FIG 4

	1	Retaining bracket	22	Support stay
	2	Pick head support bracket	23	Stay fixings
	3	Retaining plate	24	Wheel arch fixings
	4	Retaining bolt	25	Front eyebrow
	5	Duct seal	26	Pop rivet
	6	Finisher grille	27	Wheel arch fixings
7		Screw	28	Shim
	8	Front wing fixings	29	Wheel arch fixings
9		Nose panel	30	Screw
	10	Mounting panel	31	'P' clip
	11	Pop rivet	32	Captive nut
	12	Upper air duct	33	Lamp guard
	13	Seal	34	Suspension cover
	14	Air duct fixings	35	Screw
	15	Outer wing panel	36	Retainer
	16	Wing panel fixings	37	Lamp guard fast release stud
	17	Intake grille seal	38	Front wing fixings
	18	Air intake grille	39	Front wing
	19	Intake grille fixings	40	Tie plate
	20	Nose panel fixings	41	Pop rivet
21		Wheel arch		



MIL0424

Fig 4 Front wing and scuttle assembly

KEY TO FIG 5

	1	Glass	15	Tie bolt fixings
2		Glazing rubber	16	Grommet
	3	Windscreen frame	17	Dash assembly
	4	Front plate	18	Dash fixings
	5	Drain channel seal	19	Grommet
	6	Windscreen seal	20	Grommet plate
7		Ventilator control	21	Screw
	8	Ventilator control fixings	22	Windscreen clamp fixings
	9	Ventilator lid fixings	23	Hinge
	10	Front plate fixings	24	Windscreen clamp
	11	Front plate, dash fixings	25	Gasket
	12	Sealing rubber	26	Gasket
	13	Ventilator lid	27	Hinge fixing
14		Hinge pin		

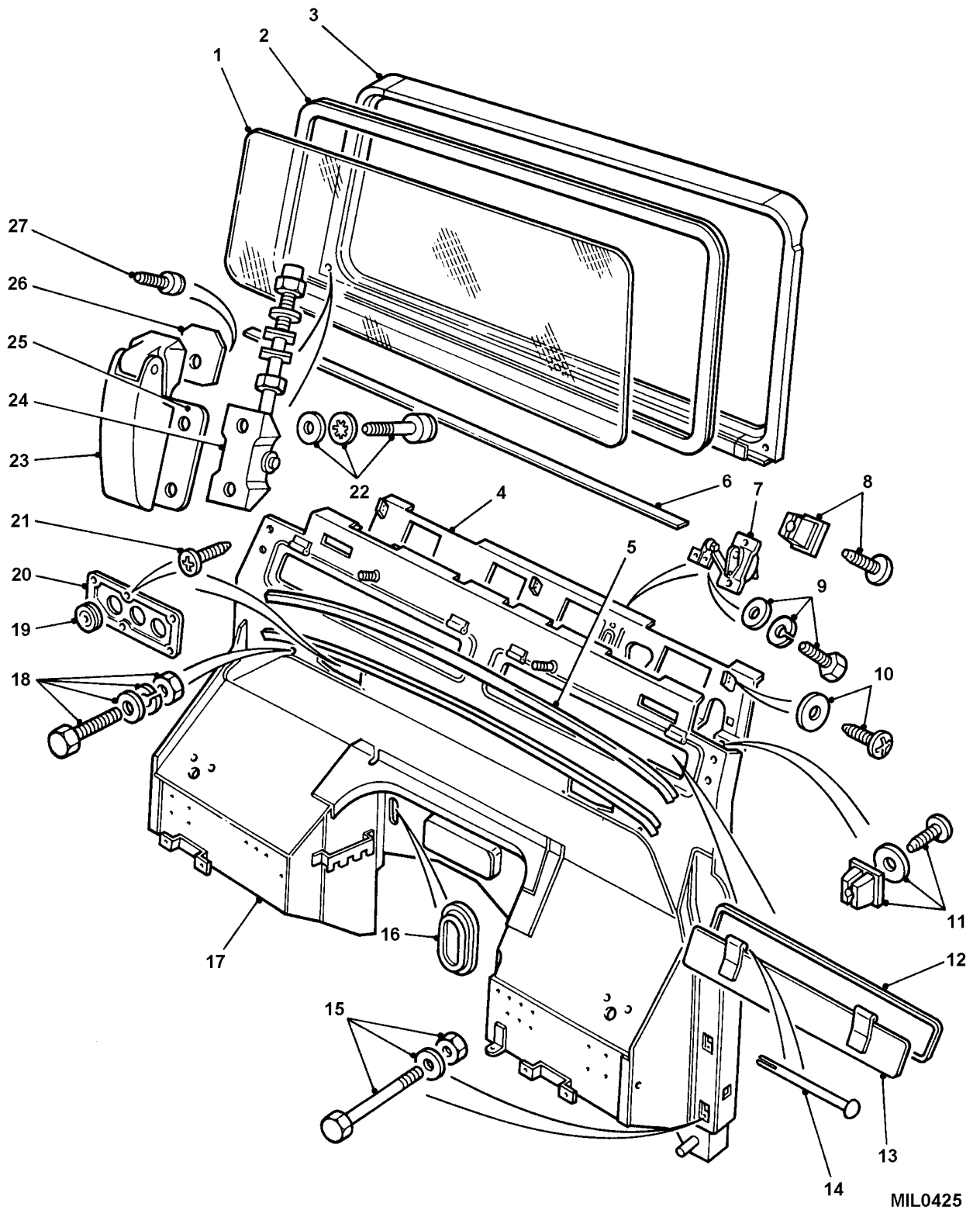


Fig 5 Scuttle assembly

KEY TO FIG 6

	1	Grab handle	24	Switch panel
	2	Grab handle fixings	25	Screw
	3	Upper crash pad fixings	26	Fuse box cover
5	4	Ash tray	27	Duct assembly fixings
		Retainer	28	Duct fixings
	6	Demister outlet	29	Wiper motor cover
	7	Demister outlet fixings	30	Finisher
	8	Trim panel upper fixings	31	Closing panel
	9	Trim panel lower fixings	32	Cover
	10	Trim panel	33	Fastener
	11	Cowl fixings	34	Trim fixings
	12	Instrument panel fixings	35	Trim finisher
	13	Instrument panel	36	Side panel
	14	Side panel fixings	37	Switch panel
	15	Parcel tray	38	Trim finisher
	16	Instrument panel fixings	39	Side panel
	17	Closing panel fixing screw	40	Stiffener base
	18	Bezel	41	Instrument cowl
	19	Seal	42	Crash pad fixings
	20	Finisher fixings	43	Upper crash pad
	21	Duct assembly	44	Grab handle fixings
23	22	Spring nut	45	Trim badge
		Screw		

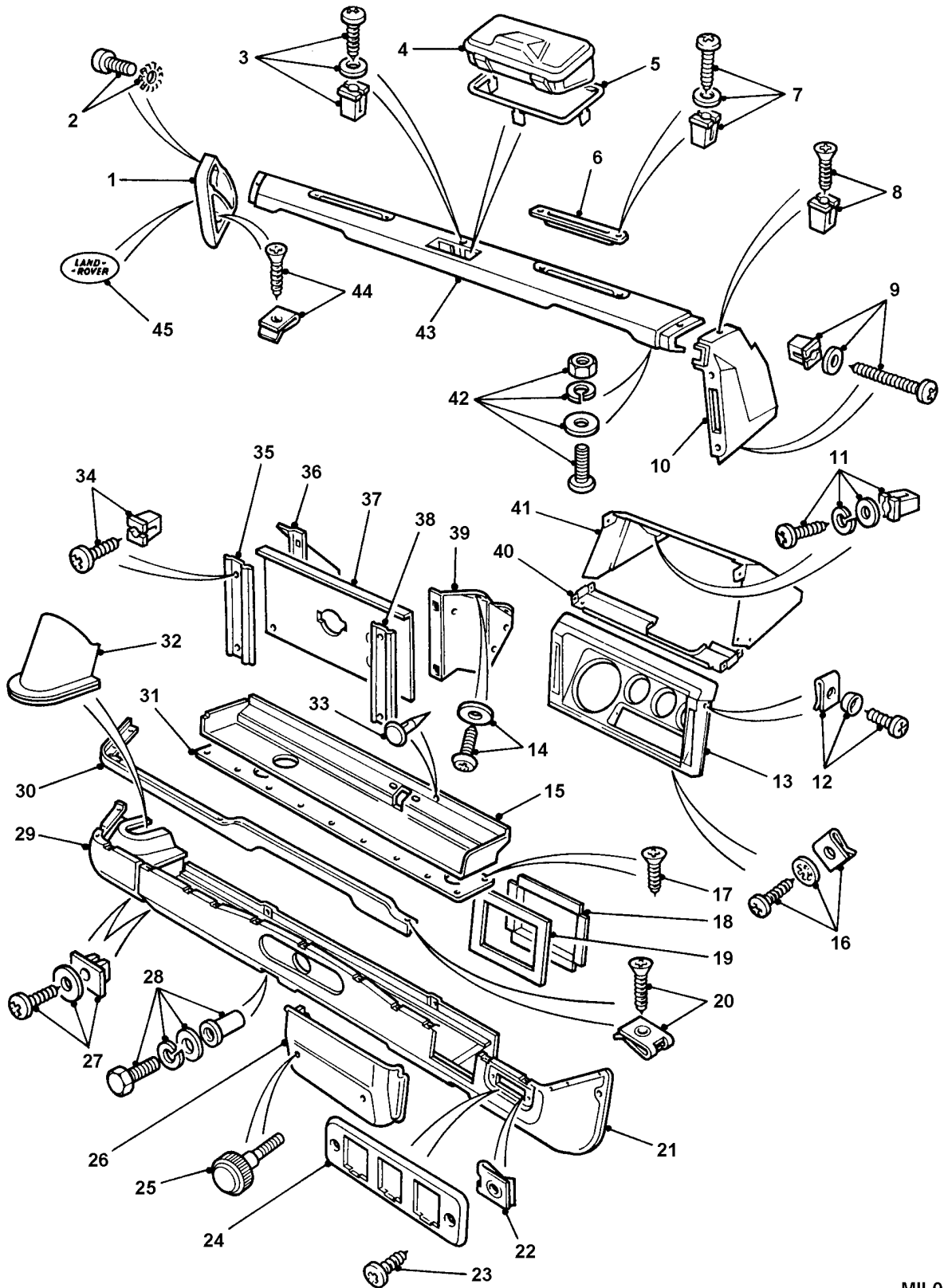


Fig 6 Dash trim assembly

MIL0426

KEY TO FIG 7

1	Fastener	36	Sill channel
	2 Kit retention bar	37	Stud plate
3	Mat	38	Battery tray
4	Pop nut	39	Catch
	5 Screw	40	Harness protection plate
	6 Centre cover fixings	41	Pop rivet
	7 Battery access cover	42	Sill channel fixings
8	Seal	43	Seal
	9 Locating angle	44	Floor plate
	10 Seat frame fixings	45	Seal
	11 Pop rivet	46	Floor plate fixings
	12 Bush plate	47	Seal
	13 Seat cushion	48	Seal
	14 Rubbing strip	49	Diaphragm panel
	15 Head restraint	50	Seal
	16 Seat squab	51	Diaphragm panel fixings
	17 Sliding seat sub-frame	52	Floor plate fixings
	18 Trim nail	53	Seal
	19 Cushion guide plate	54	Floor plate
	20 Seat base fixings	55	Floor plate fixings
	21 Seat fame fixings	56	Floor plate fixings
	22 Bracket fixings	57	Cable tie
	23 Sill channel bracket	58	Insulation pad
	24 Seat-base fixings	59	Seal
	25 Reinforcing bracket	60	Tunnel fixings
	26 Seat-base fixings	61	Tunnel panel
	27 Bracket fixings	62	Seal
	28 Bracket fixings	63	Tool locker (TUM only)
	29 Sill panel mounting bracket	64	Pop rivet
	30 Bracket fixings	65	Blanking plug
	31 Nut	66	Gaiter
	32 Stay fixings	67	Seat base
	33 Front stay	68	Centre cover
	34 Front LH sill panel	69	Cover/Fuel tank access
35	Sill fixings		

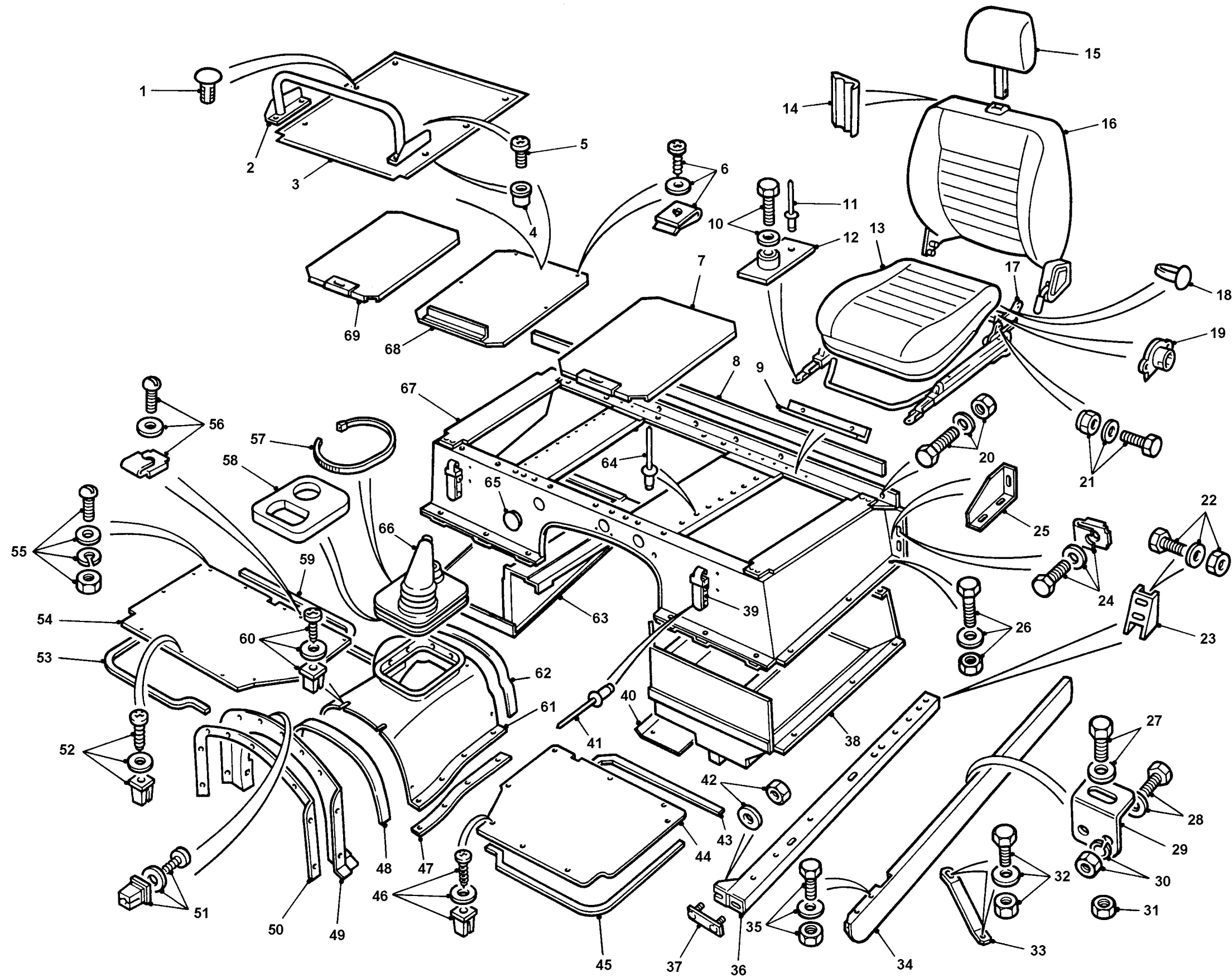


Fig 7 Gearbox tunnel and seat-base assembly

MIL0427

KEY TO FIG 8

1	Door seal	36	Slider rail outer
2	Finger pull inner	37	Top capping
3	Finger pull outer	38	Pad
4	Draught rail	39	Mirror fixings
5	Glazing felt	40	Hinge fixings
6	Glazing rubber	41	Upper hinge
7	Weatherseal rubber	42	Mirror arm
8	Inner window glass	43	Hinge screw
9	Infill rubber	44	Hinge screw
10	Inner slide rail	45	Lower hinge
11	Runner block	46	Seating washer
12	Fixing rail screw	47	'J' Nut
13	Pop rivet	48	Door assembly
14	Striker stay fixings	49	Check strap retainer
15	Striker stay	50	Door check strap rod
16	Bracket stay	51	Buffer
17	Stud plate	52	Check strap fixings
18	Nut plate	53	Retaining bracket fixings
19	Stud plate fixings	54	Rivet
20	Lock seal	55	Retaining bracket
21	Barrel lock key	56	Retaining bracket fixings
22	Door striker	57	Pop rivet
23	Door striker fixings	58	Window catch
24	Striker guide	59	Screw
25	Mirror head	60	Pad
26	Striker guide screw	61	Seal
27	Screw retainer	62	Stud
28	Retainer fixings	63	Knob
29	Door lock	64	Screw
30	lock fixings	65	Lower door seal
31	Nut retainer	66	Pop rivet
32	Side screen fixings	67	Runner block
33	Draught seal removable rail	68	Glazing felt
34	Infill rubber	69	Infill rubber
35	Window glass outer		

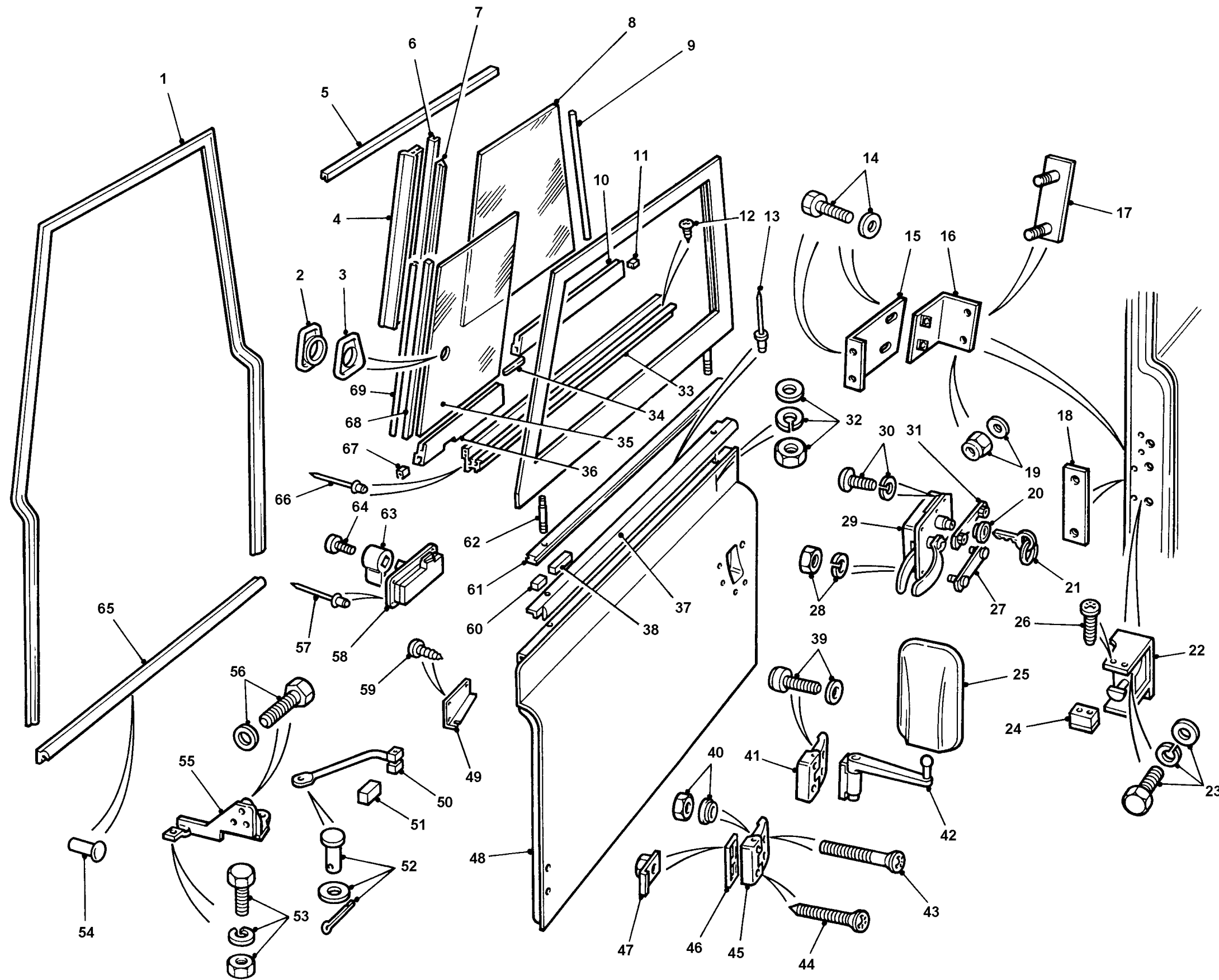


Fig 8 Side door assembly

MIL0428

KEY TO FIG 9

1	Pop rivet	39	Pop rivet
2	Plain washer	40	Pop rivet
3	Hook and strap	41	Mounting plate
4	Bench seat assembly	42	Pop rivet
5	Tie bar fixings	43	Jack mounting bracket
6	Tie bar	44	Jack retention strap
8	7 Safety harness single bracket	45	Pop rivet
	8 Screw	46	Mounting plate
	9 Seat belt lap strap	47	Fire extinguisher bracket
	10 Rear seat anchorage	48	Mounting plate fixings
	11 Pop rivet	49	Seatbase support bracket
	12 Capping	50	Support bracket
	13 Bodyside panel	51	Bracket fixings
	14 Capping	52	U bolt fixings
	15 Protection angle	53	Bracket fixings
	16 Pop rivet	54	Clip fixings
	17 Rear end panel	55	Rifle butt bracket and clip
	18 Corner bracket	56	Bracket fixings
	19 Floor plate	57	Head protection pad
	20 Pop rivet	58	Rifle barrel clip fixings
	21 Corner bracket	59	Pop rivet
	22 Antiluce fixings	60	Wheel chock bracket
	23 Antiluce cotter	61	Tool roll retaining ring
	24 Capping	62	Tool roll bracket
	25 Bodyside panel	63	Jack handle retaining clip
	26 Protection angle	64	Reinforcing plate
	27 Pop rivet	65	U bolt
	28 Mounting bracket fixings	66	Bracket fixings
	29 Mounting bracket	67	Mounting bracket
	30 Mounting bracket fixings	68	Support bracket
	31 Rear sill panel fixings	69	Support bracket fixings
	32 Lokut	70	Seat frame fixings
	33 Snapsac	71	Safety harness anchorage
	34 Rear sill panel	72	Pop rivet
	35 Front panel	73	Anchor bracket
	36 Mono bolt	74	Bolt
	37 Gasket	75	Rifle barrel bracket
	38 Cover plate	76	Rifle barrel clip

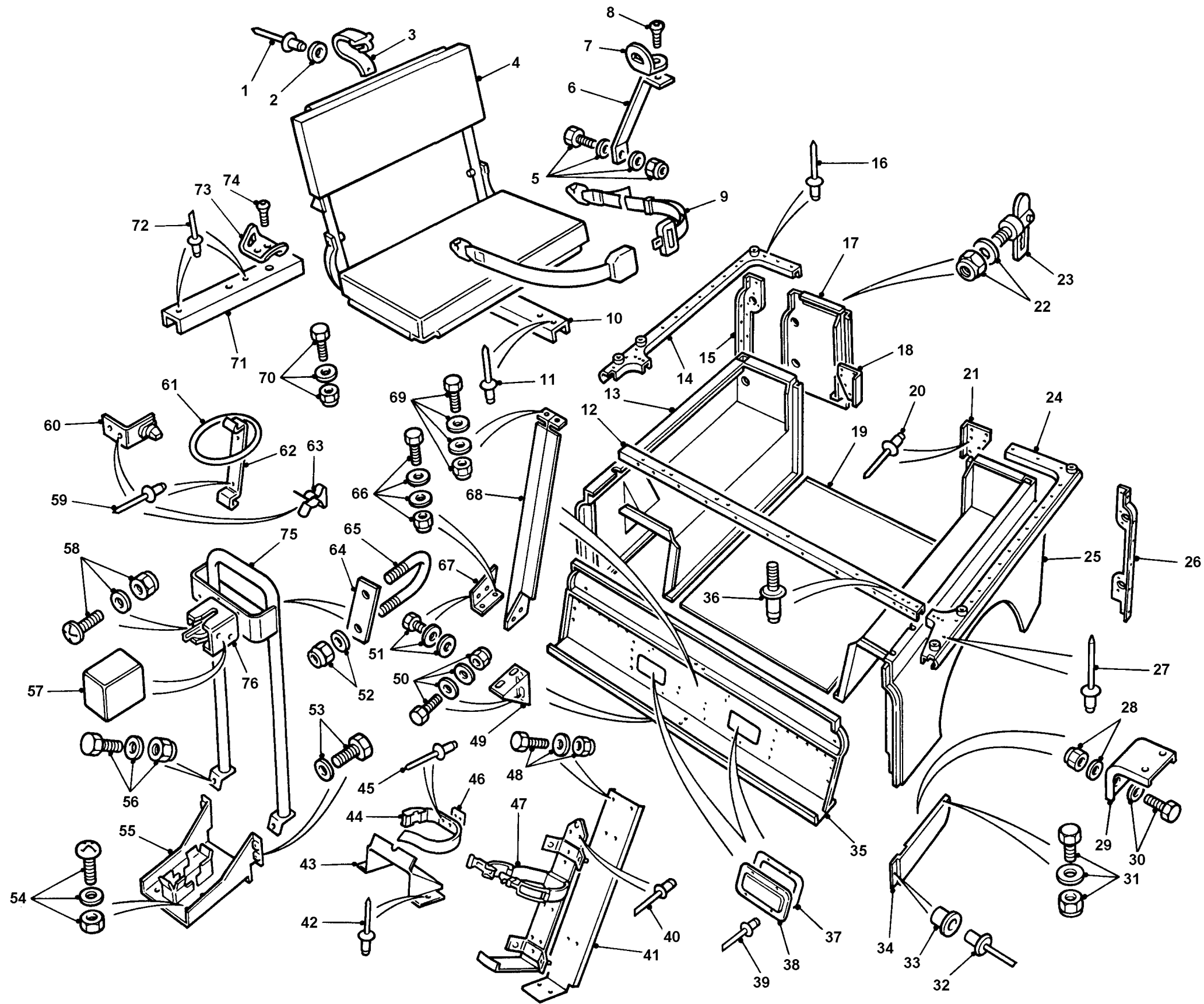


Fig 9 Lower rear body assembly I (TUL)

MIL0429

KEY TO FIG 10

	1	Lashing cleat fixings		34	Staple
	2	Angle plate		35	Jerrycan tray
	3	Lashing cleat		36	Pop rivet
5	4	Bodyside inner panel RH Nutsert		37	Jerrycan stowage rail assy
	6	Inner panel fixings		38	Rope hook
	7	Hood strap staple		39	Body to chassis fixings
	8	Pop rivet		40	Pop rivet
	9	Pop rivet		41	Pop rivet
	10	Floor tread plate		42	Safety harness anchor plate
	11	Wheel arch tread plate		43	Crossmember mounting pad
	12	Panel cover RH		44	Crossmember
	13	Cover fixings		45	Collar
	14	Cover fixings		46	Pin
	15	Tailgate stay reinforcement angle		47	Rear flag holder
	16	Cam cleat fixings		48	Pop rivet
	17	Hood rope cam cleat		49	Bracket fixings
	18	Pop rivet		50	Pop rivet
	19	Rope cleat		51	Mounting bracket
	20	Rear body mounting bracket		52	Lashing cleat fixings
	21	Bracket fixings		53	Angle plate
	22	Body fixings		54	Floor reinforcing plate
	23	Stay fixings		55	Pop rivet
	24	Stay		56	Lashing cleat
	25	Lamp access panel		57	Buckle assembly LH
	26	Lokut nut		58	Buckle fixings
	27	Fixing screw		59	Seat belt reel assy LH
	28	Rear eyebrow		60	Rear lower body assy
	29	Plastic rivet		61	Seatbelt fixings
	30	Jerrycan top rail fixings		62	Bulkhead stiffner panel
	31	Strap and buckle assembly		63	Pop rivet
33	32	Strap assembly Pop rivet		64	Front panel tread plate
				65	Seatbelt fixings

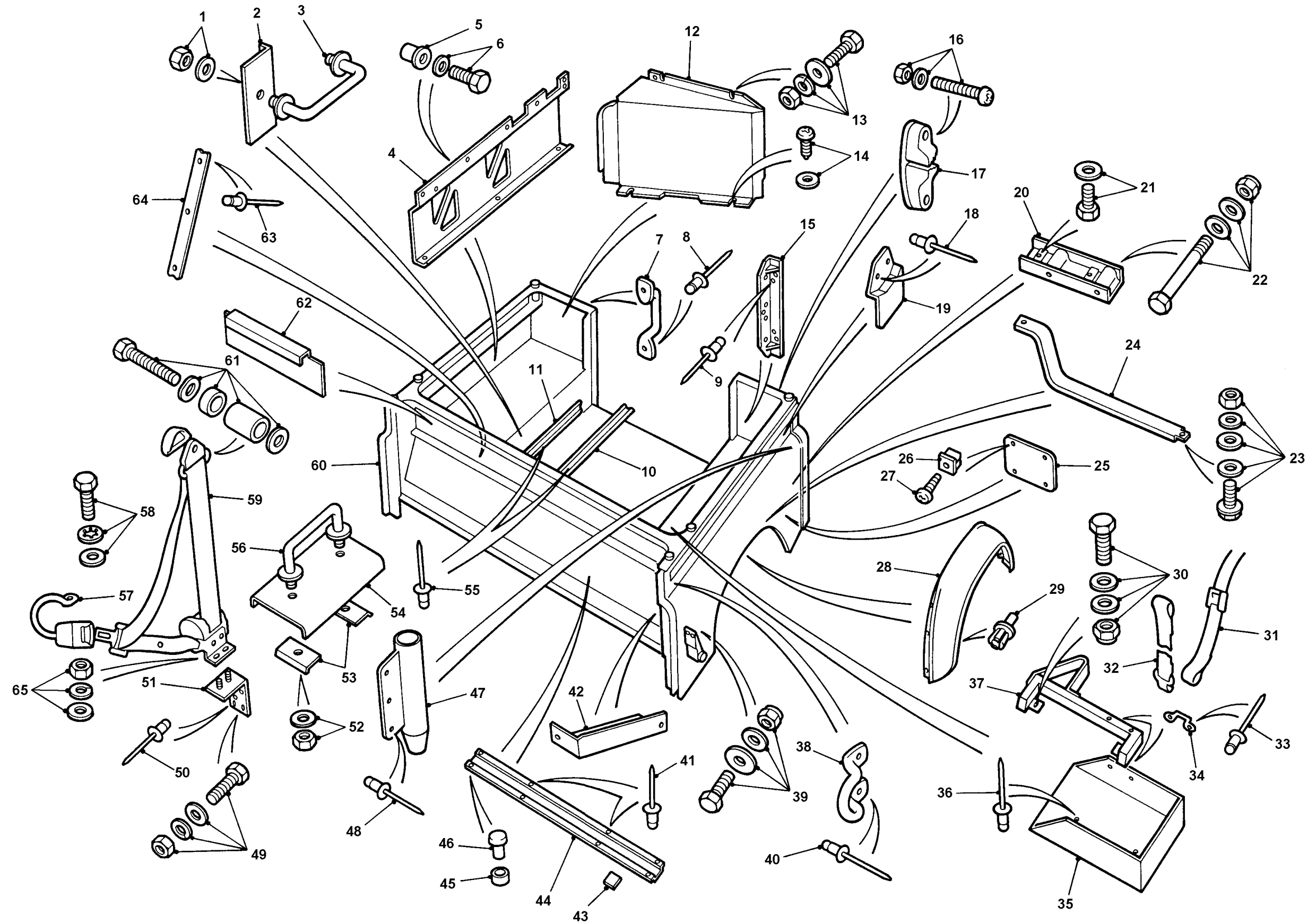


Fig 10 Lower rear body assembly II (TUL)

MIL0430

KEY TO FIG 11

1	Pop rivet	41	Cover plate
2	Plain washer	42	Pop rivet
3	Hook and strap	43	Pop rivet
4	Bench seat assembly	44	Fire extinguisher bracket
5	Tie bar fixings	45	Mounting plate
6	Bolt	46	Mounting plate fixings
7	Safety harness bracket	47	Strap plate
8	Tie bar	48	Pop rivet
9	Tie bar fixings	49	Jack retention strap
10	Seat belt lap strap	50	Jack mounting bracket
11	Rear seat anchorage	51	Pop rivet
12	Pop rivet	52	Rifle butt mounting bracket
13	Support bracket	53	Rifle clip fixings
14	Capping	54	Rifle butt clip
15	Body side panel	55	Rifle mounting bracket fixings
16	Protection angle	56	Head protection pad
17	Pop rivet	57	Rifle clip fixings
18	Capping	58	Rifle barrel clip
19	Rear end panel	59	U bolt fixings
20	Corner bracket	60	Support bracket fixings
21	Floor plate	61	Bracket fixings
22	Pop rivet	62	Mounting bracket
23	Antiluce cotter	63	U bolt
24	Antiluce fixings	64	Reinforcing plate
25	Corner bracket	65	Rifle barrel mounting bracket
26	Capping	66	Pop rivet
27	Protection angle	67	Wheel chock bracket
28	Bodyside panel	68	Tool roll bracket
29	Pop rivet	69	Jack handle retaining clip
30	Sill channel bracket	70	Bracket fixings
31	Rear sill panel fixings	71	Support bracket fixings
32	Rear sill bracket	72	Tool roll retaining ring
33	Rear sill panel fixings	73	Seat frame fixings
34	Rear sill fixings	74	Safety harness anchorage
35	Lokut	75	Pop rivet
36	Snapsac	76	Safety harness bracket
37	Rear sill panel	77	Bolt
38	Front panel	78	Seat base support bracket
39	Monobolt	79	Mounting bracket fixings
40	Gasket		

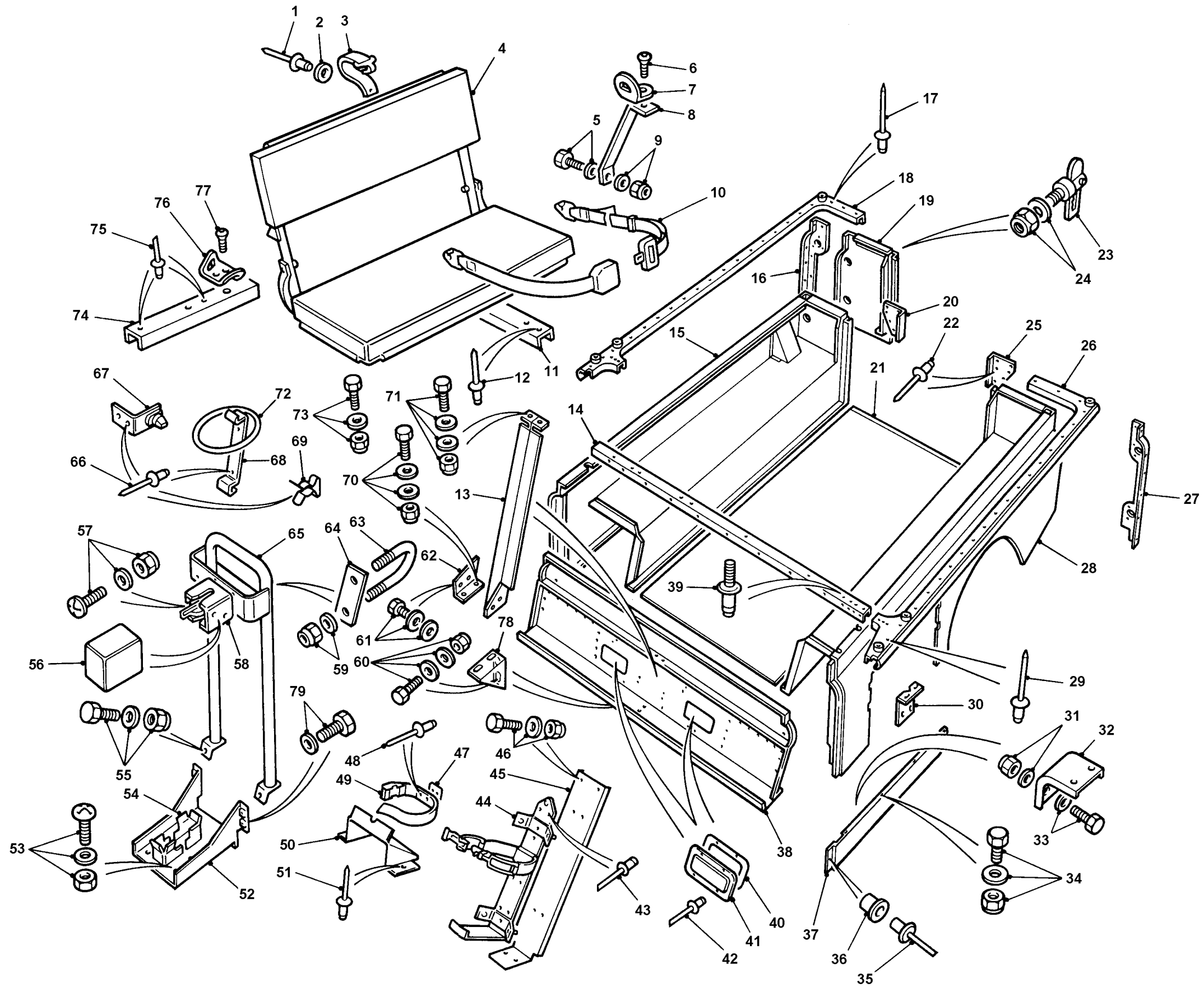


Fig 11 Lower rear body assembly I (TUM)

MIL0431

KEY TO FIG 12

1	Lashing cleat fixings	47	Nut
2	Angle plate	48	Pop rivet
3	Lashing cleat	49	Rear tread strip
4	Seat mounting bracket	50	Sealing strip
5	Nut seat	51	Tapping plate fixings
6	Bracket fixings	52	Tapping plate
7	Nut seat	53	Tapping plate retainer
8	Inner panel fixings	54	Rope hook
9	Bodyside inner panel RH	55	Pop rivet
10	Panel cover RH	56	Pop rivet
11	Bracket fixings	57	Body mount fixings
12	Pop rivet	58	Chassis fixings
13	Rear lower body assembly	59	Spreader plate
14	Hood strap staple	60	Collar
15	Rivet	61	Cotter reinforcing plate
16	Rivet	62	Pin
17	Tailgate stay reinforcement angle	63	Body mounting bracket LH
18	Cover fixings	64	Pop rivet
19	Cam cleat fixings	65	Safety harness anchor plate
20	Hood rope cam cleat	66	Cross member fixings
21	Rivet	67	Rear body mount fixings
22	Rope cleat	68	Cross member
23	Rear body mounting bracket	69	Floor spacer cross member
24	Body fixings	70	Pop rivet
25	Stay fixings	71	Rear flag holder
26	Stay	72	Angle plate
27	Lamp access panel	73	Cross member support
28	Lokut nut	74	Rubber pad
29	Fixing screw	75	Lashing cleat
30	Rear eyebrow	76	Seat belt reel assembly LH
31	Plastic rivet	77	Floor reinforcing plate
32	Tread strip	78	Mounting bracket
33	Box assembly RH	79	Bracket fixings
34	Pop rivet	80	Pop rivet
35	Door assembly	81	Seat belt reel fixings
36	Door seal	82	Buckle assembly LH
37	Pop rivet	83	Buckle fixings
38	Reinforcing plate	84	Cover (trim)
39	Box fixings	85	Seat belt fixings
40	Pop rivet t	86	Bulkhead stiffener plate
41	Strap cleat	87	Pop rivet
42	Strap hook	88	Front panel tread plate
43	Pop rivets	89	Wheel arc tread plate
44	Strap buckle	90	Floor tread plate
45	Reinforcing plate	91	Lashing cleat fixings
46	Anti-luce cotter		

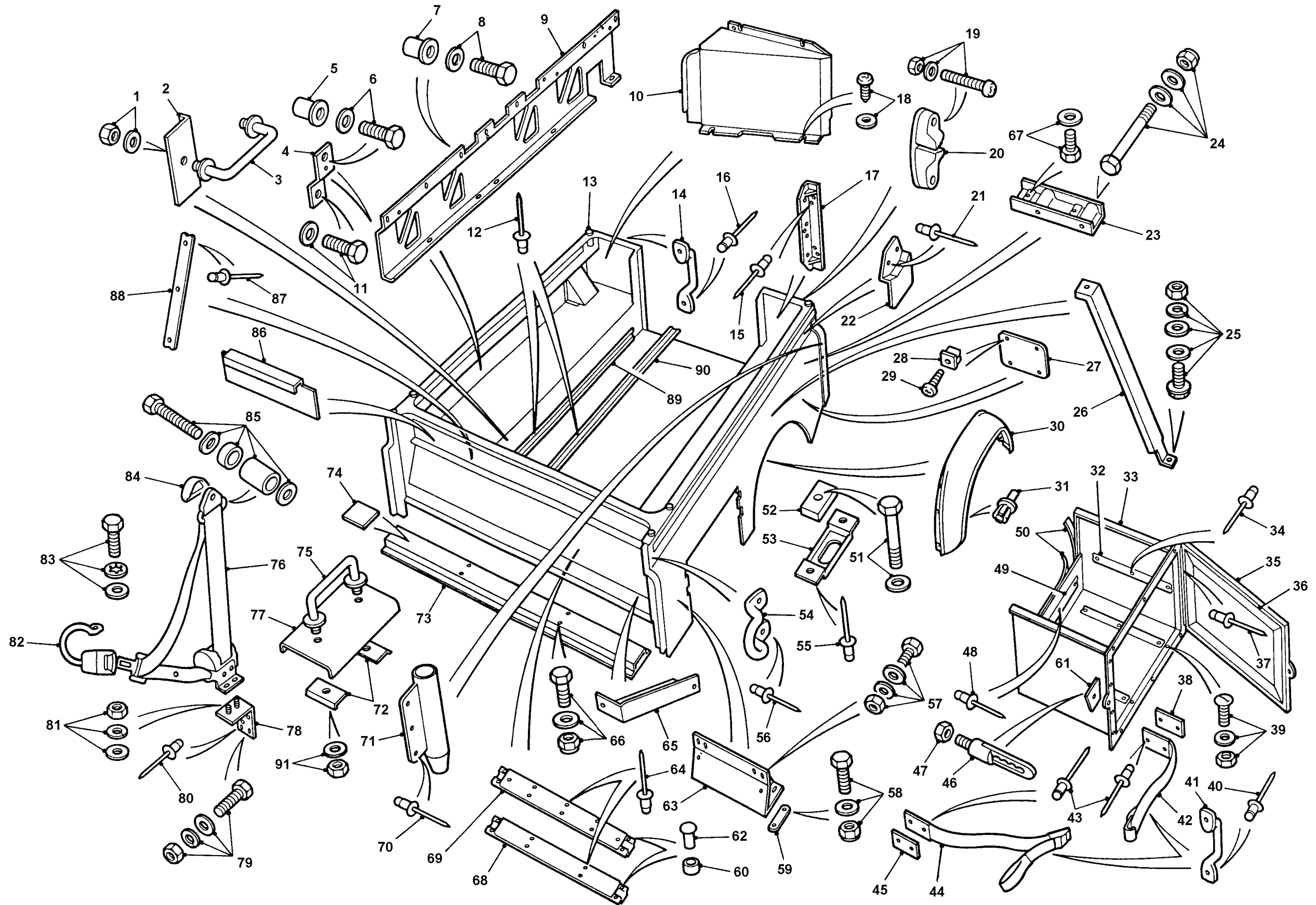
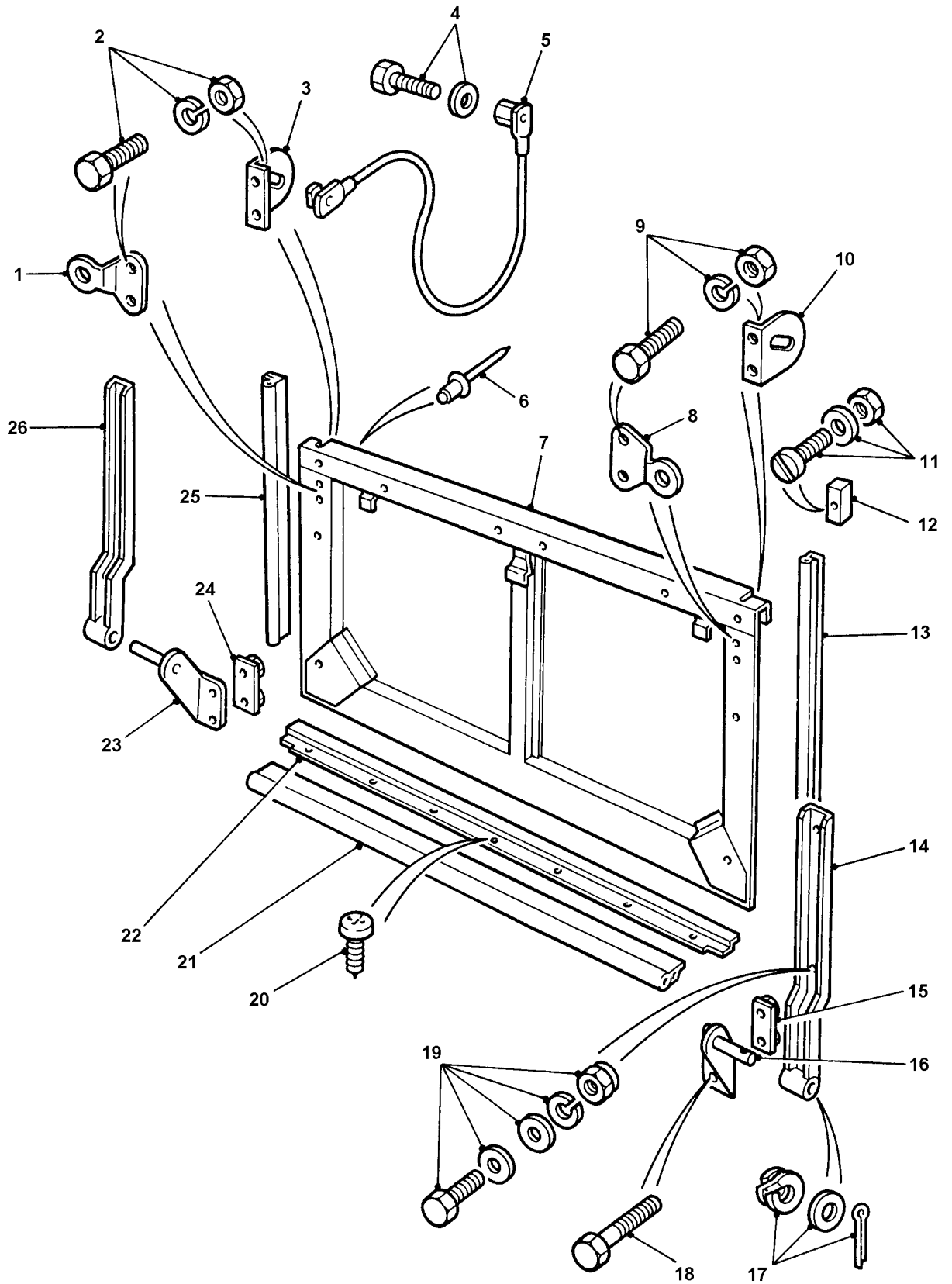


Fig 12 Lower rear body assembly II (TUM)

MIL0432

KEY TO FIG 13

	1	Locking plate	14	Tail gate hinge
	2	Locking plate fixings	15	Nut plate
	3	Tail gate cable bracket	16	Hinge pin
	4	Cable stay fixings	17	Hinge pin fixings
	5	Tail gate cable stay	18	Hinge pin bolt
6		Rivet	19	Hinge fixings
7		Tail gate	20	Screw
	8	Locking plate	21	Tail gate floor seal
	9	Locking plate fixings	22	Seal retainer strip
	10	Tail gate cable bracket	23	Hinge pin
	11	Seal finisher fixings	24	Nut plate
	12	Seal finisher	25	Tail gate seal
	13	Tail gate seal	26	Hinge



MIL0433

Fig 13 Tailgate assembly (soft top only)

KEY TO FIG 14

1	Full length hood	9	Channel fixings
2	Rivet	10	Drain chamber LH
3	Hood strap staple	11	Channel fixing bolt
4	Vertical channel LH	12	Header rail
5	Channel bracket LH	13	Header rail fixings
6	Channel bracket fixings	14	Drain channel support fixings
7	Nut sert	15	Nut sert
8	Distance tube	16	Drain channel support bracket

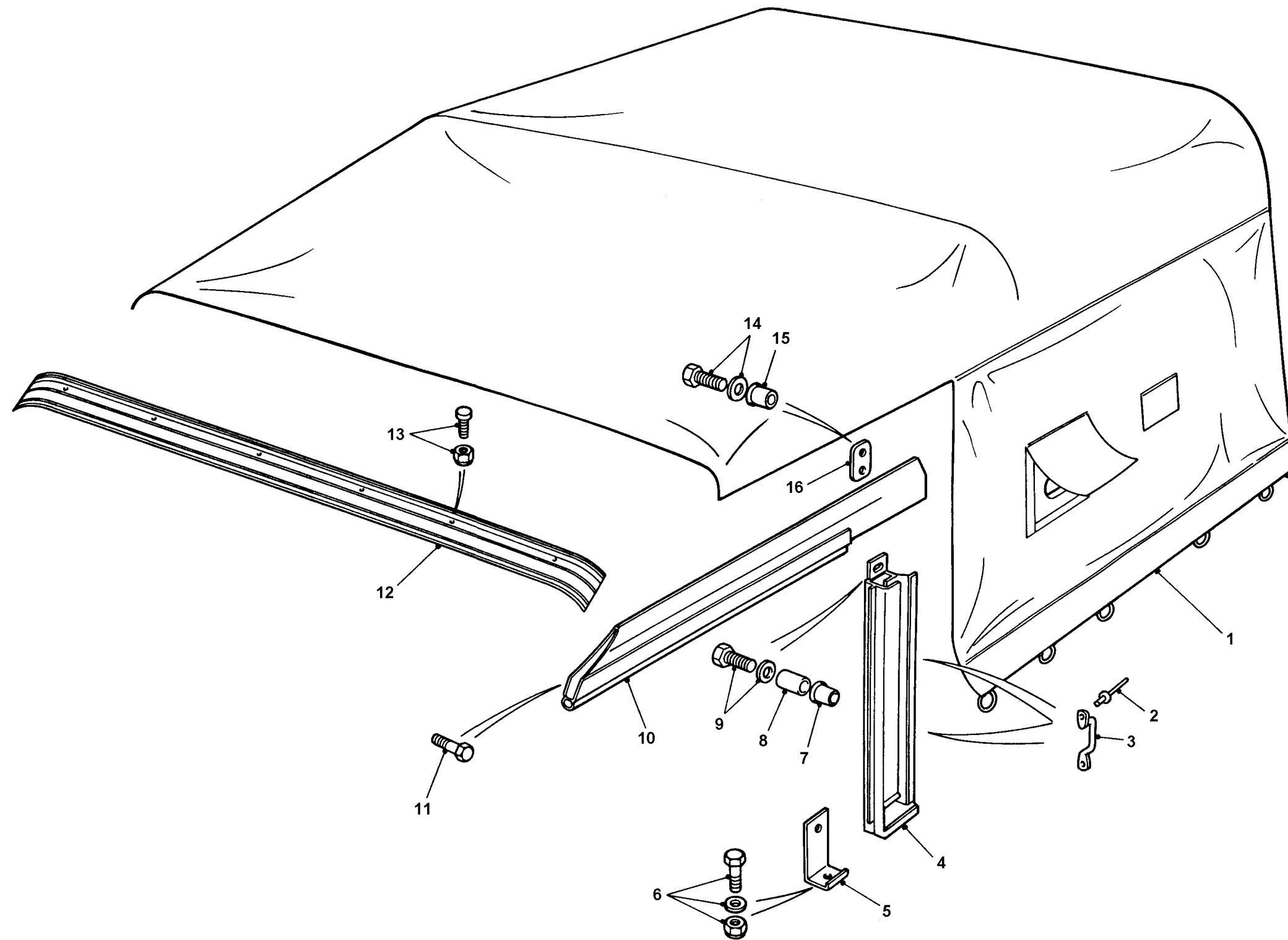


Fig 14 Soft top assembly (TUL)

MIL0434

KEY TO FIG 15

1	Full length hood	9	Channel fixings
2	Rivet	10	Drain chamber LH
3	Hood strap staple	11	Channel fixing bolt
4	Vertical channel LH	12	Header rail
5	Channel bracket LH	13	Header rail fixings
6	Channel bracket fixings	14	Drain channel support fixings
7	Nut sert	15	Nut sert
8	Distance tube	16	Drain channel support bracket

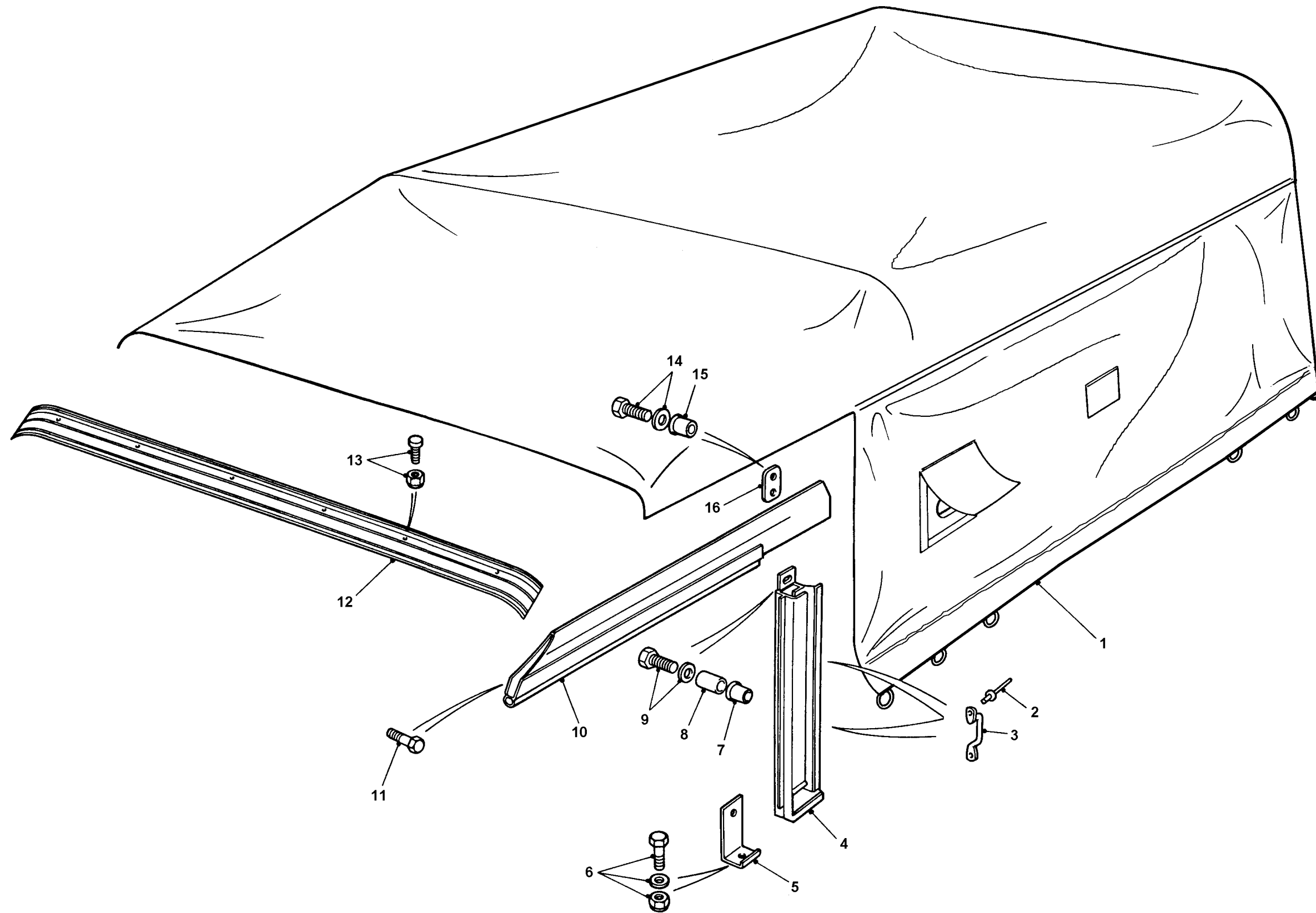


Fig 15 Soft top assembly (TUM)

MIL0435

KEY TO FIG 16

1	Roof	10	'T' bolt fixings
2	Support plate fixings	11	Capping bracket
3	Support plate	12	capping bracket fixings
4	Nut plate	13	'T' bolt
5	Rear roof fixings	14	Capping bracket fixings
6	Rear seal	15	Front corner seal
7	Bodyside seal	16	Self adhesive foam pad
8	Antenna lead blanking plug	17	Roof front fixings
9	Spare wheel blanking plug		

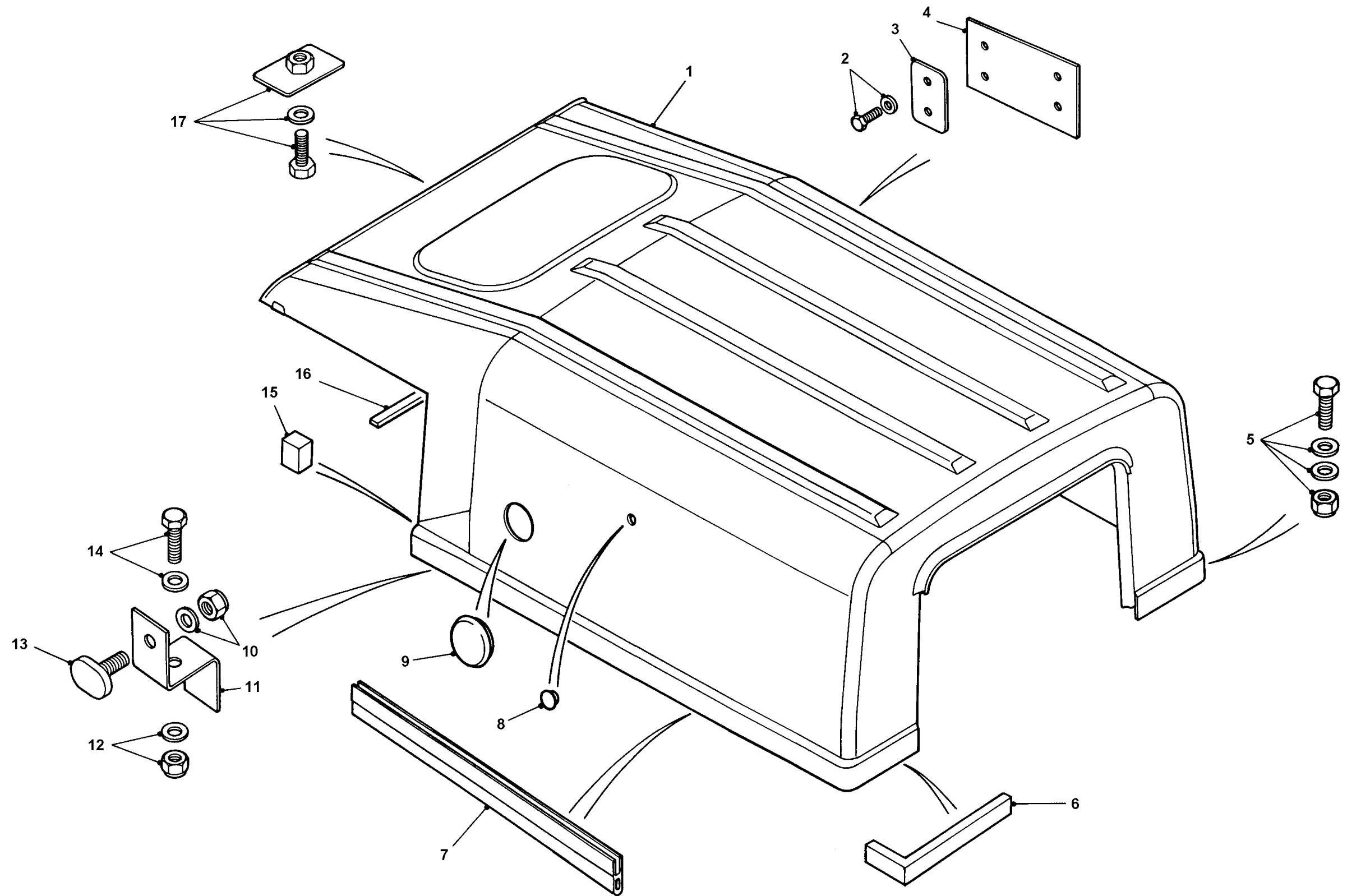


Fig 16 Hard top assembly (TUL)

MIL0436

KEY TO FIG 17

1	Roof	10	'T' bolt fixings
2	Support plate fixings	11	Capping bracket
3	Support plate	12	Capping bracket fixings
4	Nut plate	13	'T' bolt
5	Rear roof fixings	14	Capping bracket fixings
6	Rear seal	15	Front corner seal
7	Bodyside seal	16	Self adhesive foam pad
8	Antenna lead blanking plug	17	Roof front fixings
9	Spare wheel blanking plug		

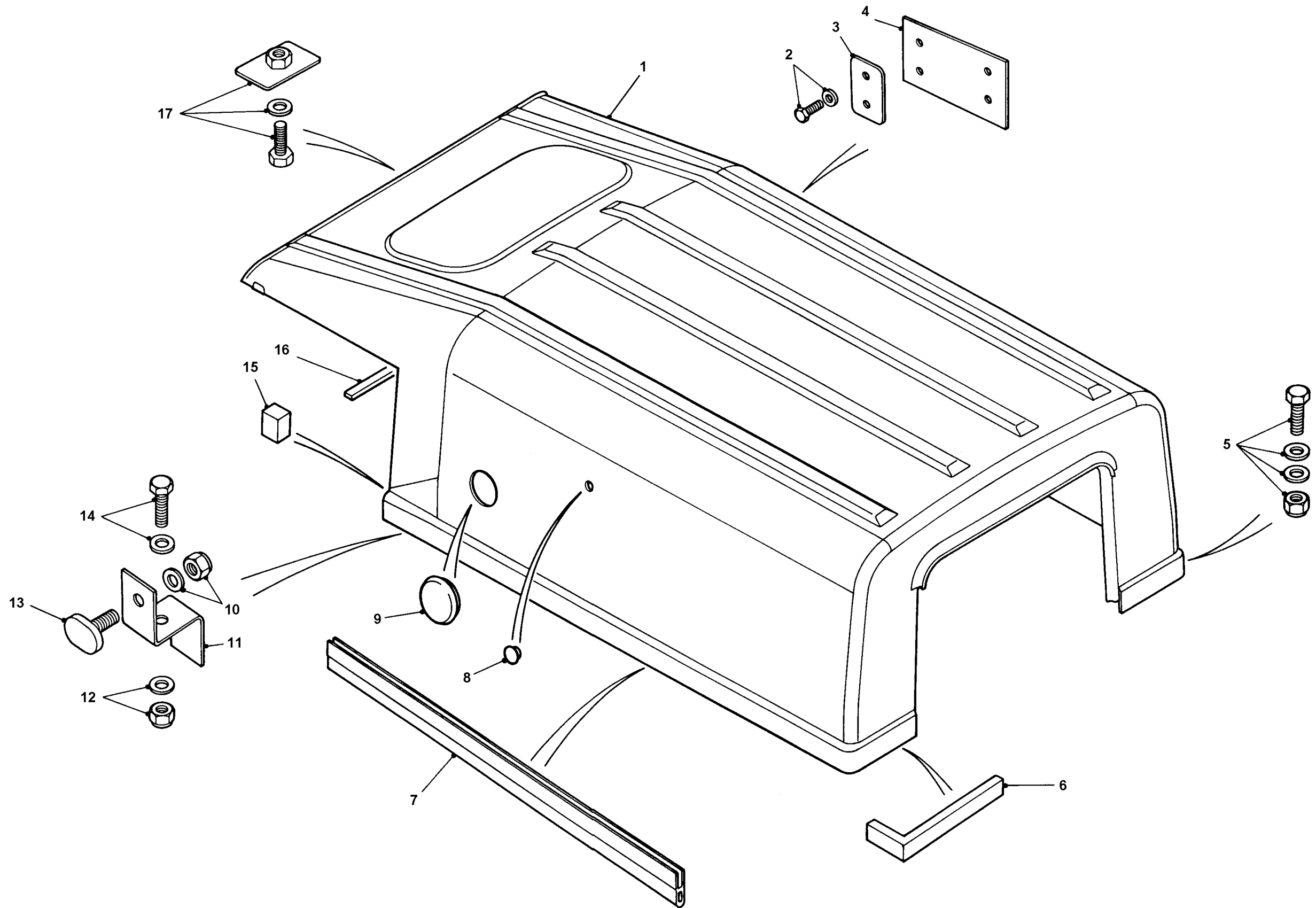


Fig 17 Hard top assembly (TUM)

MIL0437

KEY TO FIG 18

1	Upper hinge fixings	30	Pivot bracket
2	Upper hinge	31	Split pin
3	Screw (upper hinge)	32	Check link
4	Hinge pin	33	Pivot bracket fixings
5	Corner retainer	34	Pivot bracket
6	Top retainer	35	Mounting bracket
7	Door seal	36	Check link fixings
8	Seal retainer	37	Clevis pin
9	Rear door	38	Pivot bracket fixings
10	Retainer fixings	39	Rubber buffer
11	Corner retainer	40	Bottom glass retainer
12	Screw	41	Mounting bracket
13	Side retainer	42	Hinge fixings
14	Door glass	43	Lock cover
15	Door lock fixings	44	Grommet cover fixings
16	Nut retainer	45	Trim panel fixings
17	Lock seal	46	Grommet cover
18	Screw retainer	47	Trim panel
19	Door lock	48	Grab handle
20	Door striker	49	Grab handle fixings
21	Nut plate	50	Hinge fixings
22	Door striker fixings	51	Trim panel fixings
23	Door lock fixings	52	Lower hinge
24	Screw	53	Hinge screw
25	Lower seal	54	Nut plate
26	Seal retainer	55	Side retainer
27	Protector	56	Cap nut
28	Stud plate	57	Hinge fixings
29	Torsion bar and collar		

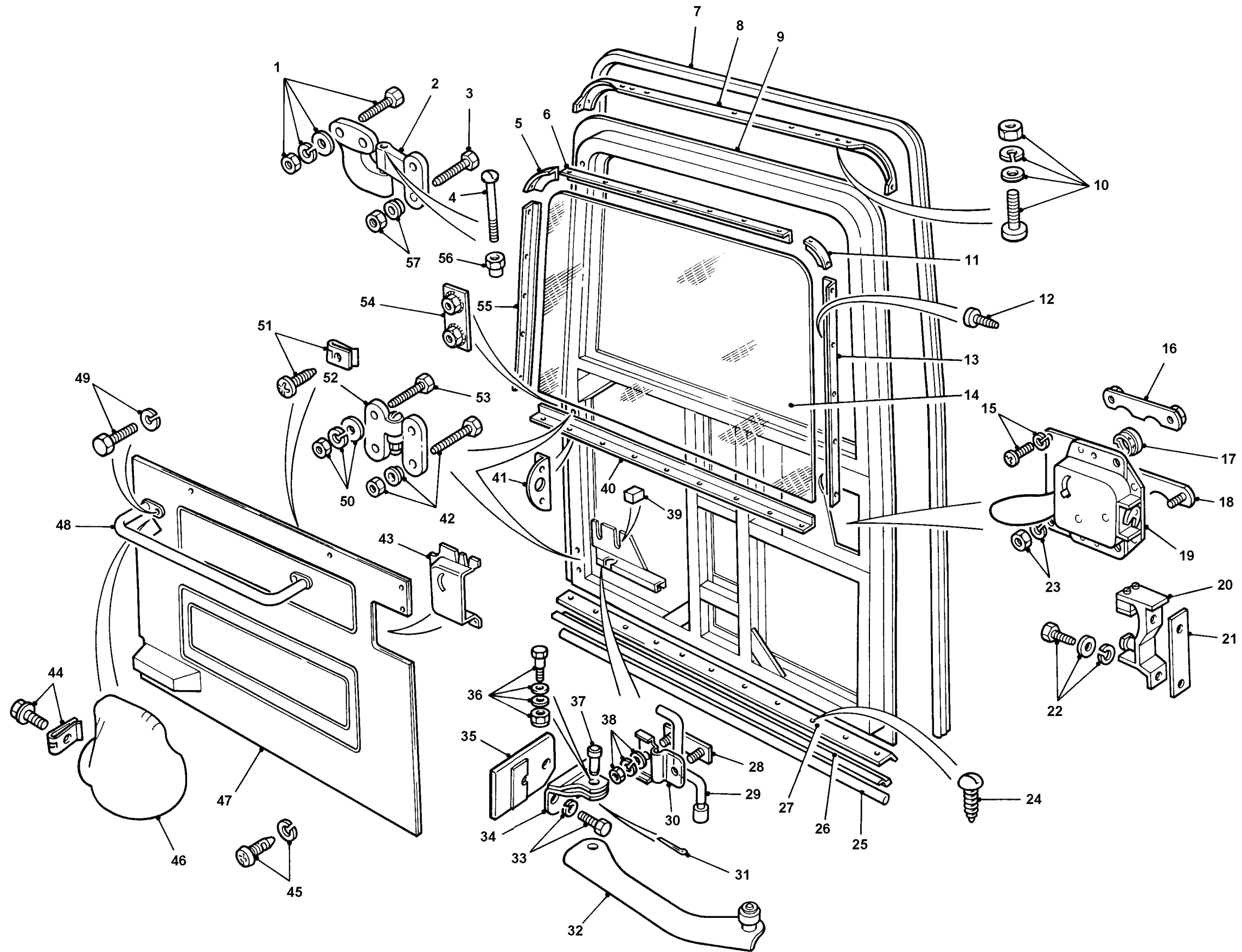
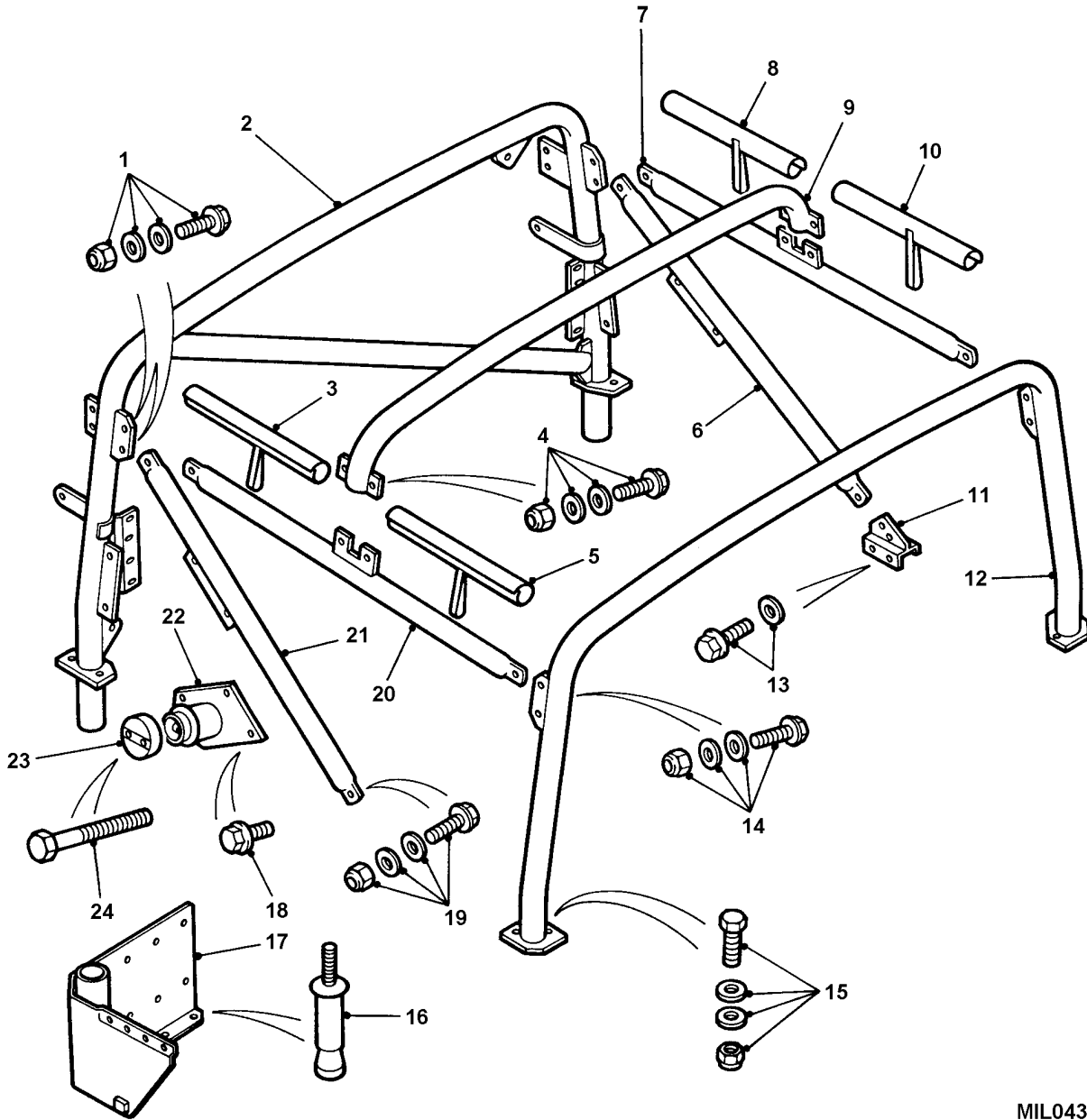


Fig 18 Rear door assembly (Hard top only)

MIL0438



MIL0439

- | | | | |
|----|----------------------------|----|--------------------------|
| 1 | Tie bar and space fixings | 13 | Mounting bracket fixings |
| 2 | Front roll protection hoop | 14 | Cantrail tie bar fixings |
| 3 | Head protection cover | 15 | Rear hoop fixings |
| 4 | Cross tube fixings | 16 | Mono bolt |
| 5 | Head protection cover | 17 | Support bracket LH |
| 6 | Brace RH | 18 | Wheel carrier fixing |
| 7 | Cantrail tie bar | 19 | Brace fixing |
| 8 | Head protection cover | 20 | Cantrail tie bar |
| 9 | Cross tube assembly | 21 | Brace LH |
| 10 | Head Protection cover | 22 | Spare wheel carrier |
| 11 | Mounting bracket RH | 23 | Spare wheel clamp |
| 12 | Rear roll protection Hoop | 24 | Clamp bolt |

Fig 19 Roll cage assembly (TUL)

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KEY TO FIG 20

1	Tie bar fixings	19	Brace RH
2	Roll protection front hoop	20	Roll protection rear hoop
3	Brace LH	21	Cantrail tie bar
4	Cantrail tie bar	22	Tie bar fixings
5	Hood support fixings	23	Rear hoop fixings
6	Hood support tube	24	Brace LH
7	Brace RH	25	Mounting Bracket LH
8	Cantrail tie bar	26	Head protection with cover
9	Head protection with cover	27	Mounting bracket fixings
10	Tie bar fixings	28	Mono bolt
11	Cantrail tie bar	29	Support bracket LH
12	Head protection with cover	30	Spare wheel carrier fixing
13	Mounting bracket RH	31	Mounting bracket LH
14	Bracket fixings	32	Head protection with cover
15	Intermediate hoop fixings	33	Spare wheel cover
16	Hood support tube	34	Spare wheel clamp
17	Roll protection centre hood	35	Clamp bolt
18	Mounting bracket RH		

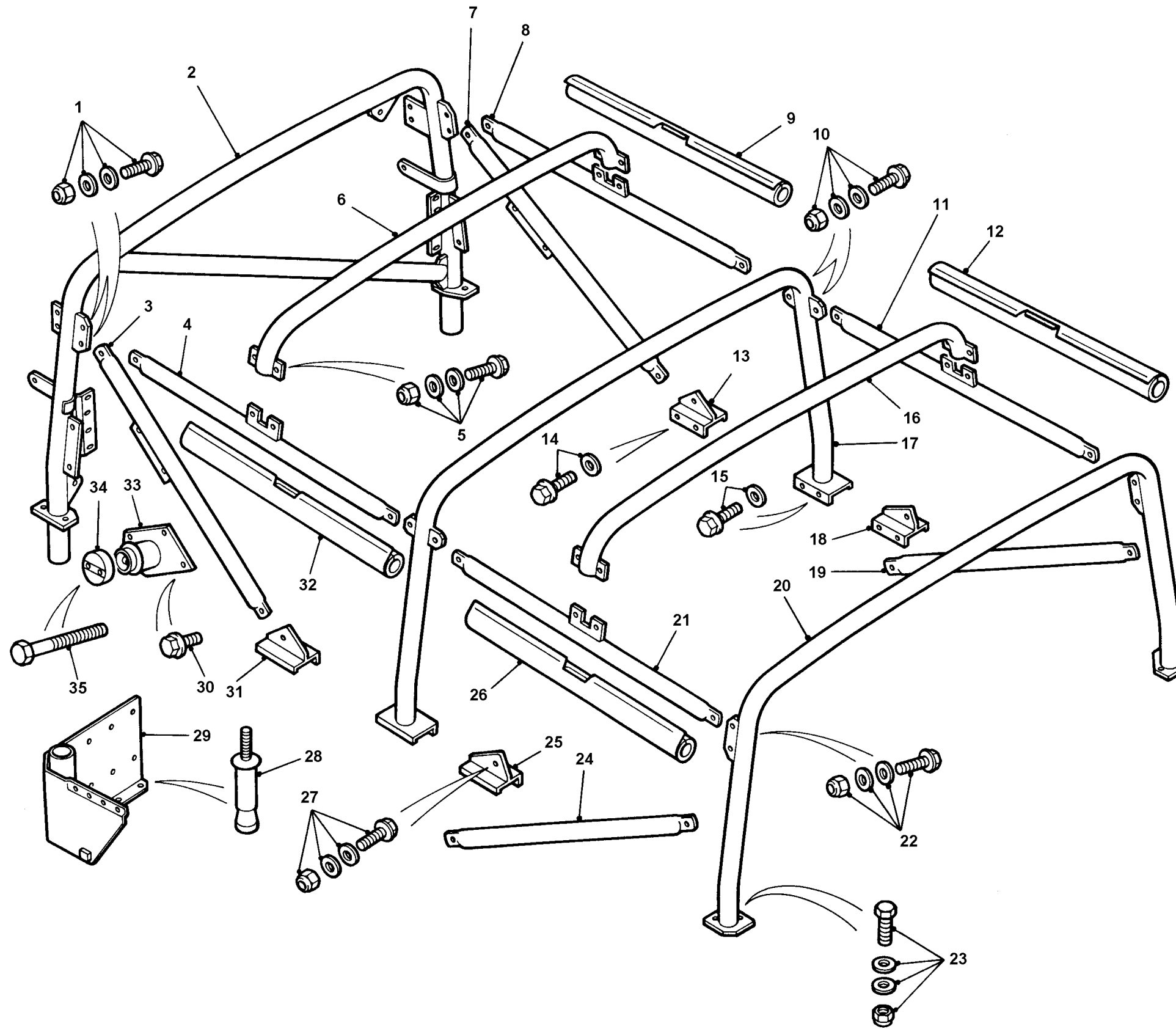


Fig 20 Roll cage assembly (TUM)

MIL0440

KEY TO FIG 21

1	V bolt fixings	30	Screw
2	Equipment rack fixings	31	Nut plate
3	Edge protection strip	32	Table support fixings
4	Bonding lead, support rack to body side	33	Battery box fixings
5	Radio table frame fixings	34	Table support bracket LH
6	Bonding lead fixings	35	Battery negative link lead
7	Bonding lead fixing	36	Terminal post
8	Bonding lead fixings	37	Battery negative link lead
9	Radio table bonding lead	38	Battery positive lead
10	Seat belt lap strap	39	Positive terminal post
11	Support rail fixings	40	Terminal box link
12	Backrest	41	Interlink battery lead
13	Cushion	42	Nut plate
14	Seat rail support	43	Battery box fixings
15	Seat frame	44	Radio table frame
16	Stud and fixings	45	Radio table top
17	Retaining strap	46	Table support bracket LH
18	Strap fixings	47	Radio battery box
19	Battery box door	48	Battery box top panel
20	Centre battery clamp	49	Grommet
21	Radio battery	50	Anti-friction strips
22	Outer battery clamp	51	Lower equipment rack
23	Radio battery box fixings	52	Equipment rack bolt
24	Wing nut	53	Table top fixings
25	Table support bracket RH	54	Bonding lead, rack to bodyside
26	Battery retaining 'J' bolt	55	Equipment rack fixings
27	Battery tray	56	Upper equipment rack
28	Locking screw	57	Equipment rack channel
29	Pop rivet		

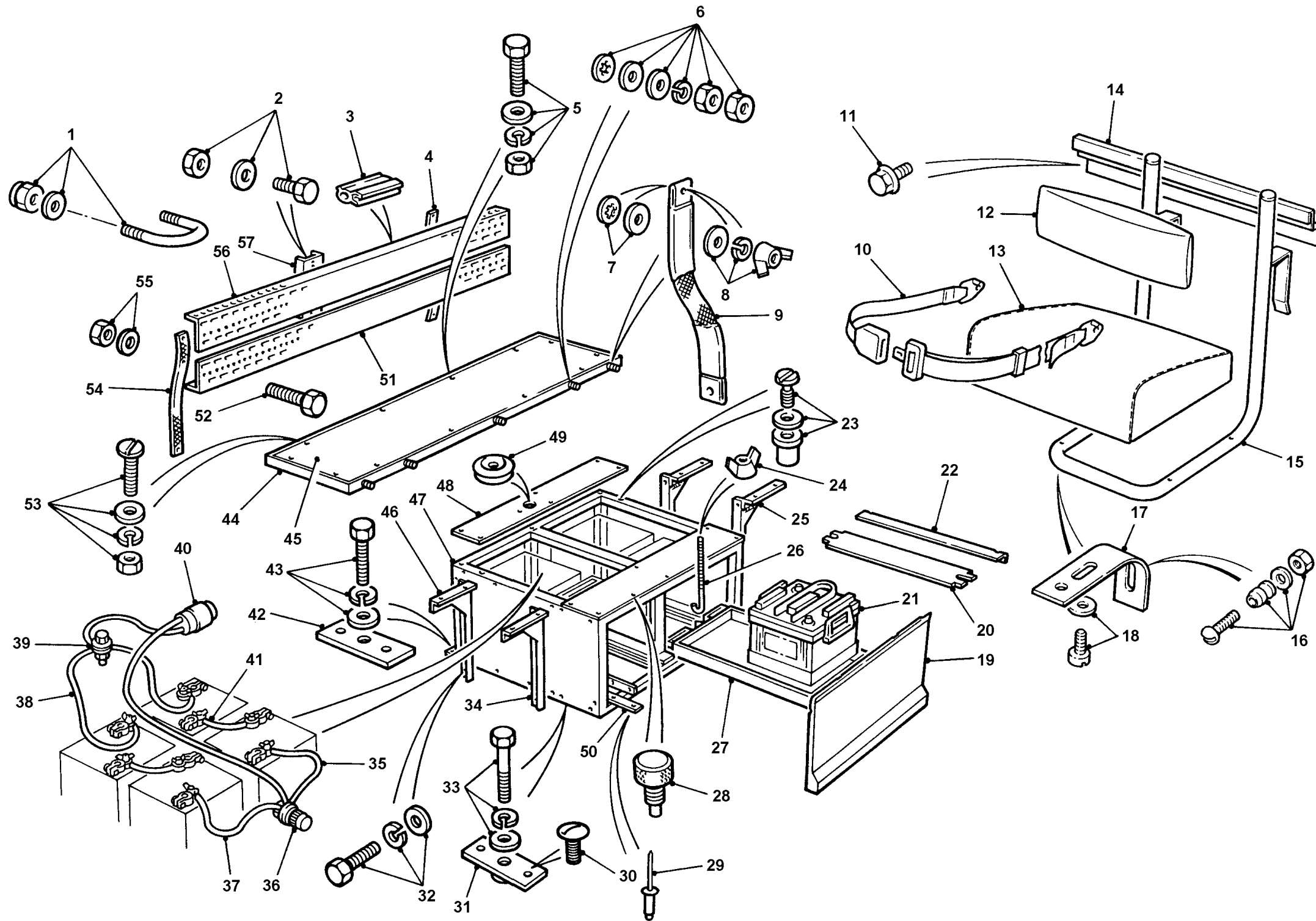


Fig 21 Radio equipment (FFR only)

MIL0441

KEY TO FIG 22

1	Support angle fixing bolt	19	Grommet
2	Reinforcement plate LH	20	Pop rivet
3	Mounting bracket fixings	21	Stowage box
4	Mounting bracket	22	Pop rivet
5	Catch (female)	23	Antenna lead clip
6	Catch (male)	24	Radio antenna lead
7	Grommet	25	TUAMM control lead
8	Support bracket fixings	26	Antenna lead clip
9	Support bracket	27	Pop rivet
10	Support bracket	28	Support bracket fixings
11	Column antenna support	29	Bolt
12	Pop rivet	30	Mounting bracket fixings
13	Antenna support bracket	31	Support plate fixings
14	Nut plate (upper)	32	Support angle fixings
15	Securing pin	33	Support angle
16	Nut plate (lower)	34	Nut plate
17	Nut plate fixings	35	Support plate
18	Support bracket fixings		

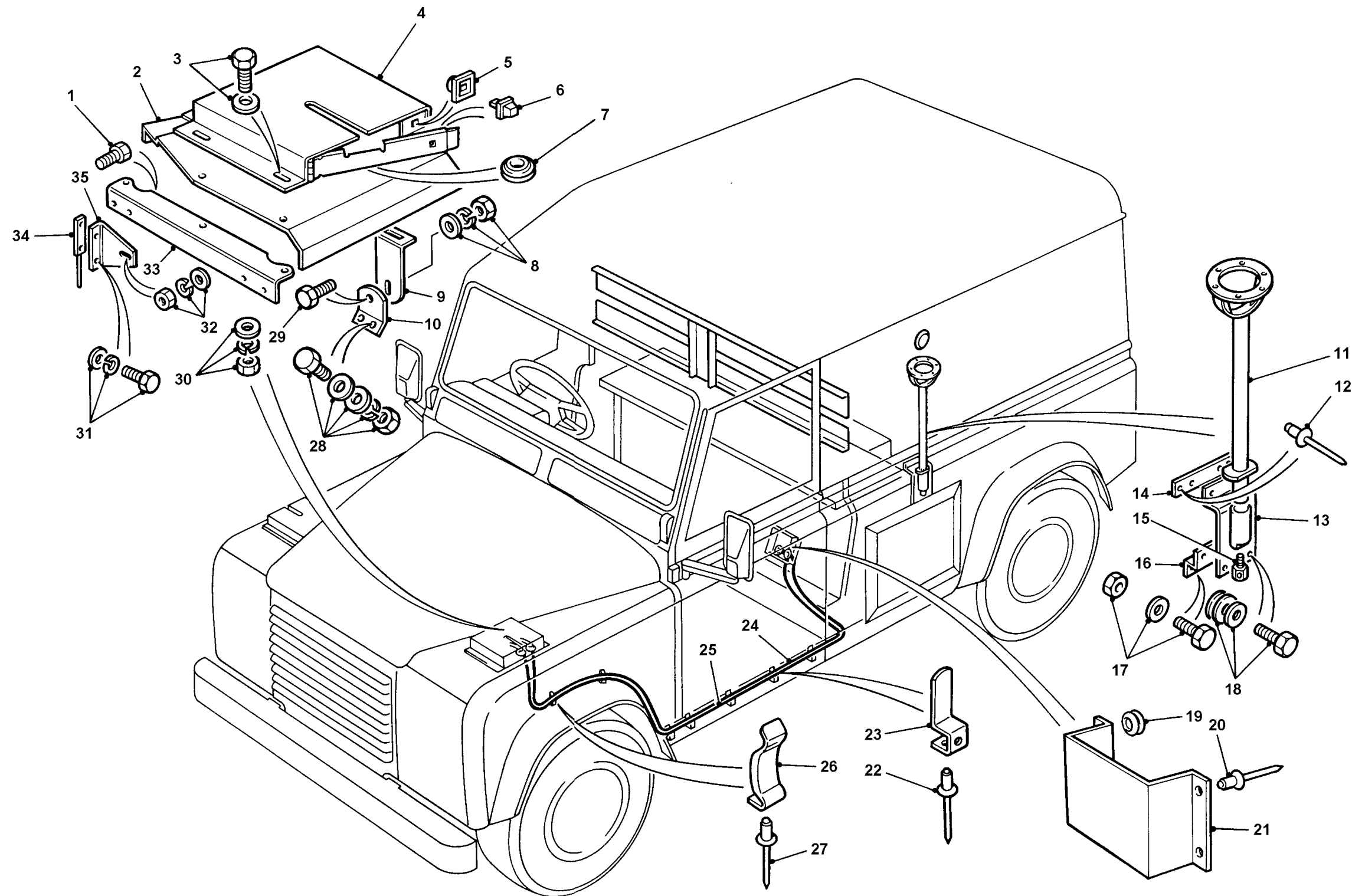


Fig 22 Antennae and aerial assemblies (FFR only)

MIL0442

CHAPTER 16-2

FIELD AMBULANCE

CONTENTS

Para

- 1 Introduction
BODYWORK
Panel Skin
- 3 Damage repair
- 5 Panel replacement
- 6 Bodywork

Table

Page

- 1 Sealants, adhesives and lubricants 1

Fig

- 1 Rear doors 3
- 2 Rear door lock mechanism 4
- 3 Underride protection bar 5
- 4 Bulkhead door 6
- 5 Bodywork mountings 7
- 6 Bodywork fittings 9
- 7 Bulkhead 10
- 8 VDV strut 11
- 9 Stretchers 13
- 10 Stretcher frames 15/16

INTRODUCTION

- 1 This chapter details the Unit repairs for the body cab and fittings as fitted on the (TUM) Ambulance HS.
- 2 The procedures are applicable to both left and right hand drive vehicles.

BODYWORK

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Sikaflex 221	8030-99-611-3031	White sealant (310 ml cartridge)

PANEL SKIN

Damage repair

NOTE

Due to the fabricated nature of the bodywork, side panels, roof panels and other panels which constitute the main external form of the ambulance body are not available as replacement items.

3 Any panels which suffer accident damage must be replaced either completely or part of by specially cut aluminium alloy sheet. An optional repair kit is available (STC 3667) to allow minor panel skin damage to be repaired. The repair kit consists of the following:

- 3.1 Patches of 2mm thick Aluminium Alloy sheet (Qty 5).
- 3.2 Wet and dry abrasive paper, grit grades 80 and 110 (Qty 2 of each).
- 3.3 Rivets (Qty 80).
- 3.4 Paint - two part polyurethane, NATO IRR Green 500 ml (Qty 2).

4 To repair a damaged panel carry out the following:

- 4.1 Repair panel must cover damaged area and overlap at least 25 mm (1.0 in.) on surrounding flat area of skin.
- 4.2 Place repair panel over damaged area and mark outline around perimeter.
- 4.3 Remove paint within damaged area using wet and dry sheets. It is imperative to have good metal to metal contact between repair panel and skin to maintain the integrity of the repair.
- 4.4 Hold repair panel over damaged area and spot through rivet holes with 4.9mm dia drill.
- 4.5 Remove repair panel and clean away swarf.
- 4.6 Rivet repair panel to damaged skin using rivets supplied.
- 4.7 Form a bead of sealant (refer to Table 1 Serial 1) around the edges of the repair.

WARNING

SKIN CARE. AVOID SKIN CONTACT AND ENSURE ADEQUATE VENTILATION OF THE WORKING AREA.

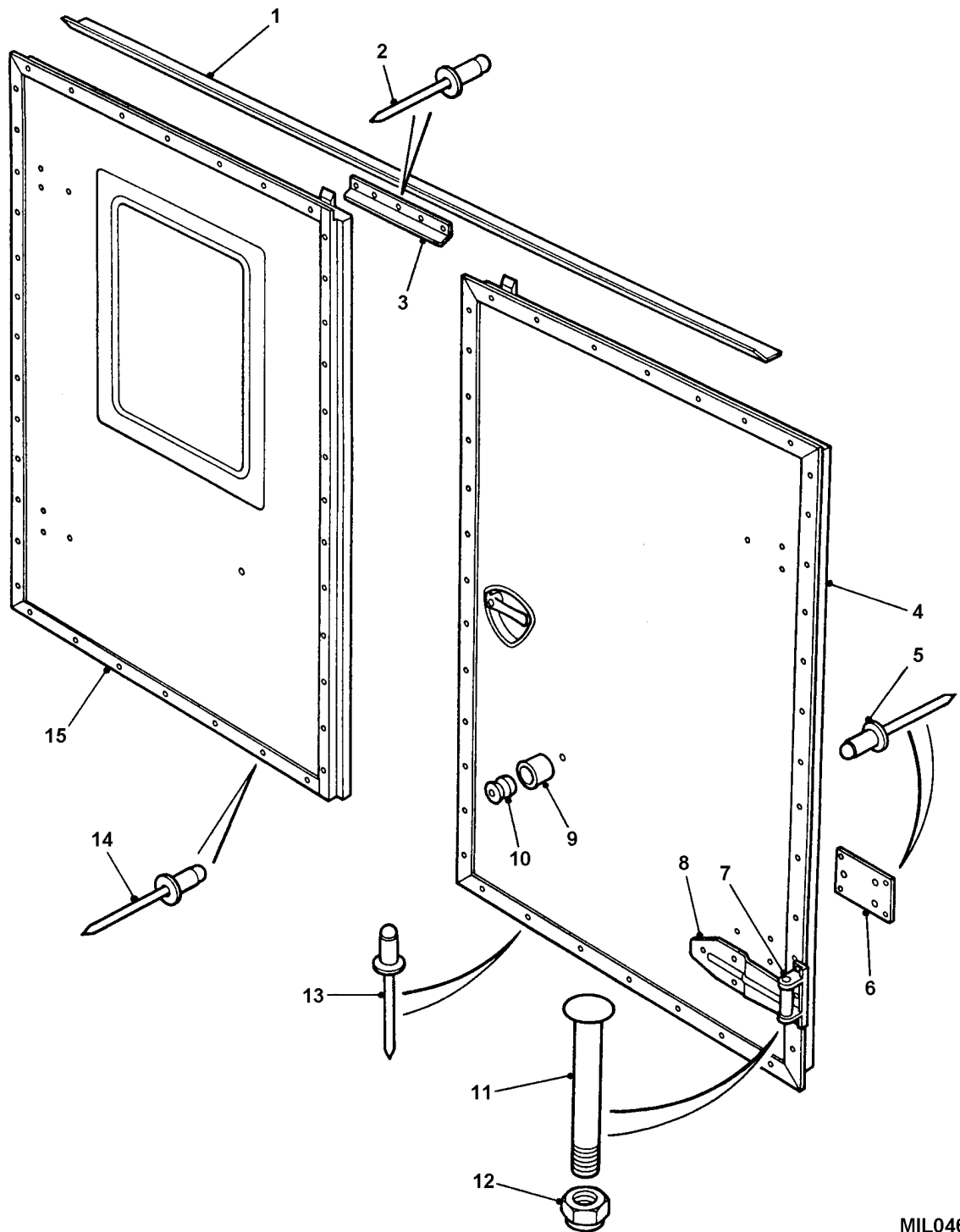
- 4.8 Protect sealant from water during the first three hours of cure.
- 4.9 Paint over rivet heads and sealant with touch-up paint mixed as manufacturers instructions (Ensure sealant has cured first, approximately 1mm per 8 hours).

PANEL REPLACEMENT

5 For details of panel replacement and repair refer to Chap 16-1.

BODYWORK

6 The following body illustrations show the make up of the ambulance body. They are divided into six illustrations for ease of reference and understanding.

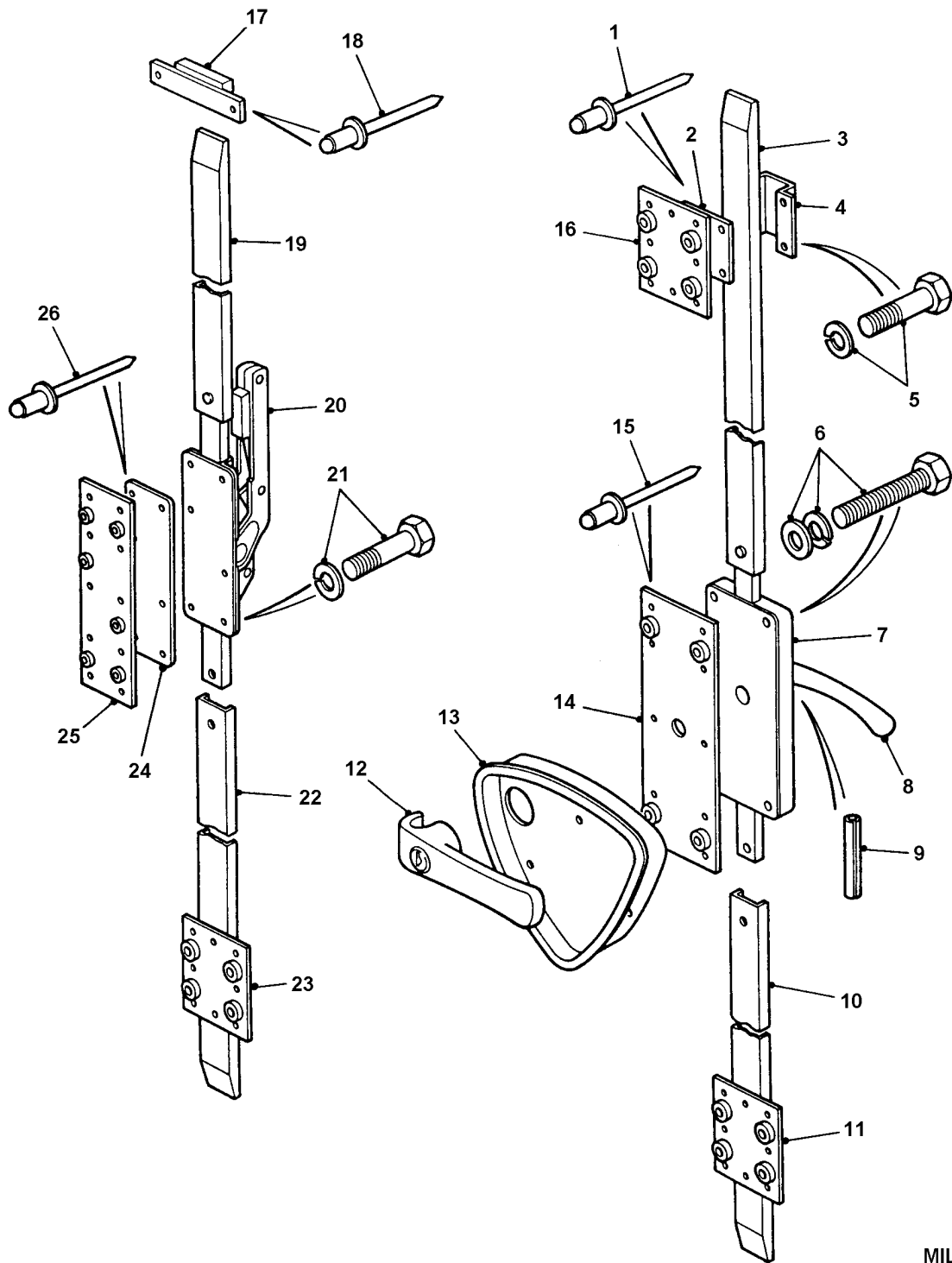


MIL0462

- | | | | |
|---|------------------------|----|--------------------|
| 1 | Upper water shed strip | 9 | Door holder outer |
| 2 | Pop rivet | 10 | Door holder inner |
| 3 | Lower water shed strip | 11 | Hinge pin |
| 4 | Rear door assembly | 12 | Hinge nut |
| 5 | Pop rivet | 13 | Pop rivet |
| 6 | Washer plate | 14 | Pop rivet |
| 7 | Hinge plate | 15 | Rear door assembly |
| | Hinge | | |

8

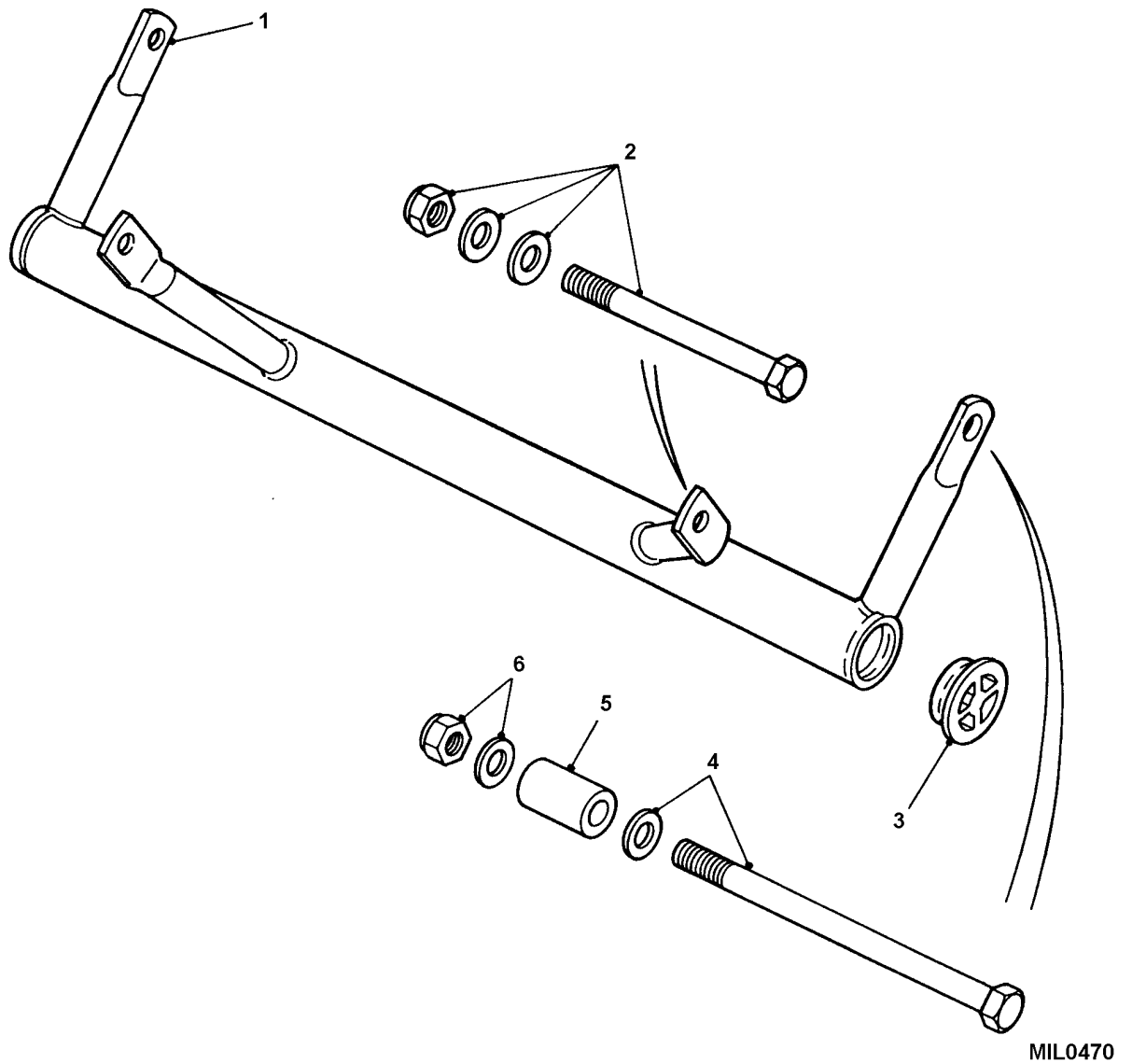
Fig 1 Rear doors



MIL0463

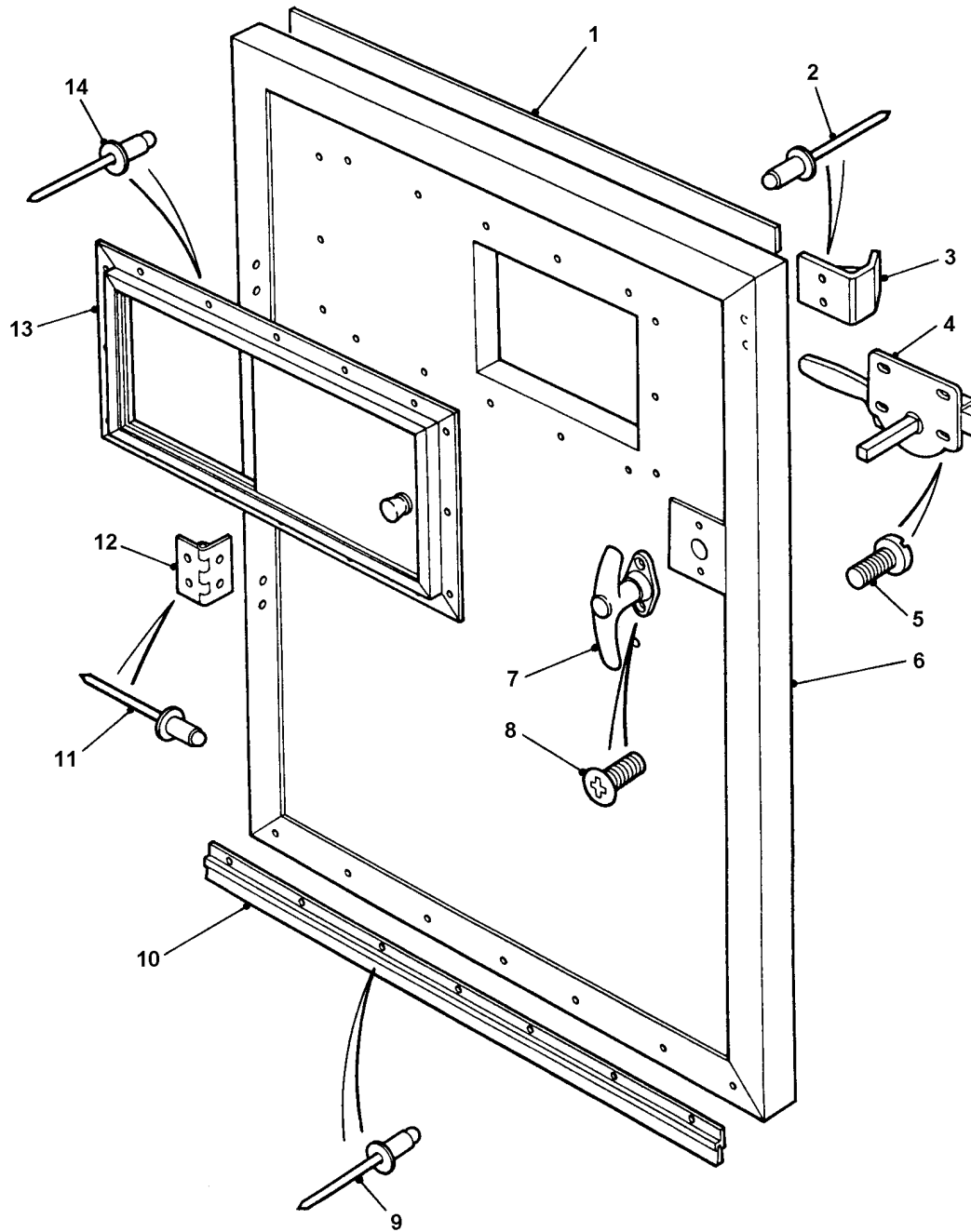
- | | | | | | |
|---|-------------------|----|--------------------|----|--------------------|
| 1 | Pop rivet | 10 | Lower locking rod | 19 | Upper locking rod |
| 2 | Wear strip | 11 | Guide runner plate | 20 | Bolt catch |
| 3 | Upper locking rod | 12 | Exterior handle | 21 | Catch fixings |
| 4 | Guide runner | 13 | Handle dish | 22 | Lower locking rod |
| 5 | Guide fixings | 14 | Centre lock plate | 23 | Guide runner plate |
| 6 | Latch fixings | 15 | Pop rivet | 24 | Packer |
| 7 | Latch assembly | 16 | Guide runner plate | 25 | Bolt catch plate |
| 8 | Interior handle | 17 | Top striker plate | 26 | Pop rivet |
| 9 | Spirol pin | 18 | Pop rivet | | |

Fig 2 Rear door lock mechanism



- | | | | |
|---|--------------------------|---|------------------------------|
| 1 | Underride protection bar | 4 | Protection bar lower fixings |
| 2 | Protection bar fixings | 5 | Spacer |
| 3 | Blanking plug | 6 | Protection bar lower fixings |

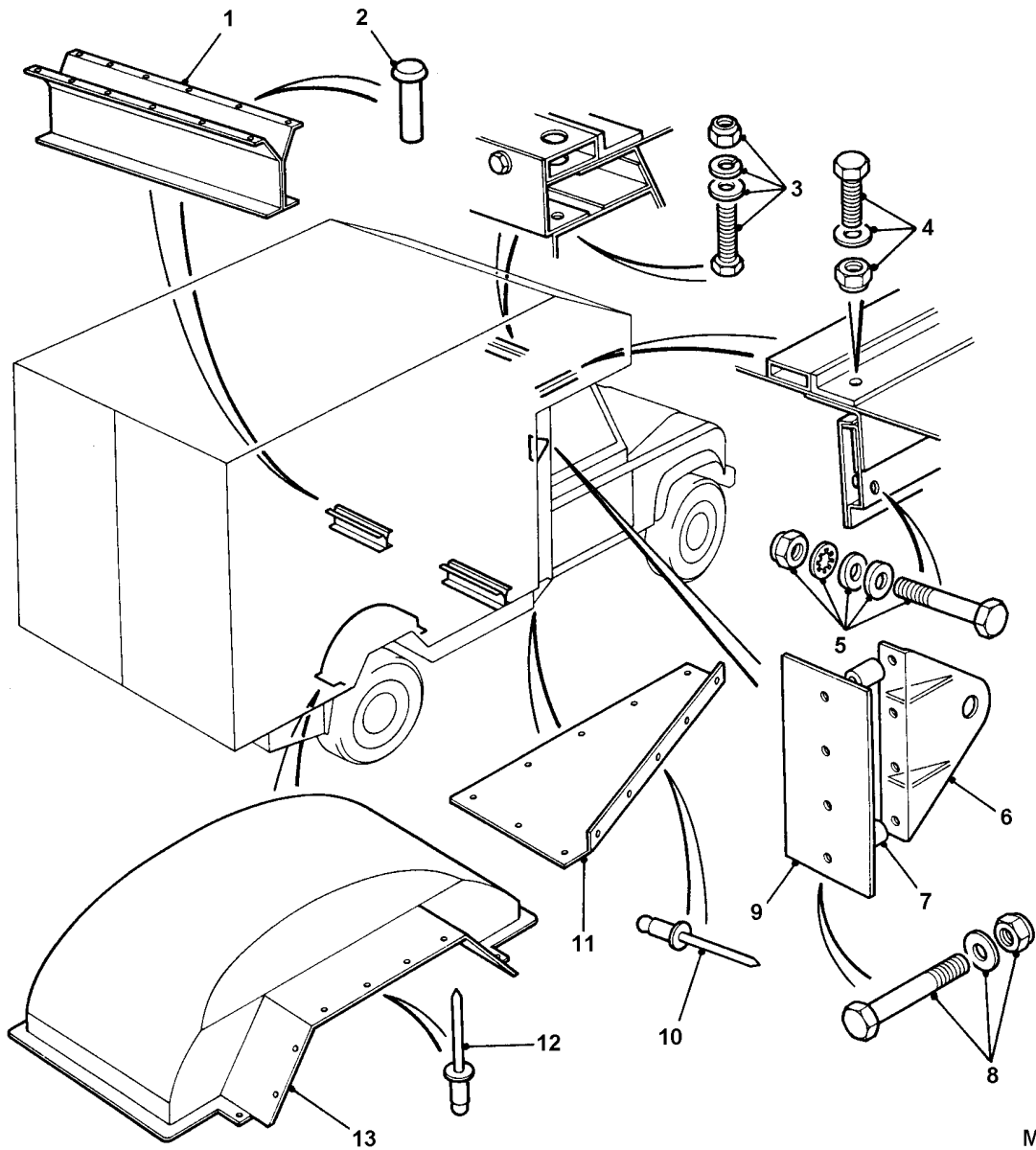
Fig 3 Under ride protection bar



MIL0464

- | | | | |
|---|-------------------------------|----|----------------|
| 1 | Rubber strip | 8 | Screw |
| 2 | Rivet | 9 | Rivet |
| 3 | Blackout switch striker plate | 10 | Sealing strip |
| 4 | Lock assembly | 11 | Rivet |
| 5 | Screw | 12 | Hinge |
| 6 | Bulkhead door assembly | 13 | Hatch assembly |
| 7 | Handle | 14 | Rivet |

Fig 4 Bulkhead door



MIL0466

- | | | | |
|---|-----------------------------|----|------------------------|
| 1 | Lower body mounting bracket | 8 | Anchor bracket fixings |
| 2 | Monobolt | 9 | Reinforcing plate |
| 3 | Screen top fixings | 10 | Pop rivet |
| 4 | Side screw top fixings | 11 | Bottom filler panel |
| 5 | Side screw fixings | 12 | Pop rivet |
| 6 | Seat belt anchor bracket | 13 | Wheel box |
| 7 | Spacer | | |

Fig 5 Bodywork mountings

KEY TO FIG 6

1	Ventilator	17	Pop rivet
2	Filter	18	Filter
3	Mesh	19	Fuel filler panel
4	Ventilator grille	20	Rear wing panel
5	Red cross flap	21	Panel fixings
6	Hinge	22	Light mounting bracket RH
7	Red cross decal	23	Bracket fixings
8	Catch	24	Mounting plate (lights)
9	Pop rivet	25	Mounting plate (lights)
10	Stud plate	26	Light mounting bracket
11	Mirror arm fixings	27	Anchor bush
12	Mirror head	28	Bracket fixings
13	Mirror arm	29	Grille fixings
14	Mirror arm lower fixings	30	Pop rivet
15	Screw	31	Nutsert
16	Louvre panel	32	Mounting plate fixings

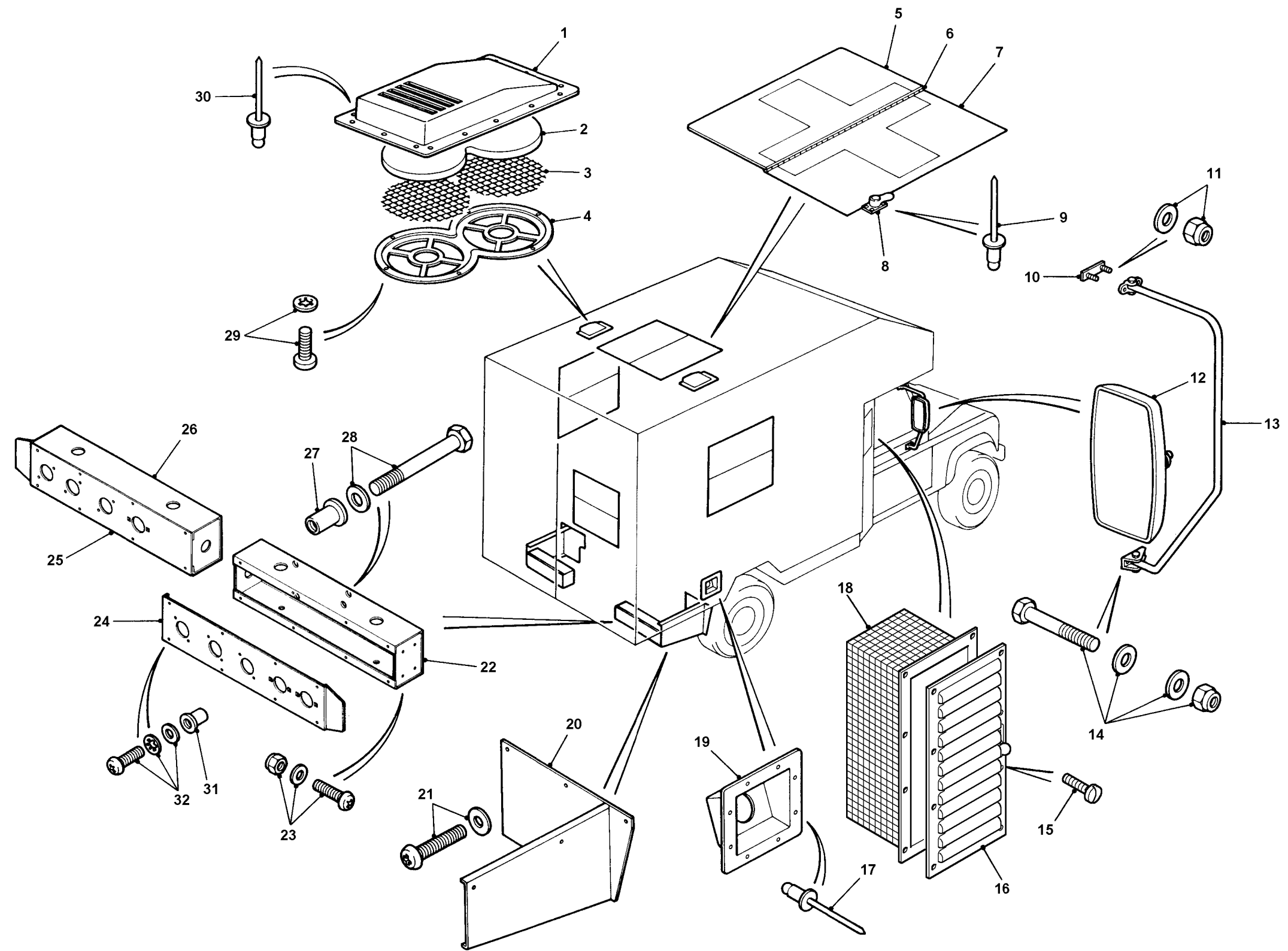
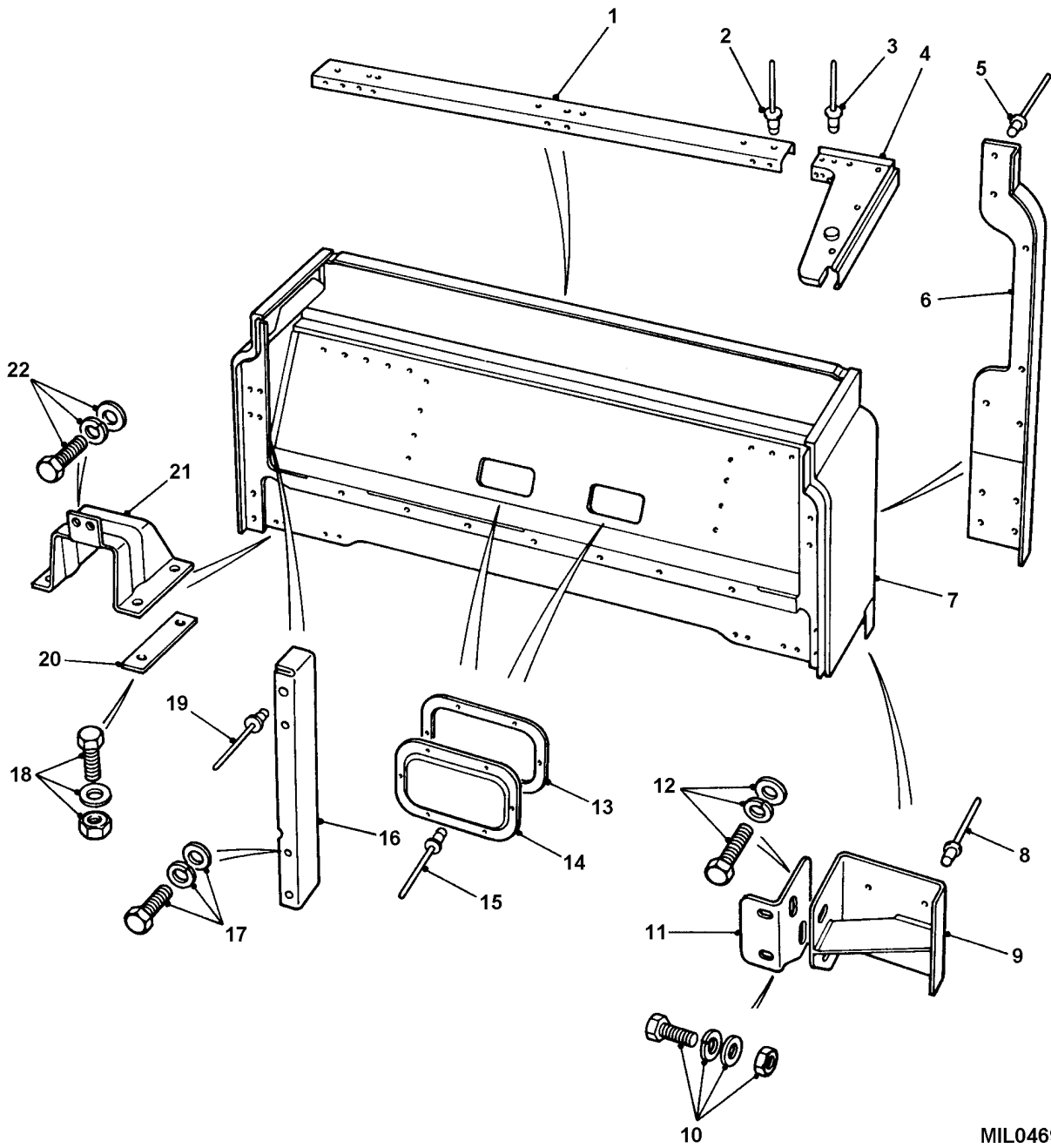


Fig 6 Bodywork fittings

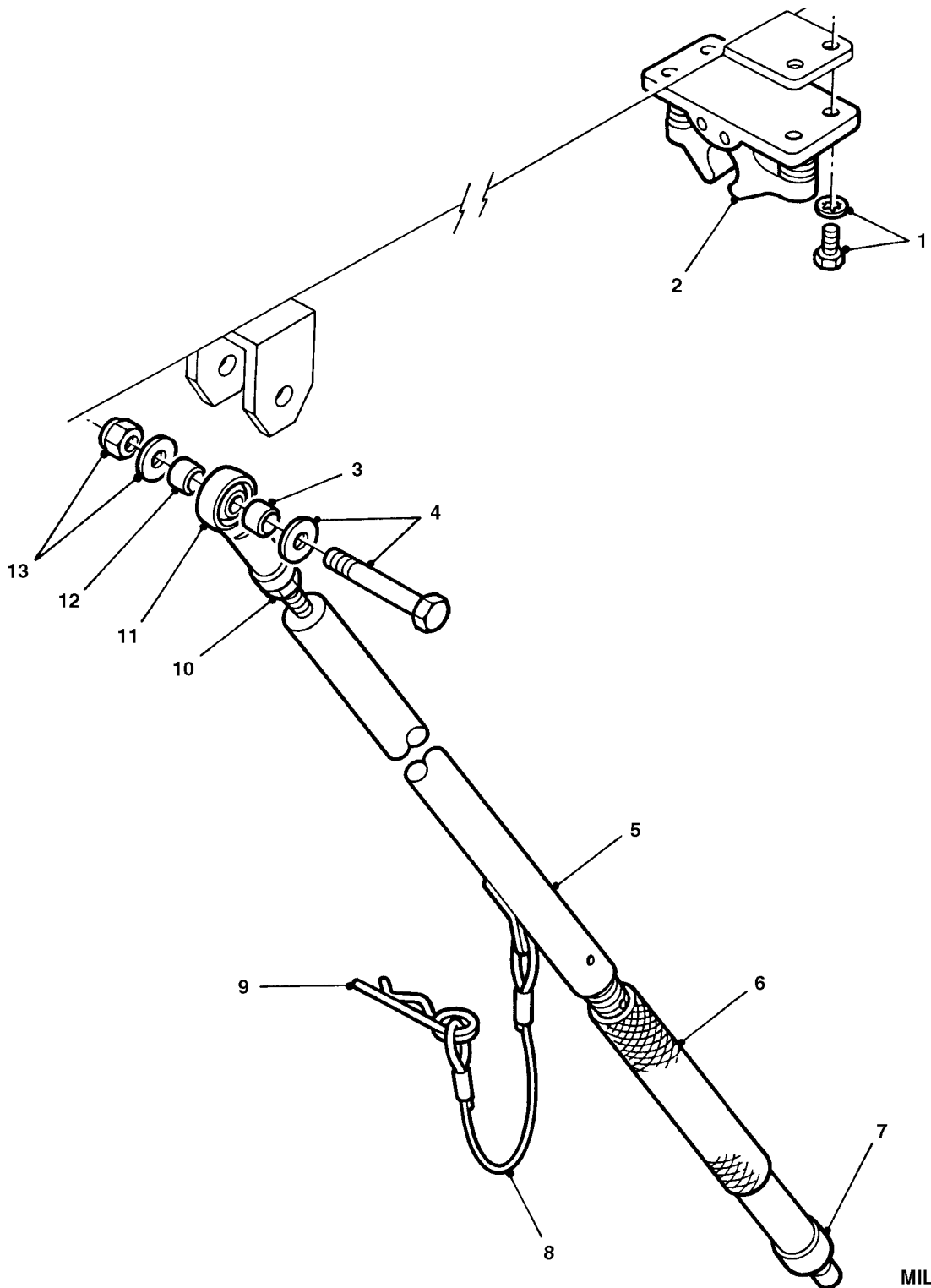
MIL0465



MIL0469

- | | | | |
|----|---------------------------|----|--------------------------|
| 1 | Bulkhead capping strip | 12 | Mounting angle fixings |
| 2 | Capping pop rivet | 13 | Gasket |
| 3 | Pop rivet | 14 | Cover plate |
| 4 | Corner capping | 15 | Pop rivet |
| 5 | Rivet | 16 | Door stiffener pillar |
| 6 | Corner protection angle | 17 | Door pillar fixings |
| 7 | Cab base assembly | 18 | Mounting bracket fixings |
| 8 | Pop rivet | 19 | Pop rivet |
| 9 | Reinforcing plate | 20 | Spreader plate |
| 10 | Reinforcing plate fixings | 21 | Chassis mounting plate |
| 11 | Mounting angle | 22 | Cab base fixings |

Fig 7 Bulkhead



MIL0354

- | | | | |
|---|----------------|----|---------------------|
| 1 | Latch fixings | 8 | Pin retaining cable |
| 2 | Spring catch | 9 | Locking pin |
| 3 | Spacer | 10 | Lock nut |
| 4 | Pivot fixings | 11 | Pivot |
| 5 | Prop | 12 | Spacer |
| 6 | Locking sleeve | 13 | Pivot Fixings |
| 7 | Locating foot | | |

Fig 8 VDV strut

KEY TO FIG 9

1	Outer stretcher stowage bracket	13	Catch
2	Inner stretcher stowage bracket	14	Seat strap and catch
3	Pop rivet	15	Seat pad assembly
4	Stretcher retaining strap	16	Screw
5	Head rest	17	Strap plate
6	Adhesive strip	18	Stop fixings
7	Rubber strip	19	End stop
8	Seat back hook	20	Adaptor
9	Seat back hook	21	'C' rail
10	Seat back rest	22	Stretcher strap
11	Staple fixings	23	Strap fixings
12	Seat back staple	24	Strap lug

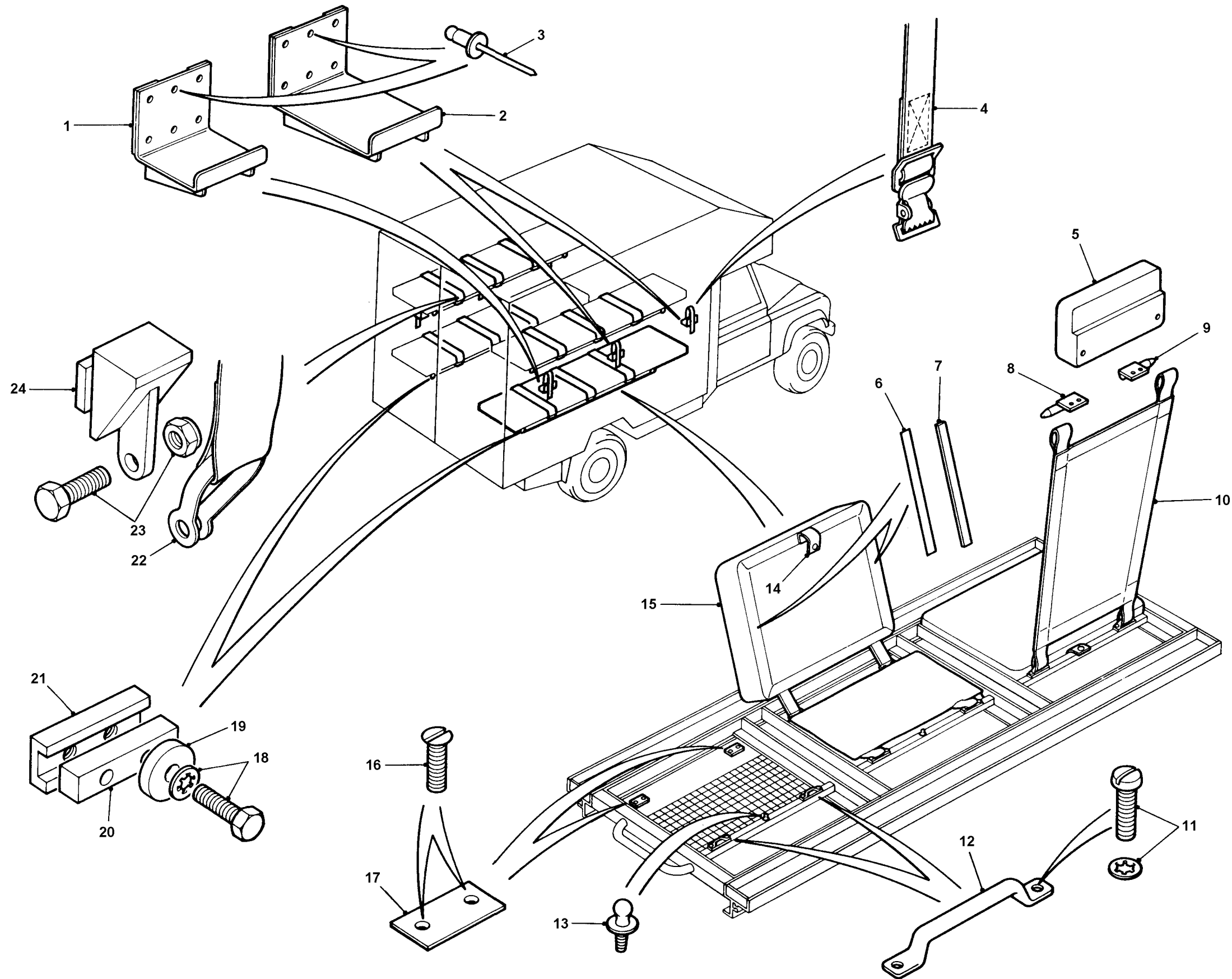
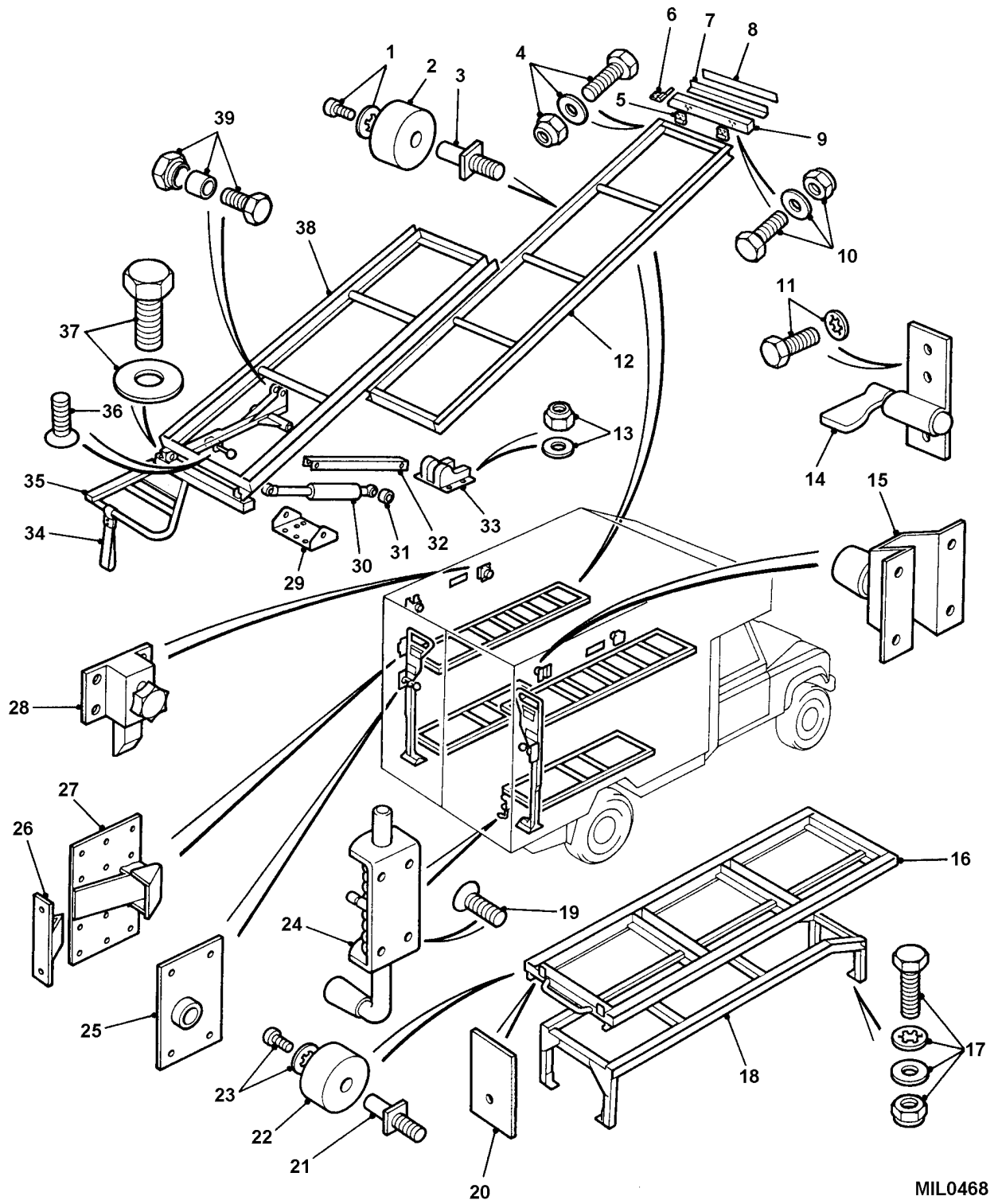


Fig 9 Stretchers

MIL0467

KEY TO FIG 10

1	Roller retainer	21	Axle
2	Roller	22	Roller
3	Axle	23	Roller retainer
4	Hinge fixings	24	Catch
5	Hinge - front support	25	Locating plate
6	Hinge - bodyside	26	Latch
7	Support angle	27	Latch plate
8	Backing plate	28	Catch assembly
9	Front support	29	Rear support bracket
10	Hinge fixings	30	Gas strut
11	Catch fixings	31	Roller
12	Top inner stretcher frame	32	Shield
13	Cover fixings	33	Guide cover
14	Catch	34	Strap assembly
15	Buffer bracket assembly	35	Rear support post assembly
16	Bottom outer stretcher frame	36	Screw
17	Frame fixings	37	Pivot fixings
18	Bottom inner stretcher frame	38	Top outer stretcher frame
19	Screw	39	Rear support post pivot fixings
20	Stop plate		



MIL0468

Fig 10 Stretcher frames

CHAPTER 16-3

WINTER/WATER

CONTENTS

Para

- 1 Introduction
- 3 Panel replacement
- 4 Bodywork and fittings

Fig

Page

1	Hard top (with escape hatch).....	2
2	Soft top (with escape opening)	3
3	Waterproof radio bag	4

INTRODUCTION

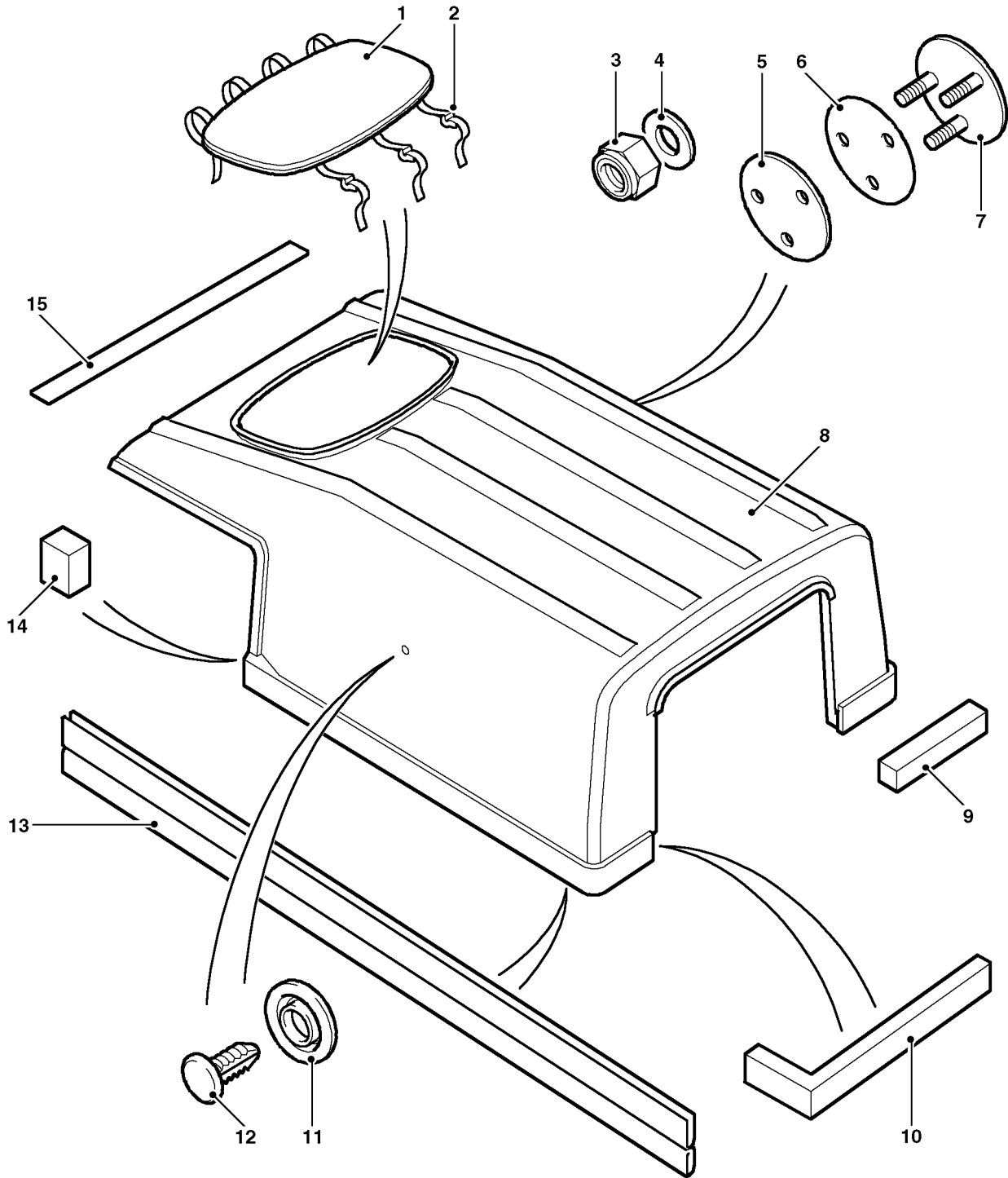
- 1 This chapter details the Unit repairs for the body cab and fittings as fitted to Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS winter/water vehicles.
- 2 The procedures are applicable to both left and right hand drive vehicles.

PANEL REPLACEMENT

- 3 For details of panel replacement and repair (refer to Chap 16-1).

BODYWORK AND FITTINGS

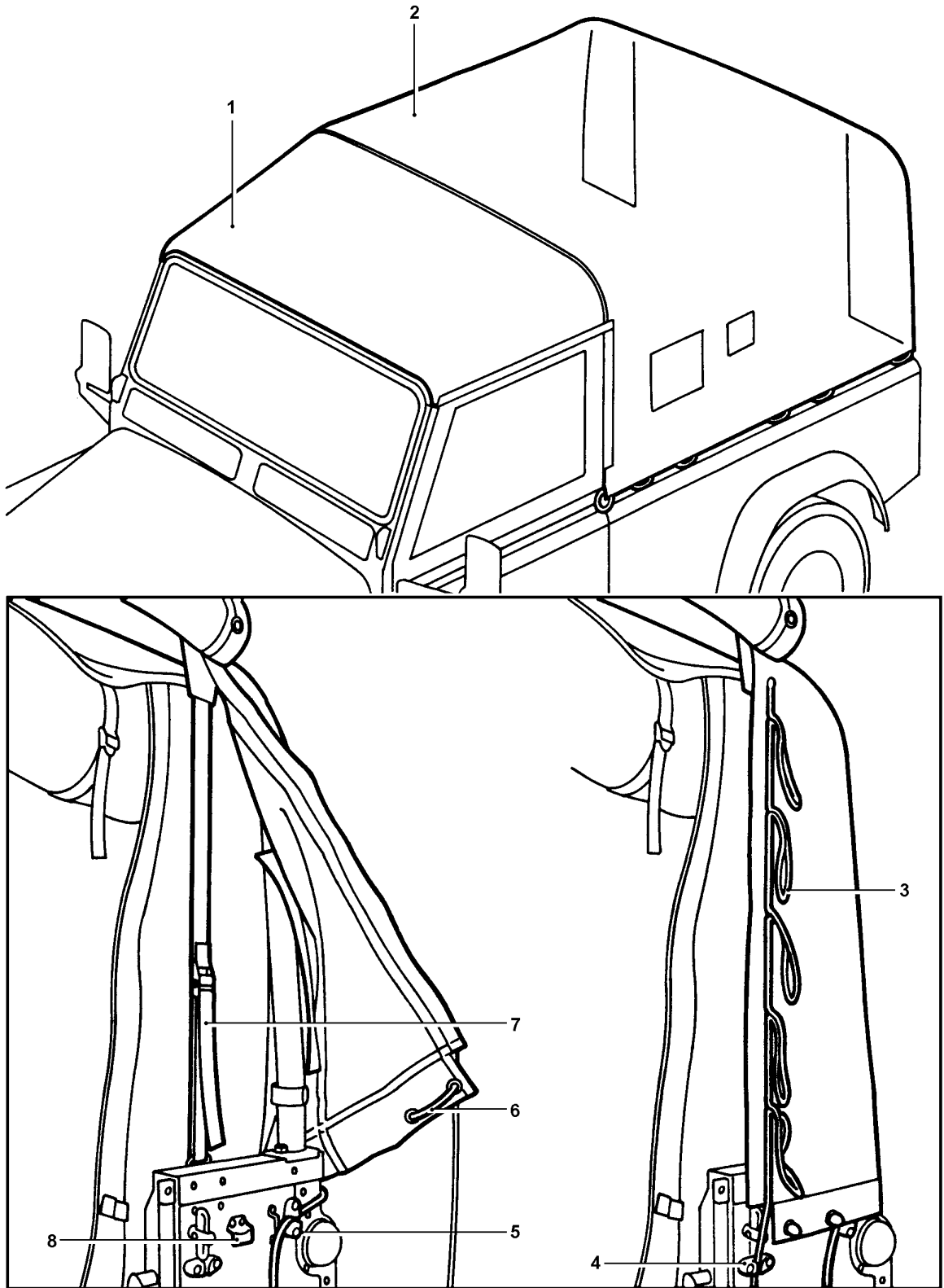
- 4 The following body illustrations show the make up of the winter/water body and fittings. They are divided into three illustrations for ease of reference and understanding.



MIL0687

- | | | | |
|---|--------------------|----|---------------|
| 1 | Escape hatch cover | 9 | Seal |
| 2 | Straps | 10 | Seal |
| 3 | Nut | 11 | Grommet |
| 4 | Washer | 12 | Stud |
| 5 | Plate | 13 | Sealing strip |
| 6 | Plate | 14 | Seal |
| 7 | Blanking plate | 15 | Sealing strip |
| 8 | Hard top | | |

Fig 1 Hard top (with escape hatch)

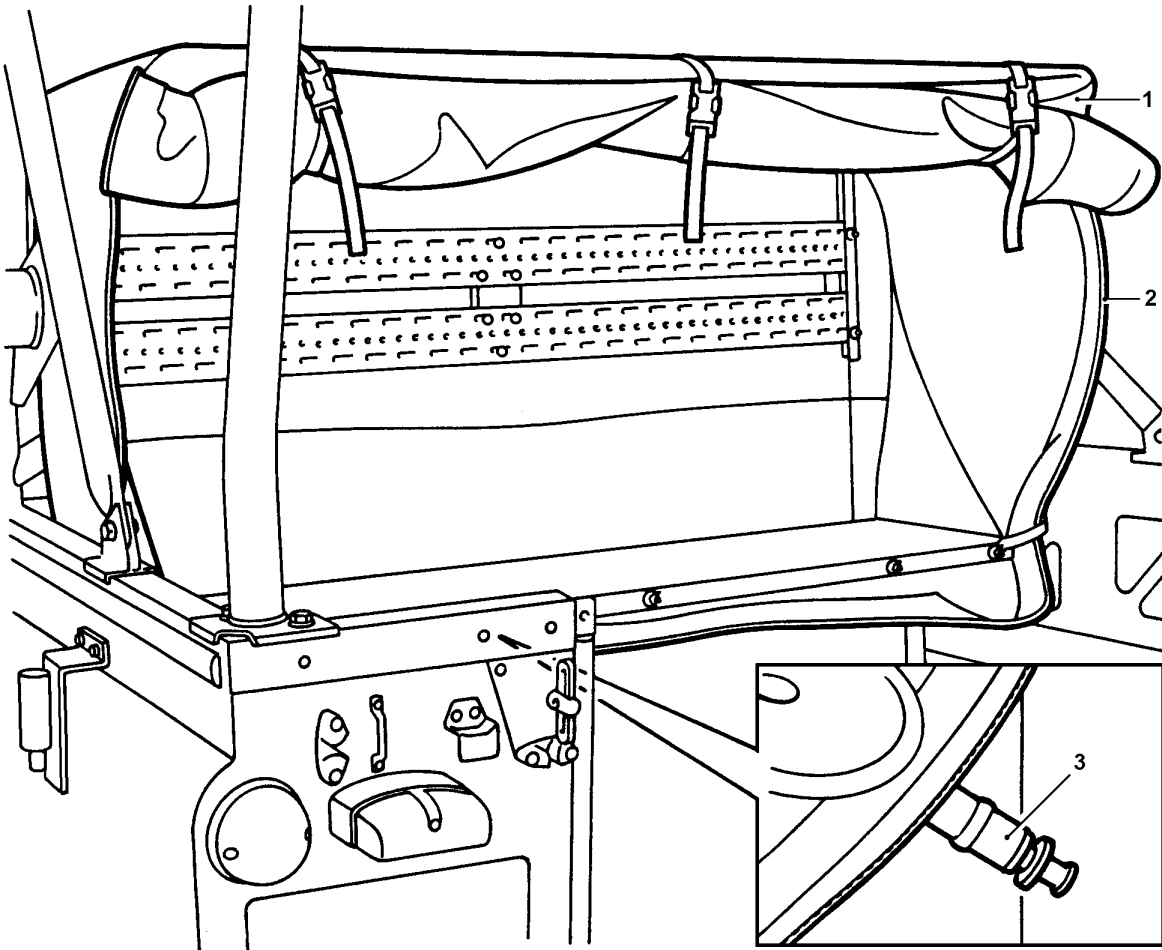


MIL0684

- 1 Hood front
- 2 Hood rear
- 3 Loops
- 4 Cam cleat

- 5 Strap
- 6 Retaining cord
- 7 Cam cleat
- 8 Cleat

Fig 2 Soft top (with escape opening)



MIL0685

2 1 Radio bag Zip

3 Air valve

Fig 3 Waterproof radio bag

CHAPTER 16-4

WINTERISED

CONTENTS

Para

- 1 Introduction
- 3 Panel replacement
- 4 Bodywork and fittings

Fig

	Page
1 Soft top winter lining.....	2
2 Driver and passenger door trim	3
3 Rear door trim	4
4 Body insulation.....	5
5 Snow blinds.....	6
6 Ski racks.....	7
7 Heater intake.....	8

INTRODUCTION

1 This chapter details the Unit repairs for the body cab and fittings as fitted to the Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS winterised vehicles.

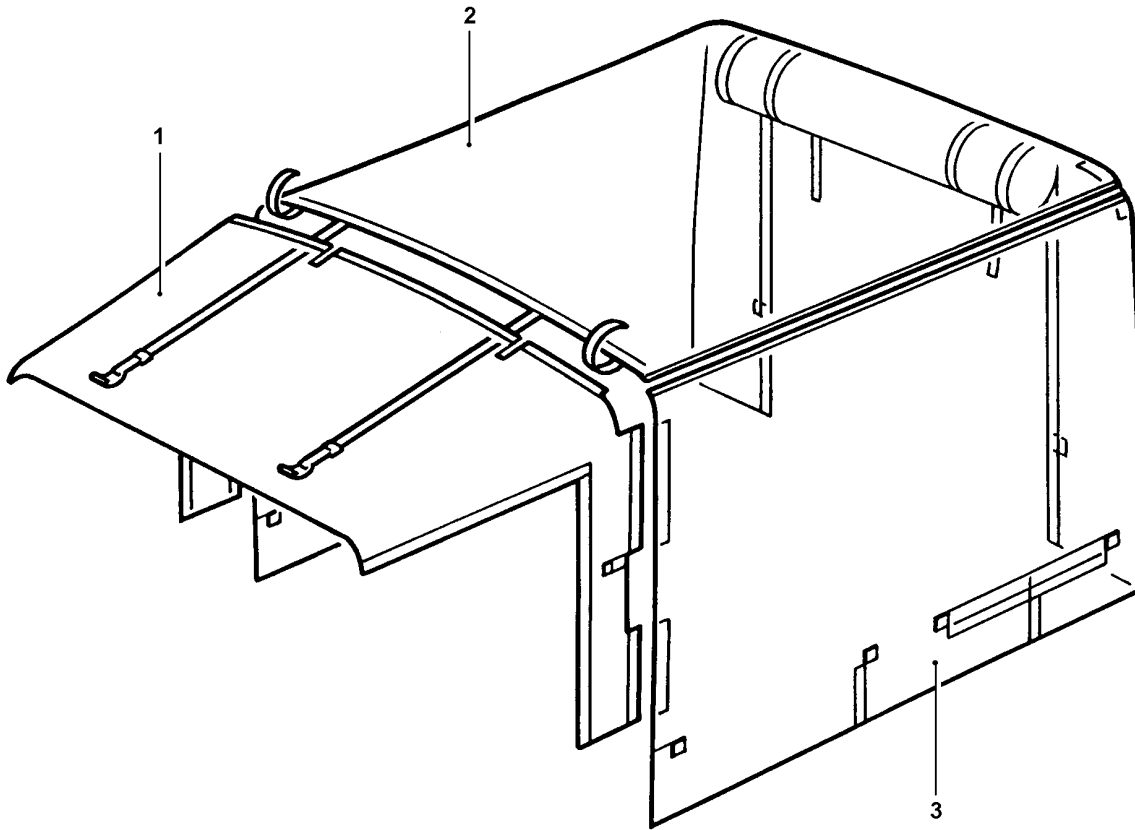
2 The procedures are applicable to both left and right hand drive vehicles.

PANEL REPLACEMENT

3 For details of panel replacement and repair (refer to Chap 16-1).

BODYWORK AND FITTINGS

4 The following illustrations show the make up of the winterised body and fittings. They are divided into seven illustrations for ease of reference and understanding.



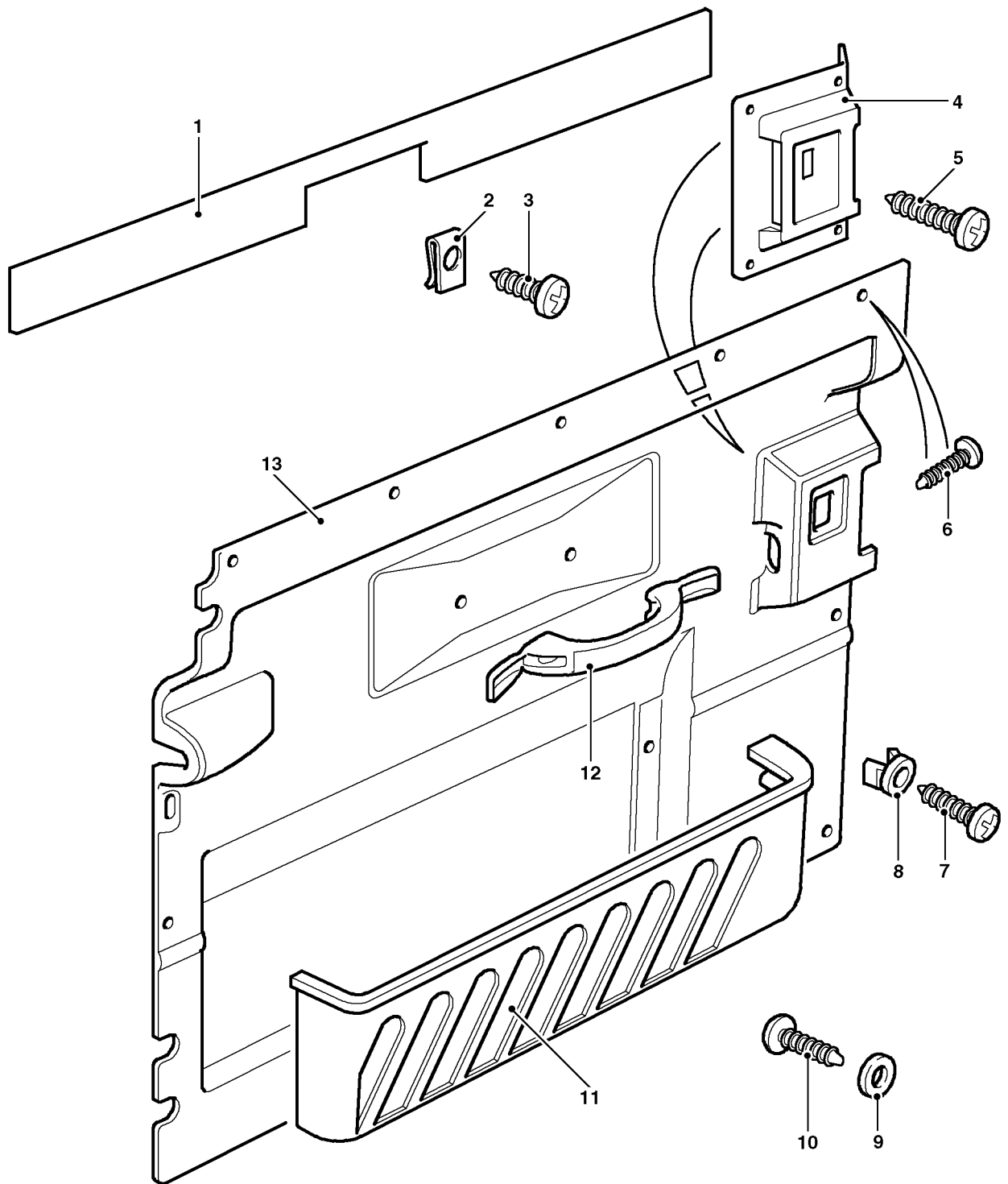
MIL0690

1 Front lining
Rear lining

3 Side lining

2

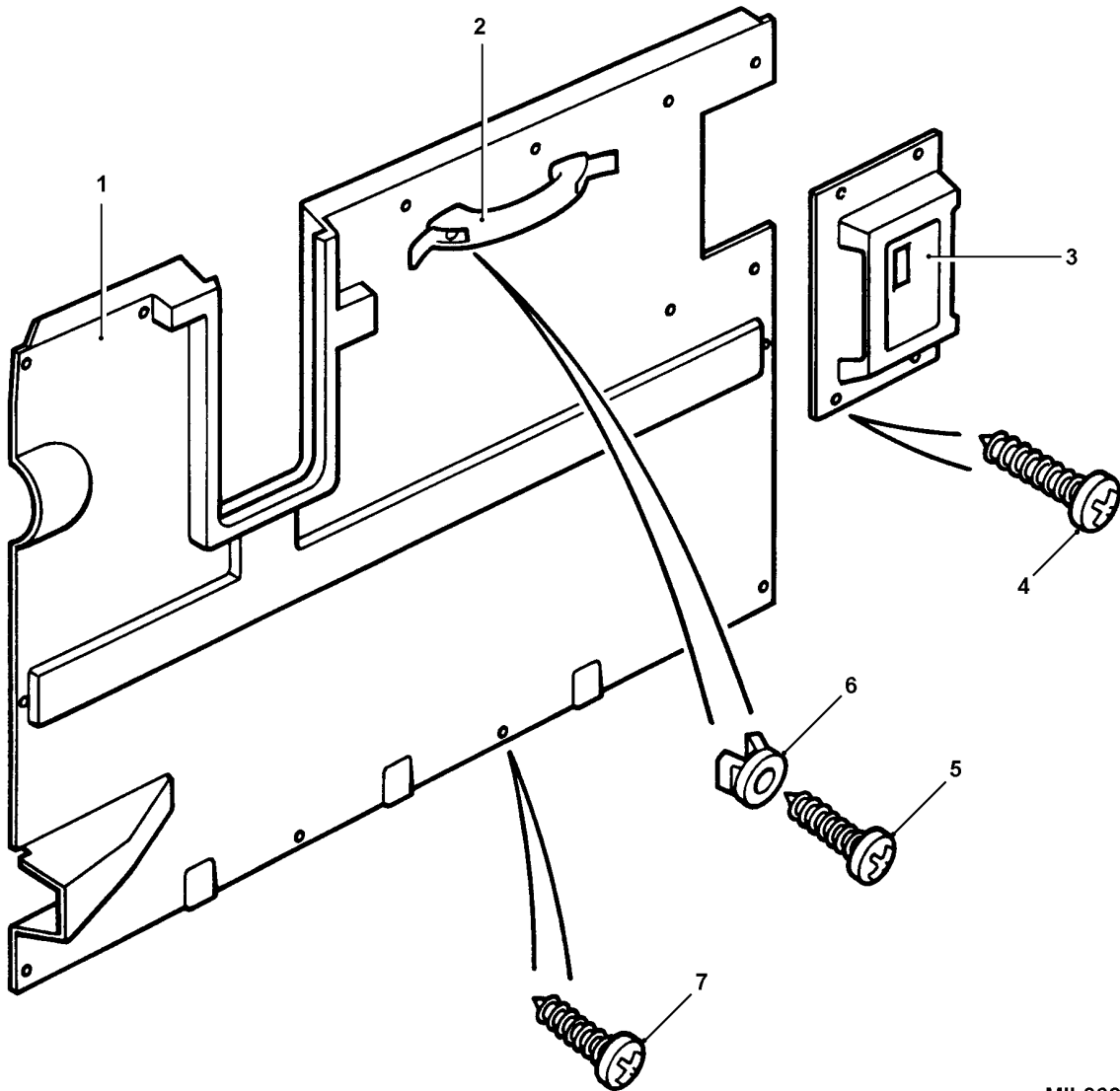
Fig 1 Soft top winter lining



MIL0686

- | | | | |
|---|---------------|----|-------------|
| 1 | Sealing strip | 8 | Captive nut |
| 2 | Spire clip | 9 | Washer |
| 3 | Screw | 10 | Screw |
| 4 | Cover | 11 | Bin storage |
| 5 | Screw | 12 | Grab handle |
| 6 | Screw | 13 | Door trim |
| 7 | Screw | | |

Fig 2 Driver and passenger door trim



MIL0687

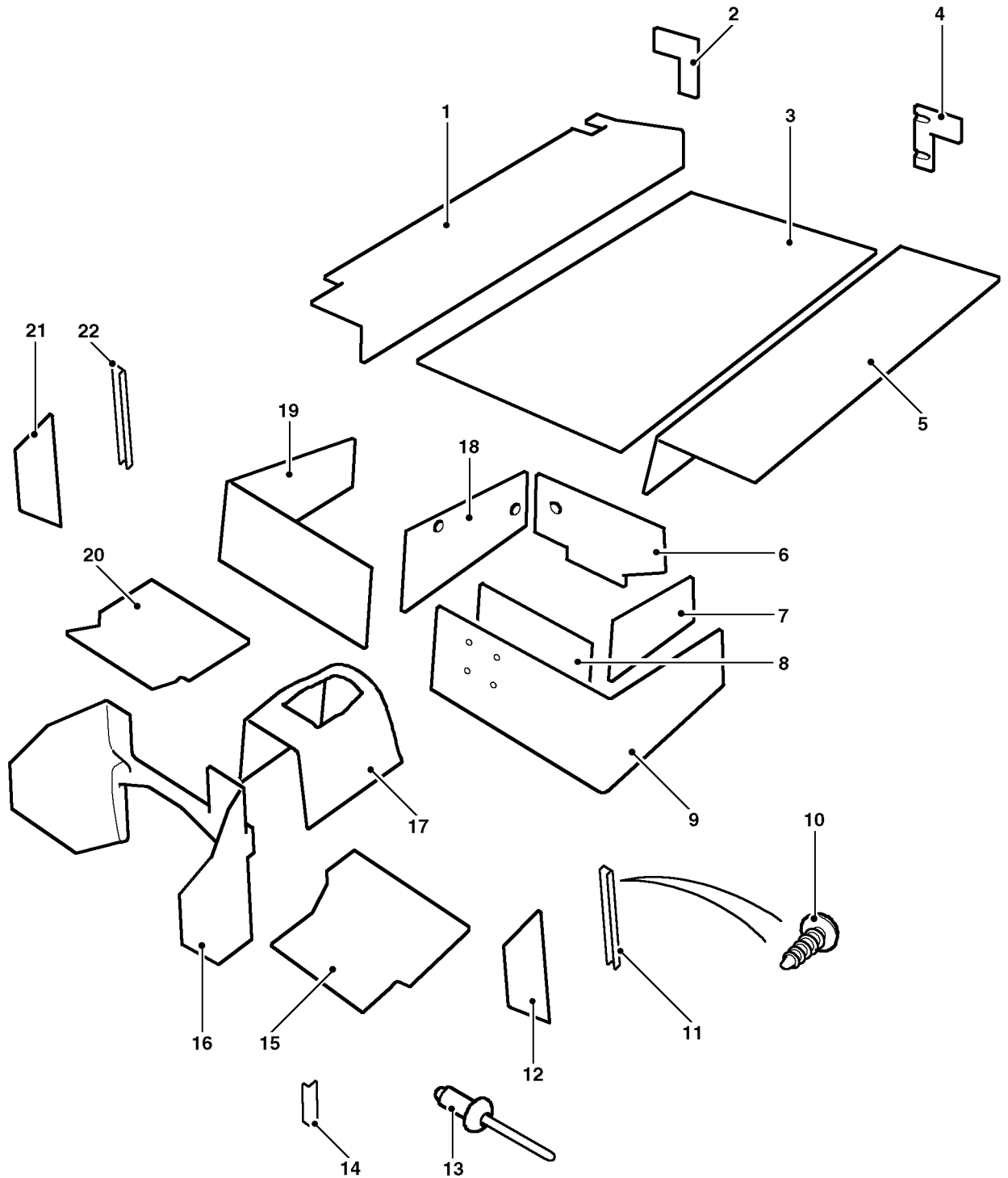
- 1 Trim
- 2 Handle
- 3 Lock cover
- 4 Screw

- 5 Screw
- 6 Captive nut
- 7 Screw

Fig 3 Rear door trim

KEY TO FIG 4

- | | | | |
|----|--------------------------|----|--------------------------------|
| 1 | RH wheel arch insulation | 12 | Footwell insulation |
| 2 | Rear body insulation | 13 | Rivet |
| 3 | Floor insulation | 14 | Capping |
| 4 | Rear body insulation | 15 | Footwell floor insulation |
| 5 | LH wheel arch insulation | 16 | Lower bulkhead insulation |
| 6 | Battery box insulation | 17 | Transmission tunnel insulation |
| 7 | Battery box insulation | 18 | Battery box insulation |
| 8 | Battery box insulation | 19 | RH heel board insulation |
| 9 | LH heel board insulation | 20 | RH footwell floor insulation |
| 10 | Screw | 21 | Footwell insulation |
| 11 | Capping | | |

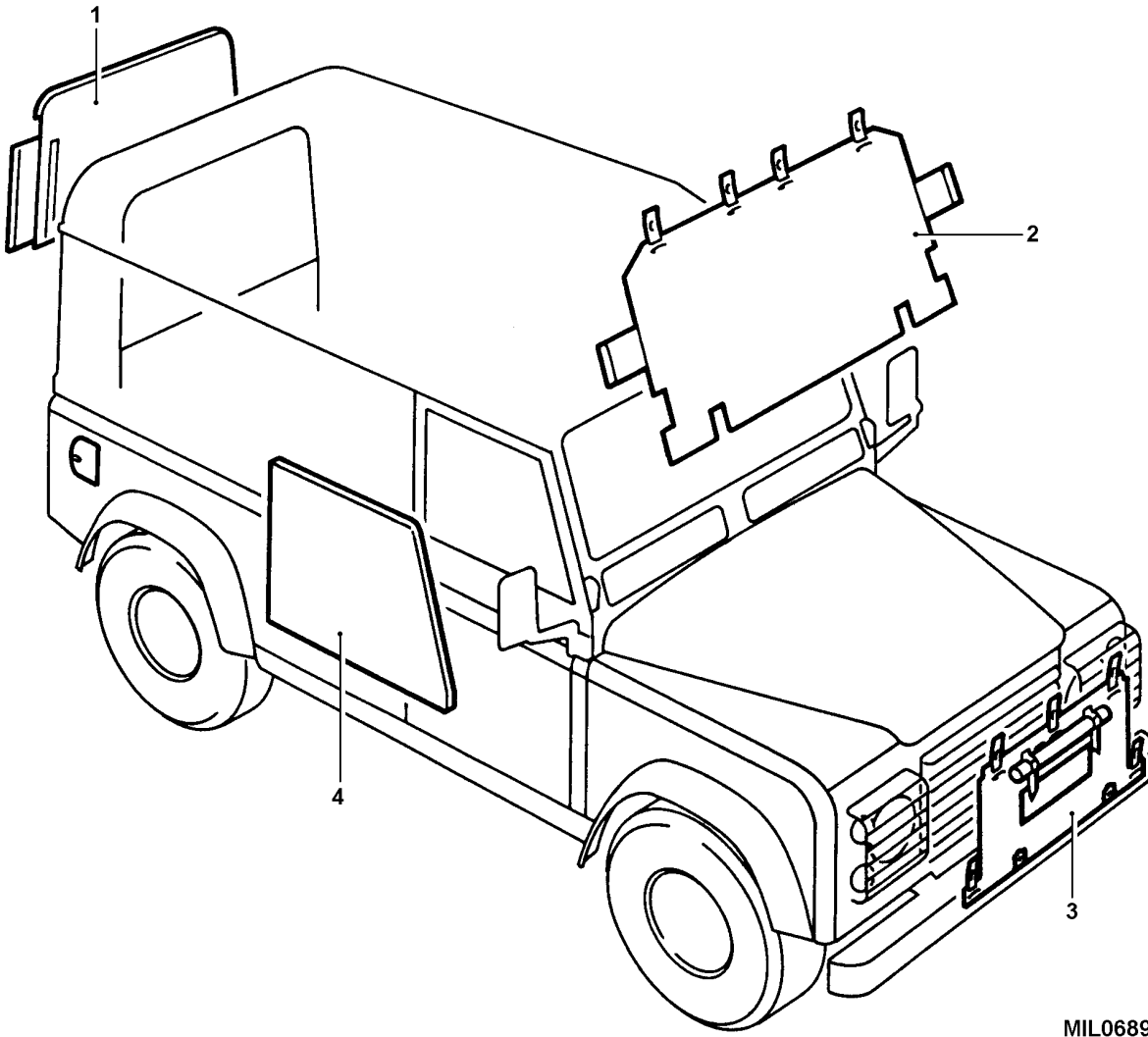


MIL0688

Fig 4 Body insulation

NOTE

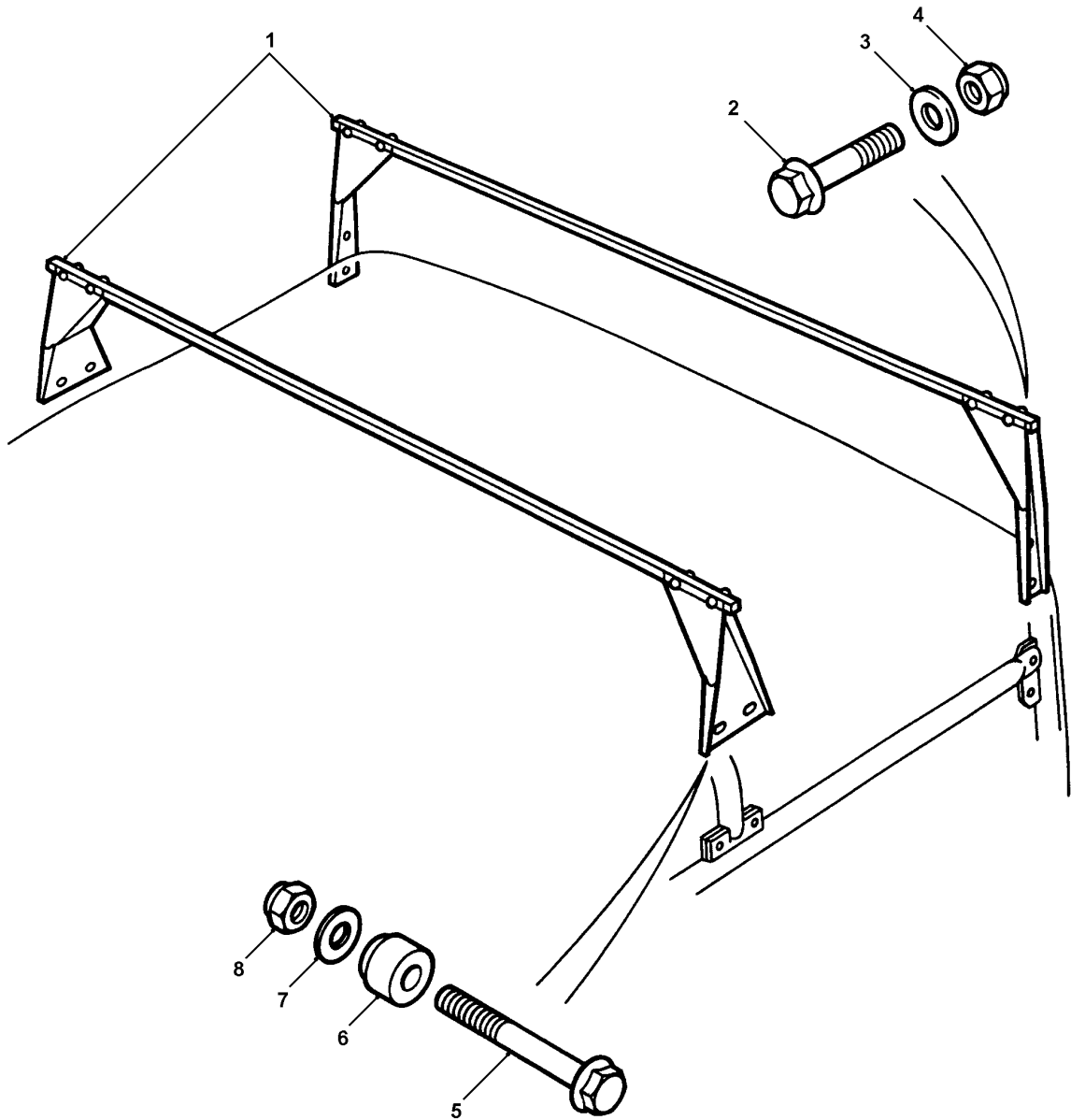
The insulation panels (Fig 4) are adhesive backed and if removed must be renewed.



MIL0689

- | | | | |
|---|-----------------------|---|------------------------|
| 1 | Rear door snow blind | 3 | Radiator muff |
| 2 | Windscreen snow blind | 4 | Side screen snow blind |

Fig 5 Snow blinds

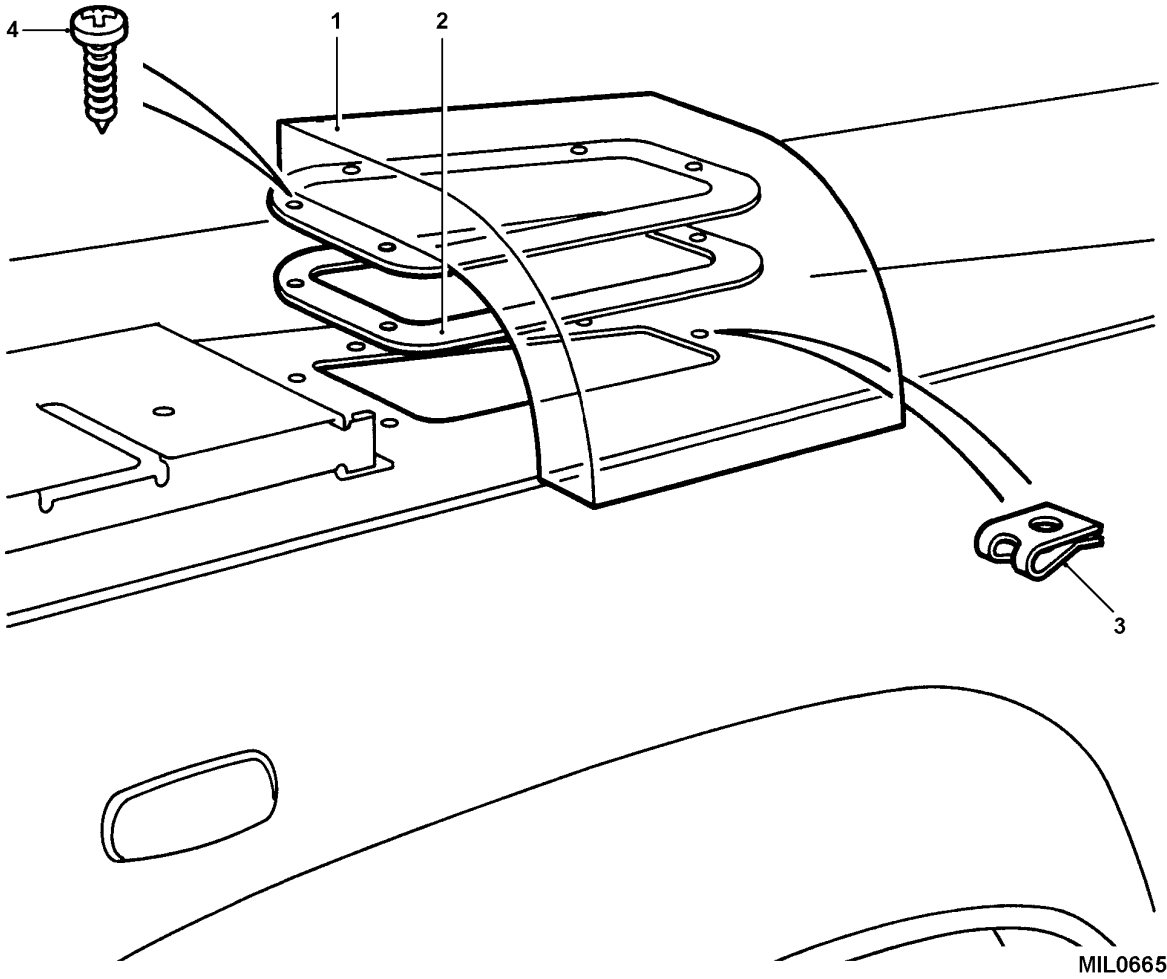


MIL0683

- 1 Ski rack
- 2 Bolt
- 3 Washer
- 4 Nut

- 5 Bolt
- 6 Spacer
- 7 Washer
- 8 Nut

Fig 6 Ski racks



1 Intake
2 Seal

3 Screw clip
4 Screw

Fig 7 Heater intake

CHAPTER 16-5

TROPICALISED

CONTENTS

Para

- 1 Introduction
- 3 Panel replacement
- 4 Bodywork

Fig

Page

- 1 Radiator grille and panel 2

INTRODUCTION

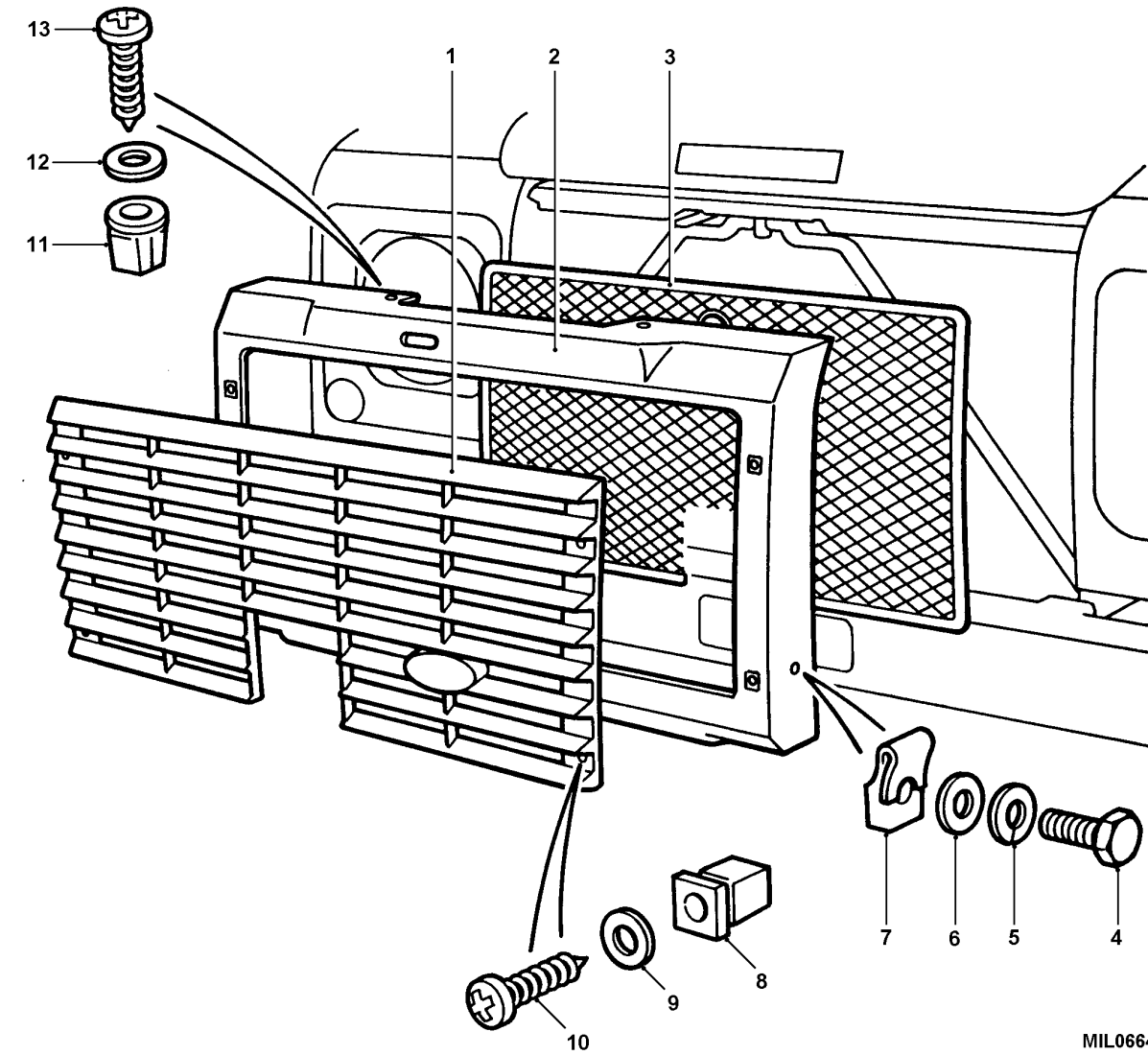
1 This chapter details the Unit repairs for the body cab and fittings as fitted to (TUM) Ambulance HS tropicalised.

PANEL REPLACEMENT

2 For details of panel replacement and repair (refer to Chap 16-2).

BODYWORK

3 The following body illustration show the make up of the tropicalised ambulance body and fittings.



MIL0664

- | | | | |
|---|---------------|----|-------------|
| 1 | Grille | 8 | Captive nut |
| 2 | Grille panel | 9 | Washer |
| 3 | Hand guard | 10 | Screw |
| 4 | Screw | 11 | Captive nut |
| 5 | Spring washer | 12 | Washer |
| 6 | Washer | 13 | Screw |
| 7 | Spire clip | | |

Fig 1 Radiator grille and panel

CHAPTER 16-6

HELICOPTER SUPPORT PLATFORM

CONTENTS

Para

- 1 Introduction
- Roof bars
- 3 Fitting
- Platform
- 4 Assembly
- Fitting the platform to the roof bars
- 5 Fitting
- Platform ladder
- 6 Fitting
- 7 Removal of the platform
- Battery box
- 8 Fitting
- 9 Remove

Fig

Page

1	Securing the roof bars.....	2
2	Assembling the platform	3
3	Securing the platform.....	4
4	Raising the platform safety bars	5
5	Fitting the ladder	6
6	Securing the battery box.....	8

INTRODUCTION

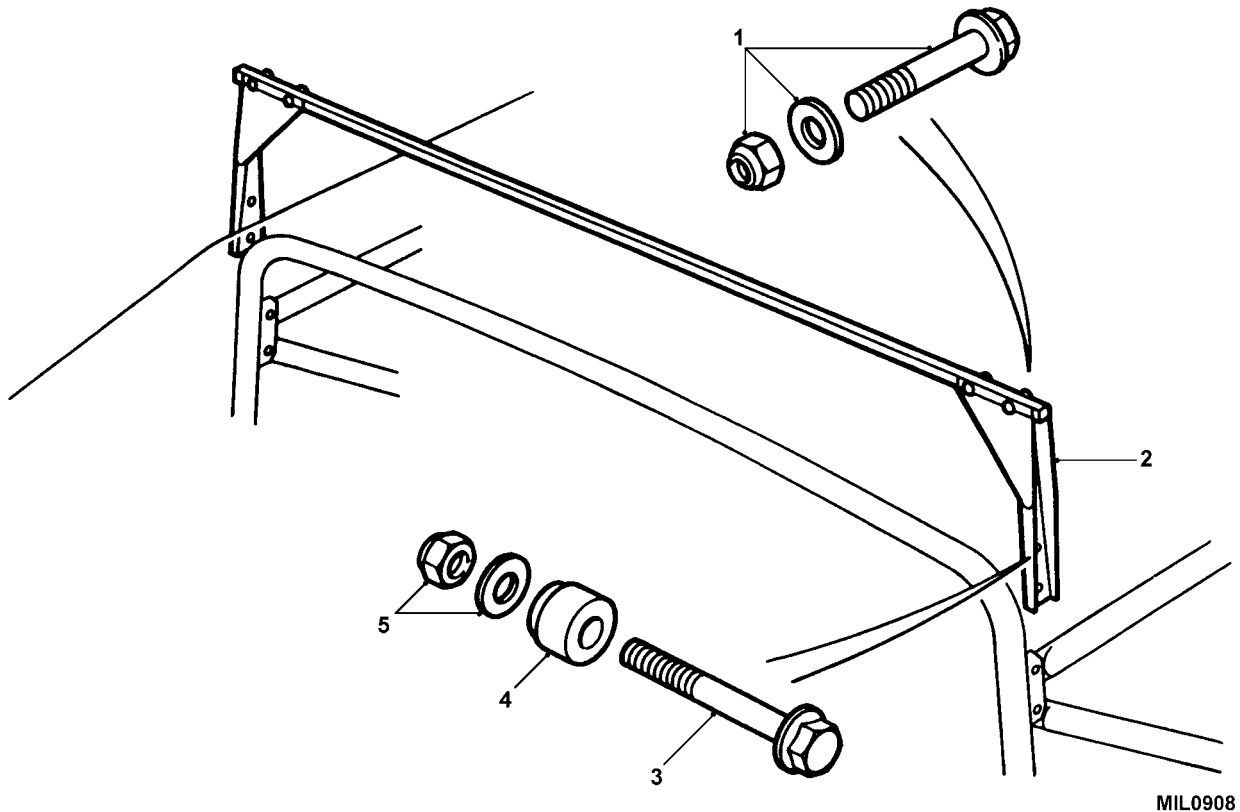
- 1 This chapter details the Unit repairs for the Helicopter support platform and fittings as fitted to Truck Utility Medium (TUM) HS vehicles.
- 2 The procedures are applicable to both left and right hand drive vehicles.

ROOF BARS

Fitting

- 3 To fit the roof bars carry out the following:
 - 3.1 Park the vehicle on a level surface, apply the handbrake and disconnect the vehicle batteries.
 - 3.2 Remove the bolts from the bracket securing the tie bar cantrail and the brace rail to the front roll protect hoop.
 - 3.3 From inside the vehicle drill out two holes in the hard top through the bracket using a suitable drill.
 - 3.4 Repeat the operation on the other side of the vehicle.

3.5 Assemble the roof bar (Fig 1 (2)) and with assistance lift it over the hardtop and offer it to the drilled positions either side. Hold in position temporarily with a screwdriver or suitable tool through the drilled holes.



3	1	Nut, bolt and washer	4	Spacer
	2	Roof bar	5	Nut and washer
	3	Bolt		

Fig 1 Securing the roof bars

3.6 Secure the roof bar in place using the long bolts (3) and nuts (5) supplied ensuring the spacers (4) are placed in between the hard top and the hoop bracket.

3.7 Tighten and secure all fixings.

3.8 Repeat the operation for the centre and rear roof bars.

NOTE

Leave the centre roof bar fixings finger tight until the platform is fitted. This will allow for easier alignment.

PLATFORM

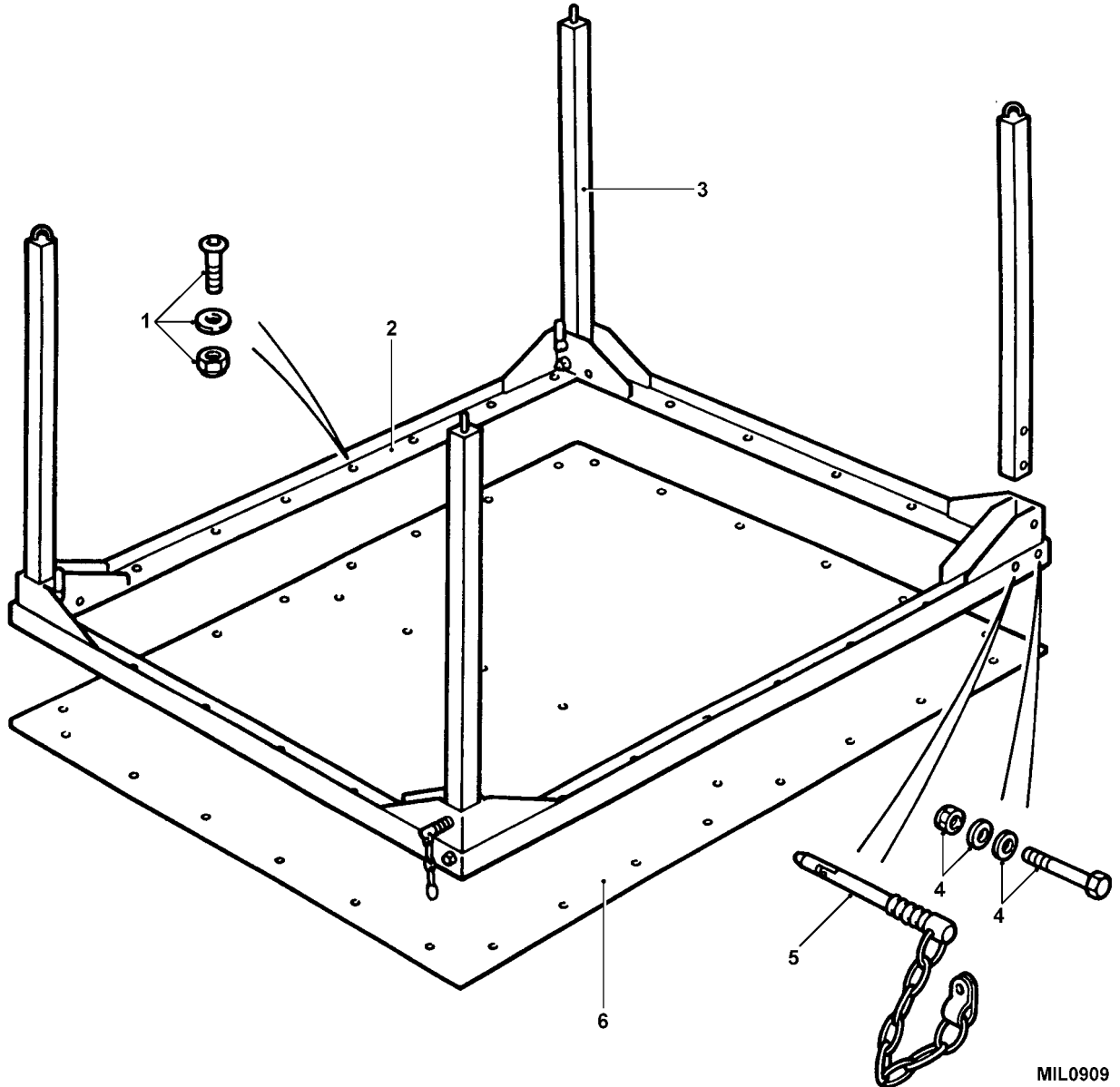
Assembly

4 Assemble the platform as follows:

4.1 Assemble the platform tread plate (Fig 2 (6)) to the frame (2) and secure with the 28 screws, nuts and washers (1) provided. Tighten and secure all fixings.

4.2 Locate the 4 safety bars (3) into the corner brackets and secure with the 4 pivot bolts (4). Ensure the bars raise and lower into position and that the spring loaded locking pins (5) line up with the respective holes in the frame.

4.3 Drop the safety bars into the transportation position and lock in place using the spring loaded locking pins.



1 Nut, washer and screw
2 Frame
3 Safety bar

4 Nut, washers and bolt
5 Locking pin
6 Tread plate

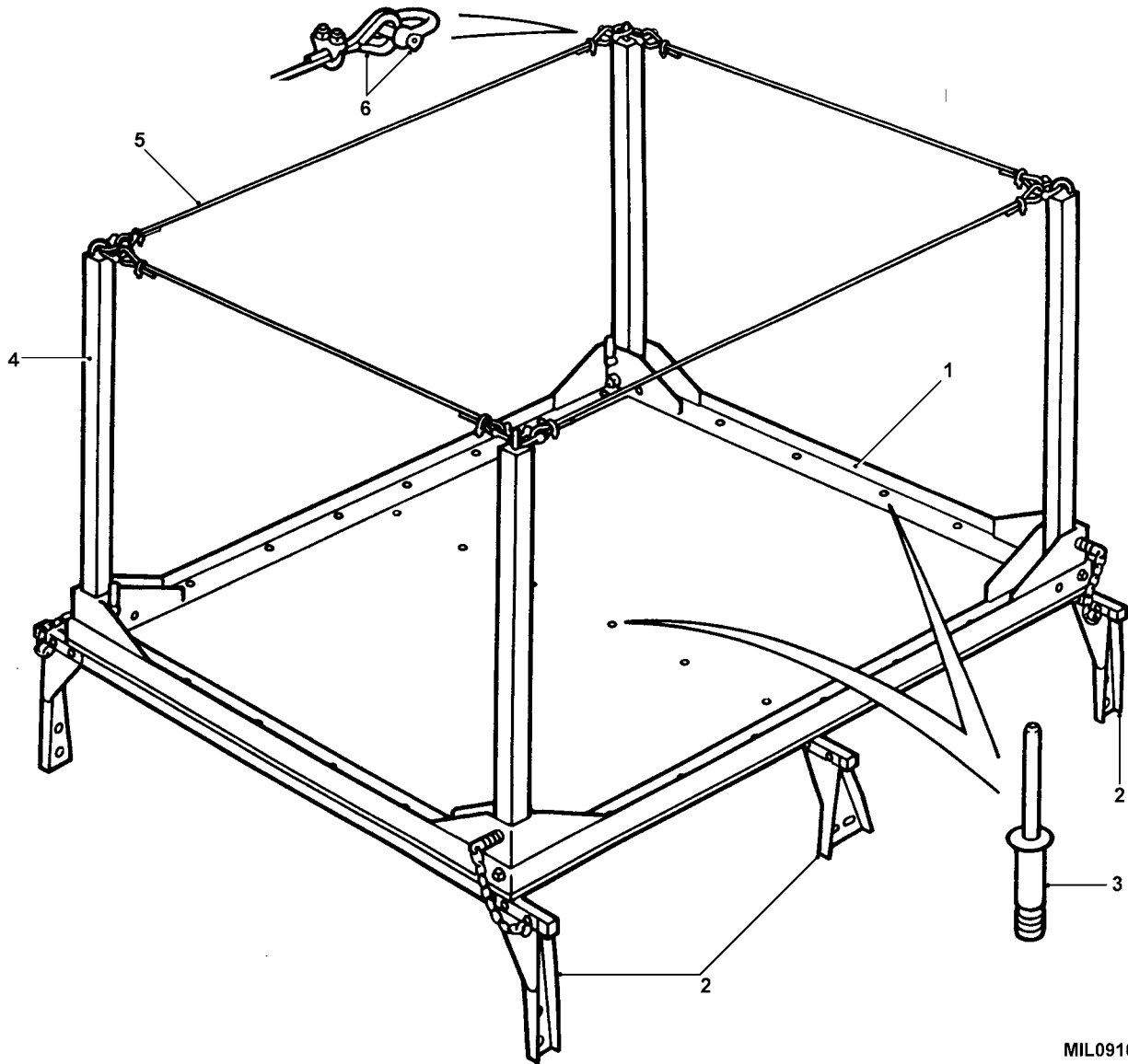
Fig 2 Assembling the platform

FITTING THE PLATFORM TO THE ROOF BARS

Fitting

5 To fit the platform to the roof bars carry out the following:

- 5.1 Using a suitable hoist and lifting rings, position the assembled platform (Fig 3 (1)) centrally onto the roof bars (2) and using suitable clamps secure into position.
- 5.2 Mark out the position of 6 equi-spaced holes down the centre roof bar and 8 equi-spaced holes down the front and rear roof bars.
- 5.3 Drill through the platform base into the roof bars using a suitable drill and counter sink the holes in the platform.
- 5.4 Secure the platform to the roof bars using the mono bolts (3) provided.



MIL0910

1 Platform
2 Roof bars
3 Mono bolt

4 Safety bar
5 Safety wire
6 Shackle

Fig 3 Securing the platform

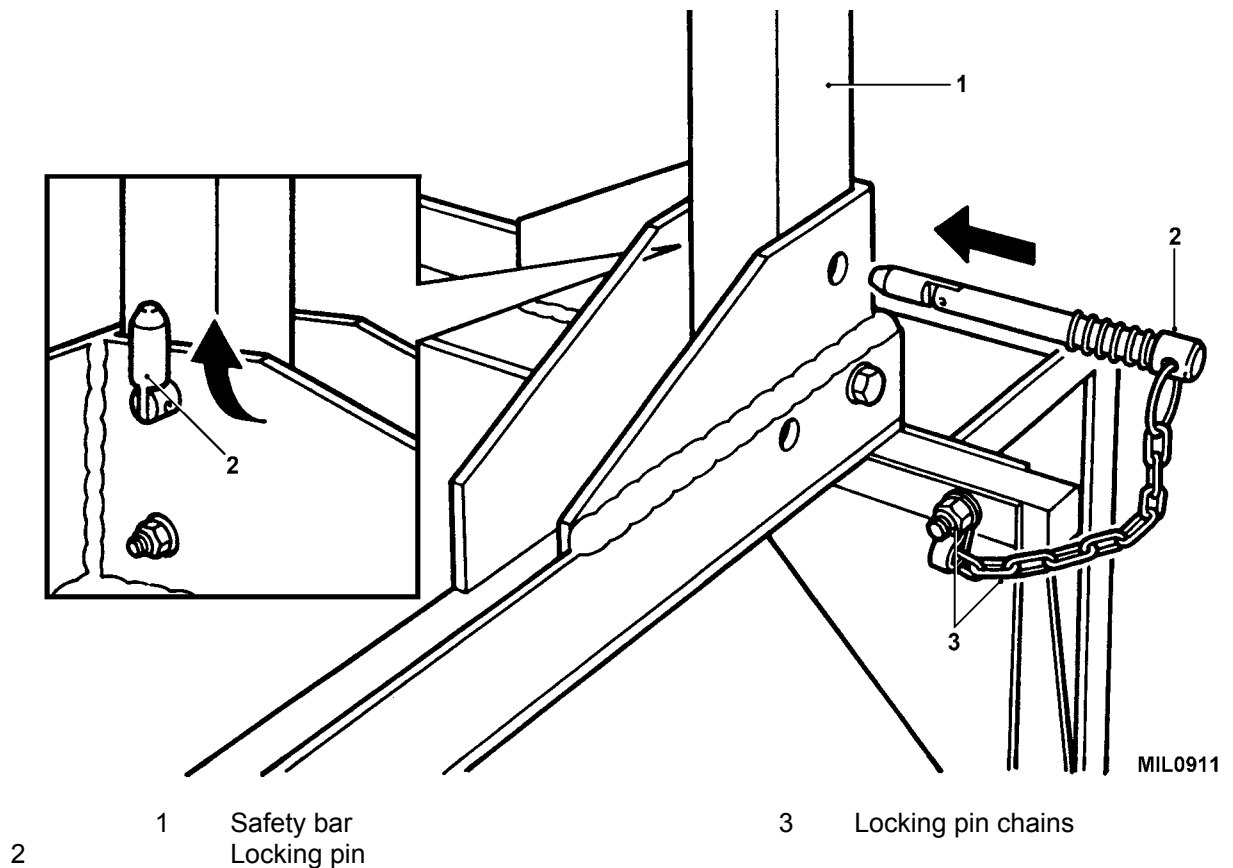


Fig 4 Raising the platform Safety bars

- 5.5 Remove the clamps.
- 5.6 Raise the safety bars (Fig 4 (1)) and lock into position using the locking pins (2). Attach the safety wires ((Fig 3 (5))) to the top of the safety bars using the shackles provided (6).
- 5.7 Secure the free ends of the locking pin chains (Fig 4 (3)) to the roof bars using the bolts provided.
- 5.8 Ensure all fixings are tightened and secure.

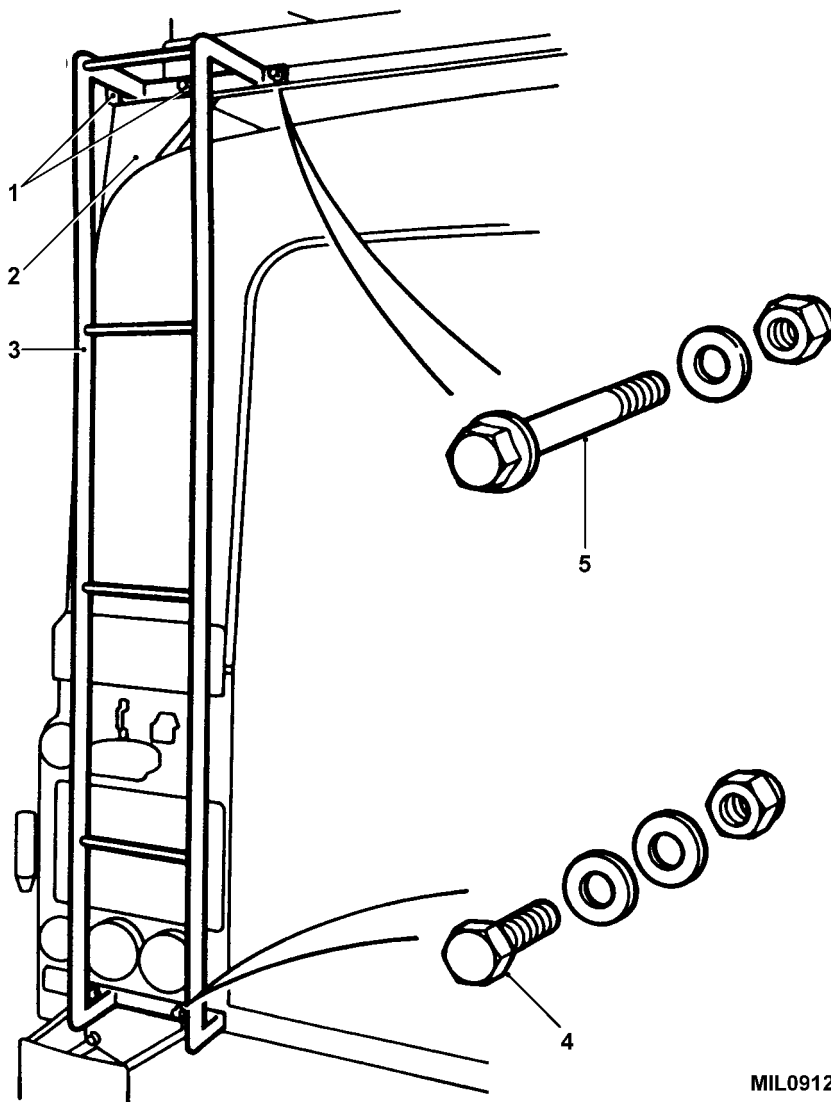
PLATFORM LADDER

Fitting

- 6 To fit the platform ladder carry out the following:
 - 6.1 Remove the nuts, washers and bolts (Fig 5 (1)) from the LH side of the rear roof bar (2).
 - 6.2 With assistance offer the ladder (3) to the rear of the vehicle and locate in position using the bolts (5).
 - 6.3 Ensure the ladder is lined up correctly with roof bar and drill through the third bolt position in the roof bar using a suitable drill.
 - 6.4 Clean off any swarf and secure with a third bolt.

6.5 With assistance hold the bottom of the ladder steady and drill through the holes in the bottom support into the bodywork using a suitable drill.

6.6 Clean away any swarf and secure in the ladder in position with bolts (4) supplied.



MIL0912

- 1 Nuts washers and bolts
- 2 Roof bars
- 3 Ladder

- 4 Nut, washers and bolt
- 5 Nut, washer and bolts

Fig 5 Fitting the ladder

REMOVAL OF THE PLATFORM

7 To remove the platform from the vehicle carry out the following:

7.1 With assistance remove the five bolts securing the ladder to the roof bars and the rear of the vehicle and remove the ladder.

7.2 Lower the safety bars into the transportation position and lock in place using the spring loaded retention pins.

- 7.3 Secure a suitable hoist and lifting rings to the platform.
- 7.4 Remove the bolts securing the roof bars to the roof bar mounting brackets at the six locations (2 bolts per fixing).
- 7.5 Using the hoist and lifting rings lift the platform off the vehicle roof.
- 7.6 Remove the roof bar mounting brackets from the six roll cage locations and collect the spacers. Replace the nuts and bolts securing the tie bar cant rails and brace rails and tighten and secure all fixings.

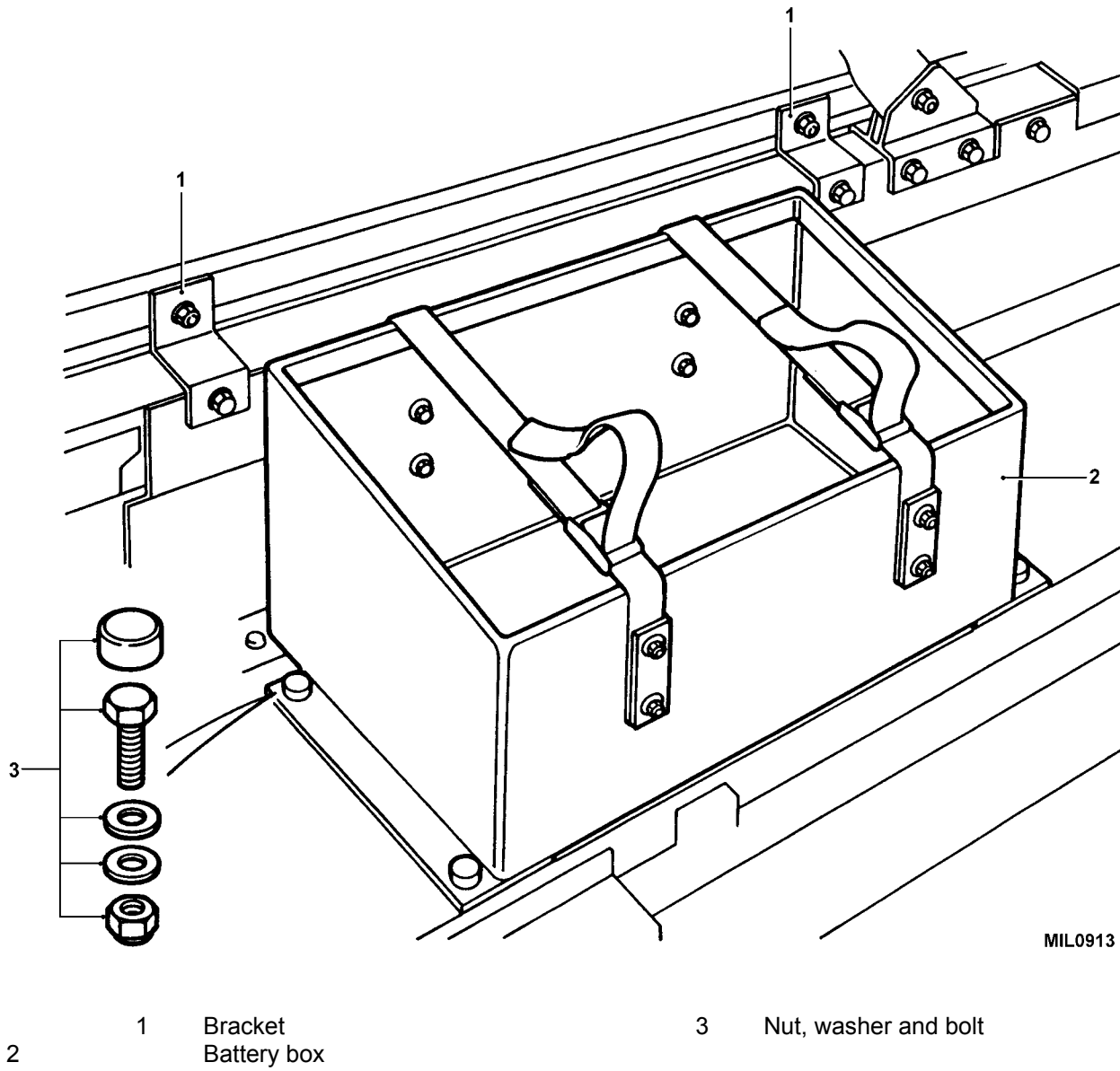
BATTERY BOX

Fitting

- 8 To fit the battery box carryout the following:
 - 8.1 Locate the battery box between the two hard top securing brackets and drill through the holes into the wheel box.
 - 8.2 Clean away any swarf.
 - 8.3 Secure the battery box in position with the bolts supplied.

Remove

- 9 Remove the battery box using the reverse of the fitting procedure. Plug remaining holes with rubber grommets.



MIL0913

Fig 6 Securing the battery box

CHAPTER 17

ELECTRIC WINCH

CONTENTS

Para

- 1 Introduction
ELECTRIC WINCH
- 2 General
Winch assembly
- 3 Remove
Planetary Gearbox
- 4 Remove
- 5 Dismantle
- 6 Inspection
- 7 Reassembly
- 8 Electric motor
- 9 Remove
- 10 Renew motor brushes
- 11 Refit
Electric motor
- 12 Renewal
- 13 Inspection
- 14 Refit
Friction plate assembly
- 15 Renewal (CAUTION)
- 16 Clutch springs
Wire rope (WARNING)
- 17 Renewal
Electric winch assembly
- 18 Refit
Control box assembly (CAUTION)
- 19 Remove
- 20 Examination and renewal
- 21 Refit
Remote control assembly
- 22 Dismantle
- 23 Examination and renewal
- 24 Reassembly

Table

- 1 Sealants, adhesives and lubricants 2

Page

Fig

- 1 Electric winch assembly removal 3
- 2 Planetary gearbox removal 4
- 3 Electric motor removal 6
- 4 Friction plate removal 9
- 5 Control box assembly removal 12
- 6 Remote control assembly dismantle 13/14

INTRODUCTION

1 This chapter details the Unit repair procedures for the electric winch fitted to Truck Utility Light (TUL) HS and Truck Utility Medium (TUM) HS vehicles.

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1 2 3	OEP 220 Texaco Molytech EP00 Sikaflex 221	9150-99-220-1477 9150-99-911-1798 8030-99-611-3031	Lubricating oil Grease Sealant

ELECTRIC WINCH

GENERAL

2 The manufacturers fill the electric winch with the correct type and quantity of oil. It is recommended that after any maintenance involving the draining of oil from the winch that it is replenished with the correct grade of oil (refer to Table 1). The freespool handle requires regular lubrication with light oil.

NOTE

Clutch linings and seals should be checked periodically.

WINCH ASSEMBLY

Remove

3 To remove the electric winch assembly proceed as follows:

NOTE

It may be necessary to remove the front grille from the vehicle to allow the winch to be removed from the front bumper mounting.

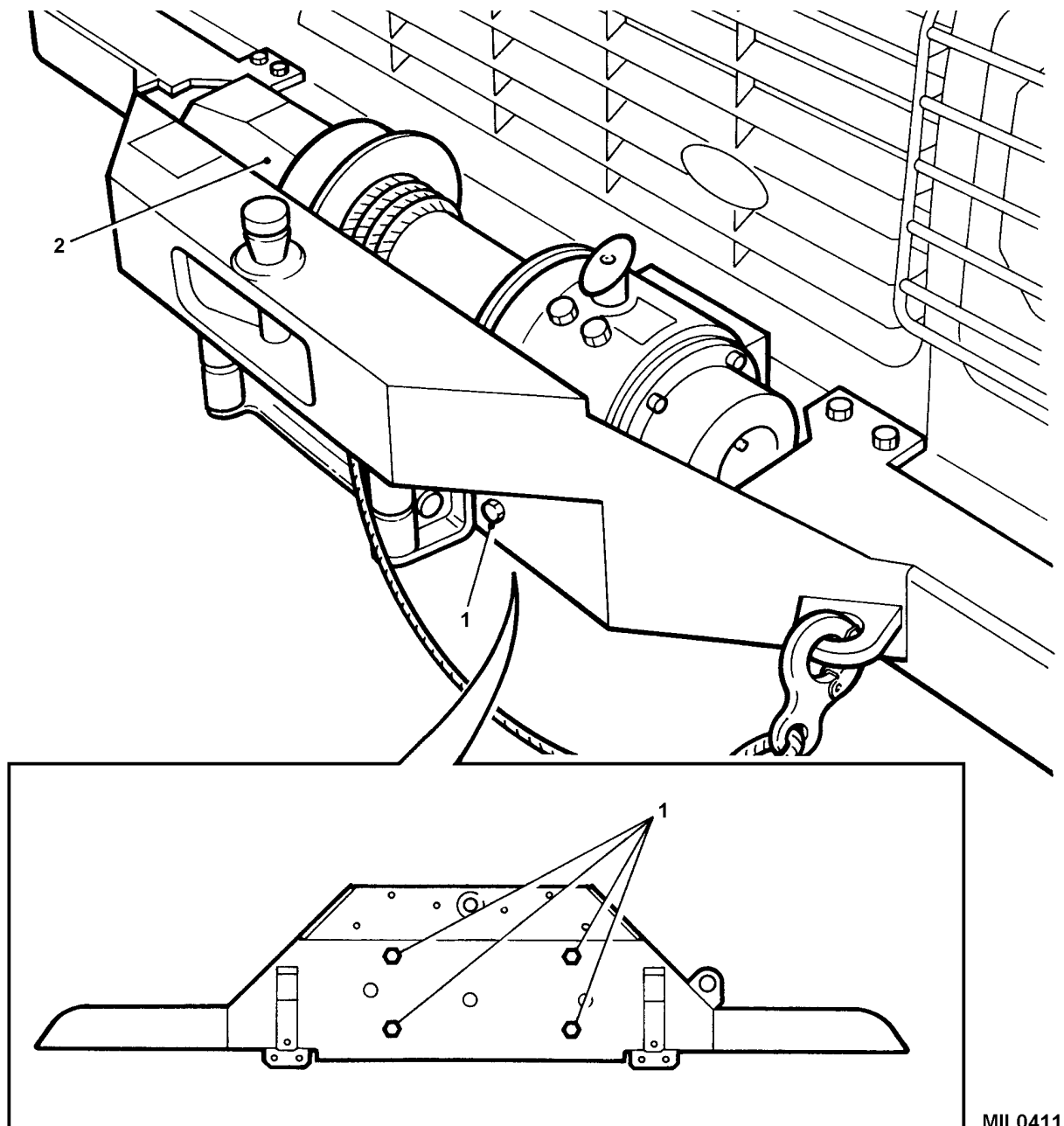
3.1 Disconnect the vehicle batteries (refer to Chap 13-1).

3.2 Remove the six bolts (Fig 1 (1)) securing the winch to the front bumper (four underneath the bumper and two at the front).

3.3 Remove cover (2) and disconnect the four cable connections to the motor unit and move the cable aside.

3.4 Disconnect any hooks or blocks from the winch cable and ensure the cable end can pass through the roller fairlead.

3.5 With the aid of an assistant, lift the winch unit clear of the front bumper and place on a suitable work bench.



1 Bolts

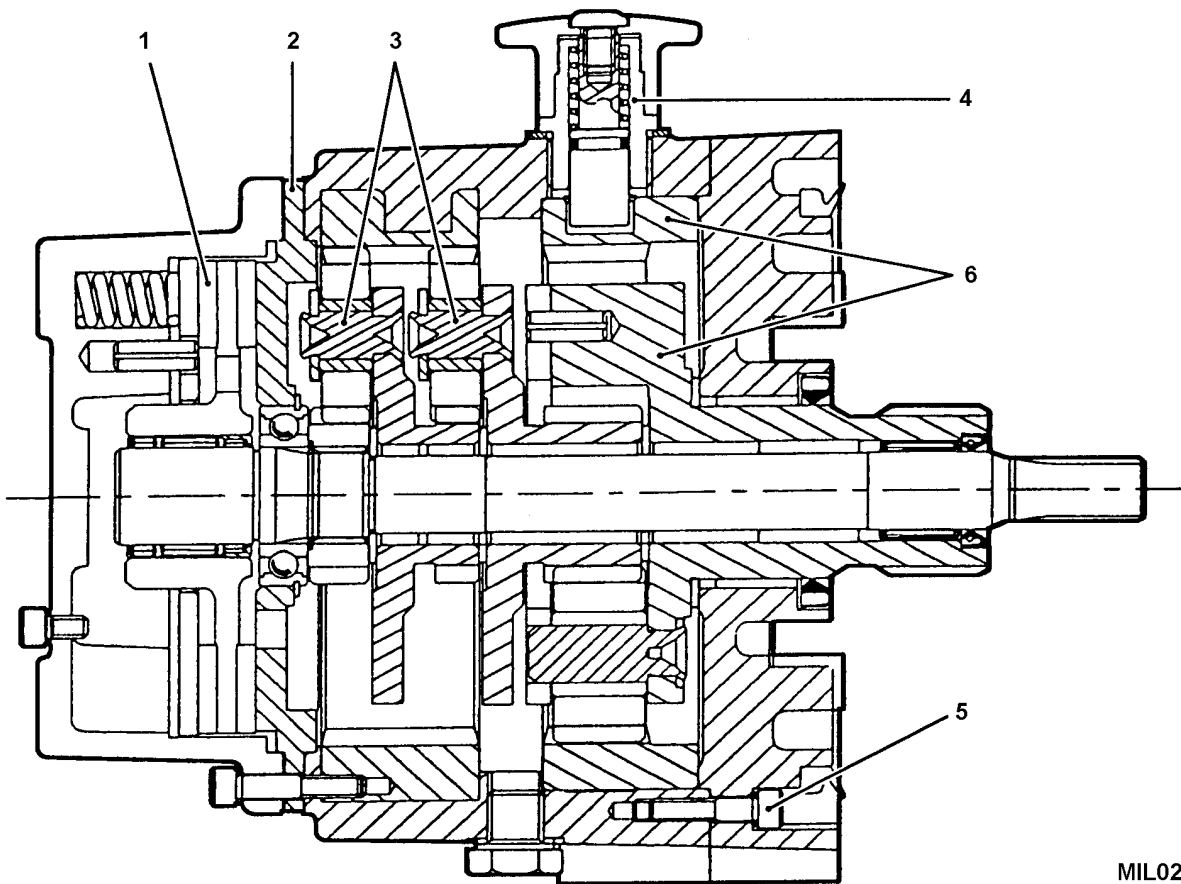
2 Cover

Fig 1 Electric winch assembly removal

PLANETARY GEARBOX

Remove

- 4 To remove the planetary gearbox carryout the following:
 - 4.1 Remove winch from bumper (refer to Para 3)
 - 4.2 Remove the four bolts securing the rear tie bar.
 - 4.3 Separate gearbox assembly from rope drum and coupling tube.



MIL0257

1 Clutch assembly	4 Freespool
2 Bearing carrier	5 Screw
3 2nd/3rd stage carrier assembly	6 Ring gear/bearing housing

Fig 2 Planetary gearbox removal

Dismantle

- 5 Dismantle the planetary gearbox as follows:
 - 5.1 Drain oil from the gearbox.
 - 5.2 Place gearbox on work surface with clutch cover uppermost.
 - 5.3 Remove clutch assembly (Fig 2 (1))(refer to Para 15).
 - 5.4 Withdraw bearing carrier/brake plate (2) and drive input shaft.
 - 5.5 Withdraw 2nd stage carrier assembly, followed by the 3rd stage carrier assembly (3).
 - 5.6 Unscrew and lift out freespool pin assembly (4) from gearbox casing.
 - 5.7 Invert gearbox assembly. Remove eight cap head screws (5) securing bearing housing.
 - 5.8 Remove bearing housing and withdraw ring gear (6).

Inspection

- 6 Check the condition of all components and replace all worn parts as necessary.
 - 6.1 Clean all components and jointing faces.

Reassembly

NOTE

Prior to reassembly ensure all thrust washers are correctly positioned. Fit new gaskets.

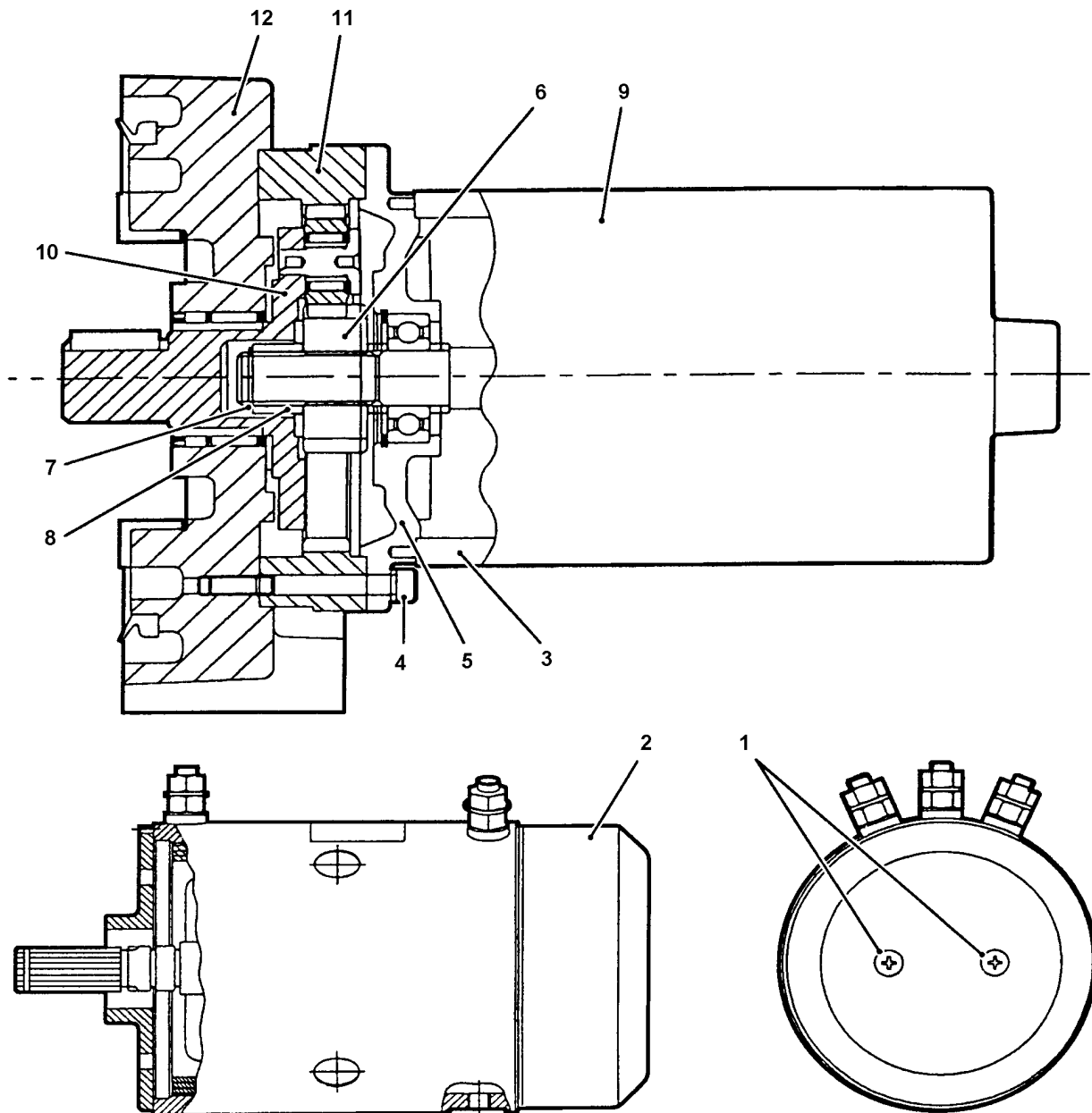
- 7 Reassemble the gearbox as follows:
 - 7.1 Lightly lubricate pin (refer Table 1 Serial 1) in freespool pin housing assembly.
 - 7.2 Lightly grease (refer Table 1 Serial 2) the needle roller bearing and oil seal, and fully grease the splines.
 - 7.3 Grease spline on input shaft.
 - 7.4 Refit bearing housing ensuring ring gear is correctly located and secure with eight screws (5).
 - 7.5 Refit freespool pin assembly (4).
 - 7.6 Insert 2nd and 3rd stage carriers (3) ensuring 0.75 mm (0.03 in.) end float on final stage carrier.
 - 7.7 Refit bearing carrier/brake plate (2) and drive input shaft.
 - 7.8 Refit clutch assembly (1).
 - 7.9 Reassemble gearbox to rope drum and coupling tube.
 - 7.10 Refill with oil (refer to Table 1 Serial 1).
 - 7.11 Refit tie bar.
 - 7.12 Refit winch to bumper (refer to Para 18).

ELECTRIC MOTOR

- 8 The motor is a 24 volt series wound waterproofed unit. Disturbing the unit will damage the integrity of the waterproofing, so the motor must be resealed before returning to service.

Remove

- 9 To remove the motor from the winch unit, carry out the following:
 - 9.1 Remove the winch from the bumper (refer to Para 3).
 - 9.2 Remove the four bolts securing the rear tie bar in position.
 - 9.3 Separate the motor and gearbox unit from the winch drum and drive coupling.
 - 9.4 Place motor drive unit onto a work surface with the motor uppermost.



MIL0258

- | | |
|-----------------|-----------------------------|
| 1 Screws | 7 Circlip |
| 2 End cap | 8 Spacer |
| 3 Long bolt | 9 Motor body |
| 4 Screw | 10 1st stage planet carrier |
| 5 Adapter plate | 11 Ring gear |
| 6 Sun gear | 12 Motor housing |

Fig 3 Electric motor removal

Renew motor brushes

10 To renew the motor brushes carry out the following:

10.1 Remove the two screws (Fig 3 (1)) at the end of the motor cap, and remove the end cap (2).

- 10.2 Taking care not to disturb the joint between the motor and motor housing, remove the two long bolts (3) securing brush holder and motor into position.
- 10.3 Remove the remaining screw locating the brush holder in position and withdraw the brushes.
- 10.4 Fit new brushes into holder.
- 10.5 Refit brush holder into motor and secure with screws and long bolts.
- 10.6 Remove all traces of old sealant from jointing faces of end cap, motor body and screw holes.
- 10.7 Apply sealant (refer to Table 1 Serial 3) to jointing face of end cap, motor body and screw head counter sinks, replace end cap and secure with screws.

Refit

- 11 Refit the motor assembly as follows:
 - 11.1 Refit the motor assembly to the winch drum and drive coupling.
 - 11.2 Refit the tie bar to the rear of the winch unit.
 - 11.3 Refit the winch assembly to the bumper (refer to Para 18).

ELECTRIC MOTOR

Renewal

- 12 To renew the motor, carry out the following:
 - 12.1 Remove the motor assembly from the winch (refer to Para 9).
 - 12.2 Remove two screws (Fig 3 (1)) from the end of motor cap and remove end cap (2).
 - 12.3 Remove two long bolts (3) securing brush holder and motor into position.
 - 12.4 Remove the seven screws (4) securing the motor adapter plate (5) to the motor housing (12).
 - 12.5 Remove motor body (9) complete with adaptor plate (5) and sun gear (6).
 - 12.6 Remove circlip (7) from end of motor shaft and slide off spacer (8) and sun gear (6).
 - 12.7 Separate adaptor plate (5) from motor body (9).
 - 12.8 Remove 1st stage planet carrier (10) and ring gear (11) from motor housing (12).

Inspection

- 13 Clean and renew all worn or damaged 1st stage planet carrier components. Remove all traces of gaskets and sealant..

Refit

- 14 Refit the motor as follows:
 - 14.1 Transfer small spacer (8) to replacement motor.

- 14.2 Apply sealant (refer to Table 1 Serial 3) around motor jointing face and motor adaptor plate (5).
- 14.3 Locate motor into adaptor plate, ensuring peg engages into location hole in motor adaptor plate, and secure with two long bolts (3).
- 14.4 Apply sealant to jointing face of end cap (2), motor body (9) and screw head counter sinks. Replace end cap and secure with screws.
- 14.5 Fit sun gear (6) to motor shaft. Fit spacer (8) and secure with new circlip (7).
- 14.6 Reassemble 1st stage planet carrier (10) and ring gear (11) to motor housing (12).
- 14.7 Secure motor housing (12) to adaptor plate (5) with seven screws (4).
- 14.8 Refit the motor assembly to the winch (refer to Para 11).
- 14.9 Refit winch to bumper (refer to Para 18).

FRICITION PLATE ASSEMBLY

Renewal

- 15 To renew the friction plate assembly proceed as follows:
 - 15.1 Remove winch from bumper (refer to Para 3).
 - 15.2 Drain the oil from the gearbox.
 - 15.3 Remove the two screws (Fig 4 (6)) from the clutch cover (5).
 - 15.4 Replace the screws with two M5 x 38mm screws and fully tighten to secure the clutch plate to the clutch cover.
 - 15.5 Remove six screws (10) securing clutch cover, and remove cover complete with clutch plate (3).

CAUTION

CLUTCH PLATE. Do not remove clutch plate from clutch cover.

- 15.6 Slide friction plate assembly (2) from input shaft.
- 15.7 Renew friction plate assembly ensuring that boss is facing away from gearbox.
- 15.8 Fit a new gasket (1) and refit clutch cover assembly.
- 15.9 Refit and tighten six screws (10).
- 15.10 Remove two screws securing clutch plate to cover and replace with original screws (6) and washers (7).
- 15.11 Refill with oil (refer to Table 1 Serial 1).
- 15.12 Refit winch to bumper (refer to Para 18).

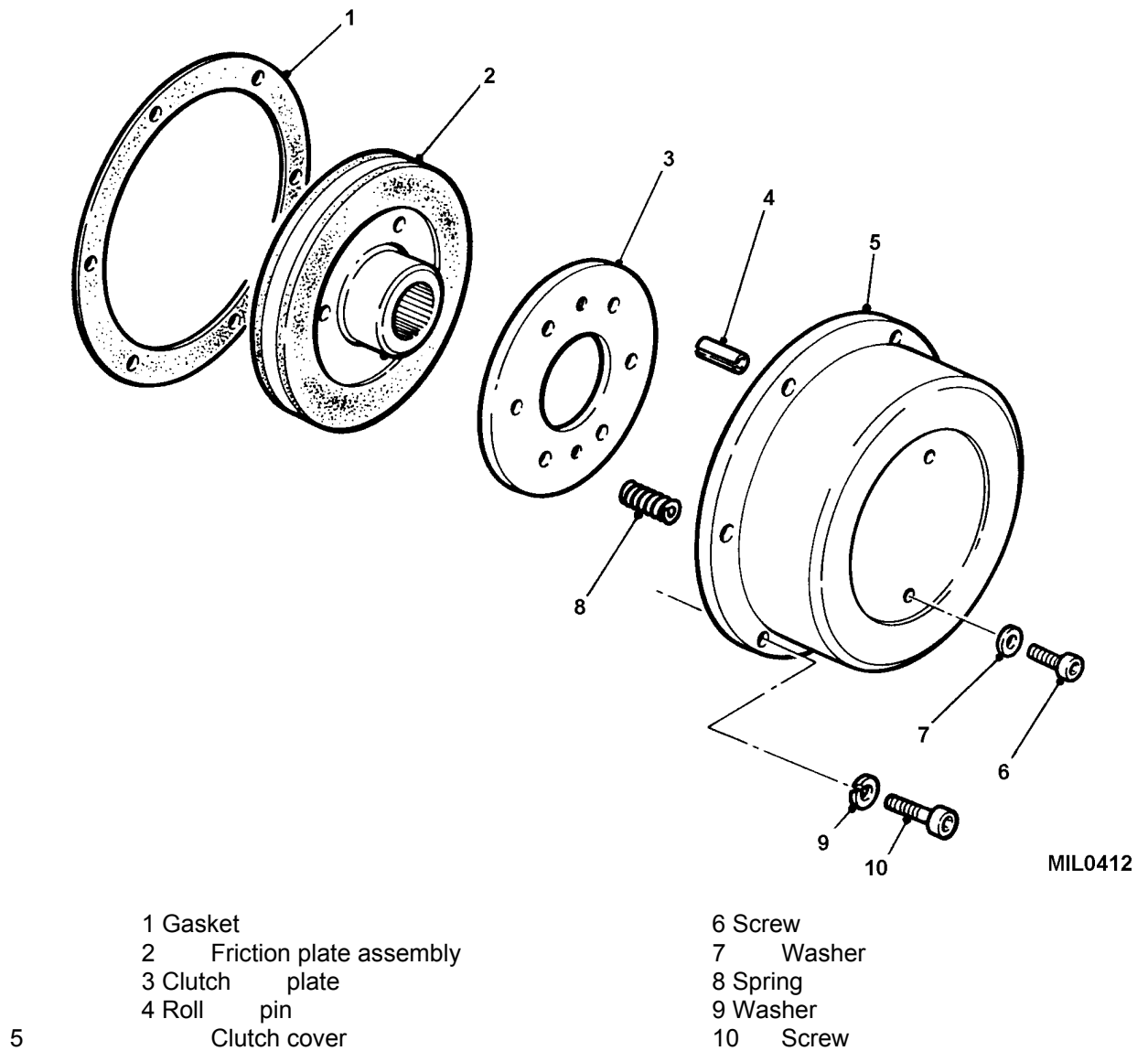


Fig 4 Friction plate removal

Clutch springs

16 To renew the clutch springs proceed as follows:

- 16.1 Remove winch from bumper (refer to Para 3).
- 16.2 Drain the gearbox oil.
- 16.3 Remove the two screws (Fig 4 (6)) from the clutch cover (5).
- 16.4 Replace with two screws M5 x 38mm to secure the clutch plate to the clutch cover.
- 16.5 Remove the six screws (10) securing the clutch cover (5) complete with clutch plate.
- 16.6 Slacken the two clutch plate securing screws carefully and remove the clutch plate (3) to expose the six springs (8).

- 16.7 Renew springs.
- 16.8 Replace clutch plate (3), ensuring roll pins (4) align with holes in clutch plate.
- 16.9 Replace the two clutch plate securing screws and tighten to draw the plate down onto the springs, ensuring roll pins align with holes in clutch plate.
- 16.10 Fit a new gasket (1) and refit the clutch cover assembly.
- 16.11 Refit and tighten six screws (10).
- 16.12 Remove two screws securing clutch plate to cover and refit original screws (6) and washers (7).
- 16.13 Refill with oil (refer to Table 1 Serial 1).
- 16.14 Refit winch to bumper (refer to Para 18).

WIRE ROPE

WARNING

GLOVES. WEAR HEAVY LEATHER GLOVES WHEN HANDLING THE WIRE ROPE.

Renewal

- 17 To renew the wire rope proceed as follows:
 - 17.1 Disconnect the vehicle batteries (refer to Chap 13-1).
 - 17.2 Disengage the cable drum by lifting and turning the freespool handle on top of the main gearbox housing.
 - 17.3 Pull out the cable by hand until the drum is empty of cable and the retaining grub screw is visible.
 - 17.4 Remove the wire cable retaining grub screw and withdraw the cable end from the drum.
 - 17.5 Pass the tapered end of a new wire rope through the fairlead guide bracket, under and over the winch drum and secure in the hole in the drum with the grub screw.
 - 17.6 Reconnect the vehicle batteries (refer to Chap 13-1).
 - 17.7 Select 'winch in' on the remote control hand grip and reeve the cable evenly onto the drum under a tension of at least 230 Kg (500 lb), until the final loop is held neatly by the fairlead guide.

NOTE

Always ensure that the cable on the drum 'winches in' and 'winches out' from the bottom of the drum so that correct automatic brake operation can take place when the winch is in use.

ELECTRIC WINCH ASSEMBLY

Refit

- 18 To refit the electric winch carry out the following:
 - 18.1 With the aid of an assistant, locate the winch into position on the bumper.

- 18.2 Feed the cable end through the through the roller fairlead.
- 18.3 Reconnect any hooks or blocks to the winch cable.
- 18.4 Reconnect the cable connections to the motor terminals.
- 18.5 Refit the six mounting bolts that secure the winch to the bumper and tighten to a torque of 44 Nm (33 lbf ft).
- 18.6 Refit the terminal cover to the motor.
- 18.7 Reconnect the vehicle batteries (refer to Chap 13-1).
- 18.8 Before initial use of the electric winch, plug in the remote control lead and test for proper forward and reverse operation, keeping hands free of the wire rope.

CONTROL BOX ASSEMBLY

CAUTION

CONTROL BOX DISCONNECTION. If the vehicle is to be driven with the winch or control box removed, the main electrical feed to the control box from the vehicle batteries must be disconnected and insulated to prevent it from coming into contact with other electrical equipment.

Remove

NOTE

The control box is mounted under the front right hand wing and is secured to the wheel arch.

- 19 To remove the control box carry out the following:
 - 19.1 Disconnect the vehicle batteries (refer to Chap 13-1).
 - 19.2 Without disconnecting the fuel pipes, remove the fuel filter complete with mounting bracket from the inner wing and place aside.
 - 19.3 From under the wheel arch, remove the two nuts (Fig 5 (1)) securing the control box to the wheel arch.
 - 19.4 Manoeuvre the control box assembly out from under the wing into the engine compartment.
 - 19.5 Remove the screw (2) securing the plastic cover (3) and noting the colour, order and type of each connection (for reassembly), disconnect the main cable terminals (4) and the overload assembly terminals (5).
 - 19.6 Remove the control box from the vehicle.

Examination and renewal

- 20 Examine the solenoids for signs of overheating and renew if necessary.

Refit

- 21 The refitting of the control box is the reverse of the removal.

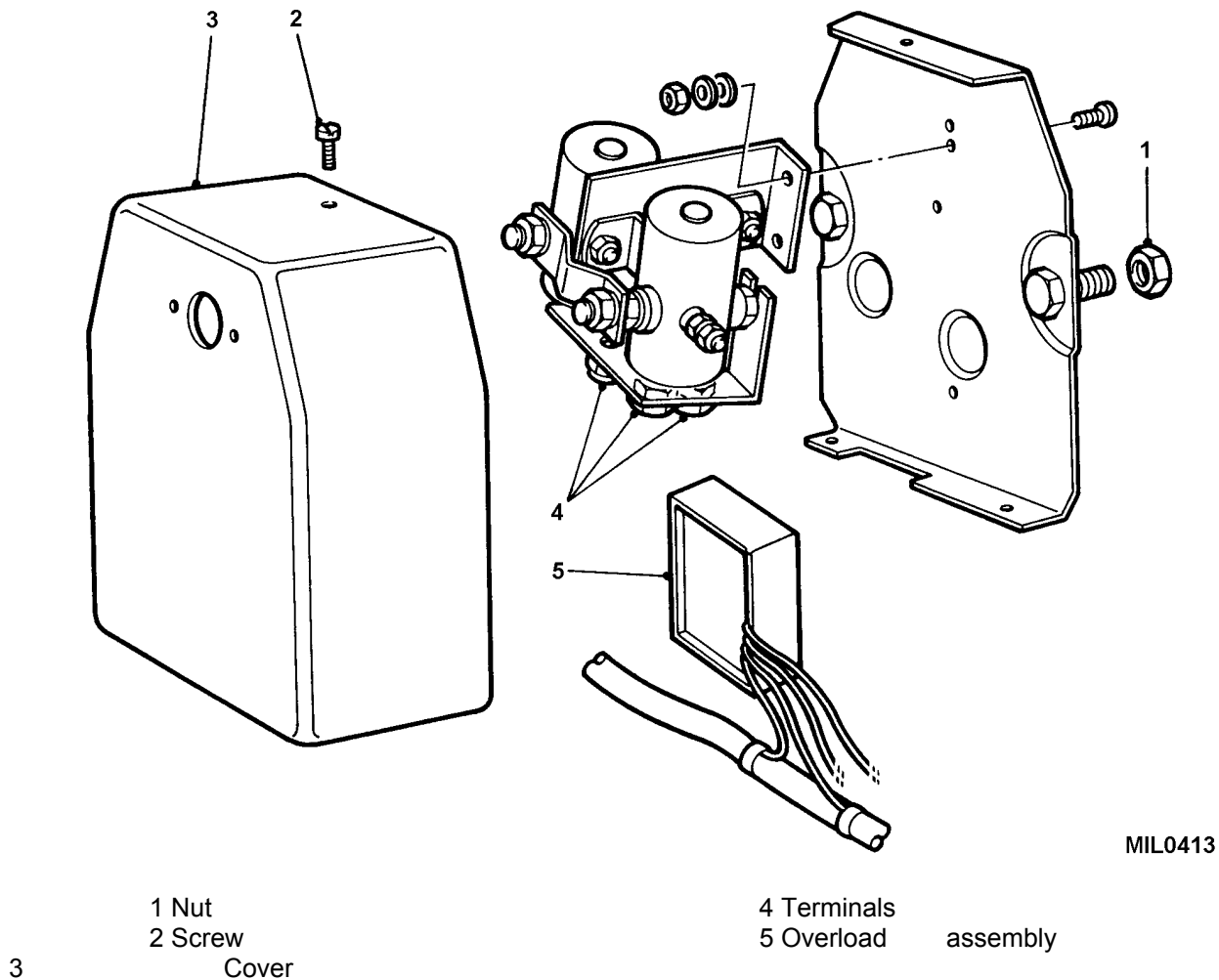


Fig 5 Control box assembly removal

REMOTE CONTROL ASSEMBLY**Dismantle**

22 Dismantle the remote control assembly as follows:

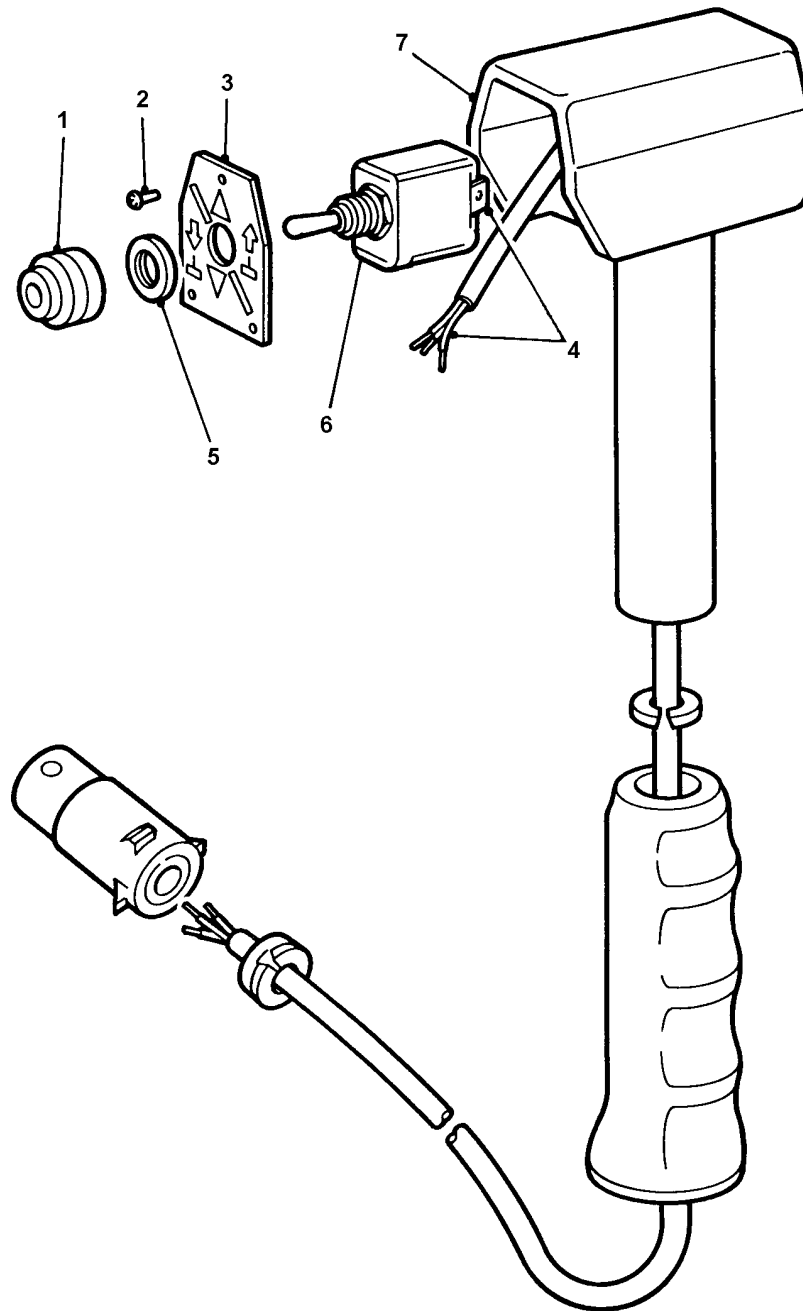
- 22.1 Remove the rubber grommet (Fig 6 (1)).
- 22.2 Remove the two screws (2).
- 22.3 Lift out the switch panel (3) from the handle (7) and disconnect the cable terminals (4).
- 22.4 Unscrew the knurled nut (5) and separate the switch unit (6) from the switch panel (3).

Examination and renewal

23 Examine all components for signs of overheating and wear and renew if required.

Reassembly

24 Reassemble the remote control in the reverse order used to dismantle.



MIL0414

- | | |
|------------------|--------------------|
| 1 Rubber grommet | 5 Knurled nut unit |
| 2 Screw | 6 Switch |
| 3 Switch panel | 7 Handle |
| 4 Terminals | |

4

Fig 6 Remote control assembly

CHAPTER 18

HEATING AND VENTILATION

CONTENTS

Para

- 1 Introduction
- 2 General

INTRODUCTION

1 This chapter details the Unit repair for the heating and ventilation systems as fitted to Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and (TUM) Ambulance HS vehicles.

General

2 This chapter has been sub-chaptered to allow for the various types of vehicle heating and ventilation as detailed below.

- 2.1 Chapter 18-1 TUL/TUM, FFR and Ambulance cab
- 2.2 Chapter 18-2 Field Ambulance rear body
- 2.3 Chapter 18-3 Winter/water
- 2.4 Chapter 18-4 Winterised
- 2.5 Chapter 18-5 Tropicalised

CHAPTER 18-1

TUL/TUM, FFR AND AMBULANCE CAB

CONTENTS

Para

1	Introduction
	Heater/fan unit
2	Removal
	Fan motor assembly
3	Removal
4	Examination and replacement
5	Reassembly
	Heater matrix
6	Removal
7	Examination
8	Reassembly
	Resistor unit
9	Removal
10	Reassembly
	Heater/fan unit
11	Refitting
	Heater control cable - temperature control
12	Removal
13	Refitting
	Heater control cable - air distribution
14	Removal
15	Refitting
	Heater control cable and blower motor switch
16	Removal
17	Refitting

Table

Page

1	Sealants, adhesives and lubricants	2
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Fig

1	Removing the heater/fan unit.....	3
2	Removing the heater/fan unit lower nuts and bolts	3
3	Fan motor assembly	4
4	Removing the heater matrix.....	5
5	Refitting the heater matrix.....	6
6	Heater control assembly removal	8
7	Heater control cable removal - temperature control	9
8	Heater control cable removal - air distribution	11
9	Heater control assembly removal	12
10	Heater control cable and blower motor switch removal.....	14

INTRODUCTION

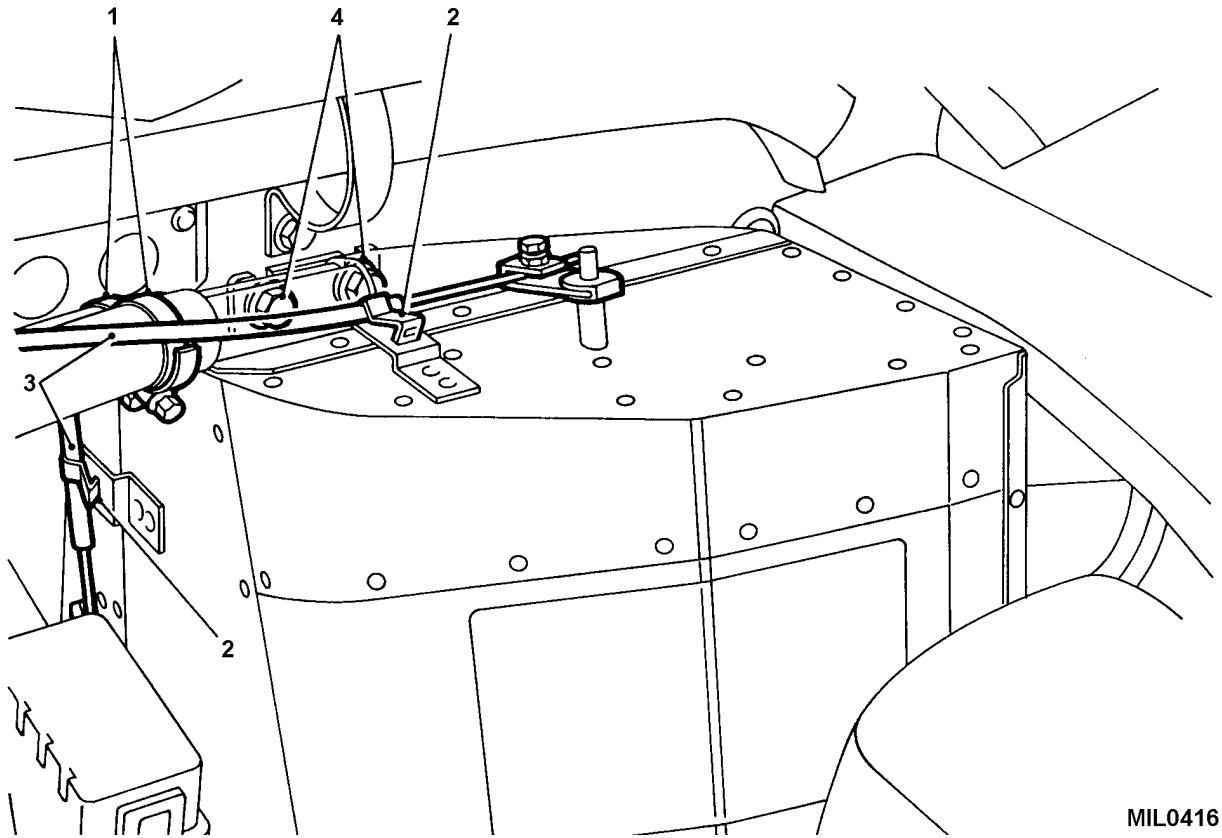
1 This chapter covers the Unit repairs for the heating and ventilation system as fitted to the Truck Utility Light (TUL) HS, Truck Utility Medium (TUM) HS and the cab section only of the (TUM) Ambulance HS vehicles.

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Bostik 1261	8040-99-763-8189	Adhesive

HEATER/FAN UNIT**Removal**

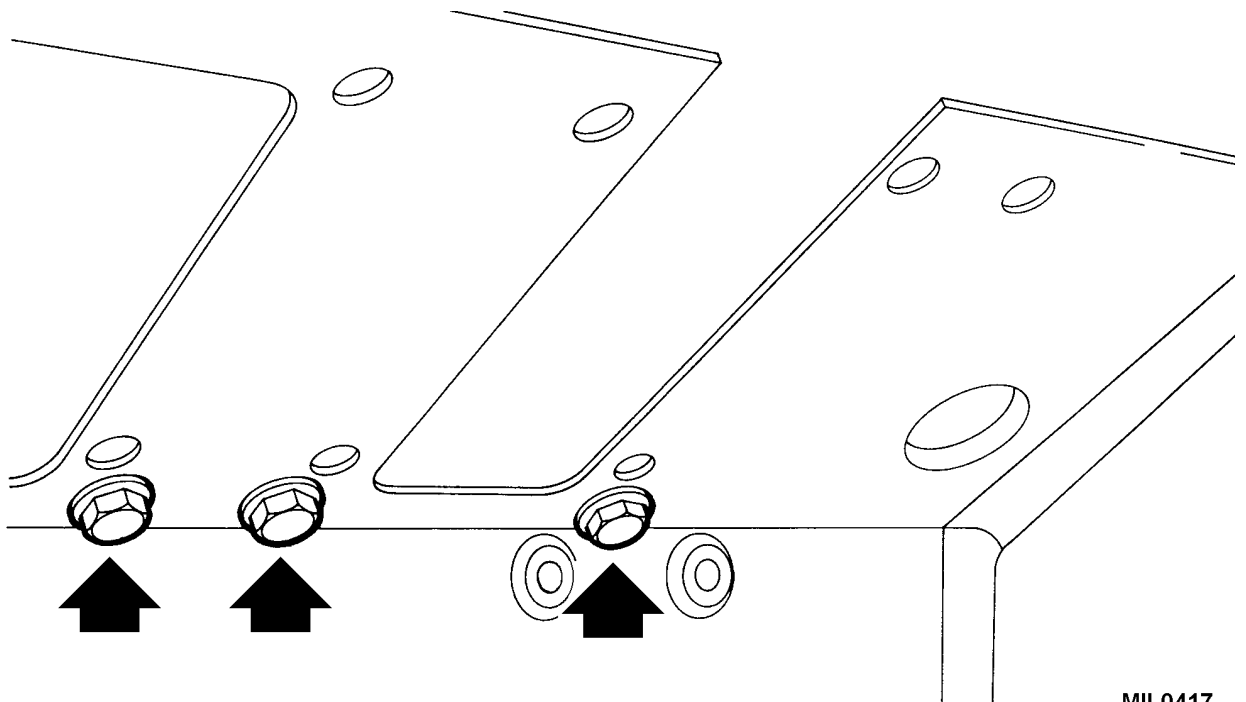
- 2 To remove the heater/fan unit carry out the following:
 - 2.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
 - 2.2 Remove the bonnet.
 - 2.3 Remove radiator bottom hose and drain the cooling system (refer to Chap 12).
 - 2.4 Slacken the clips (Fig 1 (1)) and remove the heater hoses at heater box unions.
 - 2.5 Remove outer cable securing clips (2).
 - 2.6 Slacken and remove control cables (3) at the heater box.
 - 2.7 Remove heater wiring harness securing loop.
 - 2.8 Disconnect harness multiplug.
 - 2.9 Remove interior bulkhead trim.
 - 2.10 Remove the lower nuts and bolts (Fig 2) securing the heater unit to the bulkhead.
 - 2.11 Slacken heater unit upper retaining bolts (Fig 1 (4)).
 - 2.12 Manoeuvre heater unit clear of engine bay.



MIL0416

- | | | | |
|---|----------------------------|---|-----------------------|
| 1 | Heater hose clips | 3 | Control cables |
| 2 | Outer cable securing clips | 4 | Upper retaining bolts |

Fig 1 Removing the heater/fan unit



MIL0417

Fig 2 Removing the heater/fan unit lower nuts and bolts

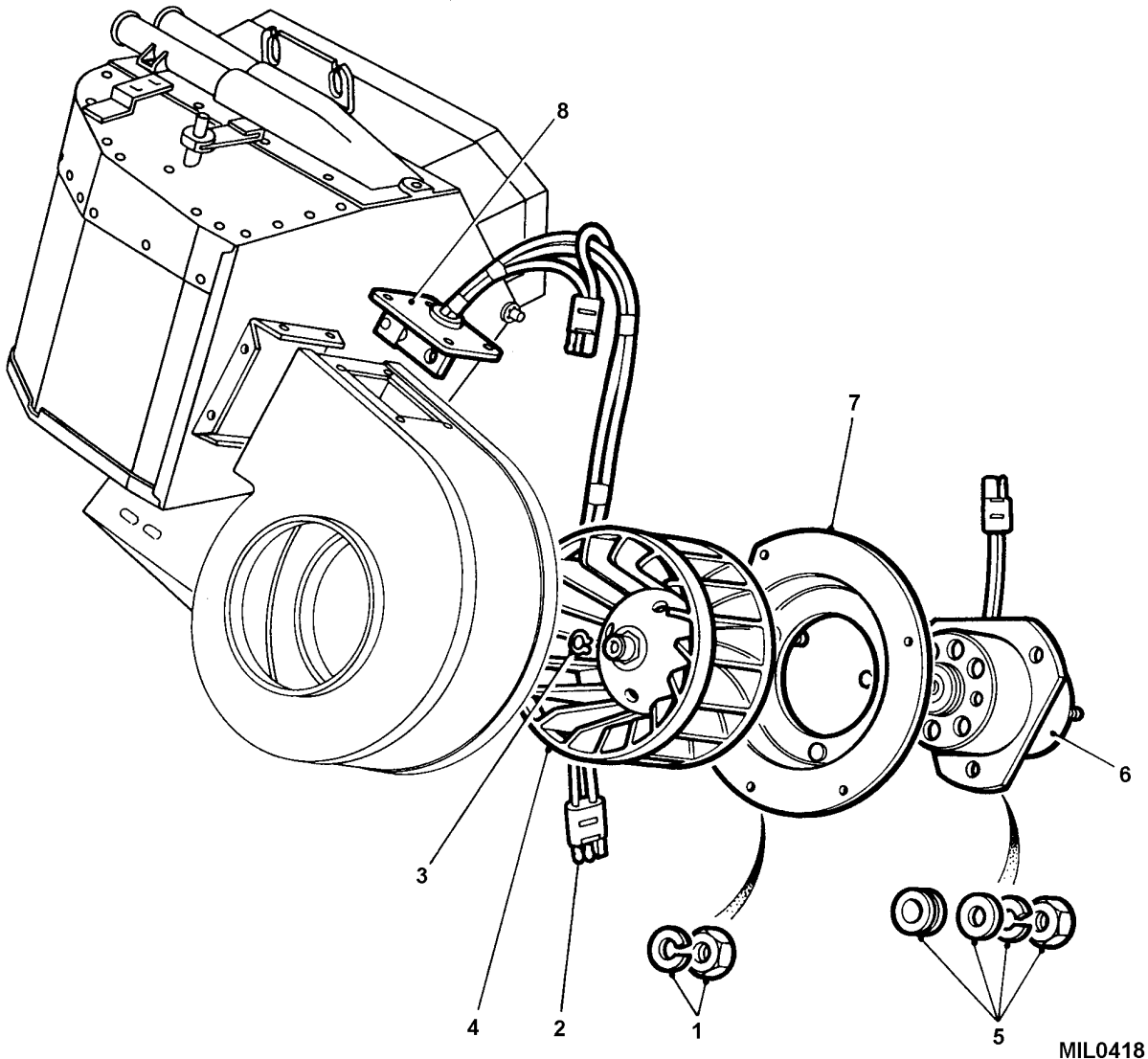
FAN MOTOR ASSEMBLY**Removal**

3 To remove the fan motor assembly, carry out the following:

3.1 Remove the nuts securing the angled bracket to the heater and remove bracket.

3.2 Remove the five nuts and spring washers (Fig 3 (1)) securing the fan assembly to the heater unit. Unplug the connector (2) and remove the fan assembly from the heater unit.

3.3 Remove the circlip (3) holding the impeller (4) to the drive shaft and remove the impeller.



1 Nut and spring washer
2 Connector
3 Circlip
4 Impeller

5 Nut, spring washer, washer and grommet
6 Fan motor
7 Mounting plate
8 Resistor mounting plate

Fig 3 Fan motor assembly

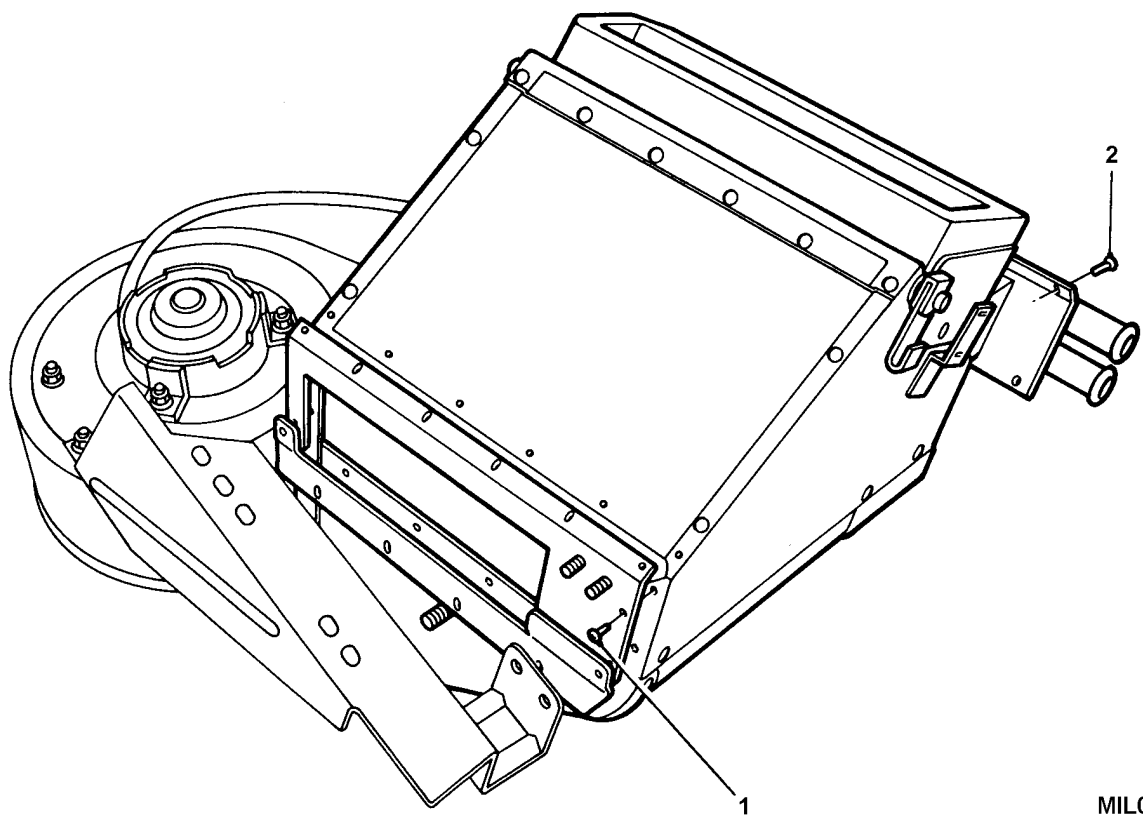
3.4 Remove the three nuts (5) securing the fan motor (6) to the mounting plate (7) and release the motor from the plate.

Examination and Replacement

- 4 Examine all components for signs of wear and replace as necessary.

Reassembly

- 5 To reassemble the fan motor assembly carry out the following:
 - 5.1 Fit fan motor (6) into mounting plate (7), apply adhesive (refer to Table 1 Serial 1) to mating surfaces and secure with the three nuts (5).
 - 5.2 Refit impeller (4) to fan drive shaft and fit circlip (3).
 - 5.3 Refit fan assembly to casing and secure with the five nuts and spring washers (1).
 - 5.4 Plug in connector (2) to resistor harness and refit angled bracket.



MIL0419

- | | | | |
|---|------------------------------|---|---------------------------|
| 1 | Bottom retaining plate screw | 2 | Top retaining plate screw |
|---|------------------------------|---|---------------------------|

Fig 4 Removing the heater matrix

HEATER MATRIX

Removal

- 6 To remove the heater matrix carry out the following:
 - 6.1 Remove the 14 screws (Fig 4 (1)) securing the two bottom matrix retaining plates.
 - 6.2 Remove the 9 screws (2) securing the matrix top retaining plate.
 - 6.3 Withdraw heater matrix through top of heater casing.

Examination and replacement

7 Examine the heater matrix and replace as necessary.

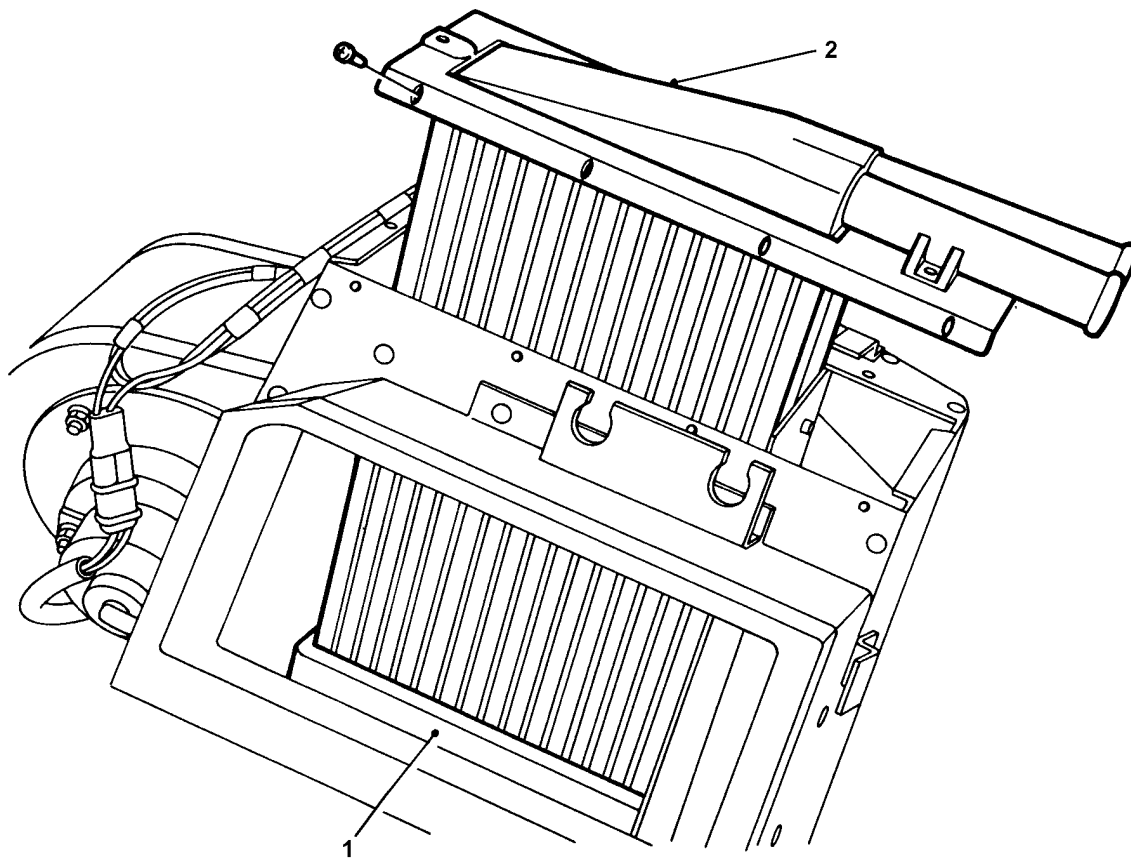
Reassembly

8 To reassemble the heater matrix carry out the following:

8.1 Fit foam rubber to heater matrix casing (Fig 5 (1)) and position matrix (2) in casing.

8.2 Check that flap valves operate correctly and without sticking.

8.3 Refit top and bottom retaining plates.



MIL0420

1 Heater matrix casing

2 Heater matrix

Fig 5 Refitting the heater matrix

RESISTOR UNIT**Removal**

9 To remove the resistor unit proceed as follows:

9.1 Drill out the four rivets retaining the resistor mounting plate (Fig 3 (8)) and lift out plate with resistor.

Reassembly

10 Apply adhesive (refer to Table 1 serial 1) to resistor plate and secure in position with rivets.

HEATER/FAN UNIT

Refitting

11 To refit the heater/fan unit proceed as follows:

- 11.1 Smear heater unit sealing rubber with a suit able impact adhesive (refer to Table 1 Serial 1) and locate to heater.
- 11.2 Place heater unit into engine bay and manoeuvre into position on bulkhead.
- 11.3 Loose fit lower heater unit nuts and bolts.
- 11.4 Tighten heater unit upper retaining bolts (Fig 1 (4)).
- 11.5 Tighten lower nuts and bolts (Fig 2).
- 11.6 Refit interior bulkhead trim.
- 11.7 Locate heater wiring harness into securing loop and tighten nut.
- 11.8 Connect harness multiplug.
- 11.9 Refit control cable outer clip and inner cable pinch bolts.
- 11.10 If necessary, prime heater matrix with coolant mixture.
- 11.11 Connect hoses to heater unit and tighten hose clips.
- 11.12 Refit radiator bottom hose and refill cooling system with the required anti-freeze concentration (refer to Chap 12).
- 11.13 Refit bonnet
- 11.14 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2) and check for leaks.
- 11.15 After engine has cooled, check coolant level and top up if necessary.

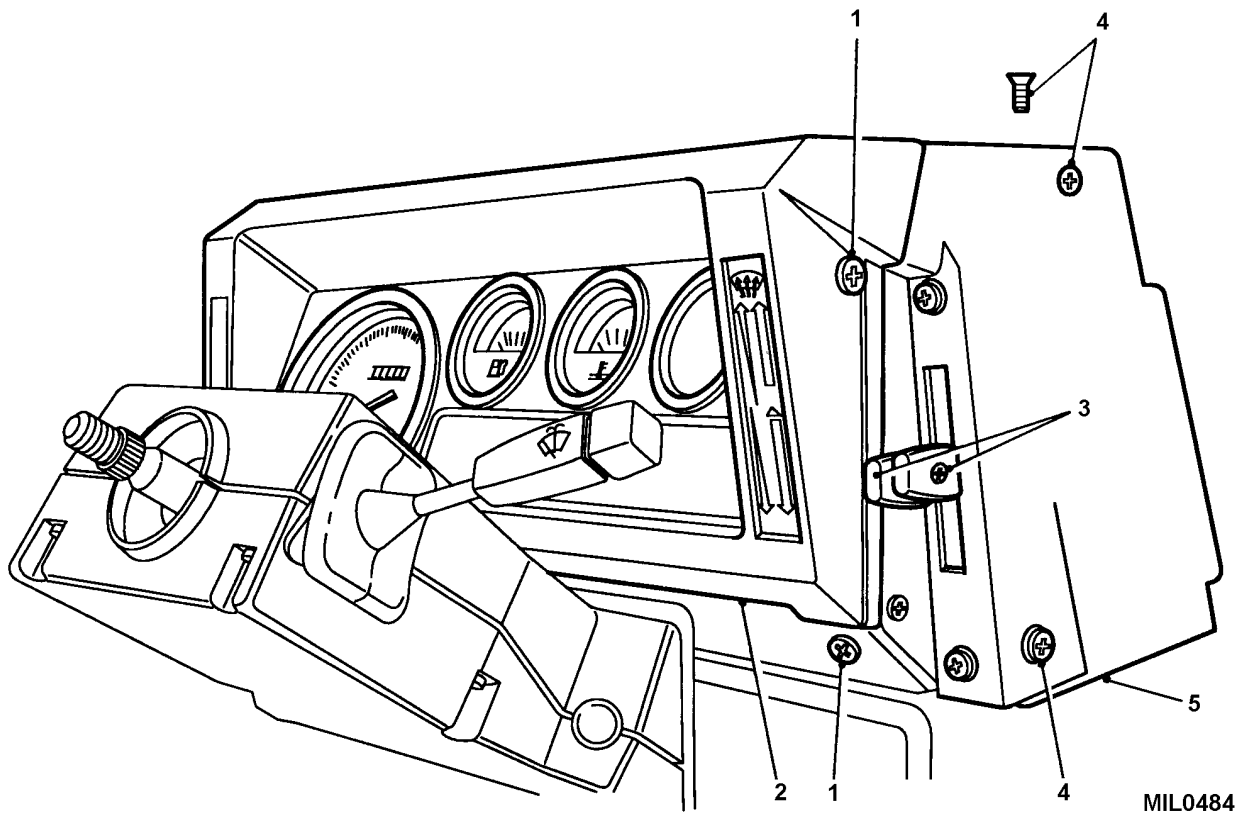
HEATER CONTROL CABLE - TEMPERATURE CONTROL

Removal

12 To remove the temperature control cable carry out the following:

- 12.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 12.2 Remove 4 screws (Fig 6 (1)) securing instrument binnacle (2) to fascia cowl.
- 12.3 Pull instrument binnacle away from fascia and disconnect speedometer cable to give easier access to control cable at bulkhead,
- 12.4 Remove retaining screws (3) and pull off air distribution and temperature control lever knobs.

12.5 Remove 3 screws (4) and detach side cover (5), complete with control lever assembly.



MIL0484

- | | |
|-----------------------|--------------|
| 1 Screw | 4 Screws |
| 2 Binnacle | 5 Side cover |
| 3 Control knob screws | |

Fig 6 Heater control assembly removal

12.6 Remove two screws (Fig 7 (1)) securing control lever assembly to side cover and remove cover.

NOTE

Plastic screw spacers (2) are fitted between cover and control lever assembly (3) and must be retained.

12.7 Remove small bolt (4) and release outer cable retaining clip (5).

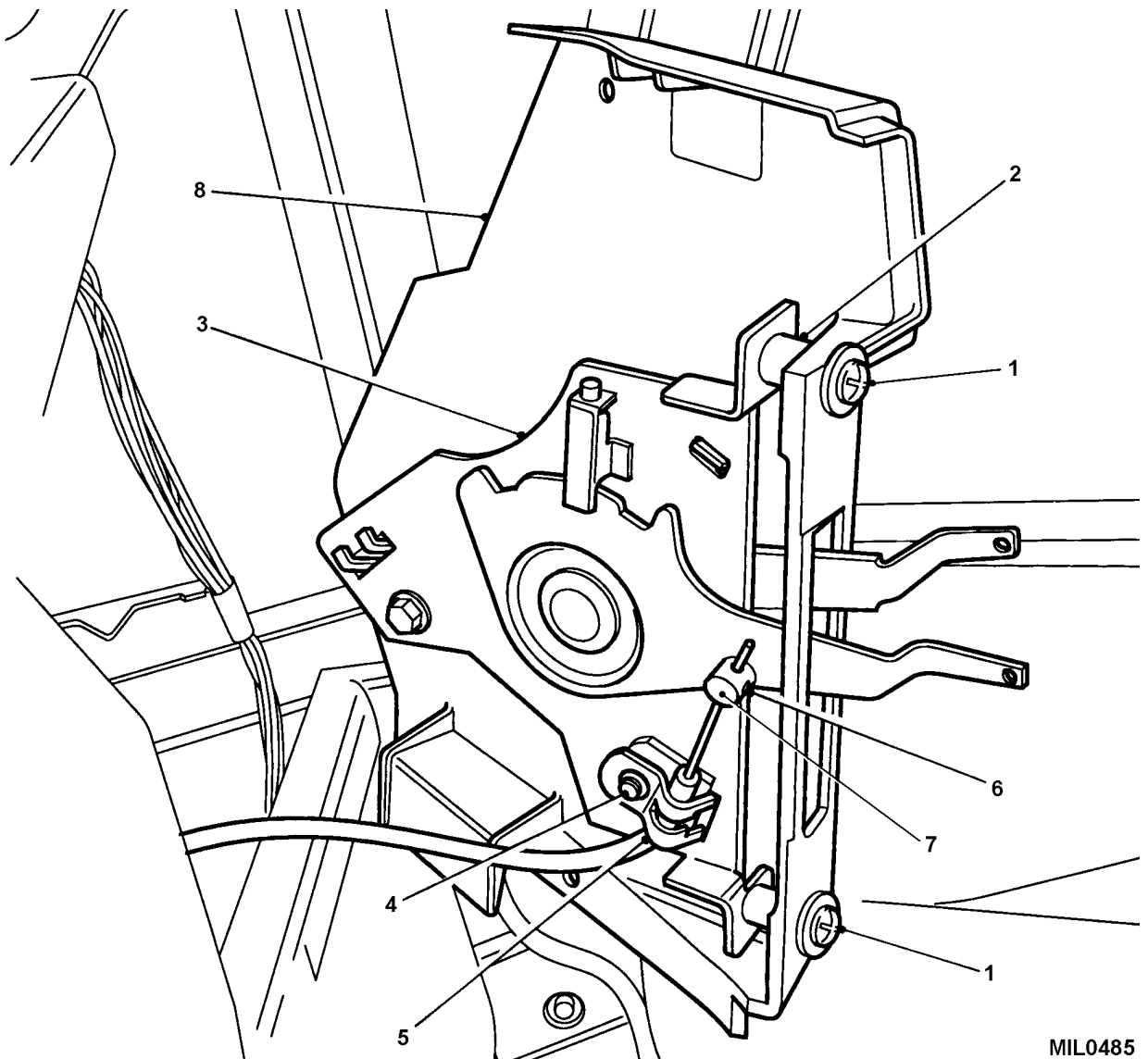
12.8 Slacken grub screw (6) and release inner cable from clevis (7).

12.9 From inside engine compartment, release outer cable retaining clip at heater unit.

12.10 Slacken trunnion fixing and release inner cable from heater unit flap lever.

12.11 Release two retaining clips securing control cables to engine bulkhead and heater hoses.

12.12 Pull control cable through bulkhead grommet and remove from vehicle.



- | | | | |
|---|------------------------|---|----------------------------|
| 1 | Screw | 5 | Outer cable retaining clip |
| 2 | Spacers | 6 | Grub screw |
| 3 | Control lever assembly | 7 | Clevis |
| 4 | Bolt | 8 | Side cover |

Fig 7 Heater control cable removal - temperature control

Refitting

13 To refit the control cable carry out the following:

- 13.1 Fit new control cable to heater flap lever trunnion with approximately 10 mm of inner cable protruding from trunnion. Fully tighten trunnion.
- 13.2 Secure outer cable with retaining clip.
- 13.3 Route control cable along inside of engine bulkhead through the sealing grommet, to fascia binnacle.
- 13.4 Secure control cables to engine bulkhead and heater hoses with retaining clips,

- 13.5 With control lever in closed position, fit inner cable to lever clevis (7) and fully tighten clevis grub screw (6).
- 13.6 Fit outer cable retaining clip (5) and fully tighten securing bolt.
- 13.7 Fit side cover (8) to control lever assembly (3).
- 13.8 Ensure fixing screw spacers (2) are positioned between cover and lever assembly.
- 13.9 Fit side cover to fascia.
- 13.10 Fit control lever knobs.
- 13.11 Reconnect speedometer cable and fit instrument binnacle.
- 13.12 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted for Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

HEATER CONTROL CABLE - AIR DISTRIBUTION

Removal

14 To remove the air distribution cable carry out the following:

- 14.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 14.2 Remove steering wheel (refer to Chap 7).
- 14.3 Remove steering column nacelle (refer to Chap 7).
- 14.4 Remove instrument binnacle (refer to Para 12).
- 14.5 Remove retaining screws (Fig 6 (3)) and pull off air distribution and temperature control lever knobs.
- 14.6 Remove 3 screws (4) and detach side cover (5), complete with control lever assembly.
- 14.7 Remove 2 screws (Fig 7 (1)) securing control lever assembly to side cover and remove cover.

NOTE

Plastic screw spacers (2) are fitted between cover and control lever assembly and must be retained.

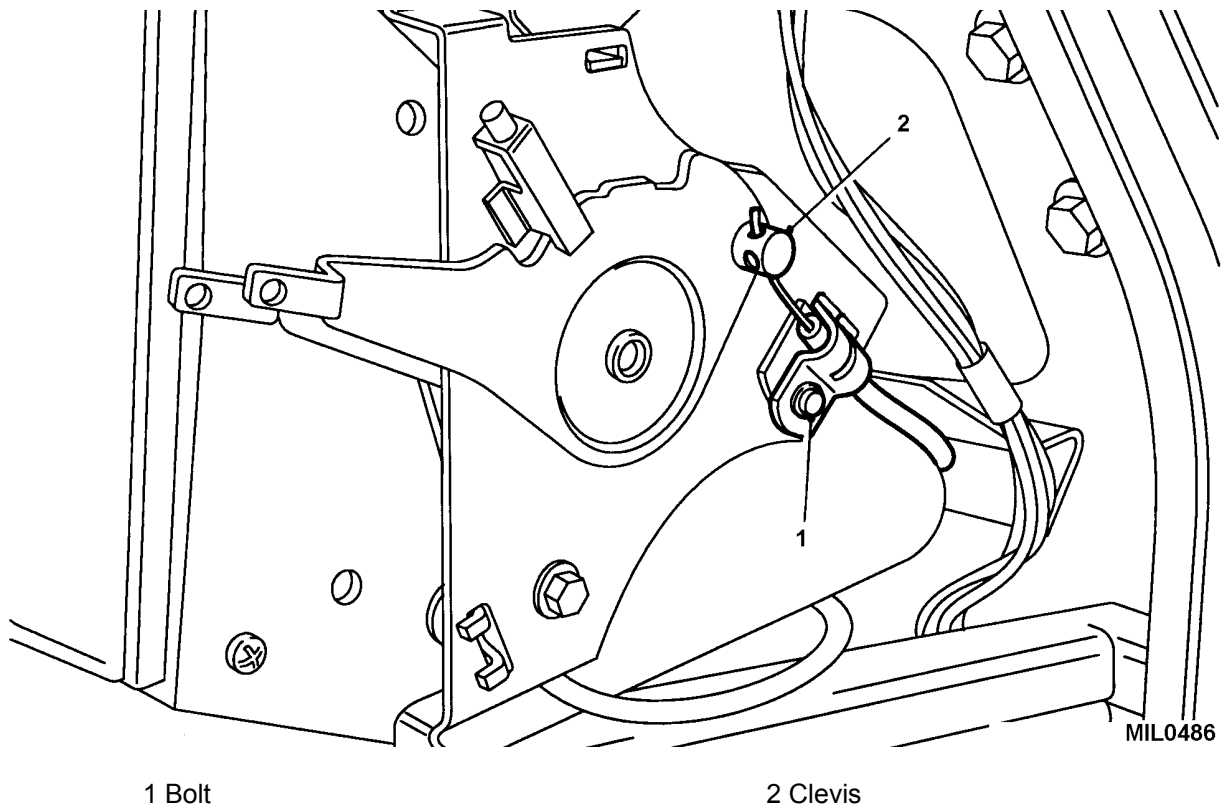


Fig 8 Heater control cable removal - air distribution

- 14.8 Remove small bolt (Fig 8 (1)) and release outer cable retaining clip.
- 14.9 Slacken grub screw and release inner cable from clevis (2).
- 14.10 Remove heater duct assembly.
- 14.11 Remove 19 screws and lift off heater duct cover.
- 14.12 Slacken vent flap trunnion fixing, release air distribution control cable and remove from heater duct.
- 14.13 Check condition of foam sealant on heater duct cover and renew if necessary.

Refitting

- 15 Fit new control cable through heater duct cover and secure to vent flap trunnion. Bend over cable end to fully secure.
 - 15.1 Fit heater duct cover.
 - 15.2 Fit heater duct assembly to fascia bulkhead.
 - 15.3 Route control cable along fascia bulkhead to control lever assembly.
 - 15.4 With control lever in closed position, secure cable to clevis (2).
 - 15.5 Fit outer cable retaining clip to lever assembly, and tighten small bolt (1).
 - 15.6 Fit lever assembly to side cover. Ensure screw spacers are fitted between cover and lever assembly.

- 15.7 Fit side cover to fascia cowl.
- 15.8 Fit control lever knobs.
- 15.9 Fit instrument binnacle Instrument.
- 15.10 Fit steering column nacelle.
- 15.11 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

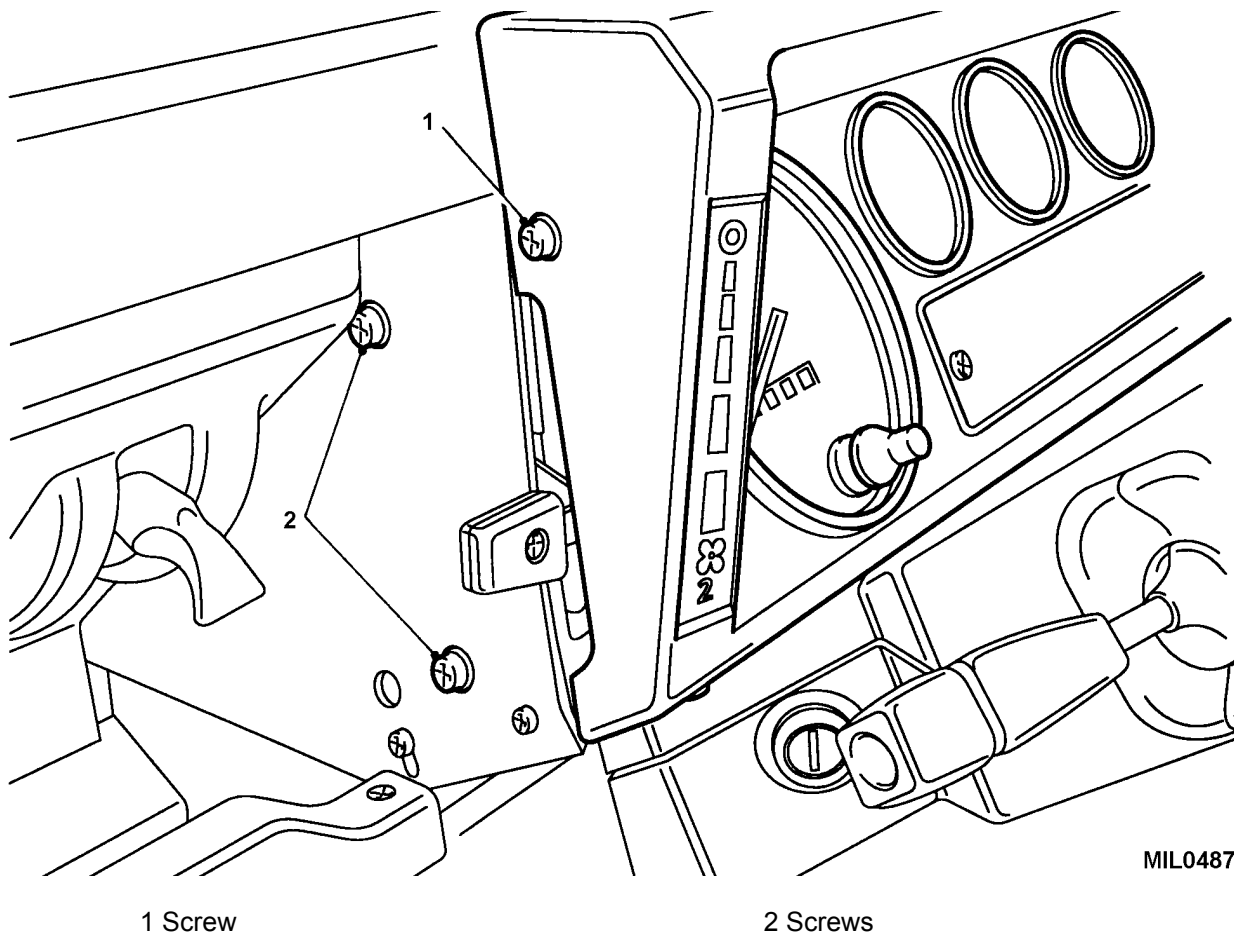


Fig 9 Heater control assembly removal

HEATER CONTROL CABLE AND BLOWER MOTOR SWITCH

Removal

- 16 To remove the control cable and blower motor switch carry out the following:
 - 16.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
 - 16.2 From inside engine compartment, release outer cable retaining clip at heater unit.
 - 16.3 Slacken trunnion fixing and release inner cable from heater unit flap lever.
 - 16.4 Release 2 retaining clips securing control cables to engine bulkhead and heater hoses.

- 16.5 Remove four screws (Fig 9 (1)) securing instrument binnacle to fascia cowl.
- 16.6 Pull instrument binnacle away from fascia and disconnect speedometer cable to give easier access to control cable.
- 16.7 Remove 2 screws (2) securing control lever assembly to side of fascia binnacle cowl.

NOTE

Plastic screw spacers are fitted between cowl and lever assembly and must be retained.

- 16.8 Release lever assembly and disconnect three blower motor connectors (Fig 10 (1)), noting their positions.
- 16.9 Pull control cable through bulkhead grommet and out from instrument binnacle cowl.
- 16.10 Release retaining clip (2) securing outer cable to lever assembly.
- 16.11 Release inner cable from lever peg (3).

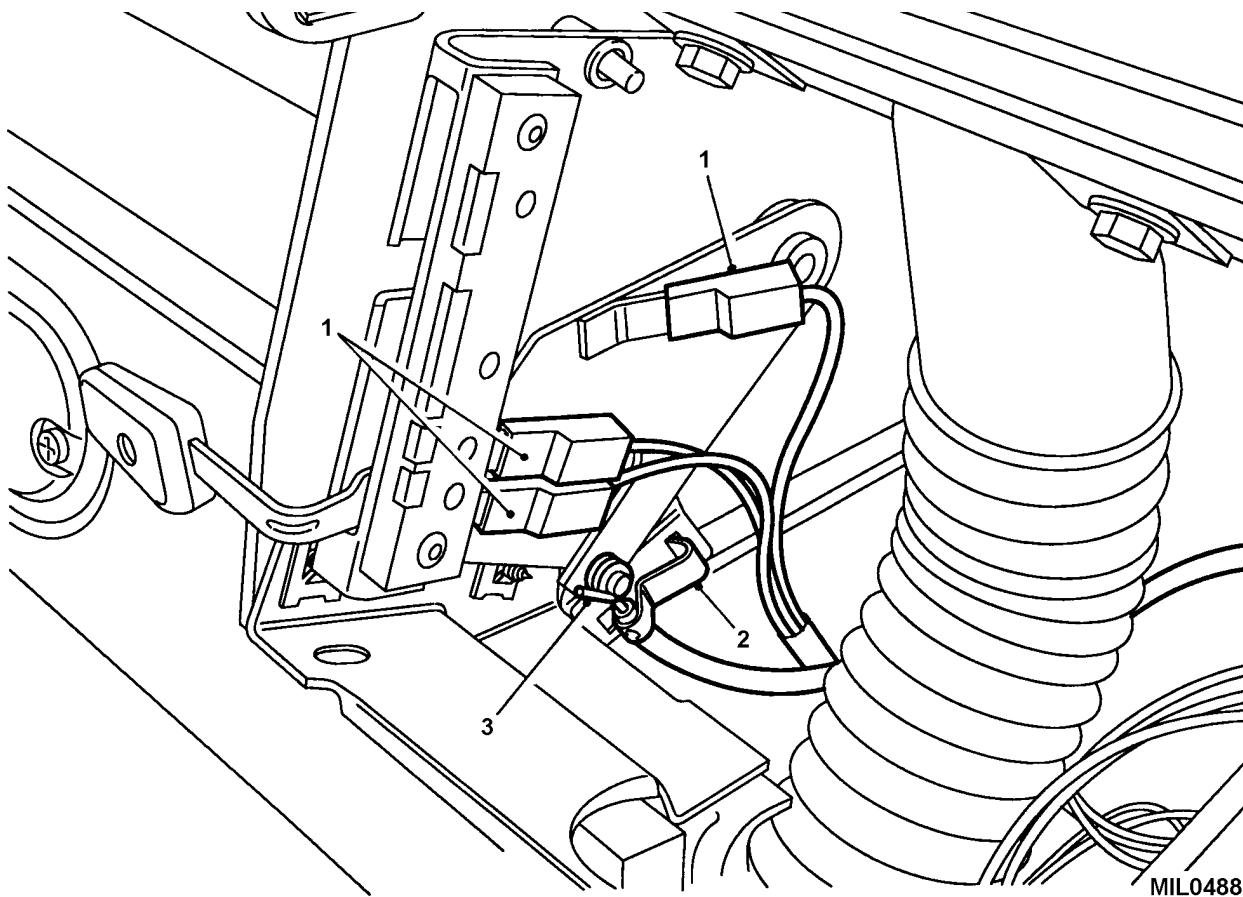
NOTE

If the blower motor switch is faulty the complete lever assembly will have to be renewed.

Refitting

17 To refit the control cable carry out the following:

- 17.1 Fit new control cable to lever assembly peg.
- 17.2 Fit retaining clip to secure outer cable.
- 17.3 Reconnect blower motor connectors.
- 17.4 Route cable to rear of instrument binnacle cowl, along bulkhead and out through grommet into engine compartment.
- 17.5 Fit lever assembly to binnacle cowl. Ensure screw spacers are fitted between cowl and lever assembly.



- 2 1 Connectors 3 Lever peg
 Retaining clip

Fig 10 Heater control cable and blower motor switch removal

- 17.6 Fit instrument binnacle to fascia cowl.
- 17.7 With lever in closed position, fit control cable to heater unit flap lever trunnion.
- 17.8 Secure outer cable with retaining clip.
- 17.9 Secure control cables to engine bulkhead and heater hoses with retaining clips.
- 17.10 Reconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

CHAPTER 18-2

FIELD AMBULANCE REAR BODY

CONTENTS

1	Introduction	
	HEATER ASSEMBLY	
3	General	
	Heater unit (WARNINGS)	
4	Removal	
5	Refit	
	Glow plug	
6	Removal	
7	Refit	
	Fuel pump	
8	Removal	
9	Refit	
	Exhaust pipe (combustion air)	
10	Removal	
11	Refit	
	Combustion air inlet pipe and silencer	
12	Removal	
13	Refit	
	Filter and panel assembly	
14	Removal	
15	Refit	
	Function tests (CAUTION)	
	Measuring the fuel quantity	
16	Preparation	
17	Measurement	
18	Evaluation	
19	Testing the blower motor	
20	Testing the safety thermal cut-out switch	
21	Testing the flame sensor and temperature sensor	
22	Test unit for heater control switch	
	VENTILATION UNIT	
	Blower motor	
23	Removal	
24	Refit	
Table		Page
1	Sealants, adhesives and lubricants	2
Fig		
1	Heater unit removal.....	3
2	Glow plug removal	4
3	Fuel pump removal	5
4	Exhaust pipe removal	6
5	Inlet pipe and silencer removal	7
6	Filter and panel removal	8
7	Test apparatus	9

(continued)

CONTENTS (continued)

Fig		Page
8	Fuel evaluation graph	10
9	Test adapter for PCB	11
10	Test unit for heater switches	12
11	Blower motor removal.....	13

INTRODUCTION

1 This chapter details the Unit repairs for the heating and ventilation system fitted to the field ambulance.

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

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Sikaflex 221	8030-99-611-3031	Sealant

HEATER ASSEMBLY**GENERAL**

3 The Eberspacher D5L Diesel fired air heater system fitted to this vehicle operates independently to the standard heating equipment supplied in the drivers cab. It is capable of producing between 1800 W to 4800 W of heat using an average of 0.42 litres of fuel per hour.

HEATER UNIT**WARNINGS**

(1) COOLING. THE HEATER UNIT OPERATES AT EXTREMELY HIGH TEMPERATURES. ENSURE THE HEATER AND EXHAUST SYSTEM HAS COOLED DOWN SUFFICIENTLY BEFORE ATTEMPTING TO CARRY OUT ANY MAINTENANCE WORK.

(2) FUEL. ENSURE ALL DISCONNECTED FUEL LINES ARE PLUGGED OR CLAMPED TO PREVENT THE ESCAPE OF HAZARDOUS FUEL.

(3) VENTILATION. ENSURE ALL WORK IS CARRIED OUT IN A WELL VENTILATED AREA.

(4) TESTING. ENSURE ALL TEST RUNNING OF THE HEATER IS CARRIED OUT IN A WELL VENTILATED AREA.

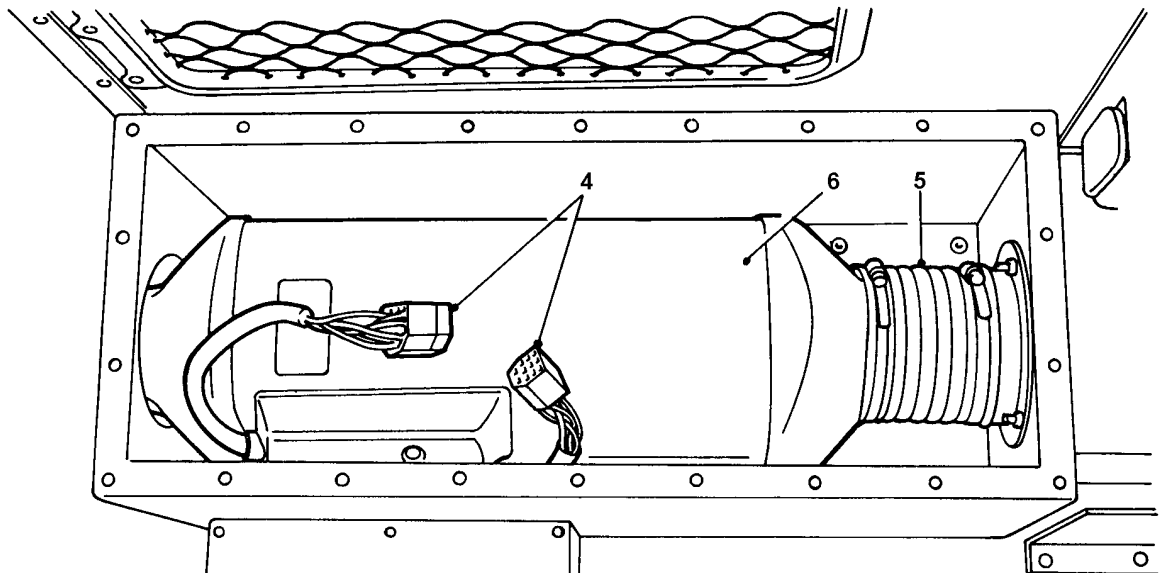
Remove

4 To remove the heater unit carry out the following:

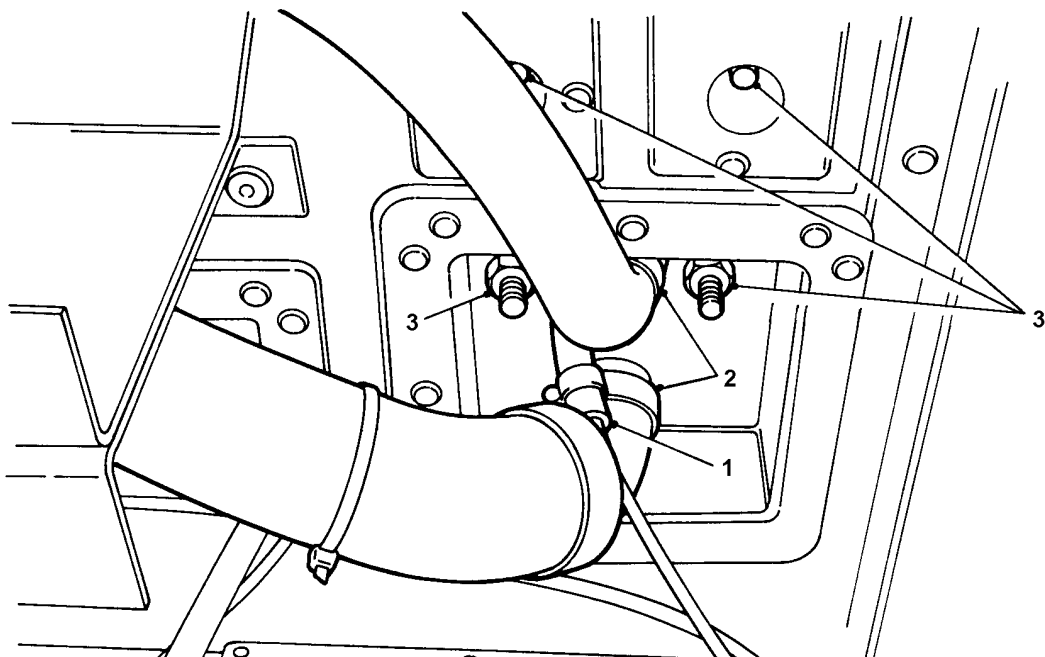
4.1 Disconnect the vehicle batteries (refer to Chap 13-1).

4.2 From inside the vehicle remove the 22 screws securing the lid to the heater compartment and remove the lid.

- 4.3 From under the vehicle disconnect the fuel line (Fig 1 (1)) to the heater and clamp the end to prevent the loss of fuel and the ingress of dirt.
- 4.4 Loosen the clamps (2) securing the air inlet and exhaust pipes and pull them free of their connections.
- 4.5 Remove the four nuts (3) securing the heater unit to the floor mounting.



VIEWED FROM ABOVE WITH THE COVER REMOVED



VIEWED FROM UNDER THE VEHICLE

MIL0473

1 Fuel line
2 Clamps
3 Nuts

4 Multiplug
5 Heater ducting unit
6 Heater unit

Fig 1 Heater Unit removal

4.6 Disconnect the multiplug (4) from the heater unit and place aside the harness and connector.

4.7 Disconnect the flexible heater ducting (5).

4.8 Lift out the heater unit (6) from the compartment.

Refit

5 Refit the heater unit in the reverse order of removal.

GLOWPLUG

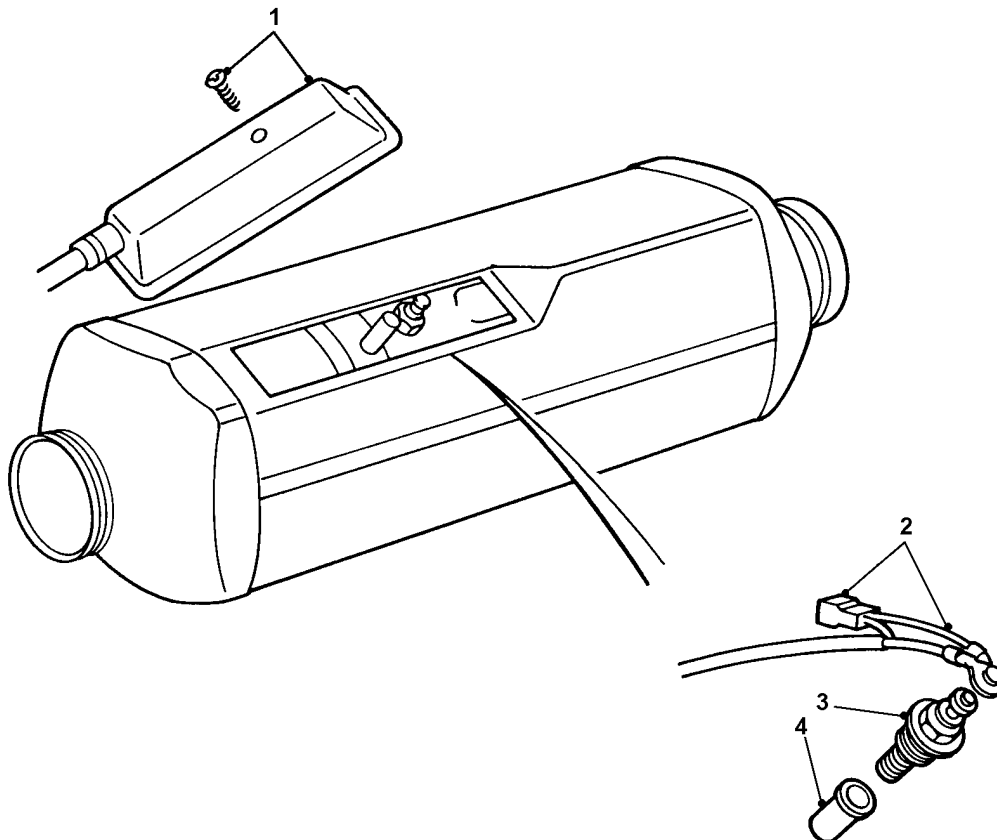
Removal

6 To remove the glowplug carry out the following:

6.1 Disconnect the vehicle batteries (refer to Chap 13-1).

6.2 From inside the vehicle remove the 22 screws securing the lid to the heater compartment and remove the lid.

6.3 Remove the screw (Fig 2 (1)) securing the cover cap to the top of the heater.



MIL0474

1 Cover cap screw
2 Electrical leads

3 Glowplug
4 Strainer

Fig 2 Glow plug removal

- 6.4 Disconnect the electrical leads (2) to the glow plug (3) and printed circuit board (PCB).
- 6.5 Remove the glowplug (3).

NOTE

When fitting a new glow plug check the plug strainer (4) and clean or replace as necessary. Ensure strainer is located correctly in the glow plug recess.

- 6.6 Clean or renew the glowplug as necessary.

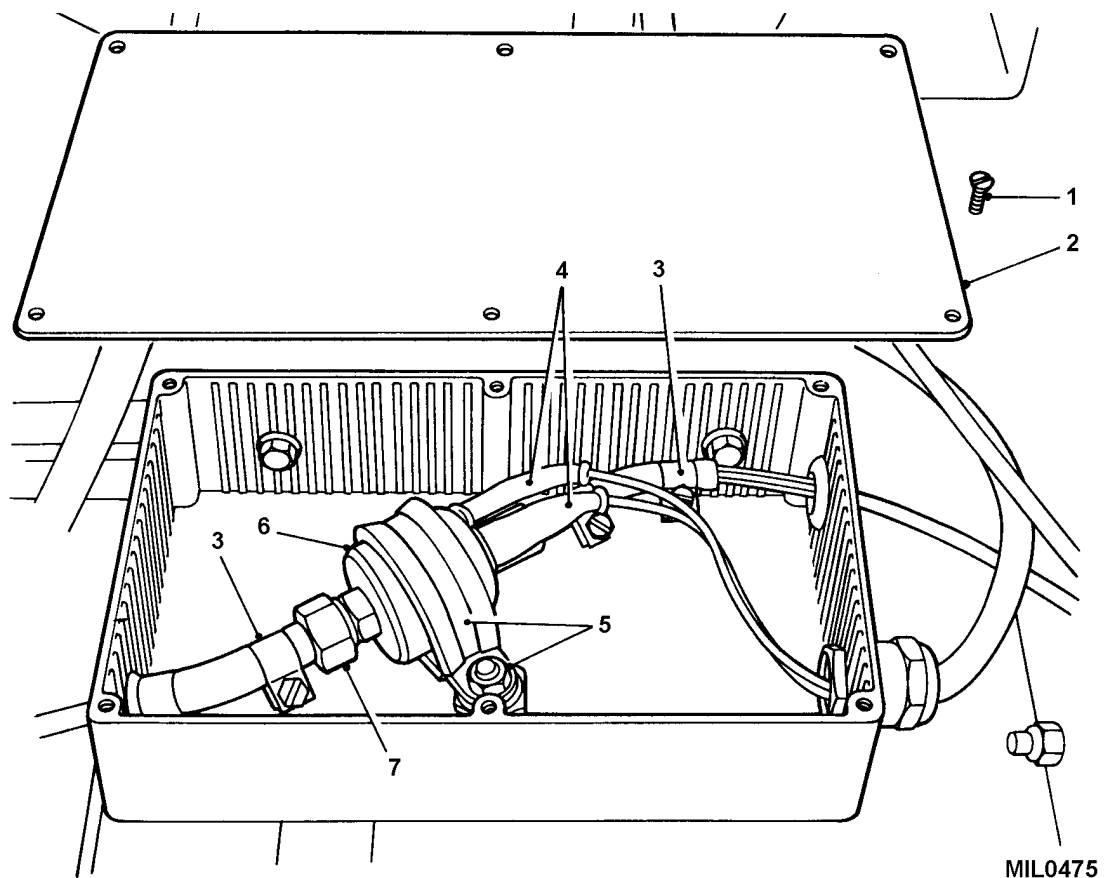
Refit

- 7 Refit the glowplug in the reverse order of the removal.

FUEL PUMP AND FILTER

NOTE

The pump has an integral filter located in the inlet port, which can be removed for cleaning purposes only. The pump requires no other maintenance and should be renewed in the event of failure.



- 1 Screw
- 2 Cover
- 3 Fuel lines
- 4 Electrical leads
- 5 Nut
- 6 Pump
- 7 Union

Fig 3 Fuel pump removal

Remove

8 To remove the fuel pump carry out the following:

8.1 Disconnect the vehicle batteries (refer to Chap 13-1).

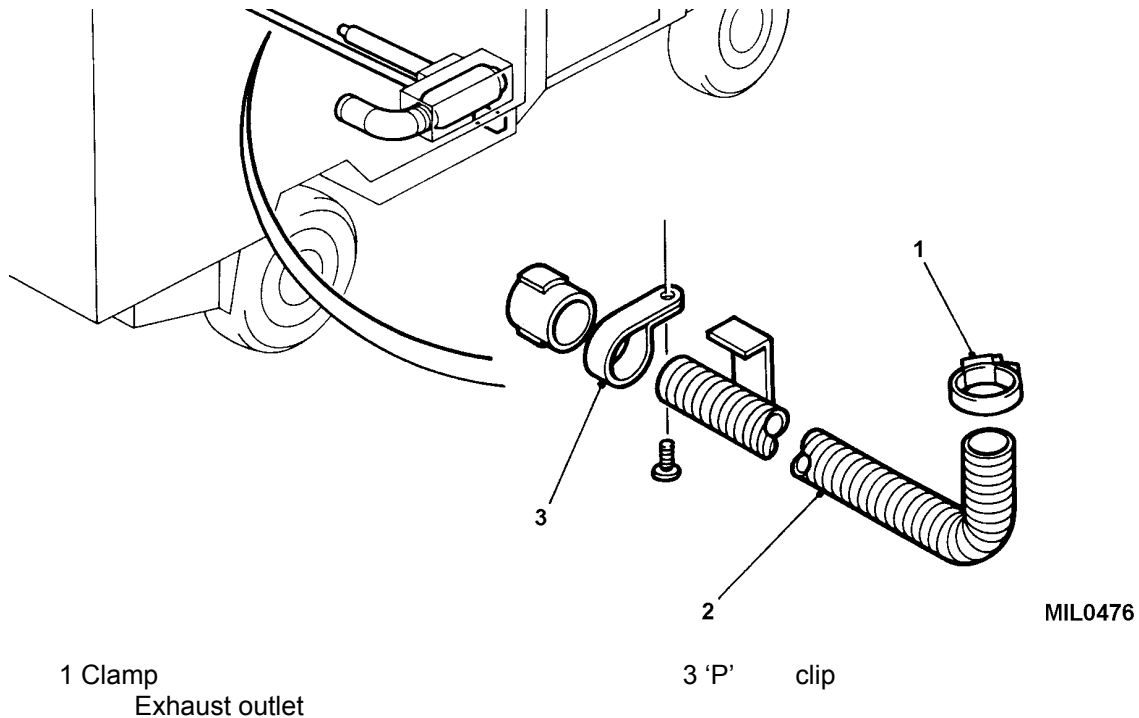


Fig 4 Exhaust pipe removal

8.2 From underneath the vehicle locate the pump box and remove the six screws (Fig 3 (1)) securing the cover (2).

8.3 Disconnect the fuel lines (3) to the pump and clamp the ends to prevent the loss of fuel and the ingress of dirt.

8.4 Disconnect the electrical leads (4).

8.5 Remove the nut (5) securing the pump to the 'P' clip inside the pump box, and remove the pump (6) from the vehicle.

8.6 Unscrew the union (7) on the inlet to the pump to release the filter.

8.7 Renew the pump and filter if required.

Refit

9 Refit the pump and filter in the reverse order of removal.

EXHAUST PIPE (COMBUSTION AIR)**Remove**

10 To remove the exhaust pipe carry out the following:

10.1 From underneath the vehicle loosen the clamp (Fig 4 (1)) securing the exhaust outlet (2) to the heater unit.

10.2 Remove the 'P' clip (3) securing the exhaust to the vehicle underside and remove the exhaust outlet from the vehicle.

10.3 Renew the exhaust as required.

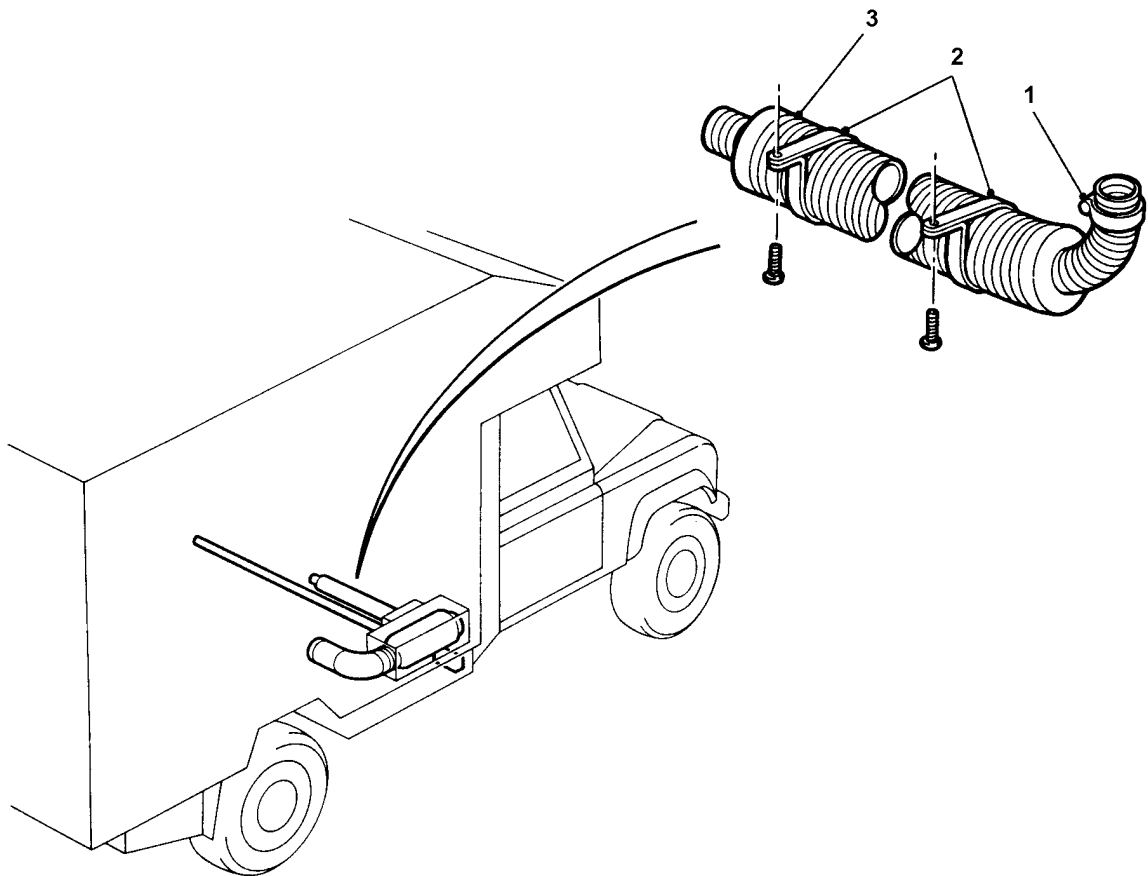
Refit

11 Refit the exhaust in the reverse order of removal.

COMBUSTION AIR INLET PIPE AND SILENCER

Removal

12 To remove the combustion air inlet pipe and silencer, carry out the following:



MIL0477

2 1 Clamp
'P' clips

3 Air inlet pipe

Fig 5 Inlet pipe and silencer removal

12.1 From underneath the vehicle loosen the clamp (Fig 5 (1)) securing the combustion air inlet to the heater unit.

12.2 Remove the 'P' clips (2) securing the air inlet pipe (3) to the underside of the vehicle and remove the pipe from the vehicle.

Refit

13 Refit the inlet pipe in the reverse order of removal.

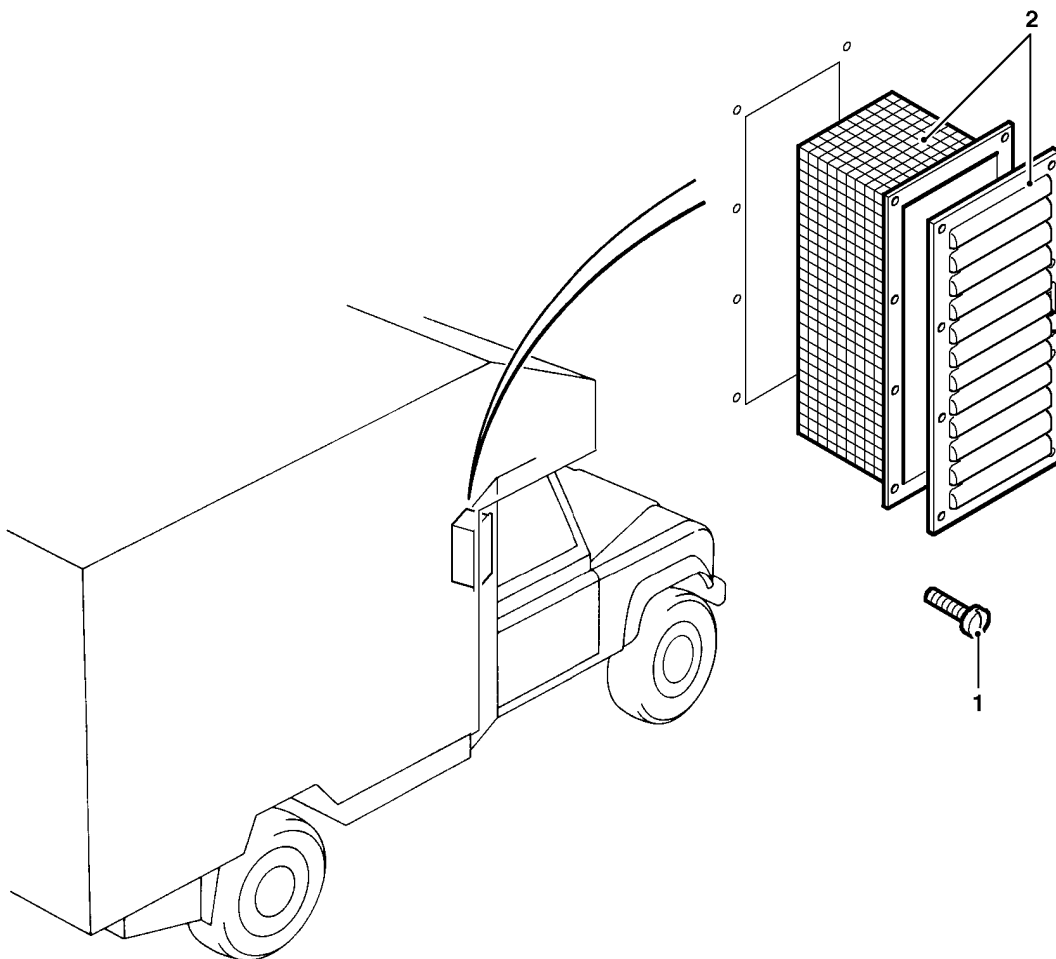
FILTER AND PANEL ASSEMBLY**Removal**

14 To remove the filter carry out the following:

- 14.1 Locate the filter assembly in the external body panel behind the drivers door.
- 14.2 Remove the six screws (Fig 6 (1)) securing the filter assembly to the body panel.
- 14.3 Remove the filter assembly (2) from the panel.
- 14.4 Renew the filter if necessary.

Refit

15 Refit the filter assembly in the reverse order of removal.



1 Screw

2 Filter assembly

MIL0478

Fig 6 Filter and panel removal

FUNCTION TESTS

Measuring the fuel quantity

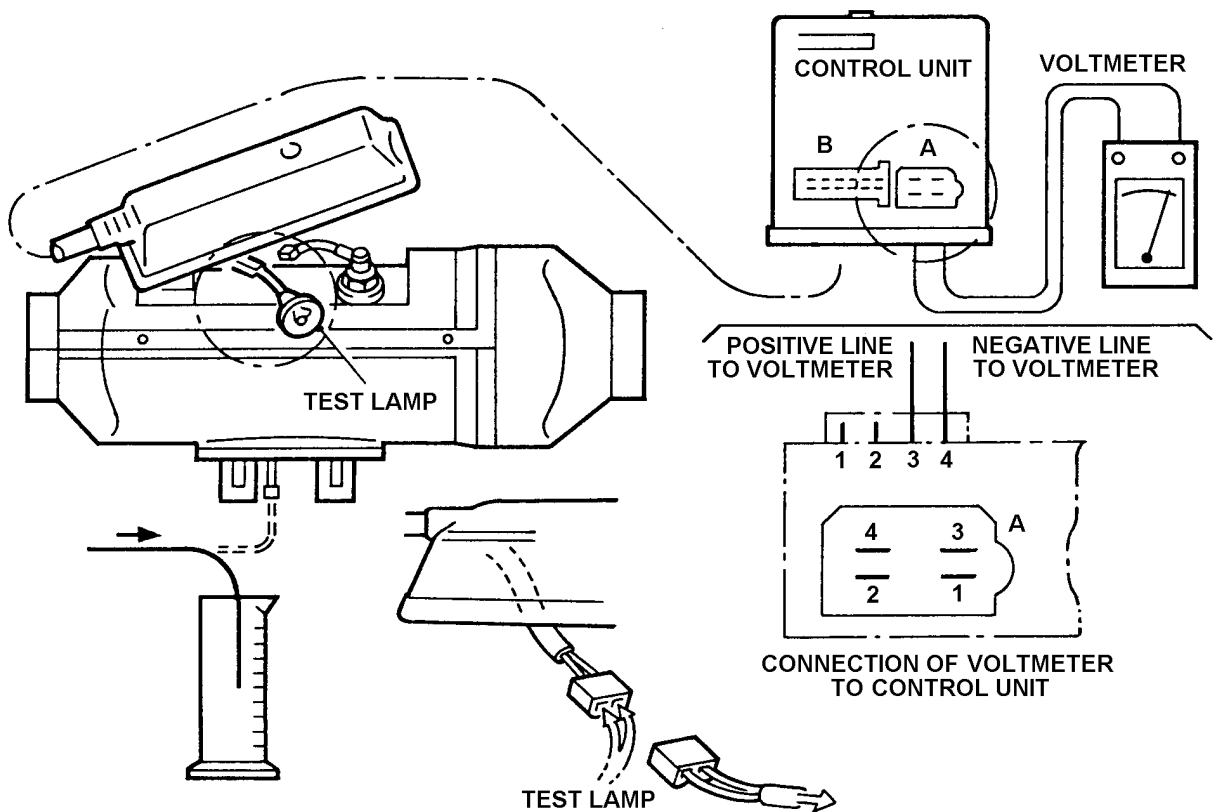
CAUTION

FUEL MEASUREMENT. Only measure the fuel when the battery is sufficiently charged - at least 22 volts or more. 26 volts should be applied to the control unit during measurement.

Preparation

16 To prepare the system for testing proceed as follows:

- 16.1 Disconnect the plug connector under the cover cap on the heater and connect a test lamp (Fig 7).
- 16.2 Detach the fuel line from under the vehicle and insert into a measuring glass.
- 16.3 Connect a voltmeter to the 4 pin plug, terminals 3 (+) and 4 (-), of the control unit.
- 16.4 Switch on the heater.
- 16.5 When the fuel is being pumped steadily (a round 25 - 55 seconds after switching on), and the fuel line is filled and free of air, switch off the heater and empty the measuring glass.



MIL0479

Fig 7 Test apparatus

Measurement

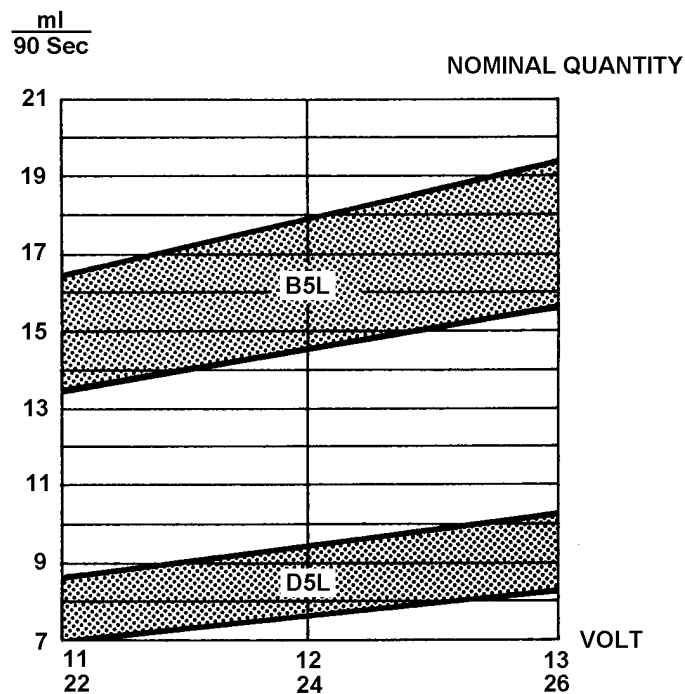
17 To measure the system proceed as follows:

- 17.1 Switch on the heater.
- 17.2 Fuel is pumped, after approximately 25 - 55 seconds after switch on.
- 17.3 Hold measuring glass at level of plug during measurement.
- 17.4 Read off the voltage at the voltmeter.
- 17.5 Switch off heater.
- 17.6 After 90 seconds of fuel pumping, this stops automatically.
- 17.7 Read off the fuel quantity in the measuring glass.

Evaluation

18 Transpose the readings onto the graph (Fig 8) as follows:

- 18.1 Fuel consumption is acceptable when the intersection of both values is within the limit curve.
- 18.2 If the intersection is outside the curve, the fuel metering pump must be replaced.
- 18.3 The fuel metering pump, when switched on, supplies the fuel quantity for the medium setting. Rated quantity at 24V is 8.5ml/90secs.



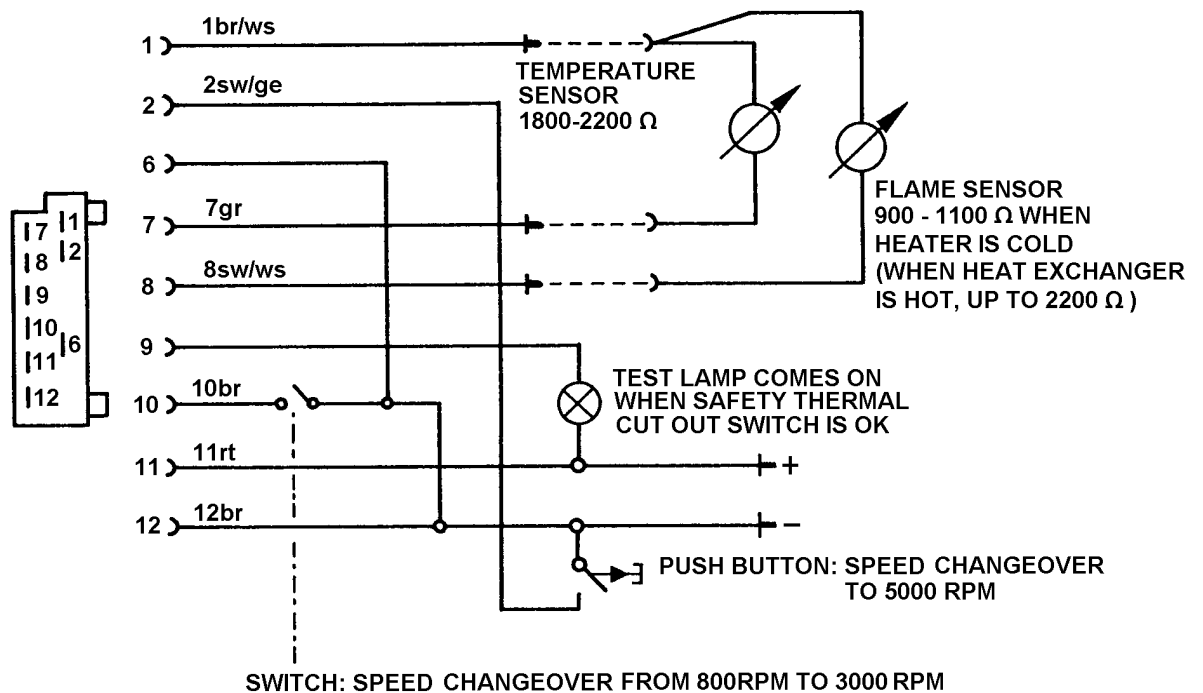
MIL0480

Fig 8 Fuel evaluation graph.

Testing the blower motor

19 Disconnect the plug from the PCB and connect up a test adapter and proceed as follows:

- 19.1 Apply operating voltage + and - to the adapter.
- 19.2 The blower motor must start up at once.
- 19.3 Measuring the speed:
 - 19.3.1 Switch closed - 3000rpm
 - 19.3.2 Switch open - 800rpm
 - 19.3.3 Press button (Fig 9) motor switches to high speed, 5000rpm.
- 19.4 If the blower motor does not run:
 - 19.4.1 Check PCB visually for burnouts.
 - 19.4.2 If PCB trips out, change blower.
 - 19.4.3 If the speed changeover still does not work, change the PCB.



MIL0481

Fig 9 Test adapter for PCB

Testing the safety thermal cut-out switch

20 The test lamp must come on as soon as the operating voltage has been connected.

- 20.1 If the lamp does not come on, check the PCB, cable, plug contacts for breaks, check the safety thermal cut-out switch for continuity.

Testing the flame sensor and temperature sensor

21 The internal flame sensor arranged on the heat exchanger can be tested as follows (operating voltage does not have to be connected):

21.1 Connect an ohmmeter to the test adapter (Fig 9). Readings should be between 900 - 1100 ohms when the heater is cold and up to 2200 ohms when the heater is hot.

21.2 In the event of a fault, check the PCB for breaks or short circuits. If the flame sensor value remains outside the correct range, replace the flame sensor.

21.3 If an external temperature sensor is connected, its resistance value must be in the same range. For this purpose connect the external temperature sensor directly to the ohmmeter.

Test unit for heater control switch

22 Disconnect the plug of the heater control switch and connect switch to test unit.

22.1 Apply operating voltage.

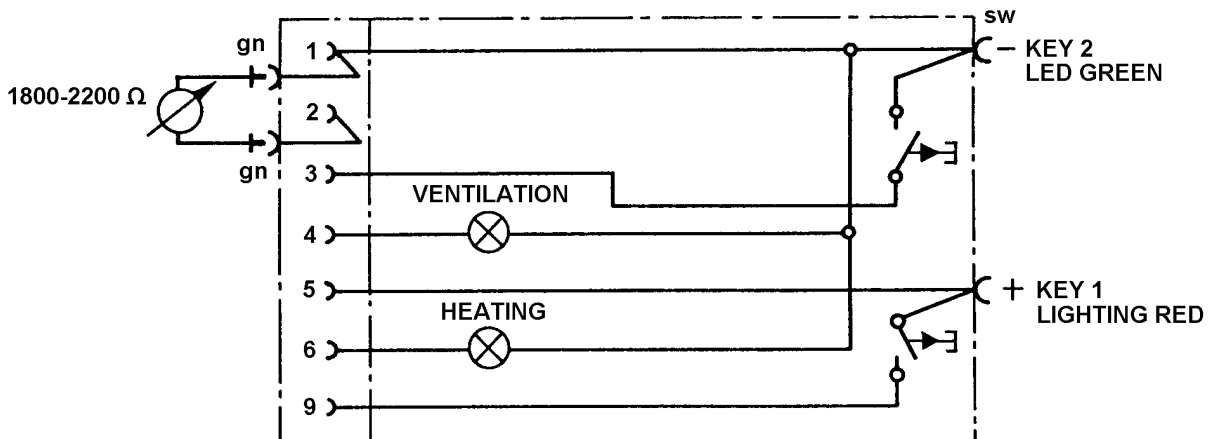
22.2 Set switch to 'Heating and Ventilation' position. The appropriate lights must come on.

22.3 The pilot light in the switch must also come on.

22.4 Turn off the heater control switch.

22.5 Call up lighting with key 1 on test unit.

22.6 Press key 1, and key 2 as well.



MIL0482

Fig 10 Test unit for heater switch

22.7 Pilot light must change from red to green.

22.8 Connect ohmmeter, turn rotary knob. Set value of 800 to 120 must be maintained without a break.

22.9 In the event of error change the control switch.

VENTILATION UNIT

BLOWER MOTOR

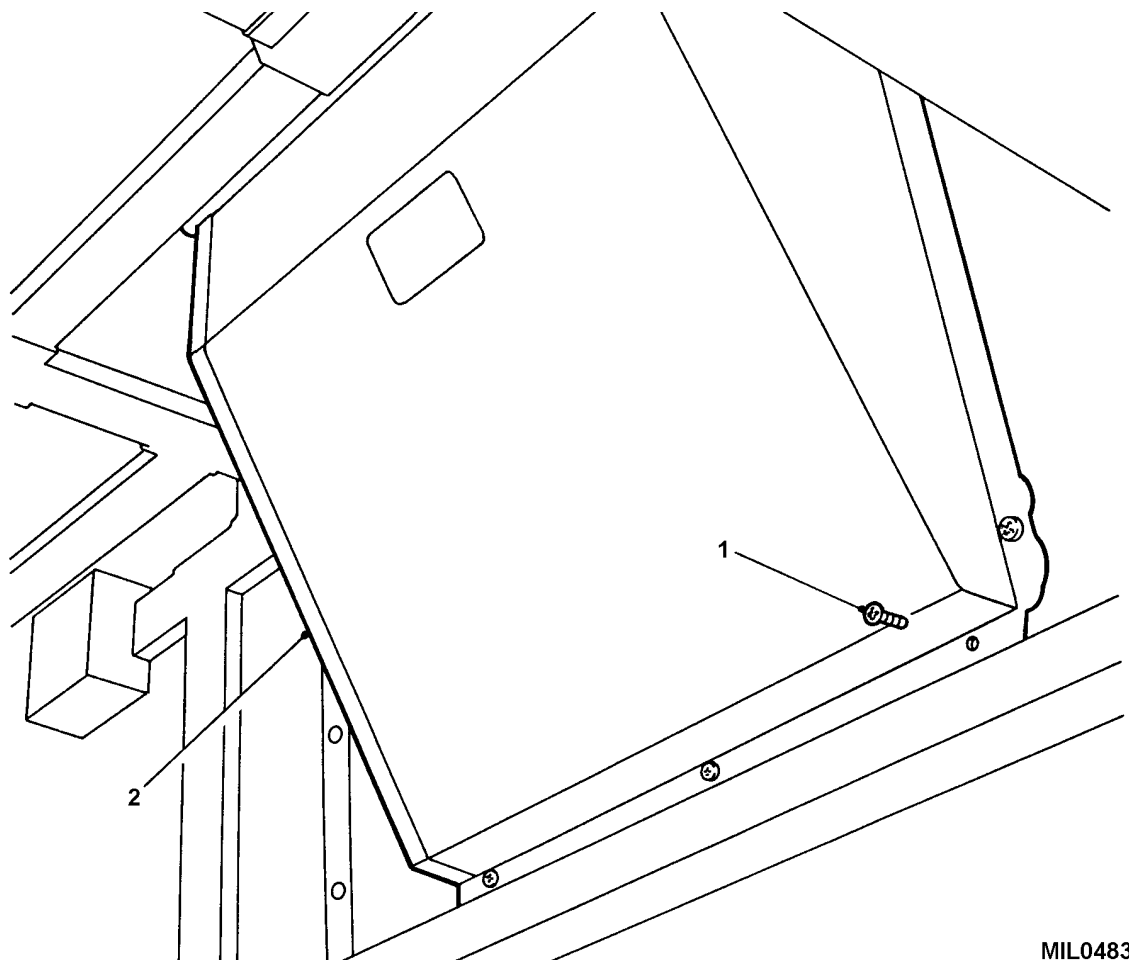
Removal

23 To remove the blower motor from the ventilation unit carry out the following:

23.1 Disconnect the vehicle batteries (refer to Chap 13-1).

23.2 From inside the drivers cab, remove the 10 screws (Fig 11 (1)) securing the ventilator diverter box (2) to the bulkhead.

23.3 Carefully ease the diverter box away from the bulkhead with the aid of a screw driver to break the sealant around the edges of the diverter box.



MIL0483

1 Screw

2 Ventilator diverter box

Fig 11 Blower motor removal

23.4 Disconnect the electrical lead to the motor and remove the assembly from the vehicle.

23.5 Remove the bolts securing the motor to the diverter box and remove the motor.

Refit

24 Clean the mating surfaces of the diverter box and bulkhead free of sealant.

24.1 Fit a new motor into the diverter box and secure with bolts.

24.2 Run a bead of sealant (refer to Table 1 Serial 1) around the mating surface of the diverter box and reconnect motor electrical connection before offering diverter box assembly to bulkhead.

24.3 Secure diverter box to bulkhead with screws and remove any excess sealant from around the joint.

24.4 Reconnect the vehicle batteries (refer to Chap 13-1).

CHAPTER 18-3

WINTER/WATER

CONTENTS

Para

- 1 Introduction
- HEATING SYSTEM
- 2 General
 - 3 Water heater (CAUTIONS)
 - 3 Remove
 - 4 Refit
 - 5 Adjustment of the CO₂ content
 - 6 Thermostatic valve
 - 7 Remove
 - 8 Refit
 - Heater/fan unit
 - 9 Remove
 - 10 Refit
 - Fan motor assembly
 - 12 Remove
 - 13 Examination and replacement
 - 14 Refit
 - Heater matrix
 - 15 Remove/refit
 - Cab heater controls
 - 16 Remove/refit
 - 17 Heater cable lubrication
 - Rear compartment radiators
 - 18 Remove
 - 19 Refit
 - Battery box radiator
 - 20 Remove
 - 21 Refit
 - Rear bulkhead stop tap
 - 22 Remove
 - 23 Refit
 - Battery box stop tap
 - 24 Remove
 - 25 Refit
 - 26 Draining and refilling the heater system
 - BREATHING SYSTEM
 - 27 General
 - 28 Breather manifold
 - 29 Remove
 - 30 Refit

Fig

Page

1	Water heater removal	4	
2	Thermostatic valve removal		6
3	Fan motor assembly	7	
4	Heater cable lubrication	9	
5	Battery box radiator, rear radiators and stop tap removal.		11
6	Breather manifold removal.....		14

Table		Page
1	Sealants, adhesives and lubricants	2
2	Special tools	2
3	CO ₂ Readings.....	5

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1	Celloseal	8030-99-225-0232	Anti-seize grease
2	WD 40	TBA	Aerosol - penetrating oil
3	Drybond 1209	TBA	Sealant

TABLE 2 SPECIAL TOOLS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1		TBA	Heater cable lubricator
2		-	CO ₂ Meter

INTRODUCTION

1 This Chapter covers the Unit repairs for the heater system and breather system fitted to Truck Utility Light (TUL) HS, and Truck Utility Medium (TUM) HS winter/water and winterised vehicles fitted with the 24 volt electrical system. The information given is applicable to both left and right hand drive vehicles.

HEATING SYSTEM**GENERAL**

2 The auxiliary heater system fitted to winter/water and winterised vehicles provides pre-heated water to both the engine and vehicle interior radiators to maintain comfortable operational conditions inside the vehicle and aid engine starting in sub zero climates.

WATER HEATER**CAUTIONS**

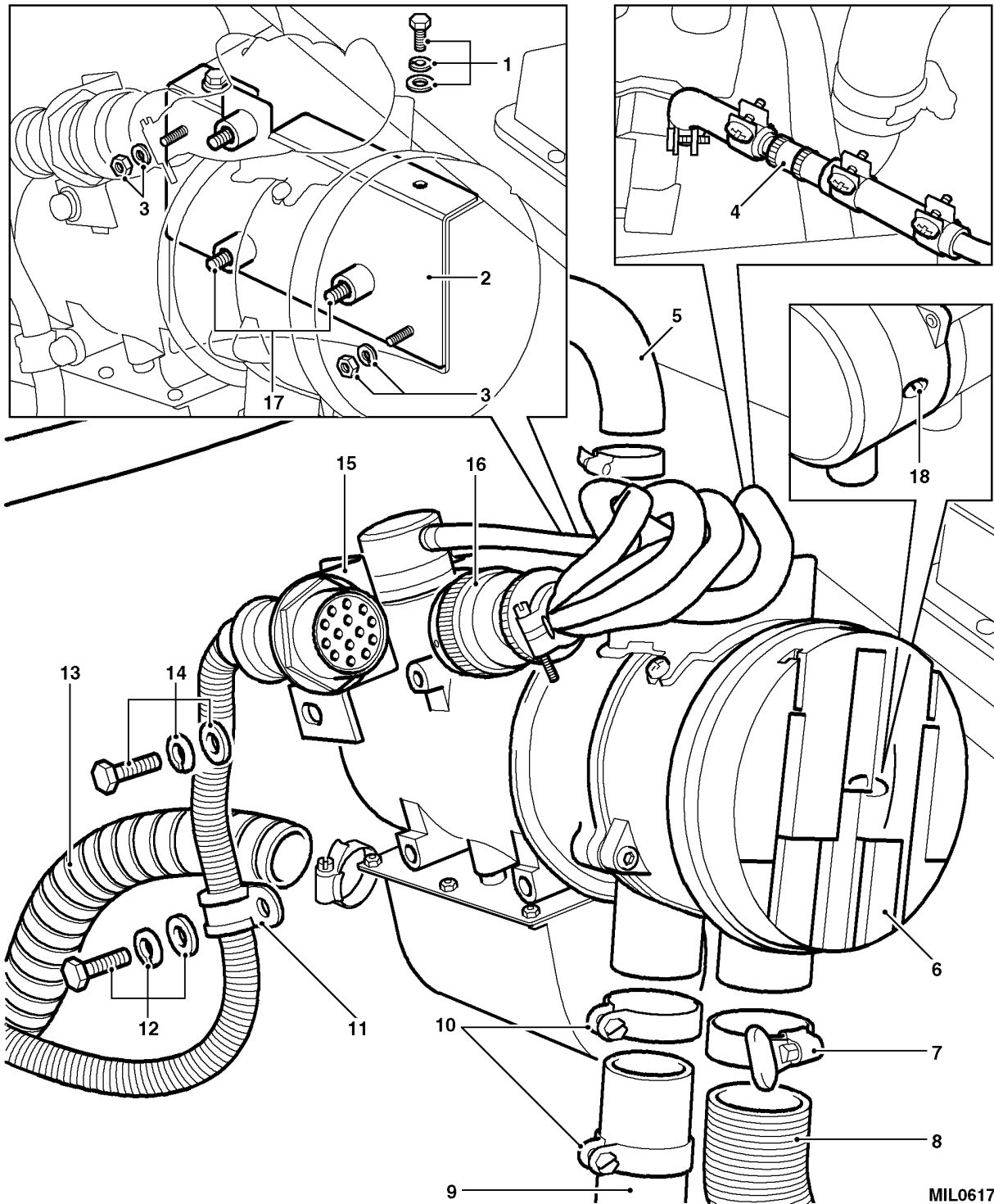
- (1) **HIGH TEMPERATURES.** The water heater runs at very high temperatures. Ensure the heater unit has cooled sufficiently before attempting to carry out any maintenance on the unit.
- (2) **VENTILATION.** Due to the danger of poisoning and suffocation, the heater must not be operated in enclosed areas such as garages or workshops without an exhaust venting facility.
- (3) **COMBUSTIBLE VAPOURS.** Do not operate the heater when in the location of combustible vapours or dust.

Remove

- 3 To remove the water heater unit, carry out the following:
 - 3.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
 - 3.2 Drain the cooling system (refer to Chap 12-2).
 - 3.3 Disconnect the 14 pin electrical plug (Fig 1 (16)) to the heater unit.
 - 3.4 Remove the bolt, spring washer and washer (12) securing the harness 'P' clip (11) to the heater.
 - 3.5 Remove the bolt, spring washer and washer (14) securing the electrical plug mounting bracket (15) to the heater and remove the electrical plug from the heater complete with mounting bracket. Tie the harness and socket assembly aside.
 - 3.6 Place a cloth or other suitable protection over the left hand wing and remove the screws securing the control box to the top of the cab heater unit. Release cable ties and move control box aside to the top of the left hand wing (refer to Chap 13-4).
 - 3.7 Loosen the clamp (7) securing the air inlet pipe (8) and remove the pipe from the heater unit.
 - 3.8 Loosen the two clamps (10) securing the exhaust pipe (9) to the heater unit (6), remove the pipe end from the heater unit and move the pipe aside.
 - 3.9 Disconnect the fuel pipe using the quick release connection (4) from the top of the heater, and cover any open ends of the pipe to prevent the spillage of fuel.
 - 3.10 Remove the two screws, spring washers and washers (1), two nuts and washers (3) securing the heater and mounting bracket (2) to the inner wing bracket, move aside the earthing straps and remove the heater unit complete with mounting bracket.
 - 3.11 Disconnect the water inlet hose (13) from the thermostat and water outlet hose (5) from the heater unit.
 - 3.12 Remove the heater unit (6) from the vehicle complete with mounting bracket (2) and drain any remaining coolant into a suitable container.
 - 3.13 If required, remove the three screws (17) securing the heater to the mounting plate and separate the heater from the mounting plate collecting the spacers.

Refit

- 4 Refit the heater unit in the reverse order of the removal.
 - 4.1 Refill and bleed the cooling system (refer to Chap 12-2) and check for any leaks.



MIL0617

- | | | | |
|---|------------------------------------|----|--------------------------|
| 1 | Screws and washers | 10 | Clamps |
| 2 | Mounting bracket | 11 | 'P' clip |
| 3 | Nuts and washers | 12 | Bolt and washers |
| 4 | Fuel pipe quick release connection | 13 | Water inlet hose |
| 5 | Water outlet hose | 14 | Bolt and washers |
| 6 | Heater unit | 15 | Mounting bracket |
| 7 | Clamp | 16 | 14 pin electrical plug |
| 8 | Air inlet pipe | 17 | Screws |
| 9 | Exhaust pipe | 18 | Combustion air set screw |

Fig 1 Water heater removal

ADJUSTMENT OF THE CO₂ CONTENT

5 To change the combustion air volume set by the manufacturer may be performed by rotating the air set screw (refer to Fig 1 (18)).

5.1 Clockwise rotation: CO₂ value decreases.

NOTE

When measuring the CO₂ levels, the heater must be running at full output.

5.2 Coarse setting: Rotate air set screw clockwise fully and then rotate back one turn.

5.3 Using a CO₂ meter (refer to Table 2, Serial 2), finely adjust the air set screw to achieve the readings shown in the table below:

TABLE 3 CO₂ READINGS

Water Heater	Operation	Readings		
CO ₂ in exhaust (Perm. operating range)	Max	10 to 12 Vol. -%		
CO ₂ setting values at approx +20°C and geographical height above SL.	Max	0m 10%	500m 10.6%	1000m 11.3%

5.4 After setting the CO₂ content the screw head must be sealed with sealant (refer to Table 1 Serial 3) to prevent water ingress.

THERMOSTATIC VALVE

6 The thermostatic valve is located under the bonnet in the heater pipe work between the rear of the engine and the bulkhead.

Remove

7 To remove the thermostatic valve carry out the following:

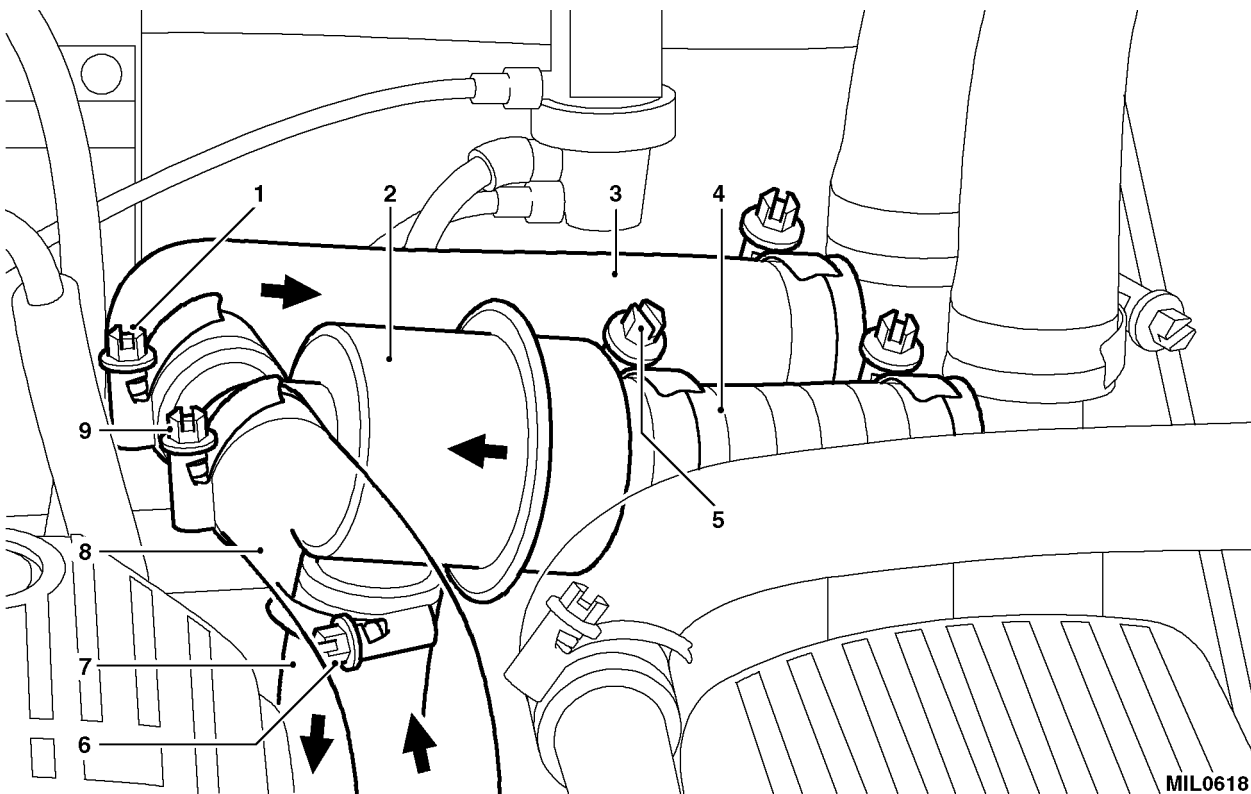
7.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

7.2 Drain the cooling system. (refer to Chap 12-2).

7.3 Disconnect the cylinder head hose (Fig 2 (8)) from the cylinder head and drain any remaining coolant into a suitable container.

7.4 Loosen jubilee clips (1,5,6 and 9)) securing the thermostatic valve (2) to the heater matrix inlet (3) and outlet hoses (4), water heater (7) and cylinder head (8) hoses and remove the valve.

7.5 Drain any coolant remaining in the valve into a suitable container.



MIL0618

- 1 Jubilee clip
- 2 Thermostatic valve
- 3 Heater matrix inlet hose
- 4 Heater matrix outlet hose
- 5 Jubilee clip

- 6 Jubilee clip
- 7 Water heater hose
- 8 Cylinder head hose
- 9 Jubilee clip

Fig 2 Thermostatic valve removal

Refit

8 Refit the thermostatic valve in the reverse order of removal.

8.1 Refill and bleed the cooling system (refer to Chap 12-2) and check for any leaks.

HEATER/FAN UNIT**Remove**

9 To remove the Heater/fan unit carry out the following:

9.1 Remove the heating system control box from the top of the heater casing (refer to Chap 13-4).

9.2 Remove the electrical multi-plugs from their mountings on the side of the heater casing.

9.3 Remove the heater/fan unit (refer to Chap 18-1).

Refit

10 Refit the heater/fan unit in the reverse order of removal.

FAN MOTOR ASSEMBLY

11 The single speed fan motor assembly is a sealed unit and can only be removed as a complete assembly.

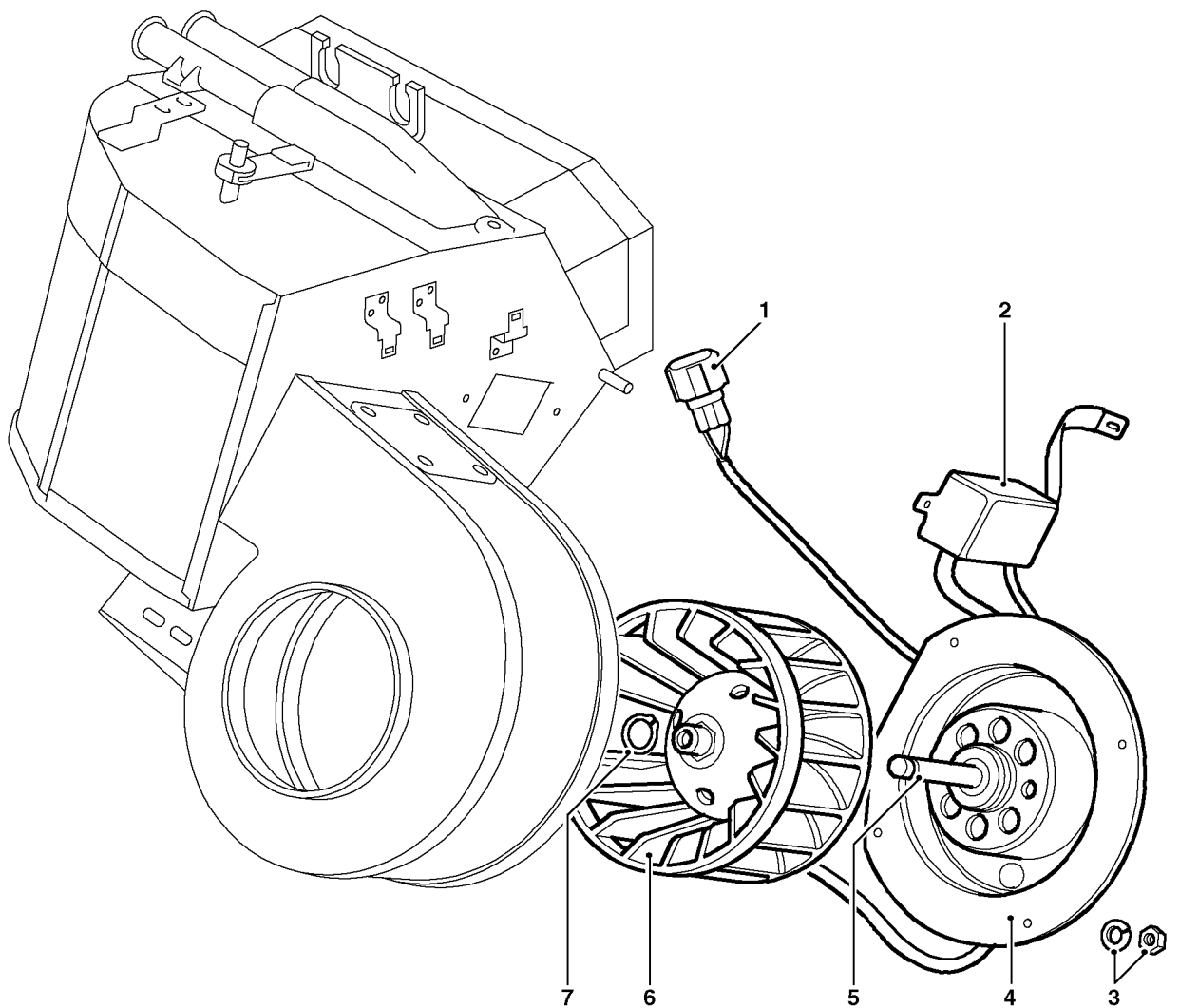
Remove

12 To remove the fan motor assembly, carry out the following:

12.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

12.2 Remove the heater/fan unit (refer to Para 8).

12.3 Remove the nuts securing the angled bracket to the heater unit and remove the bracket (refer to Chap 18-1).



MIL0619

- | | |
|-------------------------|---------------|
| 1 Connector | 5 Drive shaft |
| 2 RFI filter | 6 Impeller |
| 3 Nut and spring washer | 7 Circlip |
| 4 Fan motor assembly | |

Fig 3 Fan motor assembly

- 12.4 Remove the radio frequency interference (RFI) filter and earthing strap (Fig 3 (2)) from the heater casing.
- 12.5 Remove the five nuts and spring washers (3) securing the fan motor assembly to the heater unit and remove.
- 12.6 Remove the circlip (7) holding the impeller (6) to the drive shaft (5) and remove the impeller.

Examination and Replacement

- 13 Examine all components for signs of wear and replace as necessary.

Refit

- 14 To refit the fan motor assembly carry out the following:
 - 14.1 Refit impeller (Fig 3 (6)) to fan drive shaft (5) and fit circlip (7).
 - 14.2 Refit fan assembly to casing and secure with the five nuts and spring washers (3).
 - 14.3 Secure RFI filter and earthing strap (2) to the heater casing.
 - 14.4 Refit the angled bracket (refer to Chap 18-1).
 - 14.5 Refit heater/fan unit (refer to Para 9).

HEATER MATRIX

Remove/refit

- 15 To remove/refit the heater matrix (refer to Chapter 18-1).

CAB HEATER CONTROLS

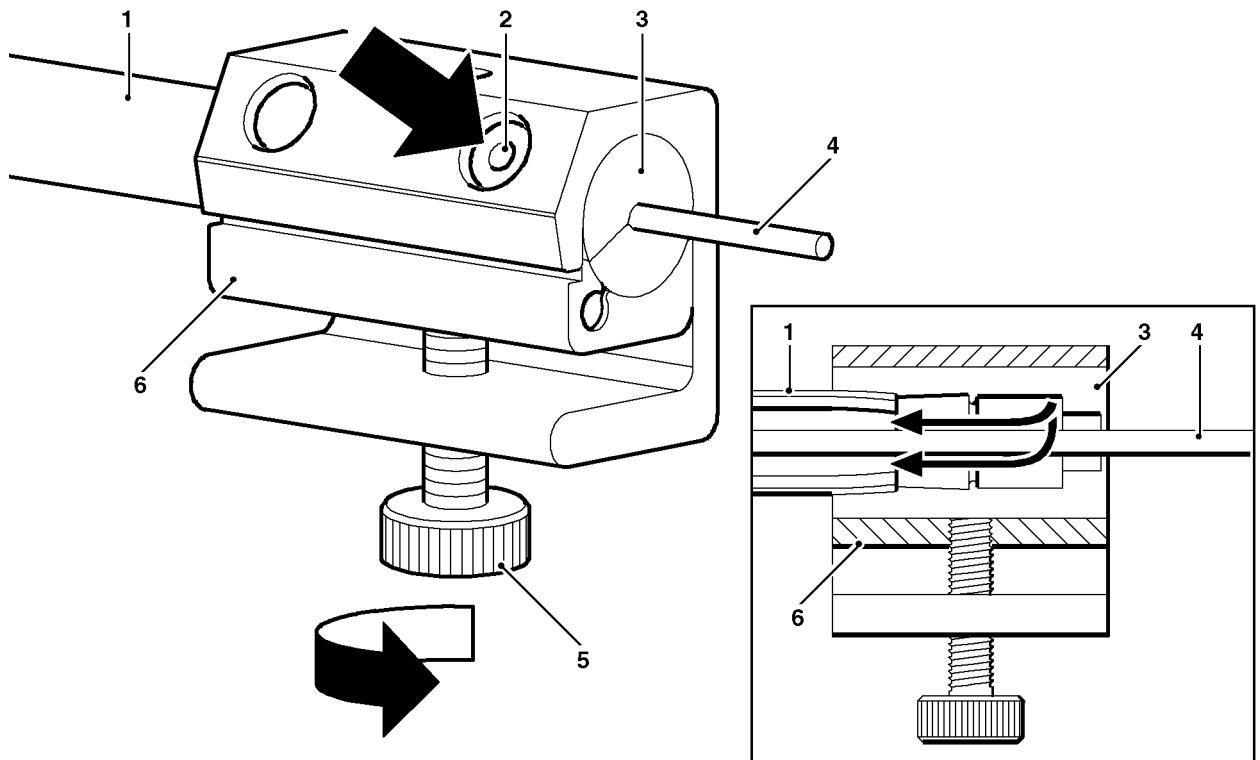
- 16 To remove/refit the cab heater controls (refer to Chapter 18-1).

NOTE

During re-assembly all heater cables must be generously coated with grease (refer to Table 1 Serial 1) to ensure protection from salt water.

HEATER CABLE LUBRICATION

- 17 The heater cables can be lubricated in situ with a special tool, (refer to Table 2, Serial 1). To lubricate the cables carry out the following:
 - 17.1 Retract the clamp (Fig 4 (5)) fully and manoeuvre the tool (6) over the cable (4) ensuring it sits inside the rubber insert (3).
 - 17.2 Slide the tool up against the outer cable (1) and clamp the tool into position.
 - 17.3 Insert the extension tube of a suitable aerosol based lubricator (refer to Table 1, Serial 2) into the rubber insert and liberally apply lubricant to the cable.
 - 17.4 Lubricant should be forced inside the outer cable.
 - 17.5 Finish the procedure and remove the tool after lubricant is seen escape from the other end of the cable.



MIL0787

1 Outer cable
2 Rubber insert
3 Rubber insert

4 Inner cable
5 Clamp nut
6 Clamp

Fig 4 Heater cable lubricator

REAR COMPARTMENT RADIATORS

Remove

18 Remove the radiators from the rear compartment as follows:

- 18.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 18.2 Drain the cooling system (refer to Chap 12-2).
- 18.3 Open the radiator stop taps mounted on the front face of the rear bulkhead (Fig 5 (37)) and the drivers heel board (36) to ensure coolant is drained from the radiators.
- 18.4 Lift the rear seat cushions and support with straps in the upright position.
- 18.5 Withdraw the screws (10,12) and remove the plastic trim panels (11,13) to expose the radiator connections.
- 18.6 Release the clips (14) and remove the hoses (15) from the feed and return radiator ports.
- 18.7 Withdraw the screws and washers (8) from the upper mounting blocks (7) and lift the radiator (9) clear of the lower mounting block.

Refit

19 Refit the radiator in the reverse order of removal.

19.1 Refill and bleed the cooling system (refer to Chap 12-2) and check for any leaks.

KEY TO FIG 5

1	Hose	20	Spacer
2	Pipe	21	'P' clip
3	Unions	22	Washer
4	Pipe	23	Screw
	5 Stop tap handle	24	Screw
6	Clip	25	Washer
	7 Upper mounting block	26	Mounting bracket
	8 Screw	27	Lower mounting block
9	Radiator	28	Nut
	10 Screw	29	Radiator
	11 Trim panel	30	Stop tap handle
	12 Screw	31	Unions
	13 Trim panel	32	Upper mounting block
	14 Clips	33	Washer
	15 Hoses	34	Nut
	16 Hose	35	Nut
	17 Clip	36	Radiator stop tap
	18 Screw	37	Radiator stop tap
	19 Washer	38	Rear bulkhead panel

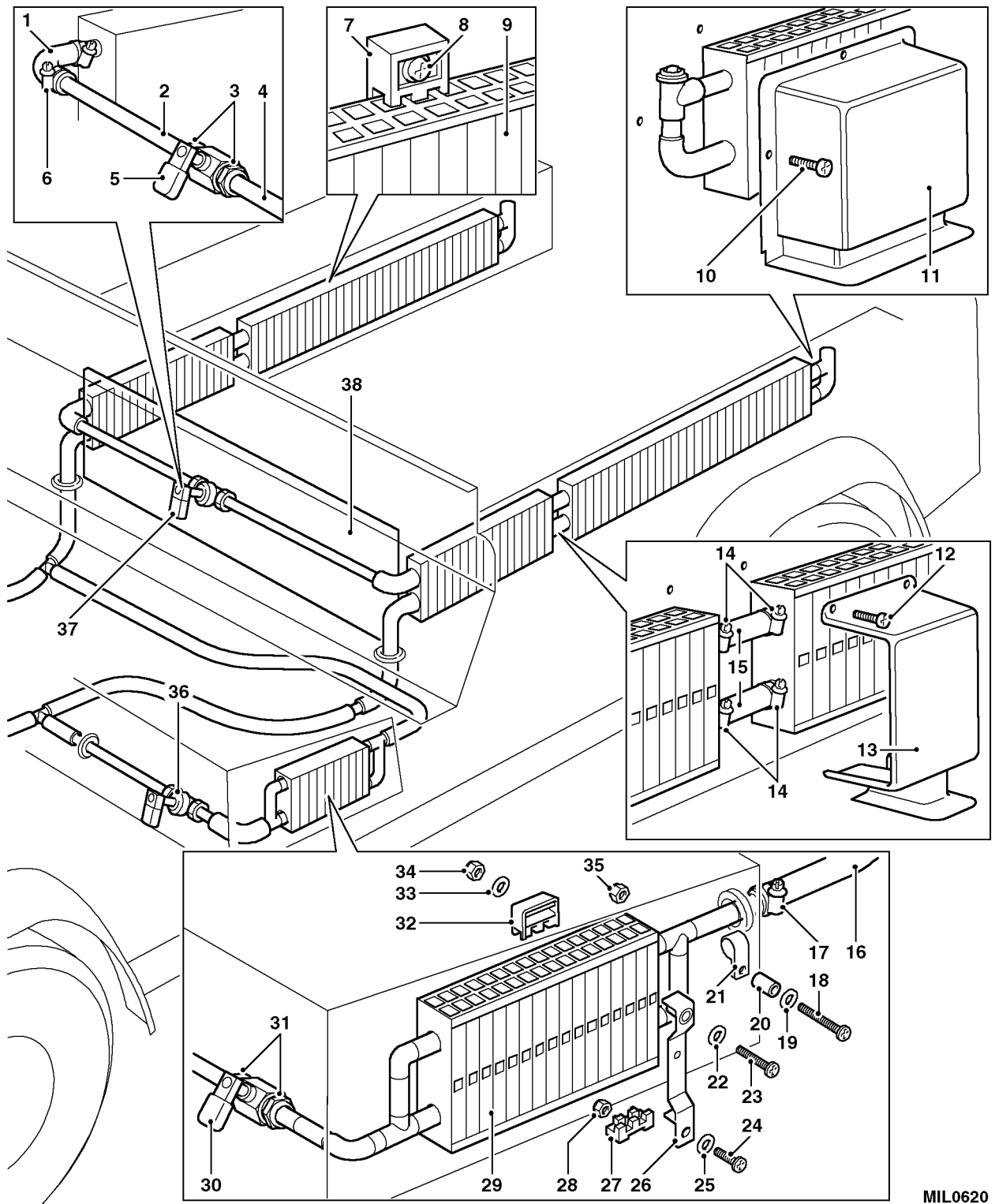


Fig 5 Battery box radiator, rear radiators and stop tap removal

BATTERY BOX RADIATOR**Remove**

20 Remove the battery box radiator as follows:

- 20.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 20.2 Remove batteries from vehicle.
- 20.3 Drain the cooling system (refer to Chap 12-2).
- 20.4 Release the clip (Fig 5 (17)) and remove the hose (16) from the feed and return radiator ports.
- 20.5 Remove the nut (35), washer (19) and screw (18) and release the 'P' clip (21) securing the pipe work to the battery box. Retrieve the spacer (20).
- 20.6 Remove the nut (34), washer (33) screw (23) and washer (22) securing the upper mounting block (32) and bracket (26) to the battery box.
- 20.7 Remove the nut (28), washer (25) and screw (24) securing the lower mounting block (27) and Bracket (26) to the battery box.
- 20.8 Disconnect the union (31) and release the radiator pipe from the stop tap (36).
- 20.9 Remove radiator (29) from battery box.

Refit

21 Refit the battery box radiator in the reverse order of removal.

- 21.1 Refill and bleed the cooling system (refer to Chap 12-2) and check for any leaks.

REAR BULKHEAD STOP TAP**Remove**

22 To remove the stop tap carry out the following:

- 22.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).
- 22.2 Drain the cooling system (refer to Chap 12-2).
- 22.3 Withdraw the 6 screws and remove the rear bulkhead panel (Fig 5 (38)).
- 22.4 Release the clip (6) and remove the hose (1) from each end of the rear bulkhead pipes.
- 22.5 Release the two unions (3) from each side of the tap connection and withdraw the pipes (4) from the tap.
- 22.6 Remove the stop tap handle (5) from the stem and withdraw the stop tap (25) through the rear bulkhead grommet.

Refit

23 Refit the stop tap in the reverse order of removal.

23.1 Refill and bleed the cooling system (refer to Chap 12-2) and check for any leaks.

BATTERY BOX STOP TAP

Remove

24 To remove the battery box stop tap, carry out the following:

24.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

24.2 Remove batteries from vehicle.

24.3 Drain the cooling system (refer to Chap 12-2).

24.4 Release the clips (Fig 5 (17) and remove the hose (16) from the input end of the battery box pipes.

24.5 Release the two unions (31) from each side of the tap connection and withdraw the pipes from the tap.

24.6 Remove the stop tap handle (30) from the stem and withdraw the stop tap (36) through the battery box.

Refit

25 Refit the stop tap in the reverse order of removal:

25.1 Refill and bleed the cooling system (refer to Chap 12-2) and check for any leaks.

DRAINING AND REFILLING THE HEATER SYSTEM

26 To drain and refill the heater system (refer to Chap 12-2).

BREATHER SYSTEM

GENERAL

27 The vehicle is fitted with a special closed breather system to allow equipment, which vents to atmosphere to breathe normally during deep water wading.

BREATHER MANIFOLD

28 The breather manifold is located under the right hand wing up against the bulkhead and is best accessed from inside the engine compartment in between the brake pedal box and the wing.

Remove

29 To remove the breather manifold, carry out the following:

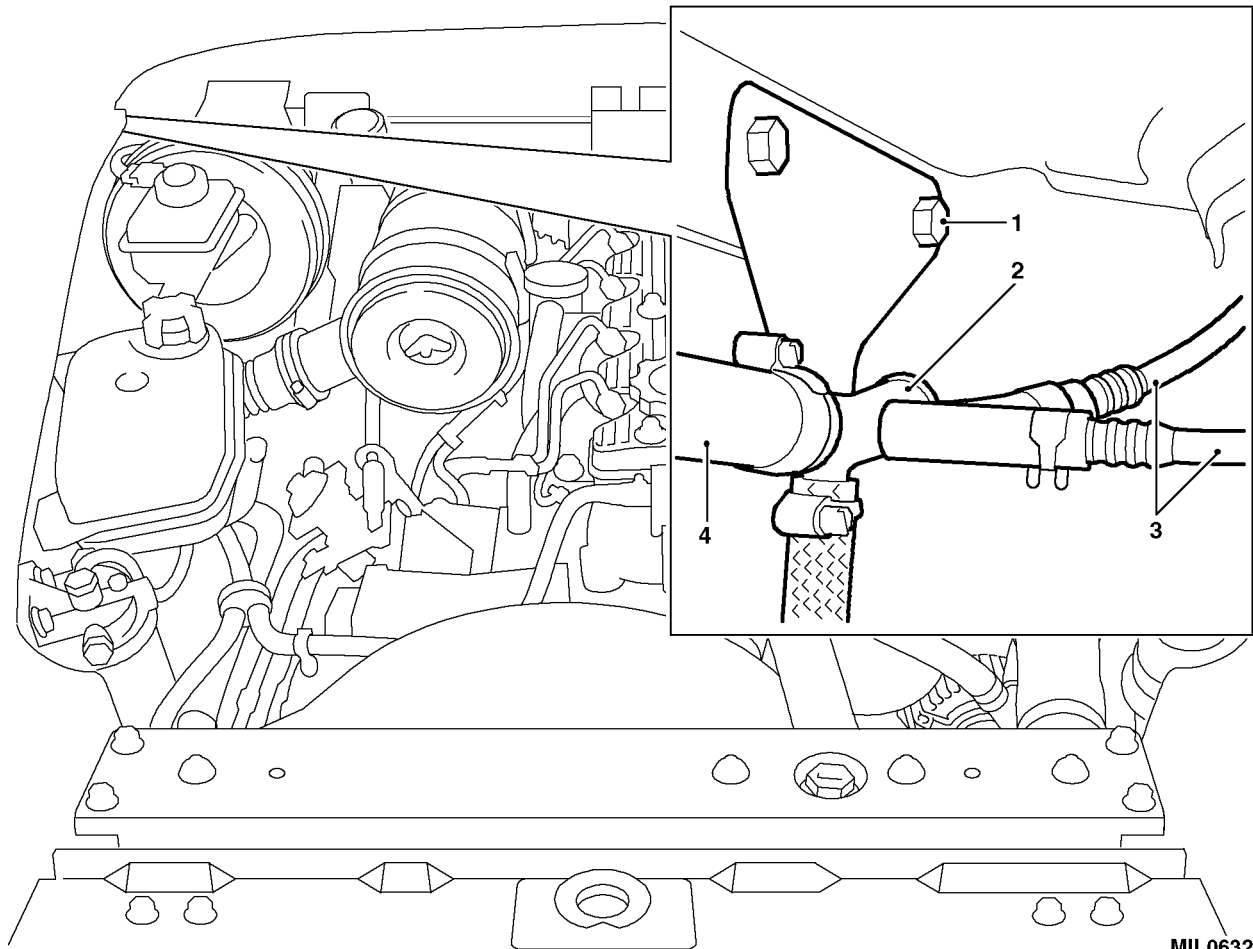
29.1 Disconnect the vehicle batteries (refer to Chap 13-1) and on Fitted For Radio (FFR) vehicles the radio batteries (refer to Chap 13-2).

29.2 Raise the bonnet and locate the breather manifold (Fig 6 (2)) under the wing along side the pedal box and brake servo unit.

- 29.3 Disconnect the breather pipes (3) from the manifold and tie aside.
- 29.4 Disconnect the manifold vent tube (4) from the manifold.
- 29.5 Reach under wing and locate the 2 fixings (1) securing breather manifold to wing and remove fixings.
- 29.6 Manoeuvre breather out from under wing complete with drain tube.

Refit

- 30 Refit the breather manifold in the reverse order of the removal.



1 Breather manifold Fixings
2 Breather manifold

3 Breather pipes
4 Manifold vent tube

Fig 6 Breather manifold removal

CHAPTER 18-4

WINTERISED

CONTENTS

Para

- 1 Introduction
HEATING SYSTEM
- 2 General
Water heater
- 3 Remove/refit
Thermostatic valve
- 4 Remove/refit
Heater/fan unit
- 5 Remove/refit
Fan motor assembly
- 6 Remove/ refit
Heater matrix
- 7 Remove/refit
Cab heater controls
- 8 Remove/refit
Rear compartment radiators
- 9 Remove/ refit
Battery box radiator
- 10 Remove/refit
Rear bulkhead stop tap
- 11 Remove/ refit
Battery box stop tap
- 12 Remove/ refit
- 13 Bleeding the heater system

INTRODUCTION

1 This Chapter covers the Unit repairs for the heater system fitted to Truck Utility Light (HS), and Truck Utility Medium (HS) winterised vehicles fitted with the 24 volt electrical system. The information given is applicable to both left and right hand drive vehicles.

HEATING SYSTEM

GENERAL

2 The auxiliary heater system fitted to winterised vehicles provides pre-heated water to both the engine and vehicle interior radiators to maintain comfortable operational conditions inside the vehicle and aid engine starting in sub zero climates.

WATER HEATER

Remove/refit

3 To remove/refit the water heater (refer to Chap 18-3).

THERMOSTATIC VALVE

Remove/refit

4 To remove/refit the thermostatic valve (refer to Chap 18-3).

HEATER/FAN UNIT

Remove/refit

5 To remove/refit the heater/fan unit (refer to Chap 18-3).

FAN MOTOR ASSEMBLY

Remove/refit

6 To remove/refit the fan motor assembly (refer to Chap 18-3).

HEATER MATRIX

Remove/refit

7 To remove/refit the heater matrix (refer to Chap 18-3).

CAB HEATER CONTROLS

Remove/refit

8 To remove/refit the water cab heater controls (refer to Chap 18-3).

REAR COMPARTMENT RADIATORS

Remove/refit

9 To remove/refit the rear compartment radiators (refer to Chap 18-3).

BATTERY BOX RADIATOR

Remove/refit

10 To remove/refit the battery box radiator (refer to Chap 18-3).

REAR BULKHEAD STOP TAP

Remove/refit

11 To remove/refit the rear bulkhead stop tap (refer to Chap 18-3).

BATTERY BOX STOP TAP

Remove/refit

12 To remove/refit the battery box stop tap (refer to Chap 18-3).

BLEEDING THE HEATER SYSTEM

13 To bleed the heating system (refer to Chap 18-3).

CHAPTER 18-5

TROPICALISED

CONTENTS

Para

- 1 Introduction (WARNINGS)
- 2 Remedial actions (WARNINGS) (CAUTIONS)
- 6 Servicing (CAUTIONS)
 - 7 Refrigerant oil
 - 9 Compressor
 - 13 Rapid refrigerant discharge
 - 14 Servicing equipment
 - Refrigerant recovery, recycling, Recharging (WARNINGS) (CAUTIONS)
 - 15 Recovery and recycling (WARNING)
 - 16 Evacuation and recharging (CAUTIONS)
 - 21 Leak test system (CAUTION)
 - 22 Leak test using inert gas
 - 23 Performance test
 - 24 System test
 - 25 Precautions when handling refrigerant lines (WARNING)
- 43 Periodic maintenance
- AIR CONDITIONING SYSTEM
- Compressor
 - 44 Remove
 - 45 Refit
 - Compressor drive belt
 - 46 Remove
 - 47 Refit
 - Condenser fans and motors
 - 48 Remove
 - 49 Refit
 - Condenser
 - 50 Remove
 - 51 Refit
 - Receiver/drier
 - 52 Remove
 - 53 Refit
 - Evaporator unit
 - 54 Remove
 - 55 Refit

Table

Page

1	Sealants, adhesives and lubricants	2	
2	Special tools.....	2	
3	Component volumes		2
4	Performance range	8	
5	Temperature and pressure range	8	

(continued)

CONTENTS (continued)

Fig		Page
1	Compressor removal	11
2	Compressor drive belt removal	13
3	Condenser fan and motors removal	15
4	Condenser removal	16
5	Receiver/drier removal	19
6	Evaporator unit removal	21/22

TABLE 1 SEALANTS, ADHESIVES AND LUBRICANTS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1 2 3	Nippon Denso R134A 3M	TBA TBA TBA	ND oil 8 Refrigerant Sealing tape

TABLE 2 SPECIAL TOOLS

Serial (1)	Product (2)	NSN/Part Number where applicable (3)	Designation (4)
1 2 3 4 5	Dry bulb thermometer Dry and wet bulb thermometer	TBA TBA TBA TBA TBA	Refrigerant recharging station Refrigerant leak detector Temperature range (+20° C to -60° C) Safety goggles and hard gloves

TABLE 3 COMPONENT VOLUMES

Serial (1)	Component (2)	Volume (3)
1 2 3 4 5	Condenser Evaporator Pipe or hose Receiver/drier Total quantity of refrigerant oil in system	40ml 80ml 20ml 20ml 140ml

INTRODUCTION

1 This chapter details the field repairs for the air conditioning system fitted to the (TUM) Ambulance HS.

WARNINGS

(1) REFRIGERANT. THE REFRIGERANT USED IN THE AIR CONDITIONING SYSTEM IS HFC (HYDROFLUOROCARBON) R134A.

(2) PROTECTIVE CLOTHING. R134A IS A HAZARDOUS LIQUID AND WHEN HANDLED INCORRECTLY CAN CAUSE SERIOUS INJURY. SUITABLE PROTECTIVE CLOTHING MUST BE WORN WHEN CARRYING OUT SERVICING OPERATIONS ON THE AIR CONDITIONING SYSTEM.

(3) TOXIC GASES. R134A IS ODOURLESS AND COLOURLESS. DO NOT HANDLE OR DISCHARGE IN AN ENCLOSED AREA, OR IN ANY AREA WHERE THE VAPOUR OR LIQUID CAN COME IN CONTACT WITH NAKED FLAME OR HOT METAL. R134A IS NOT FLAMMABLE, BUT CAN FORM A HIGHLY TOXIC GAS.

(4) SMOKING. DO NOT SMOKE OR WELD IN AREAS WHERE R134A IS IN USE. INHALATION OF CONCENTRATIONS OF THE VAPOUR CAN CAUSE DIZZINESS, DISORIENTATION, NARCOSIS, NAUSEA OR VOMITING.

(5) SPONTANEOUS COMBUSTION. DO NOT ALLOW FLUIDS OTHER THAN R134A OR COMPRESSOR LUBRICANT TO ENTER THE AIR CONDITIONING SYSTEM. SPONTANEOUS COMBUSTION MAY OCCUR.

(6) SKIN CONTACT. R134A SPLASHED ON ANY PART OF THE BODY WILL CAUSE IMMEDIATE FREEZING OF THAT AREA. ALSO REFRIGERANT CYLINDERS AND REPLENISHMENT TROLLEYS WHEN DISCHARGING WILL FREEZE SKIN TO THEM IF CONTACT IS MADE.

(7) REFRIGERANT RECOVERY. THE REFRIGERANT USED IN AN AIR CONDITIONING SYSTEM MUST BE RECLAIMED IN ACCORDANCE WITH THE RECOMMENDATIONS GIVEN WITH A REFRIGERANT RECOVERY RECYCLING RECHARGING STATION.

NOTE

Suitable protective clothing comprises of wrap around safety glasses or helmet, heatproof gloves, rubber apron or waterproof overalls and rubber boots.

REMEDIAL ACTIONS

WARNINGS

(1) HEATING EFFECTS. DO NOT ALLOW A REFRIGERANT CONTAINER TO BE HEATED BY A DIRECT FLAME OR TO BE PLACED NEAR ANY HEATING APPLIANCE. A REFRIGERANT CONTAINER MUST NOT BE HEATED ABOVE 500^oC.

(2) TRANSPORTATION. DO NOT LEAVE A CONTAINER OF REFRIGERANT WITHOUT ITS CAP FITTED. DO NOT TRANSPORT A CONTAINER OF REFRIGERANT THAT IS UNRESTRAINED, ESPECIALLY IN THE BOOT OF A CAR.

CAUTIONS

- (1) **HANDLING.** Care must be taken when handling refrigeration system components. Units must not be lifted by their hoses, pipes or capillary lines. Hoses and lines must not be subjected to any twist or stress. Ensure that hoses are positioned in their correct run before fully tightening the couplings, and ensure that all clips and supports are used. Torque wrenches of the correct type must be used when tightening refrigerant connections to the stated value. An additional spanner must be used to hold the union to prevent twisting of the pipe.
- (2) **CONNECTION.** Before connecting any hose or pipe ensure that refrigerant oil is applied to the seat of the new 'O' ring but not to the threads.
- (3) **OIL LOSS.** Check the oil trap for the amount of oil lost.
- (4) **PROTECTIVE PLUGS.** All protective plugs on components must be left in place until immediately prior to connection.
- (5) **DESICCANT.** The receiver/drier contains desiccant, which absorbs moisture. It must be positively sealed at all times.
- (6) **RECEIVER/DRIER.** Whenever the refrigerant system is opened, the receiver/drier must be renewed immediately before evacuating and recharging the system.
- (7) **CLEANING.** Use alcohol and a clean cloth to clean dirty connections. Ensure that all new parts fitted are marked for use with R134a.

2 The following remedial actions must be taken immediately if contact is made with R134a:

3 If liquid R134a strikes the eye, do not rub it. Gently run large quantities of eyewash over the eye to raise the temperature. If eyewash is not available cool, clean water may be used. Cover eye with clean pad and seek immediate medical attention.

4 If liquid R134a is splashed on the skin run large quantities of water over the area as soon as possible to raise the temperature. Carry out the same actions if skin comes into contact with discharging cylinders. Wrap affected parts in blankets or similar material and seek immediate medical attention.

5 If suspected of being overcome by inhalation of R134a vapour seek fresh air. If unconscious remove to fresh air. Apply artificial respiration and/or oxygen and seek immediate medical attention.

NOTE

Due to its low evaporating temperature of -300°C , R134a (refer to Table 2 Serial2) should be handled with care.

SERVICING**CAUTIONS**

- (1) **REFRIGERANT OIL.** Do not use any other type of refrigerant oil.
- (2) **STORAGE.** Refrigerant oil easily absorbs water and must not be stored for long periods. Do not pour unused oil back into the container.

6 Servicing should be carried out as follows:

Refrigerant oil

7 Use the approved refrigerant lubricating oil (refer to Table 1 Serial 1).

8 When renewing system components, add specified quantities of refrigerant oil (refer to Table 3).

Compressor

9 A new compressor is sealed and pressurised with Nitrogen gas, slowly release the sealing cap, gas pressure should be heard to release, as the seal is broken.

NOTE

A new compressor should always have its sealing caps in place and these must not be removed until immediately prior to fitting

10 A new compressor is supplied with an oil fill of 140 ml (X ml).

11 A calculated quantity of oil must be drained from a new compressor before fitting.

12 To calculate the quantity of oil to be drained:

12.1 Remove sealing plugs from the old compressor.

12.2 Invert compressor and gravity drain oil in to measuring cylinder. Rotating the compressor clutch plate will assist complete draining.

12.3 Note the quantity of oil drained (Y ml).

12.4 Calculate the quantity (O ml) of oil to be drained from the new compressor using the following formula: $X \text{ ml} - (Y \text{ ml} + 20\text{ml}) = O \text{ ml}$

Rapid refrigerant discharge

13 When the air conditioning system is involved in accident damage and the circuit is punctured, the refrigerant is discharged rapidly. The rapid discharge of refrigerant will also result in the loss of most of the oil from the system. The compressor must be removed and all the remaining oil in the compressor drained and refilled as follows:

13.1 Gravity drain all the oil, assist by rotating the clutch plate (not the pulley).

13.2 Refill the compressor with 90ml of new refrigerant oil.

13.3 Plug the inlet and outlet ports.

Servicing Equipment

14 Special tools and equipment required for servicing of the air conditioning system (Refer to Table 2).

REFRIGERANT RECOVERY, RECYCLING, RECHARGING

WARNINGS

(1) HIGH PRESSURE. THE AIR CONDITIONING SYSTEM IS CHARGED WITH A HIGH PRESSURE, POTENTIALLY TOXIC REFRIGERANT. AN OPERATOR FAMILIAR WITH BOTH THE VEHICLE SYSTEM AND THE CHARGING AND TESTING EQUIPMENT MUST ONLY CARRY OUT REPAIRS OR SERVICING.

(2) VENTILATION. ALL OPERATIONS MUST BE CARRIED OUT IN A WELL-VENTILATED AREA AWAY FROM OPEN FLAME AND HEAT SOURCES. ALWAYS WEAR SAFETY GOGGLES AND GLOVES WHEN OPENING REFRIGERANT CONNECTIONS.

(3) PROTECTION. WEAR EYE AND HAND SAFETY PROTECTION. OPEN CONNECTIONS SLOWLY IN CASE LIQUID OR PRESSURE IS PRESENT. ALLOW TO BLEED OFF SLOWLY.

CAUTIONS

- (1) **OVERCHARGING.** Overcharging air conditioning system will cause excessive head pressure.
- (2) **PORTABLE STATIONS.** An air conditioning portable Refrigerant Recovery Recycling Recharging Station for use with R134a refrigerant incorporates all the features necessary to recover refrigerant R134a from the air conditioning system, to filter and remove moisture, to evacuate and recharge with the reclaimed refrigerant. The unit can also be used for performance testing and air conditioning system analysis.
- (3) **INSTRUCTIONS.** The operator must adhere to the equipment manufacturers' instructions.

Recovery and recycling**WARNINGS**

- (1) **RECYCLING EQUIPMENT.** REFRIGERANT MUST ALWAYS BE RECYCLED BEFORE REUSE, TO ENSURE THAT THE PURITY OF THE REFRIGERANT IS HIGH ENOUGH FOR SAFE USE IN THE AIR CONDITIONING SYSTEM. RECYCLING SHOULD ALWAYS BE CARRIED OUT WITH EQUIPMENT WHICH IS DESIGN CERTIFIED BY UNDERWRITER LABORATORY INC. FOR COMPLIANCE WITH SAE-JL991. OTHER EQUIPMENT MAY NOT RECYCLE REFRIGERANT TO THE REQUIRED LEVEL OF PURITY.
- (2) **RECHARGING STATION.** A R134A REFRIGERANT RECOVERY RECYCLING RECHARGING STATION MUST NOT BE USED WITH ANY OTHER TYPE OF REFRIGERANT.
- (3) **REFRIGERANT TYPE.** REFRIGERANT R134A FROM DOMESTIC AND COMMERCIAL SOURCES MUST NOT BE USED IN MOTOR VEHICLE AIR CONDITIONING SYSTEMS.

15 To recover or recycle refrigerant, carry out the following:

- 15.1 Connect special equipment (refer to Table 2 Serial 1) to the high and low pressure servicing connections.
- 15.2 Operate the refrigerant recovery station.
- 15.3 Measure the amount of oil discharged from the system. Add an equal amount of new refrigerant oil to compressor before evacuation sequence.

Evacuation and recharging**CAUTIONS**

- (1) **LEAK TEST.** When a major repair has been carried out, a leak test should be carried out using inert gas (refer to Para 22).
- (2) **RECEIVER/DRIER.** Whenever the refrigerant system is opened, the receiver/drier must be renewed immediately before evacuating and recharging the system.
- (3) **EVACUATION.** The system must be evacuated immediately before recharging commences. Delay between evacuation and recharging is not permitted

16 Add refrigerant oil (refer to Table 2 Serial 1), to compressor if necessary.

17 Renew the receiver/drier (refer to Para 52, 53).

18 Connect special equipment (refer to Table 2 Serial1), to the high and low pressure servicing connections.

NOTE

If the vacuum reading is below 700 mm Hg after 15 minutes, suspect a leak in the system. Partially recharge the system and check for leaks using an electronic leak tester. Check suction lines first, then run the compressor for five minutes and then check the high pressure lines.

19 Using the special equipment (refer to Table 2 Serial1), carry out the following:

19.1 Refrigerant to charge system is 1.1 kg (2.4 lbs).

19.2 Operate the equipment.

19.3 If the full charge has not been accepted by the system, start the engine and run it at 1500 rev/min for a minimum of two minutes.

19.4 Complete charge.

19.5 Switch on the air conditioning system, open the vehicle windows, set the temperature control to cold and switch the blower to maximum speed.

20 Carry out the air conditioning system performance test (refer to Para 24).

LEAK TEST SYSTEM

CAUTION

LEAK TEST. When a major repair has been carried out, a leak test should be carried out using an inert gas (refer to Para 22).

21 The following instructions refer to an electronic type refrigerant leak detector (refer to Serial 2, Table 2) for use with R134a (refer to Table 1 Serial 2), which is the safest and most sensitive.

21.1 Place the vehicle in a well-ventilated area but free from draughts, as leakage from the system could be dissipated without detection.

21.2 Commence searching for leaks by passing the detector probe around all joints and components, refrigerant gas is heavier than air.

21.3 Insert the probe into an air outlet of the evaporator or into the evaporator drain tube. Switch the air conditioning blower on and off at intervals of ten seconds. Any leaking refrigerant will be gathered in by the blower and detected.

21.4 Insert the probe between the magnetic clutch and compressor to check the shaft seal for leaks.

21.5 Check all service valve connections, valve plate, head and base plate joints and back seal plate.

21.6 Check the condenser for leaks at the pipe unions.

21.7 If any leaks are found, the system must be discharged before rectification.

21.8 Rectify any leaks and recheck for leaks during evacuation prior to charging.

Leak test using inert gas

22 Use Nitrogen or Helium gas.

22.1 Connect gas line to recharging station.

22.2 Pressurise system to three bar.

22.3 Carry out leak test (refer to Para 21).

PERFORMANCE TEST

23 Carry out this test with bonnet and doors or windows open, air conditioning switched on, temperature control set to cold and blower at maximum speed. Set the air supply control to supply fresh air.

23.1 Close low pressure valve on special equipment (refer to Table 2 Serial 1).

23.2 Close high pressure valve on special equipment.

TABLE 4 PERFORMANCE RANGE

Serial (1)	Intake temperature (2)	Outlet temperature (3)	Low Pressure (4)	High Pressure (5)
1	20 - 24° C	4 - 10° C	18 - 28lbf/in ² 1.2 - 1.9 bar	213 – 299 lbf/in ² 14.7 - 20.6 bar
2	25 - 29° C	9 - 19° C	27 - 37lbf/in ² 1.9 - 2.6 bar	256 – 341 lbf/in ² 17.6 - 23.5 bar
3	30 - 35° C	20 - 27° C	33 - 47lbf/in ² 2.3 - 3.2 bar	299 – 384 lbf/in ² 20.6 - 26.5 bar

TABLE 5 TEMPERATURE AND PRESSURE RANGE

Serial (1)	Ambient Temperature (2)		Compound Gauge Readings (3)		High Pressure Gauge Readings (4)	
	° C	° F	bar	lbf/in ²	bar	lbf/in ²
1	16	60	1.03-1.4	15-20	6.9-10.3	100-150
2	26.7	80	1.4-1.72	20-25	9.6-13.1	140-190
3	38	100	1.72-2.1	25-30	12.4-15.5	180-225
4	43.5	110	2.1-2.4	30-35	14.8-17.2	215-250

23.3 Connect special equipment (refer to Table 2 Serial 1) to the high and low pressure servicing connections.

NOTE

If equipment is unavailable for reading accurate inlet and outlet temperatures, (refer to Table 5) for ambient temperatures outside the vehicle.

23.4 Insert dry bulb thermometer (refer to Table 2 Serial 3) into cold air outlet and position dry and wet bulb thermometer (refer to Table 2 Serial 5) close to outside air inlet.

23.5 Start engine and run it at 1500 rev/min for 10 minutes with air conditioning switched on.

23.6 Read both pressure gauges and thermometers. Check readings (refer to Table 5) with humidity between 60% and 80%.

23.7 Switch off air conditioning, stop engine and disconnect test equipment.

SYSTEM TEST

24 The following test can be made to check the integrity of the system:

- 24.1 Place the vehicle in a ventilated, shaded area free from excessive draught, with the doors and windows open.
- 24.2 Check that the surface of the condenser is not restricted with dirt, leaves, flies, etc. Do not neglect to check the surface between the condenser and the radiator. Clean as necessary.
- 24.3 Switch on the ignition and the air conditioner air flow control. Check that the blower is operating efficiently at low, medium and high speeds. Switch off the blower and the ignition.
- 24.4 Check that the evaporator condenser drain tubes are open and clear.
- 24.5 Check the tension of the compressor driving belt, and adjust if necessary.
- 24.6 Inspect all connections for the presence of refrigerant oil. If oil is evident, check for leaks, and repair as necessary.

NOTE

The compressor oil is soluble in refrigerant R134a and is deposited when the refrigerant evaporates from a leak.

- 24.7 Start the engine.
- 24.8 Set the temperature controls to cold and switch the air conditioner blower control on and off several times, checking that the magnetic clutch on the compressor engages and releases each time.
- 24.9 With the temperature control at maximum cooling and the blower control at high speed, warm up the engine and fast idle at 1000 rev/min.
- 24.10 Repeat at 1800 rev/min.
- 24.11 Gradually increase the engine speed to the high range and check the sight glass at intervals.
- 24.12 Check for frosting on the service valves.
- 24.13 Check the high pressure hoses and connections by hand for varying temperature. Low temperature indicates a restriction or blockage at that point.
- 24.14 Switch off the air conditioning blower and stop the engine.
- 24.15 If the air conditioning equipment is still not satisfactory, carry out a pressure test (refer to Para 24)

PRECAUTIONS WHEN HANDLING REFRIGERANT LINES

WARNING

PERSONAL PROTECTION. WEAR EYE AND HAND PROTECTION A WHEN DISCONNECTING COMPONENTS CONTAINING REFRIGERANT. PLUG ALL EXPOSED CONNECTIONS IMMEDIATELY.

25 The following warning must be observed at all times:

26 When disconnecting any hose or pipe connection the system must be discharged of all pressure. Proceed cautiously, regardless of gauge readings. Open connections slowly, keeping hands and face well clear, so that no injury occurs if there is liquid in the line. If pressure is noticed, allow it to bleed off slowly.

- 27 Lines, flexible end connections and components must be capped immediately they are opened to prevent the entrance of moisture and dirt.
- 28 Any dirt or grease on fittings must be wiped off with a clean alcohol dampened cloth. Do not use chlorinated solvents such as trichloroethylene. If dirt, grease or moisture cannot be removed from inside the hoses, they must be replaced with new hoses.
- 29 All replacement components and flexible end connections must be sealed, and only opened immediately prior to making the connection.
- 30 Ensure the components are at room temperature before uncapping, to prevent condensation of moisture from the air that enters.
- 31 Components must not remain uncapped for longer than 15 minutes. In the event of delay, the caps must be fitted.
- 32 Receiver/drier must never be left uncapped as they contain silica gel crystals, which will absorb moisture from the atmosphere. A receiver/drier left uncapped must not be used, fit a new unit.
- 33 The compressor shaft must not be rotated until the system is entirely assembled and contains a charge of refrigerant.
- 34 A new compressor contains an initial charge of refrigerant oil. The compressor also contains a holding charge of gas when received which should be retained by leaving the seals in place until the pipes are re-connected.
- 35 The receiver/drier should be the last component connected to the system to ensure optimum dehydration and maximum moisture protection of the system.
- 36 All precautions must be taken to prevent damage to fittings and connections. Slight damage could cause a leak with the high pressures used in the system.
- 37 Always use two wrenches of the correct size, one on each fitting when releasing and tightening refrigeration unions.
- 38 Joints and 'O' rings should be coated with refrigeration oil to aid correct seating. Fittings, which are not lubricated with refrigerant oil, are almost certain to leak.
- 39 All lines must be free of kinks. A single kink or restriction reduces the efficiency of the system.
- 40 Flexible hoses should not be bent to a radius less than 90 mm radius.
- 41 Flexible hoses should not be within 100 mm of the exhaust manifold.
- 42 Completed assemblies must be checked for refrigeration lines touching metal panels. Any direct contact of lines and panels transmits noise and must be eliminated.

PERIODIC MAINTENANCE

- 43 For periodic maintenance (refer to Cat 601)

AIR CONDITIONING SYSTEM

COMPRESSOR

Remove

- 44 To remove the compressor carry out the following:
- 44.1 Disconnect the vehicle batteries (refer to Chap 13-1).

44.2 Recover refrigerant from air conditioning system (refer to Para 15).

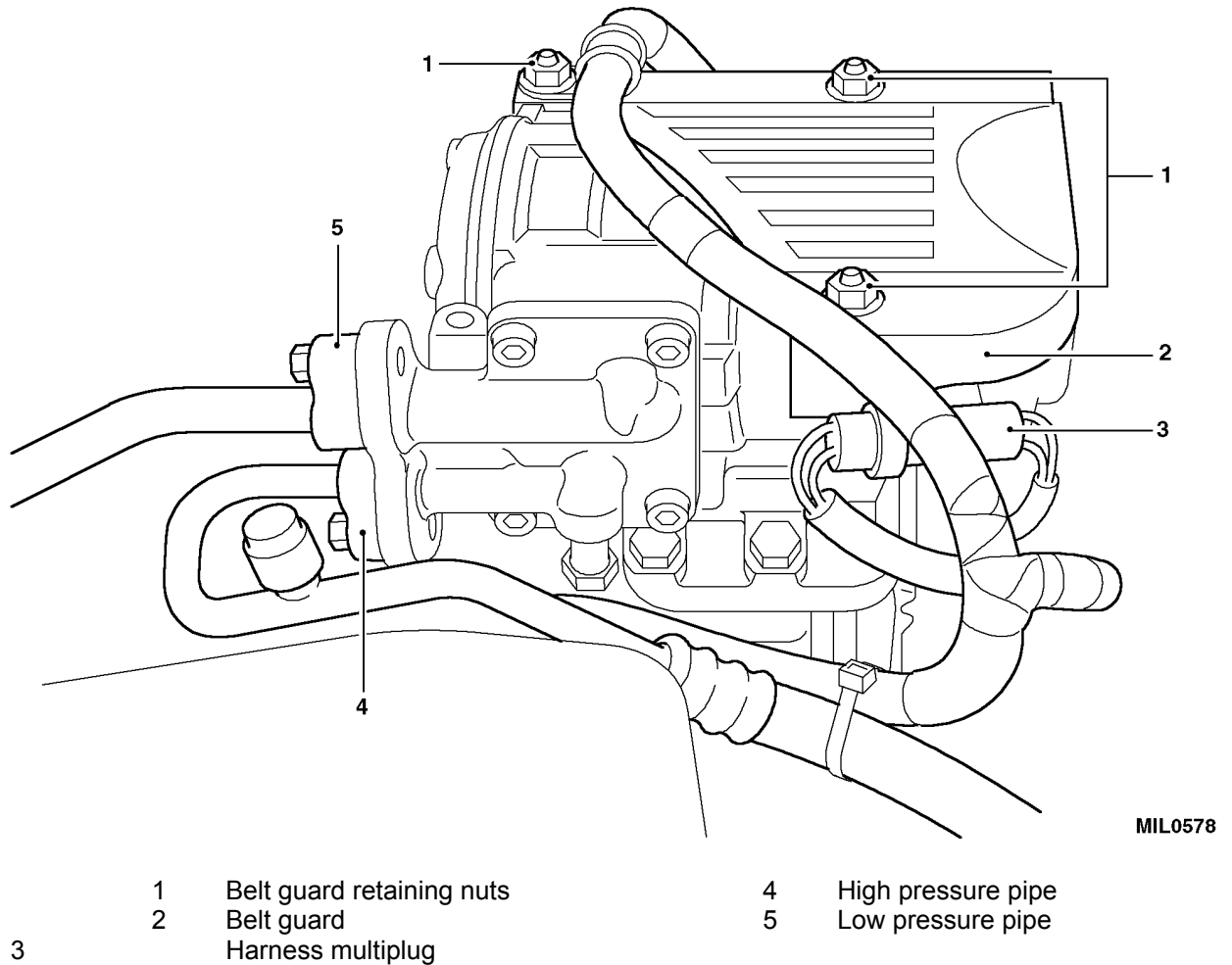


Fig 1 Compressor removal

44.3 Remove three nuts (Fig 1 (1)) securing drive belt guard to compressor retaining studs and remove the guard (2).

44.4 Remove compressor drive belt and mark the direction on belt if refitting (refer to Para 47).

44.5 Disconnect high pressure pipe (4) from compressor.

44.6 Disconnect low pressure pipe (5) from compressor.

44.7 Remove 'O' ring from each flange.

44.8 Disconnect compressor clutch harness multi-plug (3).

44.9 Remove the three retaining nuts and remove the compressor from the mounting bracket studs.

Refit

45 Refit the compressor as follows:

45.1 If a new compressor is to be fitted, drain the oil from the new compressor. Drain and measure oil from old compressor. Measure new oil equal to amount from old compressor, add 30ml extra to this amount and refill new compressor through outlet port.

- 45.2 Locate compressor over mounting bracket studs and secure with nuts.
- 45.3 Reconnect compressor clutch harness multi-plug.
- 45.4 Fit new 'O' rings to high and low pressure flanges, lubricate with refrigerant oil.
- 45.5 Fit high and low pressure hoses.
- 45.6 Fit compressor drive belt (refer to para 47).
- 45.7 Refit compressor drive belt guard and secure with three nuts.
- 45.8 Evacuate and recharge air conditioning system. (refer to Para 16).
- 45.9 Reconnect batteries (refer to Chap 13-1).
- 45.10 Perform a leak test on disturbed joints (refer to Para 21).
- 45.11 Carry out a system test.(refer to Para 24)

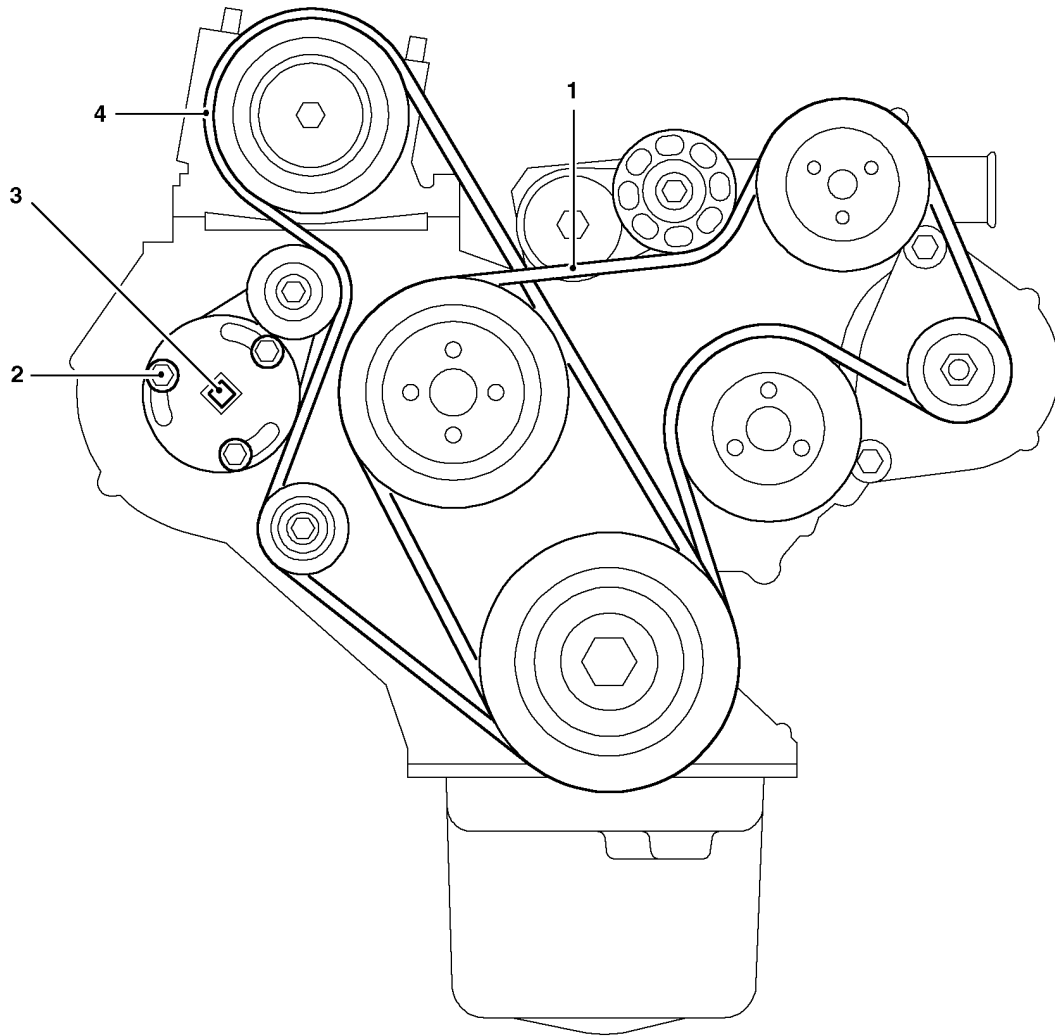
COMPRESSOR DRIVE BELT

Remove

- 46 To remove the compressor drive belt carry out the following:
 - 46.1 Disconnect the vehicle batteries (refer to Chap 13-1).
 - 46.2 Remove the serpentine belt (Fig 2 (1)) (refer to Chap 1-1).
 - 46.3 Remove the three nuts (Fig 1 (1)) securing the drive belt guard and remove the guard (2).
 - 46.4 Slacken the three belt tensioner retaining bolts (Fig 2 (2)).
 - 46.5 Remove compressor drive belt (4); mark direction on belt if refitting.

Refit

- 47 To refit the compressor drive belt carry out the following:
 - 47.1 Fit compressor drive belt (4).
 - 47.2 Fit drive belt guard.
 - 47.3 Fit torque meter to centre of tensioner (Fig 4 (3)), apply and hold a torque of 35 Nm (26 lbf/ft).
 - 47.4 Tighten tensioner retaining bolts (2).
 - 47.5 Rotate crankshaft two full turns.



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|----------------------------|-------------------------|
| 1 Serpentine belt | 3 Tensioner |
| 2 Tensioner retaining bolt | 4 Compressor drive belt |

Fig 2 Compressor drive belt removal

47.6 Reapply and hold a torque of 35 Nm (26 lbf/ft) to tensioner, then fully slacken and retighten tensioner retaining bolts to 25 Nm (18 lbf/ft).

47.7 Fit serpentine belt (1) (refer to Chap 1-1).

47.8 Reconnect the vehicle batteries (refer to Chap 13-1).

CONDENSER FANS AND MOTORS

Remove

48 To remove the condenser fans and motors carry out the following:

48.1 Disconnect the vehicle batteries (refer to Chap 13-1).

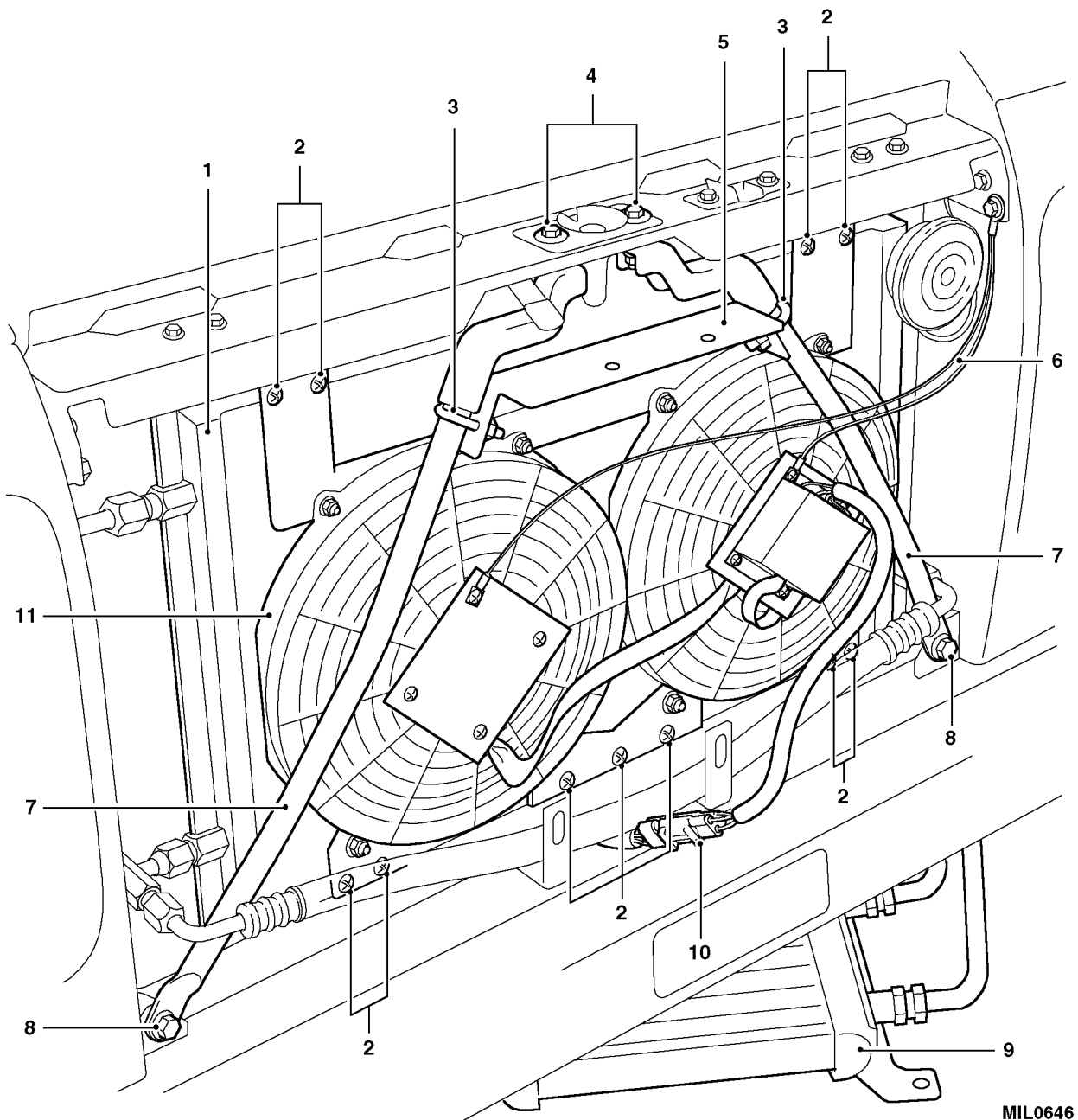
48.2 Remove the grille panel (refer to chap 16).

48.3 Remove but do not disconnect the oil cooler (Fig 3 (9)) and tie aside.

- 48.4 Remove the 'U' bolts (3) securing the oil cooler top mounting bracket (5) to the cross braces and remove the bracket.
- 48.5 Remove the bolts (4) securing the bonnet striker support plate and two cross braces.
- 48.6 Remove the two bolts (8) securing the cross braces (7) to the chassis brackets and remove cross braces.
- 48.7 Remove the screws (2) securing the fan and motor assembly (11) to the upper and lower condenser frame (1).
- 48.8 Disconnect the earth wires (6) from the grille top panel fixing.
- 48.9 Disconnect the fan motor multi-plugs (10) and remove the fan and motor assembly (11) from the condenser.
- 48.10 If required, remove screws securing the fan and motor assemblies to the mounting brackets and separate.

Refit

- 49 Refit the fan and motor assemblies in the reverse order of removal.



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|---|------------------|----|--------------------|
| 1 | Condenser frame | 7 | Cross brace |
| 2 | Screws | 8 | Bolt |
| 3 | 'U' bolt | 9 | Oil cooler |
| 4 | Bolts | 10 | Motor multiplugs |
| 5 | Mounting bracket | 11 | Fan and motor assy |
| 6 | Earth leads | | |

Fig 3 Condenser fans and motors removal

CONDENSER

Remove

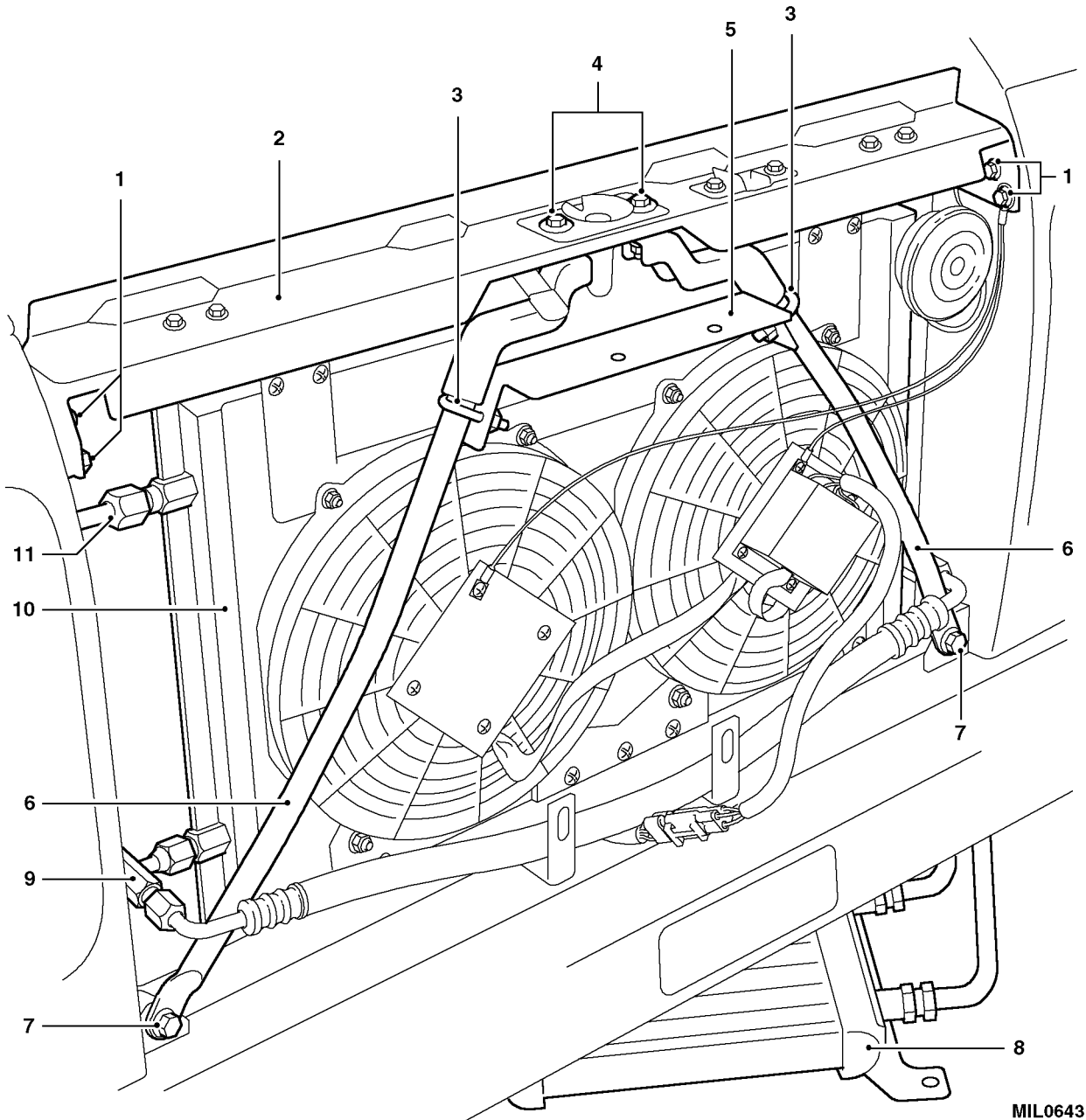
50 To remove the condenser carry out the following:

- 50.1 Disconnect the vehicle batteries (refer to Chap 13-1).

50.2 Recover refrigerant from air conditioning system (refer to Para 15).

50.3 Remove the grill panel (refer to Chap 16).

50.4 Remove but do not disconnect the oil cooler and tie aside (Fig 4 (8)).



- | | |
|-----------------------------------|-----------------------------|
| 1 Bolts | 7 Bolt |
| 2 Grille top panel | 8 Oil cooler |
| 3 'U' bolt | 9 Low pressure connection |
| 4 Bolts | 10 Condenser |
| 5 Oil cooler top mounting bracket | 11 High pressure connection |
| 6 Cross brace | |

Fig 4 Condenser removal

- 50.5 Remove the 'U' bolts (3) securing the oil cooler top mounting bracket (5) to the cross braces and remove the bracket.
- 50.6 Remove the bolts (4) securing the bonnet striker support plate and two cross braces (6).
- 50.7 Remove the two bolts (7) securing the cross braces (6) to the chassis brackets and remove cross braces.
- 50.8 Disconnect the high (11) and low pressure (9) connections to the condenser and move aside.
- 50.9 Remove the four bolts and packing washers (1) securing the grille top panel (2) to the wing sides and remove the panel.
- 50.10 Disconnect the fan motor multi-plugs.
- 50.11 Lift out the condenser (10) complete with fans and motor assembly.
- 50.12 Remove the fan and motor assemblies from the condenser if a new condenser is to be fitted (refer to Para 48).
- 50.13 Discard all pipe connection 'O' rings. Cap or plug all connections to prevent ingress of dirt and moisture.

Refit

51 Refit the condenser as follows:

- 51.1 Coat unions, threads and new 'O' rings with refrigerant oil prior to assembly.
- 51.2 Refit fan and motor assemblies to condenser (refer to Para 49).
- 51.3 Place condenser (10) into position in front of the radiator.
- 51.4 Reconnect the fan motor multi-plugs.
- 51.5 Fit the grille panel (2) ensuring the condenser top brackets are located correctly, secure with the four bolts and packing washers, ensuring that the earth leads are fitted to the lower fixing.
- 51.6 Connect the high (11) and low pressure (9) pipes to the condenser.
- 51.7 Fit the cross braces (6) and loosely fit the two bolts (7) to the chassis brackets.
- 51.8 Fit the bolts (4) securing the cross braces to the striker support plate.
- 51.9 Fit the oil cooler top mounting bracket (5) and secure with the 'U' bolts. Tighten all cross brace fixings.
- 51.10 Refit the oil cooler.
- 51.11 Evacuate and recharge air conditioning system (refer to Para 16).
- 51.12 Reconnect the vehicle batteries (refer to Chap 13-1).
- 51.13 Fit grille panel (refer to Chap 16-5).

RECEIVER/DRIER**Remove**

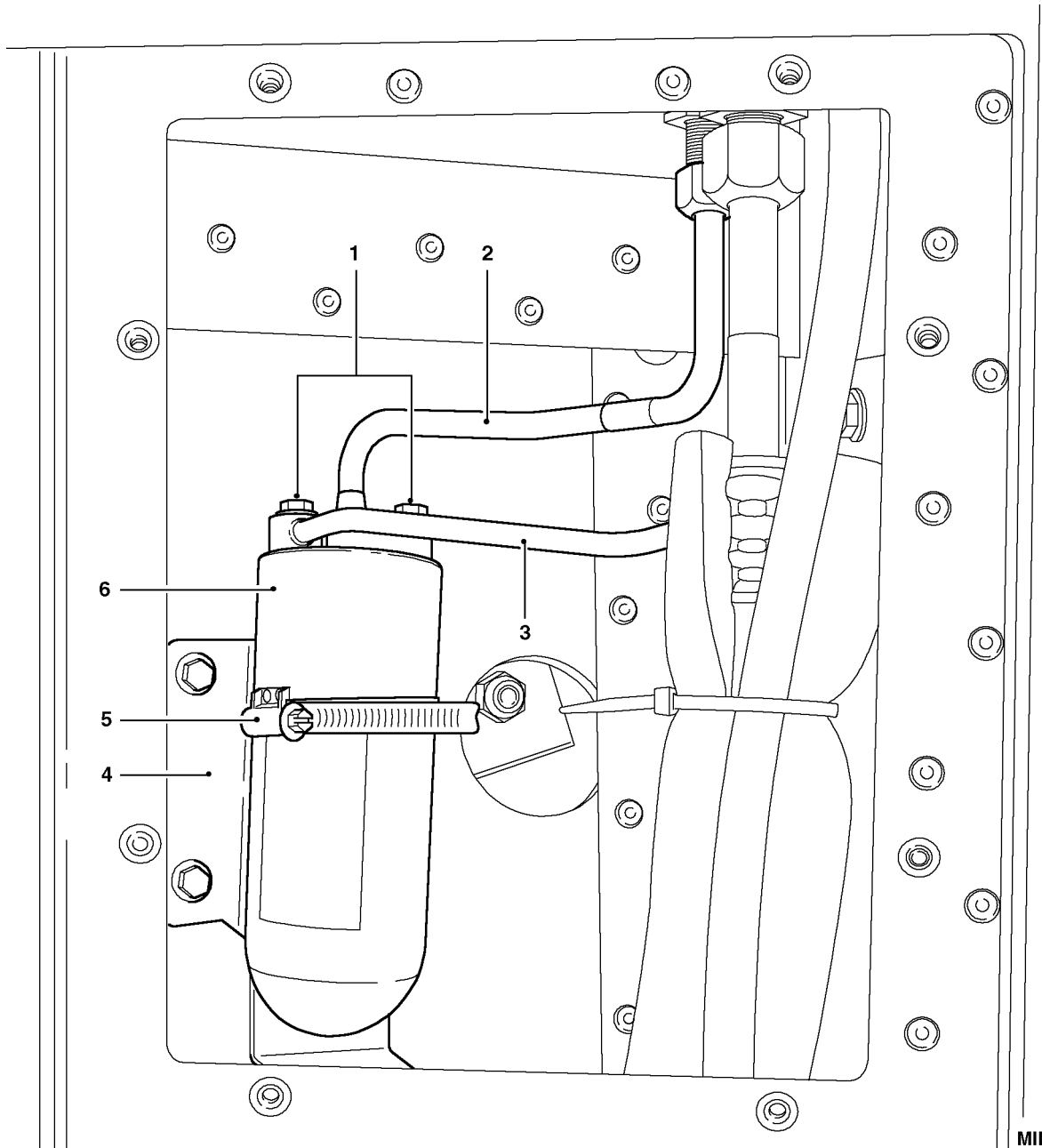
52 To remove the receiver/drier carry out the following:

- 52.1 Disconnect the vehicle batteries (refer to Chap 13-1).
- 52.2 Recover refrigerant from air conditioning system (refer to Para 15).
- 52.3 Remove screws securing cover to body panel to give access to receiver/drier.
- 52.4 Disconnect the pipe connections (2, 3) from the receiver/drier.
- 52.5 Slacken the jubilee clip (5) securing the receiver drier (6) to the mounting bracket (4) and remove the receiver/drier.
- 52.6 Discard all pipe connection 'O' rings. Cap or plug all connections to prevent the ingress of dirt and moisture.

Refit

53 Refit the receiver/drier as follows:

- 53.1 Fit the receiver/drier to the mounting bracket (4) and loosely secure with the jubilee clip (5) ensuring the pipe connections are lined up correctly.
- 53.2 Coat unions, threads and new 'O' rings with refrigerant oil prior to re-assembly.
- 53.3 Fit high pressure pipes (2, 3) to receiver/drier ensuring new 'O' rings are fitted.
- 53.4 Tighten jubilee clip and secure receiver drier.
- 53.5 Recharge air conditioning system (refer to Para 16).
- 53.6 Refit cover and secure with screws.
- 53.7 Reconnect vehicle batteries (refer to Chap 13-1)



MIL0644

- | | |
|-----------------------|--------------------|
| 1 Bolts | 4 Mounting bracket |
| 2 HP Pipe connections | 5 Jubilee clip |
| 3 HP Pipe connections | 6 Receiver/drier |

Fig 5 Receiver/drier removal

EVAPORATOR UNIT**Remove**

54 To remove the evaporator unit carry out the following:

- 54.1 Disconnect the vehicle batteries (refer to Chap 13-1).
- 54.2 Recover refrigerant from air conditioning system (refer to Para 15).
- 54.3 From inside the drivers cab disconnect the high and low pressure pipes to the evaporator unit (Fig 6 (3, 2)).
- 54.4 Disconnect the electrical connection to the fan units.
- 54.5 Remove protection bracket.
- 54.6 With the aid of an assistant to support the evaporator unit, remove the 15 (1) screws securing the unit to the roof and bulkhead of the drivers cab and remove the evaporator unit (4) from the vehicle.
- 54.7 Clean all sealing tape from all joints of main casing, top cover and outlet duct.

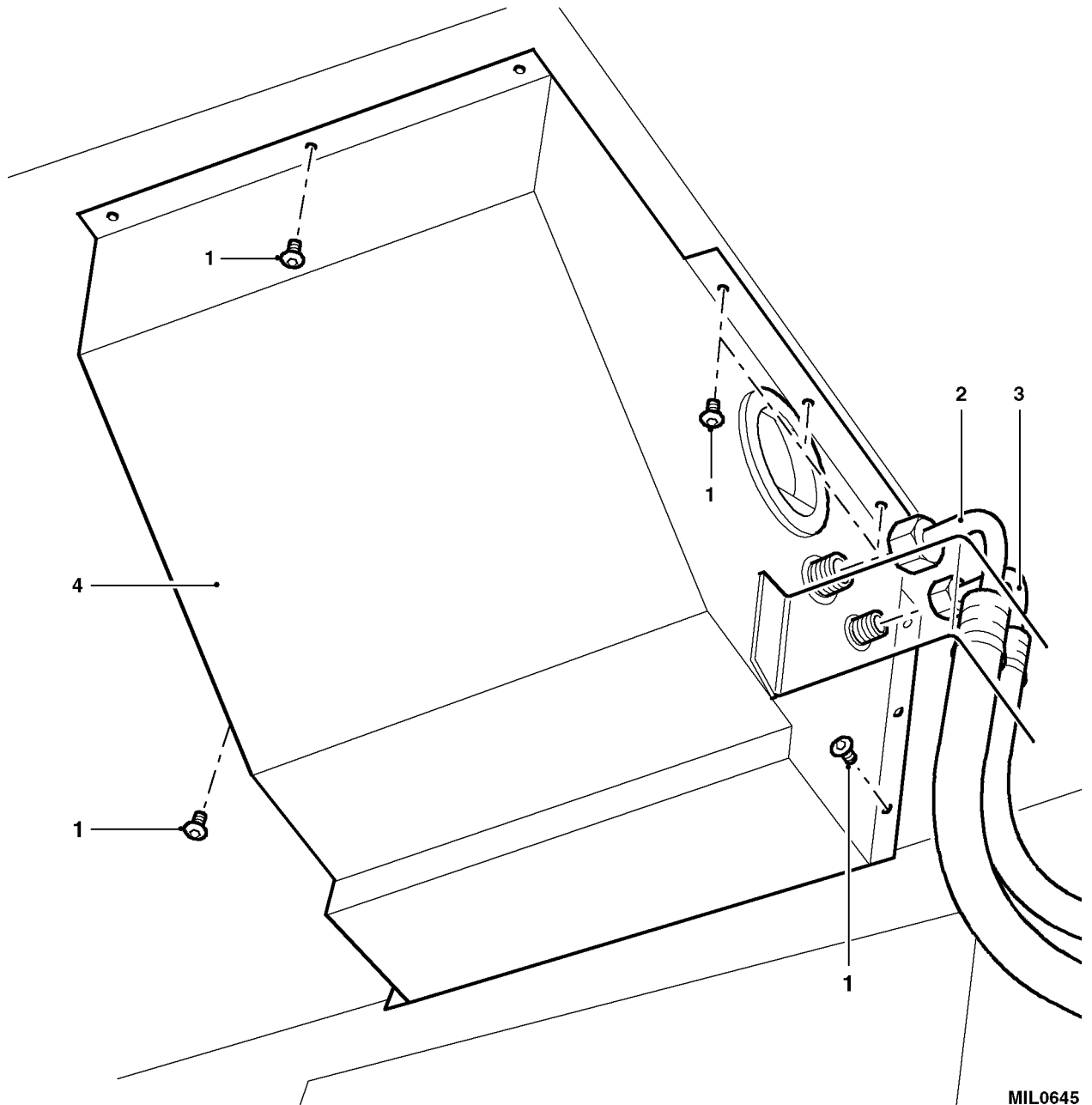
NOTE

When removing the evaporator unit from the bulkhead the temperature probe connected to the temperature switch (mounted inside the ambulance) must be removed from the evaporator matrix before the evaporator unit can be lowered fully.

Refit

55 To refit the evaporator unit carry out the following:

- 55.1 Fit new sealing tape (refer to Table 1 Serial 3) to all joints of main casing, top cover and outlet duct.
- 55.2 With the aid of an assistant locate the temperature switch probe into the evaporator matrix, offer the evaporator unit to the bulkhead and secure with 15 screws.
- 55.3 Fit the high and low pressure pipe connections to the evaporator unit.
- 55.4 Recharge air conditioning system (refer to Para 16).
- 55.5 Reconnect battery (refer to Chap 13-1).



MIL0645

1 Screw
2 Low pressure pipe

3 High pressure pipe
4 Evaporator unit

Fig 6 Evaporator unit removal

